USAID
FROM THE AMERICAN PEOPLE

EVIDENCE SUMMARY

Ecosystem-based Adaptation and Food Security

Food security is fundamental to human well-being and development. It is influenced by many factors, including poverty, access to arable land, healthy ecosystems, population growth, and transport and market infrastructure. Climate stressors such as higher temperatures, variability in rainfall and more frequent and severe droughts also have important consequences for food security, especially among the poorest and most vulnerable populations. Ecosystem-based adaptation (EbA) is a nature-based method for climate change adaptation that addresses food security by strengthening and maintaining natural systems and the goods and services they provide. EbA approaches to address food security can also provide additional benefits, including contributions to health, sustainable land use, economic growth and water security, as well as reduced greenhouse gas emissions and increased carbon storage.

PHOTO: NIALL HANAN

PHOTO: UNDP

PHOTO: 2 GREENENERGY

Background

Food security, as defined during the 1996 World Food Summit, is "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet dietary needs for a productive and healthy life." Currently, an estimated 12.9 percent of the population in developing countries is undernourished and faces food insecurity (UN 2016). An estimated 800 million people globally are undernourished. There are numerous health and economic consequences from chronic food insecurity, including stunting, reduced mental capacity, higher risk of chronic disease and decreased labor force productivity. A country can lose up to 10 percent of its GDP annually from the collective impacts of food insecurity (Brown et al. 2015).

The four components of food security are food availability, access, utilization and stability (Wheeler and von Braun 2013). Food production, a critical aspect of food availability, is highly dependent on healthy natural systems that provide a host of goods and services such as pollination, water for irrigation, wild foods and soil formation (Brown et al. 2015, Campbell et al. 2016). Some of the risks that climate change poses to food production include:

- **Higher temperatures** can lead to decreased crop yields, heat stress among livestock, potential loss or disruption of key pollinators and changes in the infestation patterns of crop and livestock pests.
- **Changes in precipitation** can lower crop yields and fisheries' productivity, reduce the quality of pasture and forage, and decrease soil moisture levels.
- **Increased intensity and frequency of extreme weather events** can result in damage to agricultural infrastructure and loss of crops and livestock.
- **Increased climate variability** can interfere with crop growth during key stages of the life cycle, not only diminishing but eliminating entire harvests, particularly in areas where crop production relies on simplified agroecosystems.

Climate stressors can also affect the other components of food security through impacts on food distribution and transportation, storage, processing and hygiene. Since EbA approaches strengthen natural systems, they are most relevant in addressing food availability. However, some EbA interventions may also address other components of food security; for example, a project that improves water provision for a community using EbA approaches contributes to both food availability (by providing water for agriculture) and utilization (by providing water for sanitation and to clean and cook food).

The world's poorest people are among the most vulnerable to the impacts of climate change and its effects on food security. Smallholder farmers, fishers and pastoralists are particularly vulnerable due to their high reliance on natural systems (Doswald et al. 2014). The United Nations Environment Programme and the International Fund for Agricultural Development estimate that 2.5 billion people globally are engaged full- or part-time in smallholder agriculture; collectively, they produce about 80 percent of the food that is consumed in developing countries (IFAD and UNEP 2013, Vignola et al. 2015). Many smallholder farmers rely on rainfall as a source of water for their agricultural activities; as a result, changes in precipitation patterns can have devastating impacts on agricultural productivity and negatively impact their food security (UN 2016). Other factors that compound smallholder farmers' vulnerability include chronic poverty, limited access to markets and credit, and marginalized social status (Vignola et al. 2015).

An International Union for Conservation of Nature project in the Panchase region of Nepal focused on the restoration of natural springs and ponds to improve water provision for agriculture and livestock, especially during the dry season. Anticipated benefits for communities include decreased time to collect water and enhanced income from increases in agricultural yields during the dry season (UNDP 2015).

PHOTO: T. ROSSI

How Can Ecosystem-based Adaptation Approaches Support Food 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). For food security, EbA covers a wide range of actions to maintain and strengthen ecosystem services that underpin agricultural productivity and resilient food production. Specific examples of EbA approaches that contribute to agricultural productivity include planting shade trees to improve soil fertility and support pollinators, restoring and managing watersheds to maintain water supplies for agriculture and diversifying crops and utilizing intercropping to improve resistance to pest outbreaks that may increase with climate variability (Colls et al. 2009, Vignola et al. 2015). EbA interventions can be tailored to the local context to address specific climate stressors and risks.

EbA approaches can also conserve and maintain intact natural systems that provide a sustainable supply of wild foods, including fish, indigenous plants, nuts, fruits and insects. Wild foods are a significant part of the diet in many developing countries and can serve as a safety-net food source during food insecure periods, such as droughts (Powell et al. 2015, Ahenkan and Boon 2011). For example, a study of wild foods in 22 Asian and African countries found that 90 to100 different species were consumed in each location, many of which were high in essential vitamins and micronutrients (Bharucha and Pretty 2010). Inland fisheries in the developing world are estimated to support the livelihoods of over 60 million people and provide food for several hundred million more (Cooke et al. 2016).

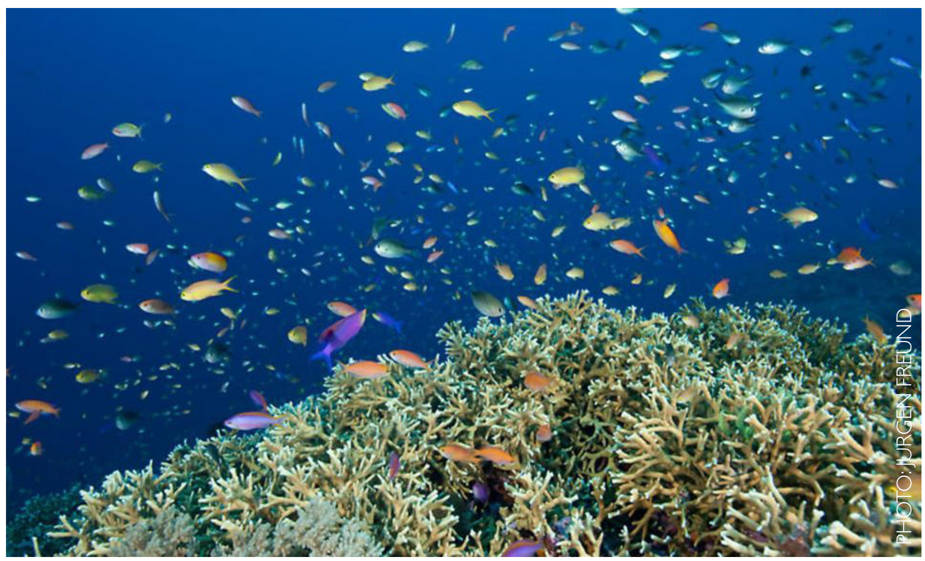
The Climate-Resilient Ecosystems and Livelihoods project in Bangladesh is an example of the application of EbA to address food security.

PHOTO: GEORGE FIGDOR

Some examples of projects that highlight the benefits of EbA approaches in supporting food security are:

- Researchers found that while rainfed crops in **Vietnam** suffered up to 40 percent yield losses during severe droughts or floods, local agroforestry systems experienced significantly less loss and were more resilient while providing multiple benefits for communities, including animal feed and income from the sale of non-timber forest products (Nguyen et al. 2013).
- In Tinambac municipality of Camarines Sur province in the **Philippines**, the establishment of a locally managed marine protected area in 2007 improved the management of the local ecosystem and increased coral reef resilience to changing sea surface temperatures, resulting in significant increases in fish biomass within the protected area. An additional benefit was a 20 percent increase in seaweed harvest, which local communities sold to generate income (Rizvi et al. 2015).
- A project in **Uganda** to build resilience to changing rainfall patterns and prolonged drought implemented EbA approaches such as reforestation, re-vegetation and agroforestry, which led to improved soil conditions, reduced planting costs and increased protein intake among local communities from the introduction of legumes as cover crops. Farmers were able to diversify their livelihoods with other activities, such as rearing livestock, due to less time spent on farming activities. Other benefits included improvements in local biodiversity and the restoration of hydrological cycles (Munang et al. 2013a, Munang and Nkem 2011).

As noted in the examples above, EbA approaches can offer benefits to other development sectors, such as economic growth and health. These approaches are also often cost-effective, sustainable and can have landscape- and seascape-scale impacts (Munang et al. 2013b, Nel et al. 2014).



How Does Ecosystem-based Adaptation Compare With Other Adaptation Approaches for Food Security?

Both EbA and non-EbA approaches can be effective in addressing food security; depending on the context, an adaptation strategy that incorporates both may be most effective. Factors that can help guide decision-making include the costs and benefits of each approach, length of time to experience results, sustainability of the intervention, availability of resources and technology to implement the intervention, and community priorities.

PHOTO: UNDP

Some common non-EbA approaches to climate change adaptation include the construction of hard infrastructure for irrigation and water storage and the use of agrochemicals to increase agricultural productivity. For example, water availability for farming can be supported by the construction of dams, water storage tanks, water treatment plants and levees, while EbA approaches to maintain water supply include measures such as planting riparian barriers, conserving forests and restoring watersheds.

EbA approaches often use local or traditional knowledge and may be more accessible for poor and rural populations since these approaches are less reliant on external inputs or technology (Colls 2009, UNDP 2015, Vignola et al. 2015). Additionally, EbA approaches usually have greater benefits for other development sectors. For example, a project in Tanta District, Peru using EbA approaches to enhance pasture and livestock management also improved provision of water for downstream communities and resulted in governance benefits through the strengthening of local land management organizations (UNDP 2015).

However, EbA approaches may take longer to implement than hard infrastructure and other non-EbA approaches, particularly when ecosystem or hydrological restoration is required. In contrast, EbA interventions are often cheaper to maintain long-term compared with hard infrastructure. In addition, EbA approaches provide more flexibility for future adaptation and development interventions compared with hard infrastructure and maintain ecosystem services that are critically important to food security such as pollination, soil formation and the regulation of hydrological cycles. In contrast, the construction of hard infrastructure can damage ecosystems and lead to substantial costs to replace the goods and services they provide. As with non-EbA approaches, additional considerations include the need for labor investment to implement EbA approaches, acquisition of the necessary technical information on EbA measures in areas where access to this type of information may be limited or nonexistent and difficulties in measuring the impacts of EbA approaches (Jones et al. 2012, Carabine et al. 2015, Vignola et al. 2015).

Conclusion

Globally, food security is under increasing threat from climate stressors, such as increasing temperatures, variable rainfall and extreme weather events. Smallholder farmers, fishers and pastoralists are among the most vulnerable due to their high level of dependence on natural systems. EbA approaches can help maintain the availability of water and wild foods, as well as support agricultural productivity and resilient food production. The current evidence base supports the consideration of EbA when developing climate change adaptation strategies for food security. Given the range of factors that impact food security, a broad and integrated adaptation strategy that incorporates both EbA and non-EbA approaches may be most effective.

Sources

Ahenkan, Albert, and Emmanuel Boon. "Improving nutrition and health through non-timber forest products in Ghana." Journal of Health, Population and Nutrition (2011): 141-148

Bharucha, Zareen, and Jules Pretty. "The roles and values of wild foods in agricultural systems." Philosophical Transactions of the Royal Society of London B: Biological Sciences 365.1554 (2010): 2913-2926.

Brown, M. E., J. M. Antle, P. Backlund, E. R. Carr, W. E. Easterling, M. K. Walsh, and C. Tebaldi. "Climate change, global food security, and the US food system." US Department of Agriculture Office of the Chief Economist, the University Corporation for Atmospheric Research, and the National Center for Atmospheric Research, 2015. Accessed September 15, 2016. http://www.usda.gov/oce/climate_change/FoodSecurity2015Assessment/FullAssessment.pdf

Campbell, Bruce M., Sonja J. Vermeulen, Pramod K. Aggarwal, Caitlin Corner-Dolloff, Evan Girvetz, Ana Maria Loboguerrero, Julian Ramirez-Villegas et al. "Reducing risks to food security from climate change." Global Food Security 11 (2016): 34-43.

Carabine E., Venton C.C., Tanner T., Bahadur A. "The contribution of ecosystem services to human resilience: A rapid review". Overseas Development Institute (2015).

Colls, A., Neville Ash, and Ninni Ikkala. "Ecosystem-based Adaptation: a natural response to climate change." IUCN, 2009. Accessed September 7, 2016. https://www.iucn.org/content/ecosystem-based-adaptation-natural-response-climate-change

Cooke, Steven J., Edward H. Allison, T. Douglas Beard, Robert Arlinghaus, Angela H. Arthington, Devin M. Bartley, Ian G. Cowx et al. "On the sustainability of inland fisheries: finding a future for the forgotten." Ambio 45, no. 7 (2016): 753-764.

Doswald, N., R. Munroe, D. Roe, A. Giuliani, I. Castelli, J. Stephens, I. Möller, T. Spencer, B. Vira, and H. Reid. "Effectiveness of ecosystem-based approaches for adaptation: review of the evidence-base." Climate and Development 6, no. 2 (2014): 185-201.

García, L.E., J.H. Matthews, D.J. Rodriguez, M. Wijnen, K.N. DiFrancesco, P. Ray. "Beyond Downscaling: A Bottom-Up Approach to Climate Adaptation for Water Resources Management. AGWA Report 01." World Bank Group, 2014. Accessed September 8, 2016. http://documents.worldbank.org/curated/en/2014/09/23005201/beyond-downscaling-bottom-up-approach-climate-adaptation-water-resources-management

IFAD, UNEP. "Smallholders, food security and the environment." Rome: International Fund for Agricultural Development (2013).

Jones, Holly P., David G. Hole, and Erika S. Zavaleta. "Harnessing nature to help people adapt to climate change." Nature Climate Change 2, no. 7 (2012): 504-509.

Munang, Richard, and Johnson N. Nkem. "Using small-scale adaptation actions to address the food crisis in the Horn of Africa: Going beyond food aid and cash transfers." Sustainability 3, no. 9 (2011): 1510-1516.

Munang, R., Thiaw, I., Alverson, K., Goumandakoye, M., Mebratu, D., & Liu, J. 2013a. "Using ecosystem-based adaptation actions to tackle food insecurity." Environment: Science and Policy for Sustainable Development, 55(1), 29-35.

Munang, Richard, Ibrahim Thiaw, Keith Alverson, Musonda Mumba, Jian Liu, and Mike Rivington. "Climate change and Ecosystem-based Adaptation: a new pragmatic approach to buffering climate change impacts." Current Opinion in Environmental Sustainability 5, no. 1 (2013b): 67-71

Nel, Jeanne L., David C. Le Maitre, Deon C. Nel, Belinda Reyers, Sally Archibald, Brian W. Van Wilgen, Greg G. Forsyth et al. "Natural hazards in a changing world: a case for ecosystem-based management." PloS one 9, no. 5 (2014): e95942.

Nguyen, Quan, et al. "Multipurpose agroforestry as a climate change resiliency option for farmers: an example of local adaptation in Vietnam." Climatic change 117.1-2 (2013): 241-257.

Powell, Bronwen, et al. "The role of forests, trees and wild biodiversity for nutrition-sensitive food systems and landscapes." FAO and WHO Publication, Geneva (2013): 1-25.

Rizvi, Ali Raza, S. Baig, and M. Verdone. "Ecosystems Based Adaptation: Knowledge Gaps in Making an Economic Case for Investing in Nature Based Solutions for Climate Change." IUCN 2015. Accessed August 4, 2016. Gland, Switzerland: IUCN 48 (2015). http://cmsdata.iucn.org/downloads/the_economic_case_for_eba.pdf

UN, 2016. "Sustainable Development Goals: 17 Goals to Transform Our World." Accessed September 10, 2016. http://www.un.org/sustainabledevelopment/hunger/

UNDP, 2015. "Making the case for Ecosystem-based Adaptation: The Global Mountain EbA Programme in Nepal, Peru and Uganda." Accessed September 8, 2016. http://www.undp.org/content/undp/en/home/librarypage/poverty-reduction/making-the-case-for-ecosystem-based-adaptation/

UNEP, 2016. "Climate Change Adaptation: Building Resilience of Ecosystems for Adaptation." Accessed September 7, 2016. https://portals.iucn.org/library/sites/library/files/documents/CEM-009.pdf

Vignola, Raffaele, Celia Alice Harvey, Pavel Bautista-Solis, Jacques Avelino, Bruno Rapidel, Camila Donatti, and Ruth Martinez. "Ecosystem-based adaptation for smallholder farmers: Definitions, opportunities and constraints." Agriculture, Ecosystems & Environment 211 (2015): 126-132.

Wheeler, Tim, and Joachim Von Braun. "Climate change impacts on global food security." Science 341, no. 6145 (2013): 508-513.

About This Series

This evidence summary is part of a series of products highlighting the potential role of biodiversity conservation and ecosystem-based adaptation in addressing climate vulnerability. This series is produced by USAID's Biodiversity Results and Integrated Development Gains Enhanced (BRIDGE) activity and can be found here: rmportal.net/usaideba.

U.S. Agency for International Development
1300 Pennsylvania Avenue, NW
Washington, DC 20523
Tel: (202) 712-0000
Fax: (202) 216-3524
www.usaid.gov

August 2017