**Handout B: Climate Change and Ecosystem-Based Adaptation**

Climate change, caused by greenhouse gases emitted into the atmosphere through human activities, is arguably the greatest threat facing humanity. Greenhouse gases emitted anywhere in the world generate physical impacts everywhere in the world that are already being felt and that will intensify over time (IPCC, 2014a; USGCRP, 2018). According to the Intergovernmental Panel on Climate Change, “Impacts from recent climate-related extremes, such as heatwaves, droughts, floods, cyclones, and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability” (IPCC, 2014b; USGCRP, 2018). Climate change’s human costs will be greatest in tropical and low-lying areas (IPCC, 2014a), and low-income populations are particularly vulnerable (Barbier and Hochard, 2018).

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| **Mitigation:** Actions that reduce net emissions of greenhouse gases.  **Adaptation:** Actions taken to help communities and ecosystems cope with changing climate conditions (UNFCCC, 2013; VCCCAR).  **Ecosystem:** A community made up of living organisms and nonliving components that interact as a functional unit.  **Ecosystem Services:** The benefits that people derive from ecosystems (MEA, 2005). |

Responses to climate change take two forms: mitigation (i.e., abatement) and adaptation. Mitigation reduces society’s net emissions of greenhouse gases, perhaps by reducing the burning of fossil fuels or decreasing deforestation. This reduces the amount of climate change that will occur. Mitigation is costly to the person or firm doing it, but benefits everyone in the world; thus, mitigation is a public good. Adaptation, on the other hand, reduces the impacts of climate change on humans and institutions. For example, a farmer might switch to a crop that is more heat tolerant, or a government might construct sea walls to protect a coastal city from storm surges. Since the climate is already changing, even if there is a great deal of mitigation, some adaptation will be necessary (IPCC, 2014a).

Adaptation includes both large-scale projects that are undertaken or funded by governments and individual-scale actions taken by households or firms. Adaptation initiatives can be classified as hard adaptation (also known as structural, engineered, or grey adaptation) or soft adaptation. Hard adaptation includes the construction of flood barriers and other infrastructure (McGeehan and Hu, 2017). Soft adaptation, on the other hand, includes policy and social initiatives (such as healthcare programs) and solutions that leverage ecosystems. These latter ecosystem-based solutions are also known as green or ecosystem-based adaptation (Chambwera et al., 2014; Depietri and McPhearson, 2017).

Ecosystem-based adaptation methods are the focus of this game. These approaches rely on natural features, leveraging biodiversity and ecosystems, to reduce the damages people face from climate change (Doswald et al., 2014; Wertz-Kanounnikoff et al., 2011). For example, a community might protect wetlands that can serve as a buffer to reduce flood risk for populated areas (Burley et al., 2012).While hard adaptation projects like revetments and sea walls may be needed to protect some communities, ecosystem-based adaptation can also be successful, and in some cases may be better than pure engineering solutions (Rao et al., 2013).

However, many ecosystem-based adaptation techniques are relatively new and there are uncertainties about their costs and benefits (Doswald et al., 2014). Pilot studies have typically been done to suggest that a technique could be beneficial, but the communities and individuals tasked with adopting these techniques may not know whether the practice will scale up or work well in local soil and weather conditions. Most people are averse to uncertainty and this may cause them to be slow to adopt ecosystem-based adaptation.

The table below gives examples from the United Nations Development Programme’s Ecosystem-Based Adaptation Program (UNDP, 2015).

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| **Nepal** | **Peru** | **Uganda** |
| * maintaining and restoring ecosystems along roads to reduce landslides * restoring wetlands, springs and ponds to ensure year-long drinking water supply * soil nutrient management to increase soil moisture during dry periods | * restoring water channels and reservoirs to support micro-watersheds & wetlands to secure provision of water for the reserve communities and downstream users * grassland management to enhance pastoral livelihoods and increase resilience to drought and frost * vicuña management to produce animal fiber for livelihoods and communal livestock management in natural grasslands | * improved water retention through roadside drainage bunds and run-off retention drains * a gravity flow engineered irrigation scheme, combined with reforestation, soil and water conservation * riverbank restoration to create a hybrid grey-green solution to catchment-scale water management * tree planting using agroforestry to stabilize soil to reduce landslides |

*Source: (UNDP, 2015)*

There are many kinds of ecosystem-based adaptation measures, but the general ways they reduce the risks communities face from climate change are: 1) keeping hazards such as floods outside communities; 2) increasing adaptive capacities, that is, providing resources that reduce damages, such as forests that store water stock and protect from storms; and 3) helping communities recover quickly from climate hazard impacts, for example, ensuring that flood waters can quickly drain away (Wamsler et al., 2016).

Communities must take steps to sustainably manage, conserve, and restore important ecosystems if they are to benefit from ecosystem-based adaptation. Ecosystem protection can yield both climate adaptation services and non-climate-related ecosystem services, like serving as habitat for important species. For example, mangrove forests both protect coastal areas and provide many other ecosystem services (Faunce and Serafy, 2006). The relationship between ecosystems and adaptation is, however, complicated. On the one hand, ecosystems can help humans adapt to climate change. On the other hand, non-ecosystem-based adaptation efforts can either protect or endanger biodiversity and ecosystem services; for example, sea walls and other barriers can either protect an inland ecosystem from damaging floods or disrupt natural flows of water and species (Secretariat of the Convention on Biological Diversity, 2009).

Since climate change affects precipitation – increasing it in some places and decreasing it in others, and making it generally more variable – water is a focus of many adaptation efforts. Shifts in population and changes in human behavior in response to climate change will increase water stress, rendering adaptation even more necessary. For example, in Uganda, farmers are moving into wetlands because of increasing rainfall variability and land degradation on historically traditional agricultural lands (UNDP Green Climate Fund, 2017), while in other countries like Guinea, farmers are moving out of rich coastal areas because the sea level is rising and formerly fresh water is becoming more saline (UNDP Green Climate Fund, 2019). Thus, adaptation measures must respond to changes in both weather conditions and human populations.

While some ecosystem-based adaptation can occur at the community level, some adaptation must happen on land parcels owned by individuals (Scarano, 2017). Adopting these practices can be costly for landowners; for example, the community may be best served by an unfarmed buffer strip near a waterway, but the farmer may want to grow crops on that land because that may be their most productive land. Laws exist to require such practices in some cases (Uganda, 2000), but they can be hard to enforce. Alternatively, payments for ecosystem services programs may be effective in promoting ecosystem-based adaptation, but such programs are not a panacea and will only be effective in certain conditions (Wertz-Kanounnikoff et al., 2011).

**References**

Barbier, E.B., Hochard, J.P., 2018. The Impacts of Climate Change on the Poor in Disadvantaged Regions. Review of Environmental Economics and Policy, 12(1), 26-47.

Burley, J.G., McAllister, R.R.J., Collins, K.A., Lovelock, C.E., 2012. Integration, synthesis and climate change adaptation: a narrative based on coastal wetlands at the regional scale. Regional Environmental Change, 12(3), 581-593.

Chambwera, M., Heal, G., Dubeux, C., Hallegatte, S., Leclerc, L., Markandya, A., McCarl, B.A., Mechler, R., Neumann, J.E., 2014, Economics of adaptation. In: C.B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, L.L. White (Ed.). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 945-977.

Depietri, Y., McPhearson, T., 2017, Integrating the Grey, Green, and Blue in Cities: Nature-Based Solutions for Climate Change Adaptation and Risk Reduction. In: N. Kabisch, H. Korn, J. Stadler, A. Bonn (Eds.). Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice. Springer International Publishing, Cham, pp. 91-109.

Doswald, N., Munroe, R., Roe, D., Giuliani, A., Castelli, I., Stephens, J., Möller, I., Spencer, T., Vira, B., Reid, H., 2014. Effectiveness of ecosystem-based approaches for adaptation: review of the evidence-base. Climate and Development, 6(2), 185-201.

Faunce, C.H., Serafy, J.E., 2006. Mangroves as fish habitat: 50 years of field studies. Marine Ecology Progress Series, 318, 1-18.

IPCC, 2014a, Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, vol. 1. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC, 2014b, Summary for Policmakers. In: V.R.B. C.B. Field, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, L.L. White (Ed.). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press Cambridge, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.

McGeehan, P., Hu, W., 2017, Five years after Sandy, are we better prepared? The New York Times. The New York Times Company, New York City, New York, USA.

MEA, 2005, Millennium Ecosystem Assessment General Synthesis Report: Ecosystems and Human Well-being. Millennium Ecosystem Assessment.

Rao, N.S., Carruthers, T., Anderson, P., Sivo, L., Saxby, T., Durbin, T., Jungblut, V., Hllls, T., Chape, S., 2013. An Economic Analysis of Ecosystem-based Adaptation and Engineering Options for Climate Change Adaptation in Lami Town, Republic of the Fiji Islands: Technical Report. 9820404746, SPREP 2013, Apia, Samoa.

Scarano, F.R., 2017. Ecosystem-based adaptation to climate change: concept, scalability and a role for conservation science. Perspectives in Ecology and Conservation, 15(2), 65-73.

Secretariat of the Convention on Biological Diversity, 2009, Connecting biodiversity and climate change mitigation and adaptation: Report of the Second Ad Hoc Technical Expert Group on biodiversity and climate change, Montreal. Convention on Biological Diversity Technical Series.

Uganda, 2000, National Environment (Wetlands; River Banks and Lake Shores Management) Regulations.

UNDP, 2015. Making the Case for Ecosystem-based Adaptation: The Global Mountain EbA Programme in Nepal, Peru and Uganda, UNDP, New York, NY, USA.

UNDP Green Climate Fund, 2017, Project Details: Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda, <https://www.gcfprojects-undp.org/tp/project/5711>.

UNDP Green Climate Fund, 2019, Project Details: Strengthening climate resillience of Guinea Marritime Communities & Development assets, <https://www.gcfprojects-undp.org/tp/project/5960>.

UNFCCC, 2013, Report on the technical workshop on ecosystem-based approaches for adaptation to climate change: Note by the secretariat, Bonn, Germany.

USGCRP, 2018, Impacts, risks, and adaptation in the United States: Fourth National Climate Assessment, Volume II. In: D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L. Lewis, T. Maycock, B.C. Stewart (Eds.). U.S. Global Change Research Program, Washington, DC, USA.

VCCCAR, Climate Change Adaptation Definitions, <http://www.vcccar.org.au/climate-change-adaptation-definitions>.

Wamsler, C., Niven, L., Beery, T.H., Bramryd, T., Ekelund, N., Jönsson, K.I., Osmani, A., Palo, T., Stålhammar, S., 2016. Operationalizing ecosystem-based adaptation: harnessing ecosystem services to buffer communities against climate change. Ecology and Society, 21(1).

Wertz-Kanounnikoff, S., Locatelli, B., Wunder, S., Brockhaus, M., 2011. Ecosystem-based adaptation to climate change: What scope for payments for environmental services? Climate and Development, 3(2), 143-158.