

Ecosystem-based Adaptation

Nature and its role in delivering resilience to climate change

Key messages

Without appropriate adaptation strategies, climate change is likely to impact businesses in a variety of negative ways. Extractive industries that operate in areas that are highly susceptible to the effects of climate change, or rely upon the ecosystem services provided by these areas, are therefore particularly exposed to potential impacts.

Ecosystem-based adaptation, the use of natural (or 'green') infrastructure to enable adaptation to climate change, is one approach available to businesses to increase their climate change resilience. Anecdotally, ecosystem-based adaptation has been shown to be effective in a number of government-led and community-based projects. Therefore, it could offer the potential for businesses to reduce climate change impacts. In addition, ecosystem-based adaptation may deliver multiple environmental, social and economic benefits (e.g. reducing the carbon footprint of operations).

Ecosystem-based adaptation is increasingly being integrated into national policies and planning, and is gaining attention from the finance and insurance sectors. Some companies, including those in the extractive sector, are already successfully integrating elements of ecosystem-based adaptation into their operations. The use of green infrastructure for water management or hybrid approaches that include both 'grey' and 'green' infrastructure are examples of this. However, many such projects are not specifically targeting potential climate change impacts, or are relying predominately on traditional 'grey' infrastructure approaches.

Tracking emerging regulatory and financial drivers for ecosystem-based adaptation and using existing tools and guidance to pilot ecosystem-based adaptation would allow companies to better understand the business case for including such approaches within broader climate adaptation strategies.

Example Climate Change Impacts	Drivers for Adaptation	Examples of Ecosystem-based Adaptation	Examples of Potential Co-benefits
<ul style="list-style-type: none"> • Water scarcity (extraction and/or processing issues, water conflict) • Coastal erosion (damage to distribution networks and other assets) • Extreme weather (reduced system functionality, worker health) • Flooding (damage to infrastructure, disruption to supply chains) 	<ul style="list-style-type: none"> • Protecting assets and inputs • Economic • Environmental • Community considerations • Regulatory 	<ul style="list-style-type: none"> • River catchment management and water treatment (e.g. reedbeds) to maintain and protect supply • Restoration of mangroves to protect coastal infrastructure from storm surges • Reforestation of upland areas to reduce run-off, landslides, sedimentation and flood events • Restoring degraded or polluted land through phytoremediation to restore ecological function and protect water resources 	<ul style="list-style-type: none"> • Climate change mitigation through increased carbon sinks (e.g. forests, mangroves) • Improving capacity of ecosystems to support local communities (e.g. sustainable fisheries, more secure water supply) • Creation / restoration of habitats for wildlife • Reduced maintenance costs compared to grey infrastructure

Ecosystem-based Adaptation

What is Ecosystem-based Adaptation?

Defined by the Convention on Biological Diversity¹ as “the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change”, ecosystem-based adaptation has been shown to be potentially effective in addressing a broad range of climate change impacts².

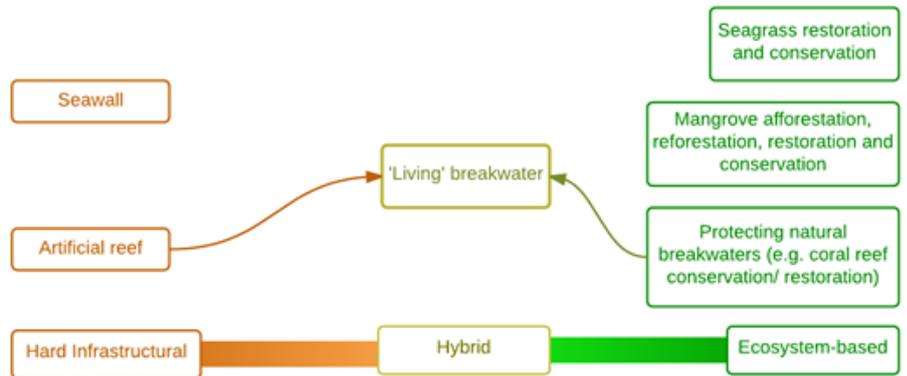
Examples of ecosystem-based adaptation include:

- flood reduction through watershed ecosystem management;
- reducing the risk of landslides by restoring or conserving slope vegetation; and
- reducing the risk of damage from storm surges through mangrove restoration and expansion.

Ecosystem-based adaptation has the potential to deliver a range of climate change adaptation, social and other environmental benefits. For example, water purification, soil stabilisation, carbon sequestration and flood protection can all be delivered by increasing tree/plant cover that in turn can help create habitat for wildlife.

There is strong anecdotal evidence for the benefits of ecosystem-based adaptation, but the approach would benefit from more rigorous analysis to understand its full potential.

Figure 1: Diagram of the spectrum of adaptation options for protecting against coastal erosion and wave damage due to sea level rise and changing intensity of storms (Source: UNEP)



To date, ecosystem-based adaptation has mostly been applied in the context of protecting communities from climate change impacts, although the implementation of ecosystem-based adaptation measures in urban areas is also increasing. The experience of governments and conservation organisations suggests a business case may be emerging for companies to incorporate it into their climate change strategies³.

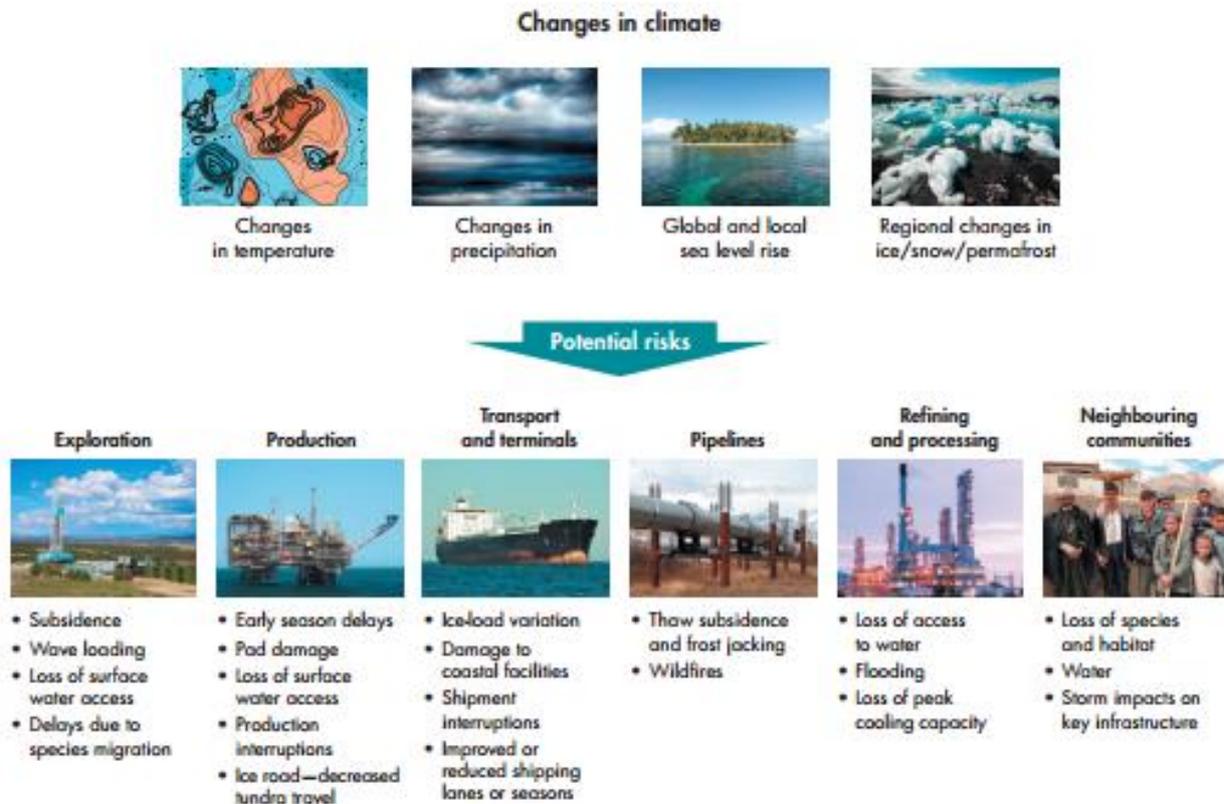
Ecosystem-based adaptation for business purposes, such as the protection of assets, may in turn provide local communities with protection from climate change impacts. Similarly, ecosystem-based adaptation focused on the protection of local communities may benefit businesses. As with all forms of climate change adaptation, the potential impacts of private sector ecosystem-based adaptation approaches should be carefully considered and

formulated. This is important to avoid ‘maladaptation’ or ‘actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future’⁴. Maladaptation could include designing flood protection measures in such a way that protects infrastructure but increases the flooding risks for local communities by diverting flood waters in an inappropriate way⁵.

Businesses that are engaging on the issue of climate change resilience often focus on engineered solutions to risks from extreme events, rather than those arising from gradual changes. However, the use of ecosystem-based adaptation offers a complementary or supplementary approach to such engineered adaptation solutions (see Figure 1⁶) and it can address gradual, or slow-onset, changes emerging from climate change.

Drivers for Business

Figure 2: Potential risks to oil and gas operations from changing climate (Source: IPIECA)



The Carbon Disclosure Project collated a list of over 1,000 physical risks from climate change identified by over 400 companies from a wide range of sectors⁷.

The International Council on Mining and Metals produced a report in 2013 on the implications for the mining and metals industry of adapting to a changing climate⁸. The key messages were that there are physical risks posed to mining and metals operations as a result of a changing climate but, as an industry experienced in managing risk, these could be integrated into existing procedures.

IPIECA identified over twenty key hazards and risks for the oil and gas sector resulting from climate

change, spanning the range of sector activities from exploration to refinement (Figure 2⁹).

In response to a growing understanding of potential climate change impacts for businesses, an increasing number of companies across multiple sectors are developing climate change adaptation strategies¹⁰. For example, Braskem, Rio Tinto and EDF (amongst others) submitted case studies to the UN Global Compact illustrating how they are adapting their businesses to reduce impacts from climate change¹¹.

With growing evidence that ecosystem-based adaptation can help to address some climate change impacts¹², this approach

could be integrated into private sector climate change adaptation strategies.

Some of the current and potential future drivers for this are discussed in the sections that follow.

Protecting Assets or Inputs

A key challenge faced by many businesses in the extractive sector is the long-term and cost-effective protection of assets. Processes such as coastal erosion and events like flooding can endanger business assets and installations¹³ – and are predicted to increase as a result of a changing climate over time.

Activities such as restoring mangroves along coastlines have the potential to protect coastal infrastructure (as well as inland habitats and local communities) from the effects of erosion or storm surges.

Unlike 'hard engineering', or 'grey infrastructure' (e.g. concrete-based sea walls for the protection of coastal installations), well managed and established mangroves can also help reduce climate change by creating habitat that captures and stores carbon. Such actions have obvious potential benefits for communities and biodiversity.

Hard engineered measures are well-established and tested approaches to addressing a specific hazard (or hazards). However, such interventions often have limited capacity for co-benefits and can in some cases disrupt the ecosystem processes that deliver important services to both business and local communities¹⁴. Many are also designed for specific scenarios, with limited capacity for adaptation to unpredictable climate conditions, thus potentially becoming obsolete over time.

Ecosystem-based adaptation provides a potential alternative to grey infrastructure for the protection of assets by using nature-based approaches to achieve similar goals. Working with ecosystems offers more flexibility in the face of climate variability and strengthens social-ecological resilience more broadly.

Table 1 provides some examples of climate change related risks relevant to the extractive sector that could potentially be addressed through ecosystem-based adaptation.

Economic

Comparing ecosystem-based adaptation with grey infrastructure/technological options, the Royal Society¹⁵ concluded that, while the examples of grey infrastructure

that were reviewed may prove most effective in reducing some impacts of climate change (and have a strong evidence base), ecosystem-based adaptation options are generally considered more affordable and potentially able to deliver additional co-benefits.

Hybrid approaches show promise as a way to deliver effective protection against climate change impacts whilst potentially being

Table 1: Potential ecosystem-based adaptation solutions to key climate related risks for the extractive sector

Climate-Induced Business Impacts	Potential Ecosystem-based Adaptation Solution(s)
<p>Coastal Damage: Sea level rise and extreme weather events (e.g. increasing hurricane intensity and/or frequency), particularly within exploration and production operations, may place coastal assets at risk from inundation and other disruptions.</p>	<ul style="list-style-type: none"> • Use of well-maintained coastal ecosystems is a well-established coastal defence strategy. • Natural coastal habitats (wetlands, salt marshes, mangroves and coral reefs) have the potential to shield coastal oil and gas operations against storm surges and reduce coastal erosion.
<p>Flooding: Operations situated on floodplains will be increasingly exposed to changes in river flows deriving from greater rainfall variability and storm intensities. River systems with flows influenced by glacial and snow melt may experience increased inundation of floodplains. Increasing development in drainage basins will compound the effects of climate change.</p>	<ul style="list-style-type: none"> • Private sector contributions to integrated river basin management could both reduce the risk of flooding, and tie into offset strategies or biodiversity targets. • Creating or preserving woodlands, peatlands or wetlands further inland within a catchment will slow run-off, reducing the risk of flooding downstream.
<p>Water Scarcity: Climate change forecasts suggest there will be changes in the seasonality, frequency and amount of rainfall in certain locations. This may threaten the ability of extractives to access water.</p>	<ul style="list-style-type: none"> • Creation or preservation of natural water stores may reduce the risk of water scarcity for extractive operations, as well as for neighbouring communities. • Green infrastructure, such as constructed wetlands or other 'natural' systems can help treat wastewater from industrial and agricultural processes so it can be reused or to protect drinking water sources.

cheaper than traditional grey infrastructure and delivering more co-benefits. Initial costs are likely to be lower for ecosystem-based adaptation as natural, pre-existing structures or processes are capitalised upon to mitigate against climate risk. Furthermore, maintenance and operating costs may be lower than for engineered solutions as natural processes tend to be self-sustaining.

The effectiveness of such projects will depend on appropriate choice of location and planning. Limited data are available for a detailed review of cost-benefit analysis of ecosystem-based adaptation schemes at present, particularly those relevant to business.

However, there is growing evidence from the non-commercial sector that ecosystem-based adaptation can be both cost effective and efficient¹⁶ (see Box 1¹⁷).

Cost-benefit analyses and feasibility studies that include both monetary and non-monetary values are very important to aid selection of appropriate adaptation options. A 2017 publication on valuing the benefits, costs and impacts of ecosystem-based adaptation provides a useful discussion on the challenges and opportunities of this approach, as well as providing a number of case studies¹⁸.

Finance standards and insurance policies for businesses generally do not include explicit requirements or guidance on the use of ecosystem-based adaptation.

Box 1: The Global Mountain Ecosystem-based Adaptation

As part of the Global Mountain Ecosystem-based Adaptation Programme, pilots were undertaken in three climate change vulnerable countries to look at the case for ecosystem-based adaptation. The pilots included: the use of an indigenous plant (broom grass) to rehabilitate degraded land, stabilise soil and provide a sustainable livelihood in Nepal; sustainable management of grassland, vicuña and livestock to support hydrological and other ecosystem services in Peru; and the implementation of farming practices that help reduce soil erosion, landslides, drought and flooding (as part of a wider scheme) in Uganda.

The study included a cost-benefit analysis of the ecosystem-based adaptation pilot projects. It was determined that a 'net benefit' resulted from investment in the use of broom grass in the Nepal project. It was found to be 'economically preferable' to adopt sustainable, ecosystem-based adaptation approaches to grassland, livestock and vicuña management in the community of Tanta, Peru, compared to 'business as usual'. In Uganda, farming practices based around ecosystem-based adaptation were assessed as being 'profitable' (compared to those that were not classified as such) and it was considered that this profitability 'can be sustained in the long run'.

Source: United Nations Development Programme¹⁷

However, the insurance industry in particular has shown interest in the use of ecosystem-based adaptation or nature-based solutions as a means of managing risk exposure¹⁹.

Environmental

Whilst traditional grey infrastructure will play an important role in the extractive industries for the foreseeable future, such structures can have negative impacts on ecosystems and the services they deliver²⁰.

Conversely, ecosystem-based adaptation can have positive impacts on biodiversity, ecosystem services and the wider environment. For example, the restoration and replanting of forest areas and their protection to stabilise soil, help secure a water source, sequester carbon and

mitigate pollution, will also create habitat for wildlife.

Similarly, the replanting or restoration and protection of mangrove forests along a coast line may not only help protect assets and communities from storm surges and sequester carbon resulting from operations, but will also create habitat for fish and other wildlife. In turn, this may help support fishing livelihoods for local communities.

However, it should be noted that there may be environmental trade-offs associated with ecosystem-based adaptation as well. Managing ecosystems to encourage silt accumulation for coastal protection, for example, may modify local habitats or change the recreational value of an area²¹.

Community Considerations

Local communities and marginalised groups are likely to be particularly vulnerable to the impacts of climate change. Appropriate, well planned and well-funded use of ecosystem-based adaptation has the potential to support the livelihoods, wellbeing and resilience of these groups and put human rights considerations at the core of business operations

One example of this is managing water scarcity by creating a wetland, which delivers a more reliable water source for industry whilst potentially climate-proofing local fishing activities²². By their nature, such activities need to be specific and appropriate to a local area. Engagement with local communities in the planning process of ecosystem-based adaptation schemes is not only vital for appropriate design, but can increase local buy-in and support for projects that deliver co-benefits²³.

Regulatory

Governments are increasingly recognising the value of

ecosystem-based adaptation in helping to mitigate potential climate change impacts. The European Union's Green Infrastructure Policy puts a clear emphasis on promoting investment in, and implementation of, green infrastructure. Many other countries are incorporating elements of nature-based solutions into legislation and policy (e.g. the Philippines, Australia and Canada²⁴).

Some countries have begun to incorporate ecosystem-based adaptation into national plans, strategies and targets (e.g. National Biodiversity Strategies and Action Plans under the Convention on Biological Diversity and National Adaptation Programmes of Actions under the United Nations Framework Convention on Climate Change).

Ecosystem-based adaptation is also increasingly being included in disaster management plans, development policy and drought relief policy²⁵. A review of intended Nationally Determined Contributions, covering 189 countries, found that while only 23

of the 162 Intended Nationally Determined Contributions submitted to the United Nations refer explicitly to ecosystem-based adaptation, 109 indicate ecosystem-orientated visions for adaptation²⁶.

The continued adoption of ecosystem-based adaptation considerations by governments may increase future regulatory and / or policy requirements on business. Building an understanding of such approaches and testing them in the field may therefore assist businesses in responding to potential future regulatory changes.

Case Studies

There are few published examples of private sector use of ecosystem-based adaptation specifically to address potential climate change impacts.

Examples of hybrid approaches to adaptation in the extractive sector and in other contexts are given in Box 2²⁷ and Box 3^{28,29} respectively.

Box 2: Case Study

Oyster Reef Creation in Louisiana, Shell – Hybrid approach to adaptation in the extractive sector²⁷

A Shell pilot project in Louisiana, in partnership with The Nature Conservancy, looked at the feasibility of creating oyster reefs along a stretch of coastline to protect an oil pipeline from excessive erosion. This would be considered a hybrid approach to adaptation because the reef acts as a breakwater to dissipate wave energy, whilst also creating a living oyster reef, supporting biodiversity.

This strategy is particularly relevant because a living reef can cope with changing water depth resulting from sea level changes. Climate change is likely to result in both coastal erosion and sea level changes. Creation of oyster reefs costs US\$1 million per mile compared to an estimated US\$1.5-3 million per mile for engineered rock barriers, making it an economically viable option.

Source: Green Infrastructure Case Studies²⁷

Box 3: Case Study

Building with Nature in Indonesia – Ecosystem-based adaptation and hybrid approach to adaptation in coastal environment²⁸

Coastal environments are likely to be particularly impacted by erosion and storms exacerbated by climate change. This has major implications for many coastal communities, livelihoods and infrastructure. A project in Indonesia is looking at 'Building with Nature' in a location where hard engineered solutions were ineffective (and did not create the conditions to support sustainable livelihoods) and mangroves could not be restored due to high rates of erosion and insufficient silt inputs. Permeable dams were used to help to reduce wave strength and therefore encourage silt deposits, creating areas suitable for mangrove rehabilitation. Once mature, these reclaimed areas of mangroves, in combination with the permeable dams, will help protect 20km of previously eroding coastline and support livelihoods such as sustainable aquaculture. The project involved extensive stakeholder consultation and capacity building to integrate the approach into community plans. It is hoped that this approach could be scaled up to improve the resilience of urban and rural coastal communities to climate change.

Green façade for heat wave buffering in Vienna – Hybrid approach to adaptation in an urban environment²⁹

The effects of climate change will impact urban environments in a range of different ways, with implications both for the health and wellbeing of residents and the functioning of infrastructure. A project in Vienna is looking at the potential of hybrid adaptation – in this case the greening of a building façade on a public administration building – to combat the city 'heat island effect' (where built up areas experience hotter temperatures than surrounding areas) and loss of biodiversity. As part of a collaborative public and private partnership, 850 square meters of the façade of a public administration building in Vienna was planted with appropriate species (mainly perennials, grasses and herbs). Other co-benefits of green façade could include: heat and noise insulation, air purification, health benefits and amenity value associated with green spaces, and protection of the building itself. The main aim of this pilot project was to add to the evidence base for such approaches. Whilst further monitoring is required, initial results indicate that the project has raised awareness of such approaches and that the green façade has *'improved thermal insulation by 21%...and led to a change in the annual transmission losses of 54.7 kWh to 45.1 kWh per square meter of green exterior wall'*²⁸.

Source: Panorama: Solutions for a Healthy Planet^{28, 29}

Tools and Guidance

A wide range of guidance documents around climate change adaptation (including ecosystem-based adaptation) are available. UNEP-WCMC is also developing a navigator of tools and methodologies relevant for ecosystem-based adaptation, based on an inventory it compiled with over 200 entries³⁰. A small selection of the guidance and tools available is provided in Box 4.

Box 4: Example Tools and Guidance

Ecosystem-based adaptation: question-based guidance for assessing effectiveness - <http://pubs.iied.org/17606IIED/>

UNEP Guidance Manual for the Valuation of Regulating Services - http://www.unep.org/pdf/Guidance_Manual_for_the_Regulating_Services.pdf

InVEST (Integrated Valuation of Environmental Services and Trade-offs) - <http://www.naturalcapitalproject.org/invest/>

Designing Climate Change Adaptation Initiatives: A UNDP Toolkit for Practitioners - https://sustainabledevelopment.un.org/content/documents/951013_Toolkit%20for%20Designing%20Climate%20Change%20Adaptation%20Initiatives.pdf

Cost-benefit analysis (CBA) - http://unfccc.int/resource/docs/publications/pub_nwp_costs_benefits_adaptation.pdf

UNEP coastal ecosystem-based adaptation (EbA) Decision Support Tool and Options for Ecosystem-based Adaptation in Coastal environments Guidebook - <http://web.unep.org/coastal-eba/>

Tool to support the development of business strategies for climate change adaptation <http://www.empresaspeloclima.com.br/adaptation?locale=en>

Next Steps

Ecosystem-based adaptation has the potential to become a useful approach for companies to minimise both current and future climate risks, whilst delivering benefits to biodiversity and local communities.

Companies exploring the potential for this approach to contribute to their climate strategies should:

- Ensure they are familiar with emerging policy, regulatory and finance sector drivers to utilise ecosystem-based

approaches to adaptation (e.g. a recent review was produced on natural infrastructure by the World Business Council for Sustainable Development³¹);

- Track emerging guidance and tools (see Box 4) on ecosystem-based solutions for their relevance and applicability;
- Assess the effectiveness and conduct a cost-benefit analysis of corporate ecosystem-based adaptation already in use (if relevant);

- Consider sharing case studies and experiences of corporate ecosystem-based adaptation to build the evidence base; and
- Pilot ecosystem-based adaptation approaches in the design of climate change adaptation strategies and plans where significant drivers exist to do so.

Citation: UNEP-WCMC (2018) Ecosystem-based Adaptation: Nature and its role in delivering resilience to climate change, UNEP-WCMC, Cambridge, UK.

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