Food and Agriculture Organization of the United Nations

Observations and key messages on

Nature-Based Solutions for agricultural water management and food security

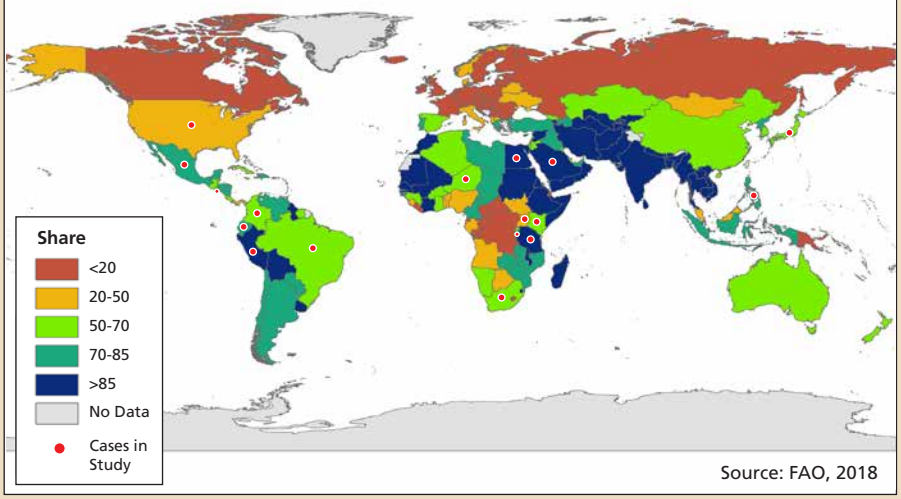
Agriculture is the largest water user

Food and agricultural systems are under a set of pressures to feed an increasingly hungry population and to cope with an intensifying competition over natural, human and financial resources, all subject to impacts of climate change. The natural resource base is already degraded to significant levels, and ''business as usual" is no longer an option.

FAO has been emphasizing the need to accelerate a global transition to sustainable food and agriculture systems, advocating an integrated approach to ensure sustainability in production and subsequent value chains processes, taking into account the sustainable management of natural resources, and water resources in particular.

This document focuses on the management of water for agricultural use, which holds the largest share of total water demand for many countries as illustrated by Figure 1. Moreover, for many countries, the prospects of improving water availability under changing climatic conditions remain a challenge, as both droughts and flood hazards are expected to increase. Conventional interventions founded on 'hard' water engineering and infrastructural development provided valuable lessons but often showed that they compromise the very ecosystem services that are required for stable water flows. Hence, calls for a paradigm shift in water management are justified and should be a priority on the political agendas.

Figure 1 | The share of agricultural water demand over total water demand



Source: FAO, 2018

Nature-Based Solutions

Nature-Based Solutions (NBS) offer a promising contribution on how to enhance the availability and quality of water for productive purposes and human consumption, while simultaneously striving to preserve the integrity and intrinsic value of the ecosystems. Moreover, NBS offers cross-cutting solutions to achieve various Sustainable Development Goals (SDGs) simultaneously. NBS contributes to SDG15 through sustainable use of terrestrial ecosystems that create favorable conditions for poverty alleviation (SDG1), zero hunger (SDG2), fresh water and sanitation services (SDG6) while mitigating negative climate change effects (SDG13).

Many concepts either align with the scope of NBS or they are comparable to it. Indeed, NBS acts as an improved water management initiative (micro- and macro levels); helps conserve/ rehabilitate natural ecosystems; and supports a circular economy. Moreover, NBS are consistent with numerous religious and cultural beliefs that advocate for harmony between man and nature representing a bridge between traditional and modern paradigms. Building on its inclusive character, NBS provides a mutually supportive approach for integrated water management that combines ecological and grey infrastructure (Mander *et al*., 2017). To reflect inherent heterogeneity and complexity of the interaction between NBS and ecosystem services, (Eggermont *et al*. 2015) suggested three typologies that represent dynamic benchmarks for many hybrid NBS that enhance their flexibility and problem-solving capacity while clarifying the trade-offs between the degree of engineering and delivery of ecosystem services.

NBS typology	
Type 1	No or minimal intervention in ecosystems. This type maintains /improves delivery of ecosystem services of preserved ecosystems. This NBS incorporates areas where people live and work in a sustainable way including nature conservation.
Type 2	Partial interventions in ecosytems. This type develops sustainable and multi-functional ecosystems and landscapes that improve delivery of selected ecosystem services. NBS benefits from natural systems, agriculture and conserving agro-ecology.
Type 3	Inclusive intervention in ecosystems. This type manages ecosystems in intrusive ways and includes full restoration of degraded or polluted areas using grey infrastructures.

Challenges implementing NBS

Implementing successful NBS for water management, however, is not an easy task since many ecosystems are severely degraded or exploited beyond their regenerative capacity. Furthermore, ecosystems are large, complex and can not easily be separated without affecting its ecosystem services. Hence, an ecosystem involves many stakeholders, such as owners, users or caretakers, each with their own set of interests and values. Reconciling these complex and conflicting objectives into a coherent set of principles and guidelines for NBS interventions requires, therefore, a structured and comprehensive approach. A key factor in finding alignment is the valuation of services provided by the ecosystem which includes the whole set of use and non-use values, in monetary terms. The valued ecosystem provides a factual basis to guide the implementation of NBS, according to transdisciplinary principles, i.e. complemented with scientific and case-specific knowledge of the eco-system in an adaptive decision-making process that involves the relevant stakeholders.

Key messages from the literature review

In the discussion paper 'Nature-Based Solutions For agricultural water management and food security', twenty-one case studies are analysed that seek associative patterns between structural project components and success and failures of NBS water management interventions. The inventory shows a wide variety of NBS techniques each in their own particular setting concerning geographic location, biophysical environment political context and community involvement.

The study shows that successful interventions comply with:

- *Understanding the ecosystems functionalities.* Knowledge on processes of the ecosystem is fundamental for planning of NBS interventions.
- *Multi- and transdisciplinary approaches.* Goals and strategies of actors are based on the findings of joint research of multiple academic disciplines (inter-disciplinary), ranging from biophysical sciences to organizational management, combining scientific knowledge with local experience (transdisciplinary).
- *Stakeholder involvement.* Resource users and other stakeholders are involved from the beginning of an NBS intervention, which creates a sense of ownership.
- *Well-designed funding schemes.* Sustainable funding is a key element for successful implementation of NBS.
- *Realistic monitoring and evaluation systems.* Information on effects of NBS intervention are required for a) timely responses to negative externalities b) rewarding good custodianship and c) penalizing neglect.
- *Endurance.* Often, lengthy periods are required to organize participatory and transdisciplinary platforms and the funding schemes needed.

Less successful water management projects tend to suffer from:

- *Limited knowledge on the understanding of ecosystems.* Inadequate factual information and lack of scientific knowledge base lead to failures in NBS initiatives.
- *Lack of political support.* Uncoordinated or insufficient stakeholder involvement resulting from a combination of a non-participatory and top-down approaches.
- *Conflicts.* The disruptive effect of armed conflict on social cohesion and opportunities for people to get organized were evident in failed case studies.
- *High initial investment.* High contributions may deter communities to implement NBS.

Difficulties to implement NBS were attributed to three main factors;

1. Characteristics of ecosystems relate to non-excludability issues in water management:

- Lumpy* indivisible water bodies (aquifers, inland waters)
- Distributed water flows require ample space
- Interconnectivity makes all places equal
- No 'closing down' if unprofitable
- Difficulty in protection from unpaid use

2. Consequences of non-excludability:

- Unpaid use of ecosystem services
- No price signals of scarcity

3. Inadequate pricing results in:

- Free rider's behavior ('Tragedy of the Commons')
- No incentive for production or maintenance of ecosystem services
- No role for ecosystem custodians

* Lumpy refers to the big solid undividable body, and they are used to describe and categorize ecosystem that included water bodies such as big lakes, rainforest, Oasis, and the desert

A roadmap for NBS interventions

The five-step roadmap for NBS interventions (Figure 2), as presented in the discussion paper, should create a productive stakeholder engagement that balances interests of resource users against quality and sustainability of the ecosystem.

Step 1. This social process starts with a structured inventory of the problematic, actors involved and their interests, acknowledging that each actor has its own goals and strategies.

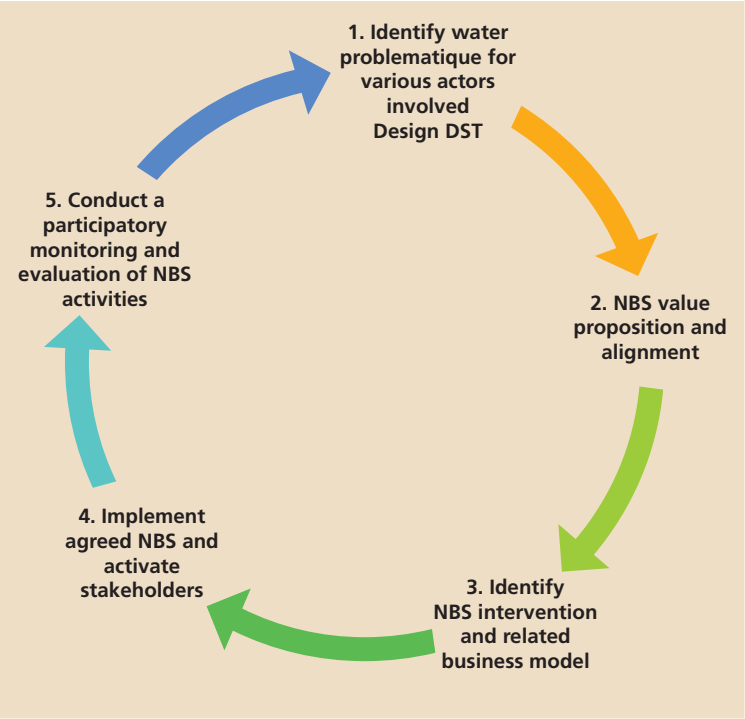
Step 2. In a process of alignment the project seeks to solve possible conflicting objectives and acknowledges retention of the subsidiarity principle: assuring active involvement of stakeholders that are closest to where NBS has its main environmental impact. This joint stakeholder process benefits immensely from the development of dedicated support tools (DST) that accumulate the multi- and transdisciplinary know-how and provide an adequate spatially and temporal representation of the impact of NBS interventions on ecosystems.

Step 3. A business model should describe how NBS adds value to its users and how it is financed.

Step 4. The implementation follows a management plan where the project is decomposed in smaller components that are formulated in terms of work packages and deliverables.

Step 5. A monitoring scheme provides a comprehensive analysis of the monetary and ecological costs and benefits to adequately informed stakeholders. Moreover, the monitoring scheme is used to reward the good functioning of NBS and to penalize abusive interventions.

Figure 2 | The five-step roadmap for NBS interventions

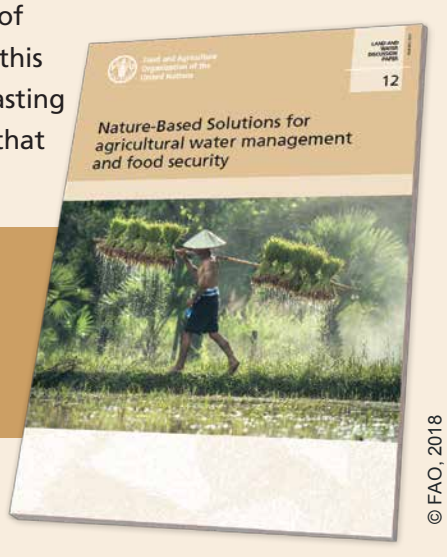


Upscaling

Successful interventions can incorporate a country-driven capacity enhancement that empowers people, strengthens organizations, institutions, multi-stakeholder processes and sharpens the enabling policy environment based on assessed needs for more sustainable NBS interventions.

Conclusion

As confirmed by the case studies, this roadmap asks for lengthy periods of time to organize the participatory and transdisciplinary platforms, the monitoring and evaluation of schemes and funding, as well as execution of the NBS intervention, which makes this process costly and requires endurance of its promoters. Yet the hope is that the lasting positive effects of well-designed NBS interventions will outweigh the quick wins that are largely based on short-sightedness.



These observations are taken from Sonneveld,B.G.J.S. Merbis, M.D. Alfarra, A. Ünver, O. and Arnal, M. F. 2018. Nature-Based Solutions for agricultural water management and food security. FAO Land & Water Discussion Paper No 12. Rome, FAO, 68 pp.

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