

# Nature-based flood protection solutions and their benefits

## Summary for public sector and private entities



### What are nature-based solutions?

This term denotes solutions implemented in landscape, watercourses or human settlements that use green and blue infrastructure. Besides flood protection, they frequently provide numerous additional benefits for ecosystems. In landscape and human settlements, they include wetlands, pools, dry polders, interception swales, ditches and baulks. Nature-based solutions with a significant flood protection effect also include solutions on agricultural land such as changes in sowing procedures and strip rotation of crops (Table 1).

Nature-based solution	Type
Dry polder	Point measure
Wetland	Point measure
Retention pools and reservoirs	Point measure
Infiltration swale / ditch	Linear measure
Interception swale / ditch	Linear measure
Drainage swale / ditch	Linear measure
Interception dyke (baulk)	Linear measure
Changes in sowing procedures	Areal/organizational m.
Strip crop rotation	Areal/organizational m.
Leaving after-harvest leftovers (mulch)	Areal/organizational m.
Contour line farming	Areal/organizational m.
Minimisation techniques with hoeing	Areal/organizational m.
Min. techniques without ploughing	Areal/organizational m.
Grassing	Areal measure
Afforestation - broadleaf trees	Areal measure
Afforestation - coniferous trees	Areal measure

Table 1: Overview of nature-based flood protection solutions (Macháč et al., 2018)

### How do nature-based solutions protect from floods?

With a view to protection of human settlements, the most important functions are increasing water retention in landscape, slowing progress and interception of torrential rain and flash flood waves. Watercourse authorities appreciate notably the ability of such solutions to reduce erosion, thus removal of sediments and choking up of watercourses. That has a significant effect on achievement of better water quality due to reduced phosphorus and nitrates that enter watercourses. Reduced soil erosion is another major benefit for farmers and landowners, who thus save costs of practical replacement of lost soil and soil nutrients.

### What are ecosystem services?

Besides reducing flood damage, implementation of nature-based solutions affects provision of ecosystem services. They are services provided by ecosystems having a positive impact on environmental quality and quality of life. As shown in the diagram below, they are divided into 4 categories (Fig. 1).

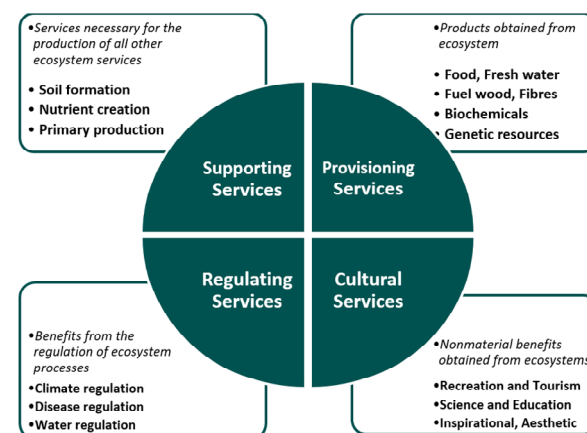


Fig. 1: Division of ecosystem services, including examples (own modification based of MEA, 2005)

### What specific ecosystem services are provided by nature-based solutions?

Regulating ecosystem services of nature-based solutions include, in particular, the positive effect on the water retention ability of landscape (thus reducing negative impacts of drought), improved water quality, soil erosion protection and regulation of sediment in watercourses, regulation of air quality and increasing biodiversity. Provisioning ecosystem benefits include, e.g., biomass production. Important cultural ecosystem benefits include increasing aesthetic value and recreational value, which is very often associated with implementation of nature-based solutions. Provision of supporting services is the basis for the above services. An interception dyke or baulk, contour line farming, soil protection, farming and areal afforestation are among the solutions that Macháč et al. (2018; Table 2) find to provide the greatest extent of ecosystem services. However, the actual extent of ecosystem service provision depends on local conditions.

	RS	PS	CS	OS
Dry polder	Not provided / very limited provision	Not provided / very limited provision	Not provided / very limited provision	Not provided / very limited provision
Wetland	Not provided / very limited provision	Not provided / very limited provision	Not provided / very limited provision	Not provided / very limited provision
Retention pools and reservoirs on plots	Not provided / very limited provision	Not provided / very limited provision	Not provided / very limited provision	Not provided / very limited provision
Infiltration swale / ditch, interception dyke (baulk)	Medium provision	Medium provision	Medium provision	Medium provision
Interception / drainage swale / ditch	Medium provision	Medium provision	Medium provision	Medium provision
Changes in sowing procedures, strip crop	Medium provision	Medium provision	Medium provision	Medium provision
Leaving after-harvest leftovers (mulch)	Medium provision	Medium provision	Medium provision	Medium provision
Contour line farming, minimising soil	Significant provision	Significant provision	Significant provision	Significant provision
Areal grassing	Significant provision	Significant provision	Significant provision	Significant provision
Areal afforestation broadleaf / coniferous	Significant provision	Significant provision	Significant provision	Significant provision

RS Regulating services  
 PS Provisioning services  
 CS Cultural services  
 OS Other services

Table 2: Extent of ecosystem service provision

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### How to imagine valuation of such ecosystem services?

A considerable part of the above ecosystem services can be expressed at the local level in monetary terms using an economic method. For solutions reducing soil erosion, for instance, one can imagine the benefit of a solution being considered as the savings of costs that would have to be spent on replacement of lost soil and soil nutrients and costs of removal of sediments from water bodies. In the case of expected improved water quality or reduction to its quantity in sewerage, one can imagine the effect of the solution as the savings of costs of wastewater treatment at WWTP. A positive flood protection effect can also be calculated, e.g., using costs of alternative (e.g., technical) flood protection solutions with the same expected effect or using savings on expected property damages.

### What are the costs and how much do nature-based solutions cost?

An economic assessment of the society-wide proportionality of a solution requires a comparison of the benefits with the total costs of the implementation. The costs of implementation of nature-based solutions have to include investment and operating costs as well as lost opportunity costs, including the frequently debated costs to farmers due to lost profits. In most cases, implementation of nature-based solutions is socially beneficial. The society-wide benefits exceed the implementation costs. An overview of the common average costs of implementation, operating costs and lost profits of nature-based solutions that are relevant to the Czech Republic is made in the Catalogue of Flood Protection Solutions produced as part of the STRIMA II project.

### Conclusion

Increasing awareness of the demonstrated benefits and economic argumentation on their beneficial nature is one of the main prerequisites for achieving support to nature-based flood protection solutions. The demonstrated solutions have a high application potential along the Bohemian-Saxonian border.

### References

Macháč J, Vacková A, Slavíková L (2018) Klasifikace a hodnocení přírodě blízkých protipovodňových opatření na vybraných veřejných statcích životního prostředí. Výstup v rámci milníku 1 projektu: Sasko-český management povodňových rizik II (STRIMA II), Reg. č.: 100282105. Ústí nad Labem. Millennium Ecosystem Assessment – MEA (2005) Ecosystems and Human Well-being: Synthesis. Island Press, Washington DC.



Annex 2: Pool (photo: J. Macháč)



Annex 3: Baulks (photo: P. Raška)



Annex 1: Wetland (photo: P. Raška)



Annex 4: Strip crop rotation (photo: Henry Be on Unsplash)