THE ROYAL SOCIETY

Royal Society submission to the Convention on Biological Diversity's request for information on biodiversity and climate change and disaster risk reduction

Introduction

1. The Royal Society welcomes the opportunity to respond to the Convention on Biological Diversity's request for information on biodiversity and climate change and disaster risk reduction. This response focuses on experiences with ecosystem-based approaches to climate change adaptation and disaster risk reduction.

2. This response is based on the findings published in the Royal Society report 'Resilience to extreme weather'[1]. The report considers the latest scientific evidence concerning the risk of extreme weather – river and coastal flooding, droughts, and heatwaves – on people throughout the world. Risk is determined by the likelihood and severity of a hazard (an extreme weather event, such as a flood), exposure (the presence of people, infrastructure, ecosystems, etc. in a given location) to the hazard, and vulnerability (susceptibility to damaging effects) in the event of a hazard. The report indicates where high densities of vulnerable people are more likely to be exposed to hazards in the coming decades, and assesses actions that can help prevent disasters. It shows how, with forethought and planning, societies can do more than simply cope with extreme weather, and can instead adapt, progress and develop: how they can build resilience.

3. There is a range of interventions, applicable at scales ranging from local to international, which can reduce risk and enhance resilience to extreme weather. The interventions have different strengths and weaknesses in different contexts, and the strength of the evidence regarding their cost-effectiveness is uneven. The report compares the evidence for, and cost-effectiveness of, interventions that fall into three broad categories: ecosystem-based approaches, engineering approaches, and hybrid approaches.

4. Ecosystem-based approaches are specific physical interventions which directly reduce the impact of extreme weather on people through the use of natural infrastructure and processes. Such interventions include: maintenance of existing vegetation, especially mangroves and reefs in the case of coastal flooding; natural flood management by increasing natural in-stream obstructions (eg woody debris) in the case of river flooding; and afforestation/reforestation in the case of heatwaves and droughts. There is substantial evidence about the contribution that healthy, natural or modified ecosystems make to reducing the risks of climate extremes and disasters. For example, large-scale ecosystems such as tropical forests are vital for climate regulation. They influence climate forcing and feedbacks through carbon sequestration. At a more local scale they can contribute to resilience by acting as a physical defence, by sustaining livelihoods and providing basic needs, and by contributing to post-disaster recovery.

5. **Key points**
   - **Recent advances in understanding the mechanisms behind ecosystem-based approaches may allow us to develop more generalisable rules** for their application in the future.

[1] Royal Society (2014) *Resilience to extreme weather* https://royalsociety.org/policy/projects/resilience-extreme-weather/

- **Ecosystem-based approaches provide many additional positive consequences** that are beneficial to local communities and are delivered consistently over time and not just when extreme weather strikes.
- **Maintaining existing vegetation is one of the most affordable options for providing resilience across all types of extreme weather**. There are few initial costs and on-going costs tend to be low.
- **Improved monitoring and evaluation of ecosystem-based approaches is needed.** Increased international oversight could help to standardise monitoring and evaluation, and ensure that the information collated can be used to make accurate comparisons between interventions.
- **Physical interventions are more likely to be effective if they are paired with social approaches.** Engaging with local communities is necessary to identify additional costs and benefits of interventions, and is vital for building resilience.

Cost-benefit analyses and trade-offs of ecosystem-based approaches

6. Recently, there have been significant advances in the understanding of how vegetation and ecosystems can reduce the impact of extreme weather. This is leading to improvements in the ability to predict the impact of, and to effectively implement, certain ecosystem-based options, in particular in coastal areas. Research needs to be continued and expanded to other areas and hazards. More evidence is needed to work towards some generalisable rules for application (which exist for engineering options).

7. Any intervention can have additional consequences beyond its impact on a particular hazard. The Royal Society's report assesses not only the cost-effectiveness of different interventions, but also the additional consequences of those interventions for other factors that contribute to resilience such as access to food, access to water, access to livelihoods, biodiversity conservation, climate change mitigation and protection against other hazards (figure 1).

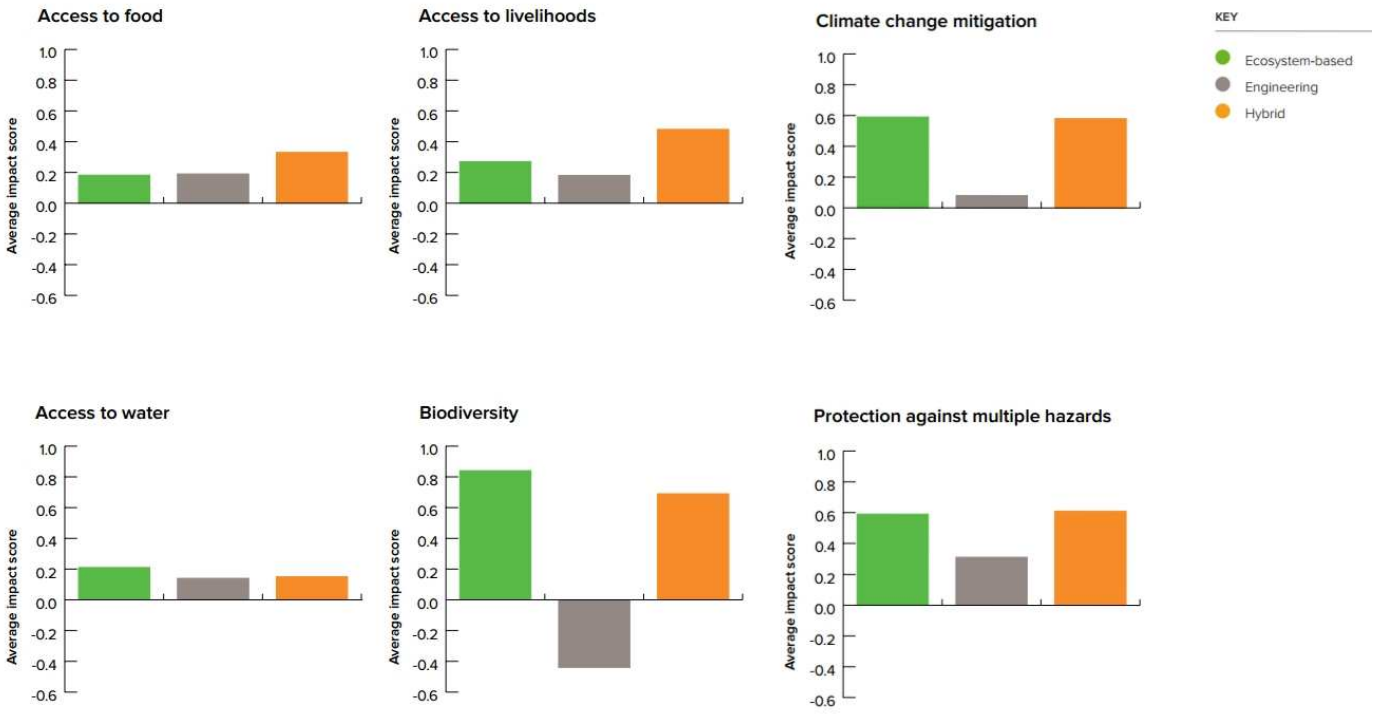

Figure 1. Additional consequences of ecosystem-based, engineering and hybrid options across coastal flooding, river flooding, droughts and heatwaves based on expert scoring. Values above 0 indicate beneficial consequences.

8. In comparison to engineering and hybrid approaches, ecosystem-based approaches are the most affordable and have positive additional consequences. However, research into the role of ecosystem-based approaches in reducing vulnerabilities is still developing. Therefore, the evidence-base to support these options tends to be weaker and there is uncertainty regarding their effectiveness over the longer term and under increased pressures.

9. Ecosystem-based approaches often offer protection against multiple hazards – for example, coastal forests can protect against coastal flooding, river flooding, high winds, and high temperatures. This is an important additional benefit given that hazards seldom occur in isolation.

10. For all types of extreme weather, maintaining existing ecosystems is one of the most affordable options because it has few initial costs and low on-going costs. Creation of new ecosystems is less affordable than maintaining existing ones due to the costs of restoring or re-establishing natural infrastructure.

11. Much work is currently being done to test ecosystem-based approaches. However, scientific monitoring is not always planned when practical projects are designed, and there are currently no standards or agreed metrics to ensure that monitoring will allow comparisons to be made between different interventions. Much evaluation is anecdotal, has not been peer-reviewed, and tends to focus on success stories.

12. The need for improved monitoring and evaluation of interventions applies not only to the assessment of specific options but also to broader disaster risk reduction and climate change adaptation plans. Increased international oversight could help in standardising monitoring and evaluation information and ensuring such information is collated, to make accurate comparisons between options more feasible.

Protection of local communities

13. Some interventions necessarily overlap with and can be prerequisites for others. Social approaches are often vital to building resilience and frequently increase the effectiveness of other options. For instance, many of the ecosystem-based interventions for resilience to drought work better where local people have recognised rights to manage land and water.

14. Many ecosystem-based approaches require significant areas of land and therefore can also have high opportunity costs. For example, the maintenance of existing, or creation of new, natural ecosystems can impact either positively or negatively on livelihoods and access to food and water depending upon what the alternative land use would be.

15. There is some evidence that ecosystem-based approaches involve local people more than other approaches and that, if managed by the community, are more enduring; they tend to be more adaptive to new conditions than manufactured structures, and are less likely to create a false sense of security.

16. Many additional beneficial consequences of ecosystem-based approaches for local communities – access to food, livelihoods, water and biodiversity – are delivered consistently over a period of time and not just when extreme weather strikes.

17. Additional consequences and costs of interventions should be identified and included in the decision-making process as far as possible. Engaging widely, with experts and local communities, makes it more likely that these consequences will be identified.

Case studies

18. A number of case studies demonstrating successful interventions to build resilience to extreme weather can be found in chapter 5 of the Royal Society's report. The principles of having a clear strategy and understanding of risk, and engaging a range of stakeholders, are common throughout the case studies. Other lessons derived from the case studies include the following:
    a. Ecosystem-based interventions can make a significant contribution to reducing risk, as well as delivering wider environmental, economic and social benefits.
    b. Collaboration and shared learning among a range of different stakeholders at local, national and international levels can galvanise resilience-building.
    c. Supra-national commitment and policies are required for extreme events that exceed national borders. Interventions are more effective when supported by appropriate national infrastructure policies and active local community networks.
    d. Knowledge-sharing and a definition of expertise that includes indigenous knowledge and traditional resilience-building practices are necessary for successful implementation of interventions.

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