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EVIDENCE SUMMARY

Ecosystem-based Adaptation and Water Security

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Fresh water sustains all life and is an essential requirement for human development. Globally, many communities are water-stressed, and an estimated 1.8 billion people are projected to live in areas with absolute water scarcity by 2025 (UNDP 2014). Communities rely on secure water resources for a wide array of purposes, including direct consumption, household use, irrigation, energy production, and sanitation and hygiene. However, as global temperatures increase and precipitation patterns change, floods, droughts and storms are likely to become more frequent and severe, which will impact water security. In many areas, climate stressors can also worsen the water stress already caused by human activity, such as overconsumption of water resources, thus further threatening water security and resulting in direct socio-economic and health impacts on the most vulnerable populations.

Ecosystem-based adaptation (EbA) is a nature-based method to address water insecurity and climate change adaptation by strengthening natural systems, conserving biodiversity and maintaining the goods and services that ecosystems provide for human development. EbA approaches to address water insecurity can also provide important benefits for other development sectors that rely on sustainable and clean sources of water.

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Background

Water security refers to protection of the physical water resource, equitable access to that resource and mitigation of water-related disasters. Water security has quantity, quality and spatial-temporal dimensions. The United Nations defines water security as "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability" (UN-Water 2014).

Globally, water insecurity is a constraint on sustainable development and poverty reduction, as nearly four billion people experience severe water scarcity at least one month per year. About 500 million people face severe water scarcity all year round, and by 2050, an estimated one in four people is projected to live in a country with recurring and long-term shortages of fresh water (Mekonnen and Hoekstra 2016, UN 2016). Today, more than 1.7 billion people live in river basins where water is being used faster than it is recharged (UN 2016).

Water scarcity can have many negative impacts on households – including decreased access to water for consumption and household use, increased incidence of waterborne disease and reduced agricultural productivity – which can make it more difficult to lift communities out of poverty (Mekonnen and Hoekstra 2016). In much of the developing world, the task of daily water collection typically falls disproportionately to women and young girls, reducing their time available for education and other opportunities (UN 2014).

Climate stressors exacerbate other pressures on freshwater resources. Increasing temperatures and evaporation, more variable rainfall and changes in water flow all impact freshwater resources. More frequent and intense weather events, such as floods, droughts and storms, can also increase water insecurity (UNDP 2014). As weather patterns change, more rivers, lakes, wetlands and aquifers are expected to dry up, and water systems will become increasingly stressed in regions susceptible to drought.

There are many other stresses on freshwater resources, with water security impacted by growing demand, population growth, unsustainable consumption, wasteful practices and pollution. Lack of sanitation services and environmental pollution contaminate water and make it unsafe for household use. At least 1.8 billion people use water sources that have fecal contamination, and over 80 percent of wastewater is not filtered before being released into rivers or the sea (UN 2016). Human land use and ecosystem degradation can also have negative impacts on water flow and quality; for example, large-scale changes in land use, such as deforestation, can potentially impact local rainfall patterns (Carabine et al. 2015).

National economies rely on secure water resources to support industry, agriculture and energy production. The World Bank estimates that water insecurity can reduce a country's GDP by up to 6 percent (World Bank Group 2016).

PHOTO: DJEMBE

How Can Ecosystem-based Adaptation Approaches Support Water Security?

EbA involves the use of biodiversity and ecosystem services to help people and communities adapt to the adverse impacts of climate change (UNEP 2016). EbA approaches can help communities adapt to water insecurity in the following ways:

EbA Can Increase Water Quantity and Enhance Water Quality

Among the world's 105 largest cities, one-third get their water from forested areas. Healthy forests, mangroves and other natural systems have a direct impact on water quantity by maintaining water flow, absorbing rainfall and replenishing watersheds (UNFCC 2011). EbA approaches that restore and conserve healthy ecosystems can be a cost-effective adaptation strategy to maintain or increase the quantity of water available for communities by recharging aquifers and improving natural water storage (Colls et al. 2009, Talberth et al. 2012, Bertule et al. 2014). These approaches can also improve access to clean water by providing water filtration benefits similar to drainage and wastewater treatments. For example, forested areas regulate water quality and decrease pollution by filtering runoff, preventing erosion and slowing sedimentation (Talbert et al. 2012; Bertule et al. 2014). Similarly, wetlands and riparian buffers filter runoff from industrial areas or farmland and remove sediment before it contaminates groundwater. Coastal wetlands can play a significant role in reducing saltwater intrusion in coastal aquifers (Bertule et al. 2014).

PHOTO: SEAN SPRAGUE

EbA approaches can improve the efficiency of water use and management, for example, through agroforestry and conservation farming (Carabine et al. 2015). Smallholder farmers, who are extremely vulnerable to water insecurity in the face of climate change, can especially benefit from the low implementation costs of these nature-based approaches (Vignola et al. 2015). For example, communities in Zambia identified conservation farming as a priority coping strategy to help them adapt to drought and rainfall variability (Colls et al. 2009).

EbA Can Minimize Impacts to Water Security from Extreme Weather Events

EbA strategies can help vulnerable communities adapt to extreme weather events. For example, the conservation and restoration of mangroves, coastal marshes and coral reefs can provide protection from storm surges, floods and hurricanes/typhoons (in addition to sea level rise) by serving as physical buffers that retain excess water, dissipate wave energy and stabilize shorelines (Baig et al. 2015). Additionally, the management and restoration of natural floodplains can reduce flood and drought risk and control erosion by regulating and controlling water flows during peak events and by recharging aquifers. For instance, the Netherlands, Germany and France have all adopted programs along the Rhine River to enable water to safely connect to natural floodplains for flood control (Bertule et al. 2014). (For more information see the **Ecosystem-based Adaptation and Extreme Events Evidence Summary** and the **Ecosystem-based Adaptation and Coastal Zones Evidence Summary**).

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EbA Provides Additional Development Benefits

EbA approaches for addressing water insecurity provide additional development benefits, including carbon sequestration, biodiversity conservation and important goods such as wild fish, fuel and non-timber forest products. In particular, EbA can protect and strengthen ecosystems such as coral reefs, mangrove forests and wetlands that are critical to conserving freshwater and marine biodiversity. EbA approaches that improve water security can also contribute to economic sectors that depend on water, such as commercial fisheries, hydropower generation and agriculture (Munang et al. 2013, Nel et al. 2014). These approaches can also be more cost-effective than conventional adaptation interventions, such as the construction of infrastructure, and have positive landscape-scale impacts (Munang et al. 2013, Nel et al. 2014). (For more information, see the **Economics of Ecosystem-based Adaptation Evidence Summary**).

PHOTO: ROB JEFF

New York City gets 90 percent of its water from the Catskill-Delaware watershed, which costs $150 million to protect and manage each year. To replace the filtration services provided by this watershed, it would cost the city an estimated $6 to $8 billion to construct a filtration plant and $300 million to operate it annually (Carabine et al. 2015).

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How Do Ecosystem-based Adaptation Approaches Compare with Hard Infrastructure for Water Security?

Both EbA approaches and hard infrastructure can be effective in addressing water security; depending on the context, an adaptation strategy that incorporates both may be most effective. Hard infrastructure options to help communities adapt to water insecurity include construction of water treatment plants, levees, sea walls, storm water drains, pipelines, dams, canals, wells and water storage tanks. These infrastructure options are often expensive and single-purpose, usually addressing one aspect of water insecurity. Built infrastructure can also adversely impact surrounding ecosystems and may lead to maladaptation in some cases (WWF and World Bank 2013). EbA approaches are often cheaper and provide longer term results, making them more accessible for poorer communities; they can also provide many additional benefits for development, and there are few, if any, negative effects from improved ecosystem management (Colls et al. 2009, Bertule et al. 2014).

For example, an analysis in India compared the costs of building a dam in the Godavari River Basin to help local communities adapt to changes in rainfall patterns and drought with the costs of a World Wildlife Fund project to restore earthen dams that had traditionally served as water storage tanks. Researchers estimated the cost of de-silting and restoring more than 6,000 natural dams at $635 million versus $4 billion to construct a new dam. In addition to the cost savings, the nature-based approach had multiple co-benefits, including reactivation of some wells and increased crop yields. Furthermore, construction of the proposed dam would have displaced 250,000 people and damaged natural habitats, including 60,000 hectares of forest (Rizvi et al. 2015).

In some instances, EbA solutions can help protect water-related hard infrastructure. For example, 16 watershed protected areas in Peru were estimated to provide almost $5 million in savings over a 10-year period by protecting dams and reservoirs from sedimentation. In addition, these protected areas provided a number of other ecosystem goods and services that were valued at over $80 million annually (Rizvi et al. 2015). In other situations, EbA approaches can be combined with hard infrastructure to address different aspects of water security. For example, a project in Bolivia helped local communities adapt to droughts by supporting the construction of hard infrastructure, such as water storage tanks, to complement EbA strategies like the establishment of protected areas around watersheds (Doswald and Estrella 2015).

Challenges to broadening the use of EbA include the length of time to see results for some approaches such as ecosystem restoration, difficulty in measuring impacts and lack of institutional capacity to implement these approaches. Effective EbA for water security goals also requires coordination among different development sectors and government ministries, the financial resources to implement approaches, and hydrological and climate information on which to base interventions. Additionally, built water management systems are still important in many aspects of water security and provide services that nature-based approaches cannot address, such as water distribution.

Conclusion

By 2050, about one in four people are projected to live in a country with recurring and long-term shortages of fresh water. As a changing climate exacerbates water insecurity globally, the poorest and most vulnerable communities will experience the greatest impacts on their health, food security, livelihoods and economic growth. The management, conservation and restoration of natural systems to prevent environmental degradation and maintain biodiversity and ecosystem services can improve water security and support human development. The evidence base supports the consideration of EbA approaches either alone or in coordination with broader adaptation strategies to optimize water security and the resilience of water systems.

For more information on EBA approaches to address water insecurity, see our case studies on the UNDP program ***Maintaining Water Security in Critical Water Catchments in Mongolia through Ecosystem-based Adaptation*** *and* ***three regional USAID projects in Peru****.*

PHOTO: TAYLOR WEIDMAN

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About This Series

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