Focus and impact on climate change adaptation and mitigation

Objective: Mitigation and adaptation to climate change by creating co-benefits and reducing trade-offs among water, energy, food, and ecosystems in highly vulnerable river basins

Today, we face multiple interlinked global challenges, including climate change, biodiversity loss, and large inequities in access to resources, which contribute, in turn, to growing food and nutrition insecurity, water stress, and energy poverty. The CGIAR Initiative on NEXUS Gains works at the critical intersection of water, energy, food, and environmental systems in selected transboundary river basins to realize multiple development benefits and reduce trade-offs.

NEXUS Gains works to achieve positive, measurable benefits across all five CGIAR Impact Areas, as outlined in the CGIAR Strategy to 2030: nutrition, health, and food security; poverty reduction, livelihoods, and jobs; gender equality, youth, and social inclusion; climate adaptation and mitigation; and environmental health and biodiversity. A key element of the nexus approach is understanding that impacts in one Impact Area can affect outcomes – positively or negatively – in all others.

National flood emergency response in Pakistan. Photo by Asian Development Bank. Creative Commons BY-NC-ND 2.0

Climate change is altering precipitation and temperature patterns, significantly impacting water resources, food production, energy generation, and ecosystem health. The combination of climatic extremes (floods and droughts) and socio-economic factors poses a substantial threat to economic development and livelihoods in vulnerable river basins that serve as vital breadbaskets, providing food for millions of people.

Climate change impacts are cross-sectoral. Single-sector solutions are unlikely to address the underlying challenges and may compound problems in other sectors. Coordination between the water, energy, food, and environment sectors is key to promoting effective climate change adaptation and mitigation strategies. Climate adaptation and mitigation are central to NEXUS Gains' work, and all five work packages contribute to climate action through new science, policy, institutions, and practices.

Work Package 1:
Trade-off and foresight methodologies

Supporting planners, policymakers, and investors with customized foresight and trade-off analysis tools to plan, assess, prioritize, and scale up climate-resilient interventions across the water–energy–food–ecosystems (WEFE) nexus.

Analyses of trade-offs and synergies are essential to understanding and managing climate adaptation and mitigation strategies. NEXUS Gains is assessing the impact of climate change on water resources and linked food and energy systems to identify policies, institutions, and investments that increase climate resilience in these interlinked systems.

An example is the collaboration with the Government of Pakistan to explore changes in the country's food production systems that could increase the resilience of its water systems to adverse climate change impacts, including glacier melt. Other studies analyze the potential of groundwater development to address climate-induced water stress for food and nutrition security in sub-Saharan Africa; and the impact of biofuel mandates in India on water scarcity, ecosystem degradation, and greenhouse gas emissions. The Initiative has also analyzed the potential impacts of scaling alternative proteins on food security, greenhouse gas emissions, and water and land use.

ENVIRONMENTAL FLOW ESTIMATION TOOLS

NEXUS Gains is working with the Government of Nepal and other partners to enhance awareness, appreciation, and use of environmental flow estimation tools by practitioners, academics, policy makers, and technical experts, to contribute to an improved understanding of trade-offs and synergies in using river water. A user-friendly suite of online and offline software tools enabling desktop estimates of environmental flow requirements is at the core of this innovation. While the suite of tools is adaptable for use anywhere in the world, the Western Nepal Environmental Flow Calculator has been explicitly developed considering the environmental, social, and cultural water requirements of the Karnali and Mohana river basins.

Ethiopia: EU boosts aid in response to El Niño drought. Photo by Anouk Delafortrie, European Union, 2016. Creative Commons BY-NC-ND 2.0

Work Package 2:
Water productivity and integrated storage management

Mapping existing water stores; developing a water storage diagnostic tool; formulating fit-for-purpose water productivity decision support systems (DSSs); and conducting political economy analyses. Integrated storage solutions, as well as activities in other areas, can reduce the negative impacts of climate change-induced water variability and improve water productivity.

Maintaining water and agricultural productivity is critical in the context of climate change. Work Package 2 supports governments and other actors to make decisions that bolster the resilience of food systems.

NEXUS Gains has conducted water storage assessments in the Limpopo, Blue Nile, Aral Sea, and Ganges basins to identify adaptation options to droughts and floods. In addition, DSSs are being developed in the Ganges and Aral Sea basins to guide decisions that stretch limited and variable water resources further. In Ethiopia's Blue Nile Basin, an integrated water storage diagnostic tool has been developed to provide a clearer picture of the volume of available surface and sub-surface water storage; local water demand; and how the 'storage gap' will change due to climate change and socio-economic development. Results indicate that total water storage has declined over time, particularly in wetlands and dams, and that the expansion of agriculture, land degradation, and sedimentation are contributing factors. Climate change, population growth, and economic growth are expected to further exacerbate the water storage gap.

The Initiative also analyzes the spatial and temporal variation in water productivity to identify policies, institutions, and investments that reduce climate risk and improve water and food security in these key river basins.

WATER PRODUCTIVITY ATLAS

In India's Ganges Basin, NEXUS Gains has designed an online water productivity atlas that shows the spatial and temporal variation in water productivity at district and sub-basin levels between 1999 and 2020 due to climate variability and change, among other factors. Water productivity includes physical (kg/m), economic ($/m^3), and nutritional water productivity (number of calories, grams of protein, and grams of fat per cubic meter). This tool helps identify potential interventions to reduce local-level climate risks, for example, by changing crops grown and altering diets.

Work Package 3:
Energizing food and water systems sustainably and inclusively

Co-developing scalable business and finance models for accelerated, inclusive access to clean energy in rural areas, focusing on women and other marginalized groups.

A lack of access to clean energy is a key obstacle to agricultural productivity and the development of agribusinesses in many low-income countries. Solar, micro-hydropower, wind, and bioenergy are critical to transforming agrifood systems while reducing dependence on fossil fuels and lowering greenhouse gas emissions. A recent study completed by NEXUS Gains with support from the World Bank for central and northern Nigeria found a potential for irrigation expansion of 5 million hectares, including 2.6 million hectares using solar energy. This could provide sufficient calories for up to 62 million people and reduce greenhouse gas emissions by 3.5 million tons of CO_2 per year compared with a fossil fuel-only solution.

NEXUS Gains also develops business and finance models that support smallholder farmers, particularly rural women, to access clean energy technologies to help them adapt to and mitigate climate change, and strengthen gender equity and climate justice. Findings on how to increase women's agency in the rural energy sector in Nepal have been published, and a compendium of case studies assessing women's benefit streams from clean energy interventions in India is being compiled.

SOLAR SIZING TOOLS

NEXUS Gains is developing an online solar sizing tool for sub-Saharan Africa that helps governments, investors, and farmers identify the size and location of profitable solar-powered water-lifting systems. The tool also calculates changes in greenhouse gas emissions from switching from diesel to solar-powered pumps. Similarly, NEXUS Gains is working with the Government of Nepal to scale a solar sizing tool to support the country's climate mitigation efforts.

Solar irrigation pump site in Samastipur district, Bihar, India. Photo by Metro Media/IWMI

Work Package 4:
Strengthening WEFE nexus governance

Enhancing the governance of natural resources through more effective multistakeholder platforms and social learning interventions.

A lack of good governance at all levels leads to the continuous degradation of water, food, land, and ecosystems, all further threatened by climate change. Multistakeholder platforms and other institutions offer the potential to bring together various actors to improve food and water systems, reduce environmental degradation, and increase climate resilience. There is also a critical need for evidence on increasing climate resilience by enhancing cooperation and breaking sectoral silos.

Groundwater is particularly important for building climate resilience, but groundwater depletion undermines this buffering capacity, increasing social inequalities. Trade-offs become even more complex as solar energy for pumping can reduce greenhouse gas emissions, but also remove incentives to limit groundwater pumping. NEXUS Gains has assessed rural women's and men's understanding of groundwater systems and the role of climate change and other factors in affecting groundwater depletion in Nepal and Pakistan. As a next step, NEXUS Gains is working with rural communities to institute rules and interventions to increase the resilience of groundwater systems for better water and food security under climate change. NEXUS Gains is also supporting the development of multistakeholder partnerships in the Incomati Basin and in Nepal to reduce trade-offs in water allocation and improve climate resilience.

GROUNDWATER GOVERNANCE TOOLBOX

NEXUS Gains has collated a toolbox of approaches that can strengthen groundwater management and resilience in the face of climate extremes and long-term climate change. This includes innovative approaches for social learning about groundwater and tools to increase information and coordination among government agencies and between government and communities. Lessons from the applications of these tools in various countries are informing efforts to create combinations of tools to address pressing groundwater issues in South Asia.

Work Package 5:
Developing capacity for WEFE actors, including emerging women leaders

Supporting capacity-strengthening efforts for improved WEFE nexus practices that target professionals working in ministries and local government organizations, the private sector, agricultural extension services, civil society, NGOs, and academia.

Developing capacity for WEFE actors, including emerging women leaders, is important for achieving more equitable, inclusive, and sustainable natural resource management. Their involvement strengthens resilience, innovation, and participatory decision-making, improving community and ecosystem outcomes, and building climate resilience. NEXUS Gains has held several training events, including online masterclasses and in-person summer schools, to build the capacity of technical specialists on systems thinking for increased climate resilience. In addition, the Initiative's Nexus Champions' Leadership Program in Nepal targets mid-level decision makers and aims to challenge traditional ways of working within WEFE sectors. Over the course of six months, participants from all stakeholder groups at federal level debated what the practice of the nexus approach requires, and how actors can push for change in the workplace and influence policy. The program has a strong emphasis on gender and social inclusion.

WATER–ENERGY–FOOD (WEF) NEXUS CAPACITY BUILDING EVENTS

WEF Nexus Masterclasses and Winter Schools were held in Pretoria, South Africa to introduce participants to state-of-the-art nexus thinking. The Masterclasses, which took place in 2021, 2022, and 2023, provided a foundational understanding of the WEF nexus concepts, analytical frameworks, and its application for guiding discourse. The Winter Schools, held in 2022 and 2023, aimed to support the integration of the WEF nexus methodology into national policies; increase societal resilience to climate change; provide training on accessing climate finance; and facilitate collaboration between countries. A total of 268 students took part in the Masterclass, and 53 completed the Winter School. In late 2023, a Global WEF Nexus Community was launched to bring together the Masterclass and Winter School alumni into a community of practice on transforming WEF systems under climate change.

Children fetch water during flooding, Sudan. Photo by Water Alternatives. Creative Commons BY-NC 2.0

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