

**Climate Adaptation and Resilience
(CARE) for South Asia Project**

**Climate Change and the
Water-Energy-Food (WEF)
Nexus in Bangladesh**

Technical Note

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1. BACKGROUND

The Asian Disaster Preparedness Center (ADPC) and the Regional Integrated Multi-Hazard Early Warning System (RIMES) are jointly implementing a five-year (2020-2025) regional project called 'Climate Adaptation and Resilience (CARE) for South Asia', with support from the World Bank. The overall objective of the project is to contribute to an enabling environment for climate resilience policies and investments in agriculture, transport, water, policy and planning, and finance sectors in South Asia. Initially, national-level activities are being implemented in Bangladesh, Nepal and Pakistan. The project has two parallel but distinct components: RIMES is implementing the first component, which focuses on promoting evidence-based, climate-smart decision-making; and ADPC is implementing the second component, which focuses on enhancing policies, standards, and capacities for climate-resilient development in South Asia. More detailed information on the project can be found at: <https://www.careforsouthasia.info/>

In light of a nexus concept among the water, energy and food sectors, three national workshops were organized in Bangladesh, Nepal and Pakistan within the scope of the CARE for South Asia project from 2021-2022. The objective of these country-level events was to initiate the nexus dialogue from a hypothetical scope into development practice which faces significant barriers. The major challenges include cross-sectoral collaboration, the complexity and incompatibility of existing institutional structures, and the impacts of climate change. In Bangladesh, the event was organized online by ADPC on 23 January 2022, with participation by 19 personnel from the government, academia and research-based institutions, as well as international organizations.

This technical note provides a summary of the reflections made as part of the water-energy-food nexus (hereinafter referred to as the WEF nexus) workshop organized in Bangladesh. The contents provided in this note are compiled in a regional technical paper for South Asia.

2. THE CHALLENGE

The Food and Agricultural Organization of the United Nations (FAO, 2014) opined that water, energy and food are essential for sustainable development and human well-being. Rising global population, rapid urbanization, economic growth and changing dietary habits are increasing the demands for water, energy and food. Agriculture accounts for 70 percent of total global freshwater withdrawals, making it the largest user of water; while the food production and supply chain consumes about 30 percent of total energy consumption globally (FAO, 2014). Urban areas and industries, too, increasingly claim more water, energy and land resources (FAO, 2011). The situation is likely to be exacerbated in the near future as 60 percent more food will need to be produced in order to feed the world population in 2050 (FAO, 2014).

Global energy consumption is projected to grow by up to 50 percent by 2035 (IEA, 2020), while irrigation withdrawal is also likely to increase by 10 percent by 2050 (FAO, 2014). Additionally, uncertainties due to climate change and the increasing frequency of extreme hydro-meteorological events are likely to significantly impact the three sectors. The growing demand will increase competition for resources, concentrated on water, energy, agriculture, and other sectors; with unpredictable impacts on livelihoods and the environment (FAO, 2014).

As South Asia is one of the most critical hotspots of climate change, a future increase in food and energy demands may face severe consequences if no suitable adaptation measures and reliable policy formulations are undertaken towards managing water resources. Bringing together policies across the sectors of water, energy and food is extremely challenging. A review of the existing national policies has shown that incorporating climate change into these sectors varies in space and time, as well as by scale. It is also observed that, despite having policy statements, in-practice cross-sectoral collaboration or integration are absent in many cases and have largely been confined to discrete projects and activities. Barriers to coordination are mainly attributed to institutional structures, limited

resources, and issues around cost recovery, as well as overlapping responsibilities of stakeholders, and insufficient institutional capacity.

3. CONTEXT: WATER, ENERGY AND FOOD IN BANGLADESH

The nexus concept has been drawing special attention recently, within the sectoral and cross-sectoral development programs. The concept evolved after the Bonn 2011 Nexus Conference (Moreno et al., 2021). The concept of the WEF Nexus emerged as a useful concept to describe and address the complex and interrelated nature of our global resource systems, on which we depend to achieve different social, economic and environmental goals (FAO, 2014). The nexus framework of water, energy and food helps us understand the complex, dynamic, interactive and interdependent relationship among these sectors; identify and measure how sustainability and development of these sectors are affected by the global drivers of change such as climate change; and formulate strategies for creating a synergy through essential coordination and collaboration among the institutions and governments, so as to achieve common development or management objectives.

The essential interactions among these resource systems include, but are not limited to the following cases.

- Water is heavily used for food production and energy generation.
- Energy is required for water extraction, distribution and treatment.
- Energy is required for food production and food supply chain management.
- Waste generated by the food sector can be used as fuel to generate energy.

The WEF Nexus environment is described by the FAO (2014) as follows.

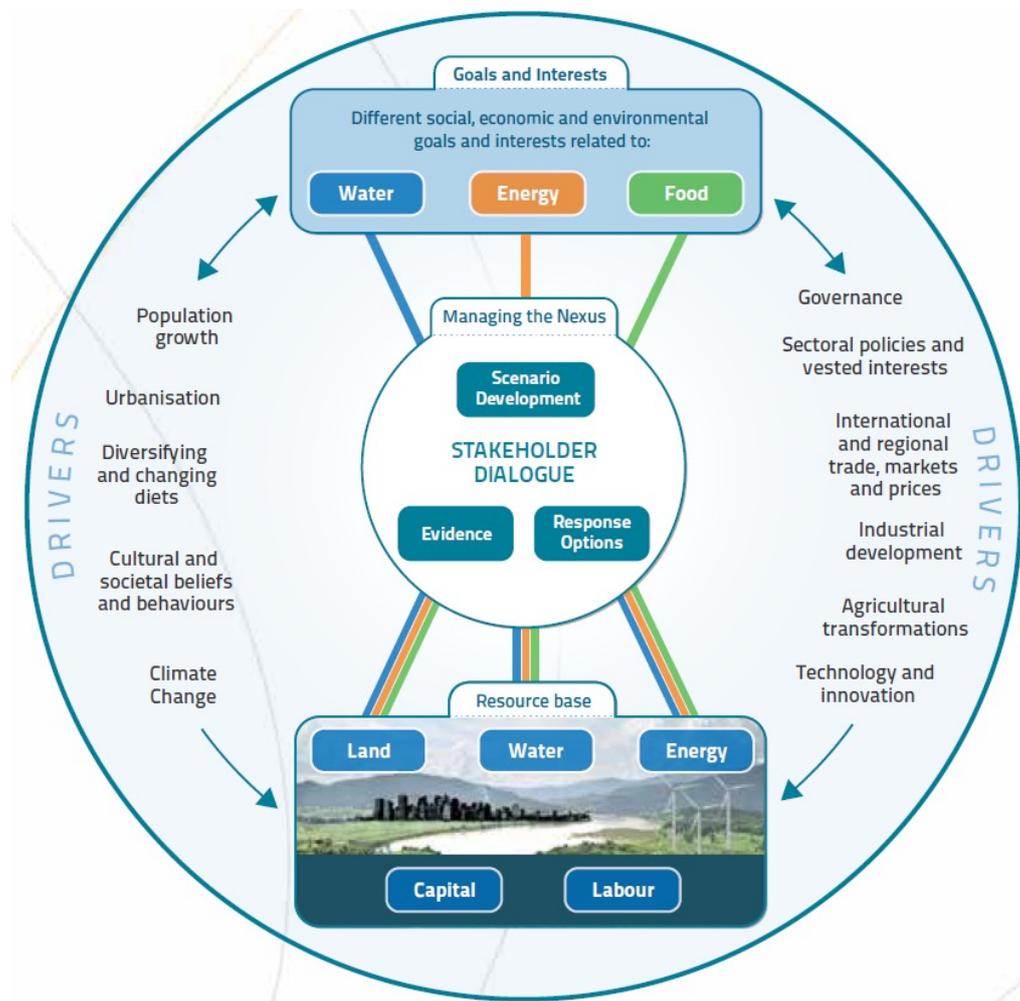


Figure 1: The WEF Nexus Described by FAO (2014)

Adopting a WEF Nexus approach means translating the conceptual framework of the water-energy-food nexus into appropriate actions, so that the purpose of the nexus is accomplished by the engaged stakeholders. The nexus approach seeks opportunities to apply a coordinated management approach, towards ensuring the best possible utilization of the resources.

Water, energy and food represent three vital resource systems on earth, and Bangladesh, one of the most climate vulnerable deltas in the world, is no exception to this rule. The nation has demonstrated a commendable ability to manage and develop those resources since its independence, in the face of acute challenges of poverty, inadequate education, population growth, unplanned and uncontrolled urbanization, natural calamities and climate change. The country's food security depends on water security as well as energy security, given the changing climate. However, the shrinking health of its water resources appears alarming, if not well-managed. Since independence in 1971, more than 100 rivers have disappeared, excessive encroachment is observed in around 139 rivers, and 29 rivers are critically polluted. Many development activities appear to show less concern about preserving the natural water flow path, as well as the aquatic life and ecosystem of existing water bodies.

Evidence of disturbance in depressed water bodies (locally known as beels) with fencing, reduction in the natural flow width in rivers during bridge and culvert construction, and filling or pollution of the ponds, etc., are all quite common. All these messes indicate an inadequate management and regulation of water resources – and this requires immediate attention from the concerned policymakers and implementation agencies.

Energy is one of the key drivers of infrastructure and economic development in Bangladesh, which is in third place in terms of GDP growth rate in South Asia (World Bank, 2021). At the same time, energy is the primary input for water harvesting, as well as food production and supply chain management processes. Unfortunately, the energy sector also accounts for the highest percentage (about 73 percent) of emissions globally (ourworldindata.org, 2020). Therefore, use of green or renewable energy is critical to the sustainability of agricultural production in Bangladesh, against the backdrop of the climate threat. Grid-electricity and diesel are two primary energy sources used for irrigation and other agricultural production and supply chain processes, at present, in Bangladesh. The share of renewable energy is only 3 percent, which the government aspires to raise up to 10 percent by 2030. Unfortunately, the prospect of renewable energy sources, including hydropower, solar and wind, are limited in the country. Recently, solar irrigation pumps (SIPs) have gained attention as they are climate-smart, cost-effective and more efficient. However, commercially SIP is not viable yet; until the government promotes it with appropriate policy framework, resource allocation and incentives. In addition, solar-based systems usually require large land areas compared to conventional power plants, which are extremely challenging in Bangladesh.

The food sector in Bangladesh is fed by the agriculture sector, which includes subsectors of crop, fisheries and livestock. This sector has demonstrated a remarkable growth since the 1970s, and the country now holds top positions globally in the production of many food items including: rice, potato, vegetables, freshwater fish, guava, jackfruit and mango. Rice production has increased from about 9.8 million tonnes to 38.7 million tonnes from 1971-2019 (BRRI, 2021).

This enormous expansion in food production is a response to the demands of population growth. At the same time, increased production has imposed immense stress upon freshwater withdrawal and energy consumption. A study conducted by Aziz et al. (2015) in the north-west region (locally known as Barind area) shows that the maximum depth of groundwater is inversely proportional to total agricultural production. Again, about 1500 MW electricity and 1.7 million tons of diesel are consumed through pumped irrigation annually, on an average, as per the record of Bangladesh Agricultural Development Corporation (WEF Nexus Workshop Proceedings, ADPC, 2022).

The above discussion provides an illustration of how these resource systems operate and interact with each other in Bangladesh. Rather than being in a silo, these resources somehow create a collective environment while contributing to the nation's economy and food security. It is worth mentioning that about 14 out of 17 sustainable development goals (SDGs) are, to a various extent, linked with these resources and natural ecosystem (Moreno et al., 2021). Therefore, the nexus

context of water, energy and food are pertinent to every instance wherein we talk about the country's natural resources management and sustainable development.

4. TOWARD ACHIEVING FOOD SECURITY

Water and energy security (particularly the renewable energy supply) are the key pillars to ensuring sustainability of food production and achieving food security for all. The governing drivers of change such as climate change, land availability and disasters that may adversely affect food production and food supply chain need to be tackled with a collective, coordinated and synergized management approach; by implementing a structured WEF Nexus in the country. The food sector has witnessed a fairly steady growth rate as of now, but soon it will be threatened, especially by climate change, if not well-managed; and if water and energy securities are not achieved. A collective effort is essential not only to support adequate food production, but also to assure an equitable distribution of resources. The anthropogenic drivers to water systems such as water withdrawal, pollution, transboundary water management practices, and irrigation technologies in use, all determine to what extent water can support the nexus. Again, the choice of energy sources is crucial to emission control and sustainable food production. Thus, a well-designed nexus arrangement for managing water and energy can only assure food security in the long run.

5. A STRATEGY FOR CLIMATE RESILIENCE

In Bangladesh, discussions or arguments are observed nowadays within communities and forums; regarding whether the WEF Nexus can be adopted as an effective strategy for climate resilience. Since the nexus approach works toward achieving synergy, through more coordinated and integrated practices, the potential benefits go beyond the capacity of individual sectors or a sum of their discrete contributions. The same potential applies to climate action. Climate resilience, undoubtedly, requires an integrated action by all sectors that contribute to and are affected by emissions.

Some of the major drivers resulting from climate change in Bangladesh are: sea level rise, and the erratic nature of rainfall and temperature, which in turn respond in the form of extreme floods and drought, salinity intrusion, severe cyclones and storm surges. The resource systems under discussion, i.e., water, energy and food, are heavily impacted by these phenomena. At the same time, the trend in climate change and climate variabilities also depend on how these systems, either individually or as a whole, are operated and managed.

The WEF Nexus explores opportunities for the best possible utilization of individual resources as well as their integration. By adopting climate-smart irrigation approaches, we can reduce water wastage, apply green energy sources such as SIPs, and promote crop species with high water productivity. The development and practice of green and renewable energy sources are critical to limiting emissions and creating successful mitigation strategy. In the food supply chain management, the government can limit the use of plastic and other harmful materials as well as water wastage, by imposing essential regulation and reinforcement measures. The energy plants may install and operate necessary treatment facilities for the cooling of contaminated water before disposing of them. All these interventions lead to an integrated approach for optimum utilization of water, energy and food sectors, and thereby contribute to achieving climate resilience.

6. BREAKING THE BARRIERS

The application of the conceptual framework of the WEF Nexus is already evident in Bangladesh in the subject sectors, though its formalization is not executed at the institutional level. Many of the sectoral interventions in water, energy and food are now more organized, interlinked and integrated. It is inspiring that the government and its working institutions have at least realized the necessity of cross-sectoral integration for combating climate change. Formulation of the Delta Plan 2100 is a

great example of this realization and the government's commitment toward building a climate-resilient delta as the ultimate vision. However, the Delta Plan has further scope for improvement by imparting knowledge and experience of the local communities, youth, and subject matter experts.

The proposed Ganges Barrage project can be an excellent demonstration of the WEF Nexus in Bangladesh if the government can successfully implement and operationalize the infrastructure which is involved. The proposed barrage will help control excessive flood during the wet period and utilize surface water for irrigation in the south-west region. It will assure a more rational use of river water, help control salinity intrusion in the coastal region, and reduce stress on groundwater withdrawal. The barrage will be used, additionally, to generate hydropower; thus, it will help reduce emissions and contribute to increasing the share of the renewable energy mix.

The country has adopted several climate-smart agriculture (CSA) and energy-smart agriculture (ESA) practices as well, especially for irrigation. SIPs are demonstrated to be a demand-driven, cost-effective, and more efficient and energy-smart technology, despite dealing with constraints of land availability and commercial scale-up. The government has prepared a roadmap for solar-based system development and expansion, which will be published soon. Again, alternate wetting and drying (AWD) irrigation, drip irrigation, floating farming, and engineered crops with high water productivity are some of the best practices of CSA. To avoid land requirements, floating solar panels are also being used in many places nowadays. These applications constitute a great demonstration to resolve existing barriers created by water, agriculture and energy sector leaders and the communities in the country.

7. ESTABLISHING THE NEXUS ARRANGEMENT

The emerging consensus on the conceptual framework of WEF Nexus now demands its successful implementation in the country, especially as an effective strategy with which to combat climate change. However, managing such a nexus is an extensive consultative process that involves key stakeholders of the resource systems which have been discussed (Moreno et al., 2021). Again, it is acknowledged that such resource systems and their nexus arrangement have a strong political dimension, which need to be considered in the nexus dialogues. A well-organized nexus process involving water, energy, food and ecosystem include several phases, as illustrated below in Figure 2.

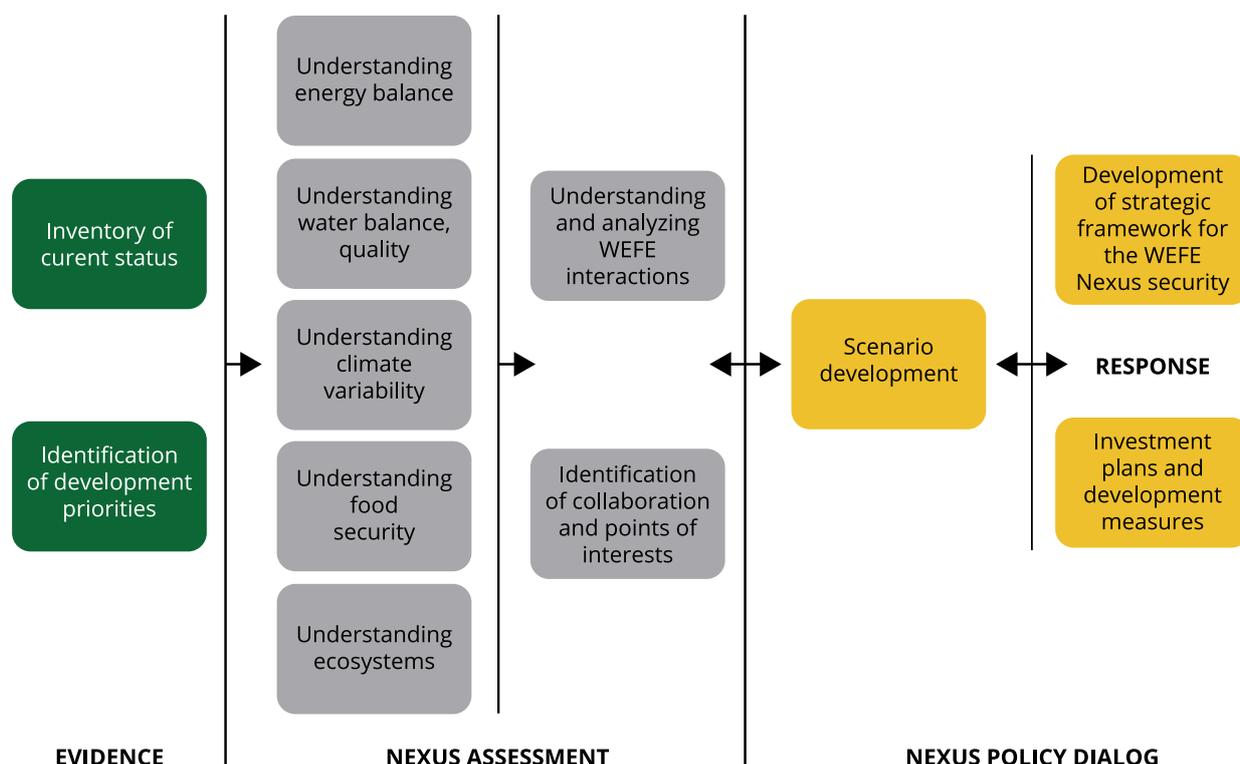


Figure 2: The Water, Energy, Food and Ecosystem Nexus Process (Source: JRC Technical Report, 2019)

Establishing the WEF Nexus is a continuous process, specific to context – regional-, national-, local- or basin-level – and problem. For example, to evaluate a national policy on water, energy and food systems, or to decide on how to intervene in a problem (FAO, 2014). In Bangladesh, the process can be initiated with stakeholder dialogue, policy formulation and institutional arrangement. It is appreciable that many research and policy forums are now discussing the concept of nexus, which will ensure an informed consensus and knowledge base on the topic. From dialogue to implementation, the nexus process in the country may adopt the following action plan in alignment with the nexus process, as shown in Figure 3.

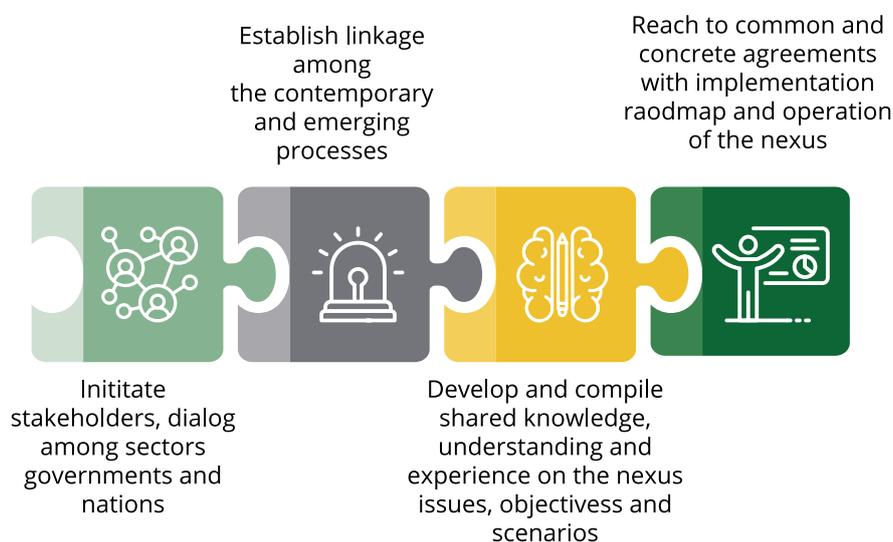


Figure 3: WEF Nexus Implementation Action Plan (Source: Moreno et al., 2021)

In the policy formulation, arguments are observed among stakeholders, as to whether the individual sector-specific policies need to be enhanced or a new integrated policy framework should be introduced to accomplish the nexus objectives. For example, there are cross-cutting policies for environment and climate change that apply to all sectoral interventions. This argument calls for the necessity of further and continued stakeholder dialogues, so as to reach to a common consensus.

A concrete agreement is also required on the institutional arrangement to support planning, implementation, and operation of the nexus. At present the sectors of water, energy and food are administered by the Ministry for Water Resources (MoWR), Ministry of Power, Energy and Mineral Resources (MPEMR), and the Ministry of Food (MoF) and their implementing departments, respectively. However, the food sector is strongly dependent on the agriculture sector, which is managed by the Ministry of Agriculture (MoA), the Ministry of Fisheries and Livestock (MoFL), and their implementing partners; such as the Bangladesh Agricultural Development Corporation (BADC), Department of Agricultural Extension (DAE), Department of Fisheries (DoF) and the Department of Livestock Services (DLS). The Water Resources Planning Organization (WARPO), under tMoWR, is the key policy-making institution on water resources management in Bangladesh.

The Power Cell under the MPEMR is the leading organization on energy sector planning. Parallel to this, the Sustainable and Renewable Energy Development Authority (SREDA) is the key department which works on the development of the renewable energy sector in the country. All these organizations, along with academia, NGOs, international agencies, and the private sector form a complex web of institutional roles within the WEF Nexus. It is frequently debated which ministry or department should play the pivotal role in the country's nexus arrangement. At present, there are three different views observed in different stakeholder forums, as follows.

- Since water resources are at the center of the country's economy and development, the Ministry of Water Resources may take the lead in the nexus arrangement and WARPO can be assigned the necessary coordination and collaborative roles with the energy, agriculture and food sectors in this context. WARPO may develop the necessary policy formulation and institutional arrangements with the leadership.
- Among the three sectors, energy acts as an essential input to both IWRM as well as food production and the supply chain. Therefore, this sector could be at the center of discussion while planning interventions for IWRM and food production. The institutional arrangement or formulation of any integrated policy instrument for the proposed nexus need to consider the role of energy sector stakeholders and may delegate responsibilities to the Power Cell under the guidance of the MPEMR.
- The core objective of the discussed sectors or the nexus approach is to ensure food security for all under the changing climate. Both water and energy provide essential inputs to sustainable production and management of the food supply chain. Thus, keeping the ultimate goal at the center of operations, the food sector should play a pivotal role in the nexus arrangement and provide necessary directions to the other two sectors about its input requirements, implementation strategies, plans for climate actions, and needs for policy and institutional reform.

All of the above perspectives are valid to the contexts they focus on, and the government needs to design an appropriate institutional arrangement by performing rigorous dialogues; and, with lessons learned from the contemporary best practices adopted in other regions of the world.

Whatever form the arrangement takes, the nexus must consider or adopt the following additional principles.

- Conservation of the ecosystem in which the nexus operates
- Adoption and promotion of nature-based solutions (NbS) for managing the resource systems
- Incorporation of the roles of fisheries and livestock sectors in the nexus arrangement
- Establishment and execution of essential awareness campaigns and capacity-building programs to ensure sustainability of the nexus approaches by the participating institutions
- Ensuring social inclusion and equity by addressing gender inclusion and responsiveness, and provisions for deprived and vulnerable communities
- Adoption of an inclusive and participatory approach by involving communities, youth, and the private sector in the nexus arrangement and related service delivery processes

8. THE WEF NEXUS FOR SOUTH ASIA

The resource systems of water, energy and food have the geospatial coverage that either extends or can potentially extend beyond national boundaries. The surface water system of Bangladesh depends on the transboundary inflow from the Ganges-Brahmaputra-River (GBM) basin. This basin contains all project locations of the CARE for South Asia project, i.e., Bangladesh, Nepal and Pakistan. Therefore, a basin-wide management approach of water resources has a regional context. Nepal has considerable hydropower potential that could be imported into Bangladesh. Again, the food supply system of Bangladesh has a strong trade-relationship with India and China. Thus, the WEF Nexus arrangement should consider this regional context to maximize the sector- or nation-specific economic benefits, enhance regional cooperation, and achieve climate resilience.

The management and sharing of transboundary flow in the South Asian region have a fairly long history of conflict and debates. The proposed nexus arrangement can also potentially unlock the barriers associated with stakeholder dialogues, both at national and regional levels. At the same

time, resources planning, allocation and utilization are likely to be better managed within a regional perspective, provided by effective collaboration.

Thus, regional programs like CARE for South Asia provide substantial opportunities with which to explore the potential for nexus implementation and apply the synergy as an evidence-based measure of climate adaptation and resilience. The development patterns along with technical experts and governments can form an alliance and work together to establish and operationalize the WEF Nexus for co-benefits, as well as sustainable development on both national and regional scales.

9. WAY FORWARD

There is a fairly wide range and large amount of nexus-related documentations, academic literature and guiding materials available now (Moreno et al., 2021). This knowledge base can help gain a clear and complete understanding of the nexus approach and how the governments can adopt such a strategy to achieve climate resilience. In Bangladesh, the conceptual framework of the WEF Nexus is still at the initial stage of understanding, and stakeholders need to arrange more dialogues so as to reach a common consensus. The subject sectors (i.e., water, energy and food) may find the reflections of different workshops or dialogues held on this topic useful for sectoral interventions as well as cross-sectoral integration and collaboration. Discussion may be initiated at the ministerial level to design and implement the WEF Nexus approach. In addition, the government may engage national academia and research institutions in collaboration with regional experts such as ADPC to design and implement the nexus approach.

CREDITS

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