COVID-19 AND CLIMATE-SMART HEALTH CARE

Country Case Studies
The World Bank report, *COVID-19 and Climate Smart Health Care: Health Sector Opportunities for a Synergistic Response to the COVID-19 and Climate Crises*, describes the actions that the health sector can take during COVID-19 response and recovery efforts to tackle both pandemic and climate change threats. Several examples of countries implementing practical measures to address the combined threats of COVID-19 and climate change were used to inform this report; they are summarized in the case studies in this document.

1. **COLOMBIA: SUSTAINABLE PROCUREMENT AND COVID-19 HEALTH CARE RESPONSE**

Sustainable procurement is a strategy that the world’s governments recognized as an important approach for achieving sustainable development at the 1992 Rio Earth Summit. Since then, several United Nations (UN) conferences and agreements have reinforced the value of sustainable procurement in fostering sustainable production and consumption; as such, action to implement it has grown. Governments on every continent have developed, or are in the process of developing, legislations, regulations, policies, strategies, and action plans to foster sustainable public procurement as a means for tackling climate change, chemical pollution, biodiversity loss, and more. The health care supply chain that plays a major role in many economies has a significant impact on human health and the environment. Consequently, the health sector has recently become engaged in sustainable procurement.

In Colombia, having a sustainable procurement program in place has allowed several hospitals and health care systems to better cope with the health emergency generated by COVID-19. The pandemic has disrupted the global health care supply chain leading to shortages of Personal Protective Equipment (PPE), single-use medical devices, disinfectants, and cleaning products. Other key elements associated with the protection of health care workers, as well as the diagnosis and care of COVID-19 patients, have also been affected. In response, a number of Colombian health care systems and facilities already implementing sustainable procurement policies and practices have been able to rapidly develop policies and actions prioritizing the use of reusable PPE and adapting the formulas for disinfectants and detergents. These same hospitals have also been accelerating the use of telemedicine in consultations associated with diagnosing and preventing non respiratory diseases. Therefore, their pandemic resilience has also produced associated climate benefits by procuring supplies and services that prioritize reusables (PPE) as well as decreasing patient and staff transport (telemedicine), thereby enabling health care institutions to reduce the carbon and environmental footprint of their COVID-19 response and the health sector in general.
SUSTAINABLE PROCUREMENT AS PANDEMIC PREPAREDNESS

Several public and private Colombian health care systems are participating in the Latin America regional component of a global program—Sustainable Health in Procurement Project (SHiPP). Financed by the Swedish International Development Cooperation Agency (SIDA), SHiPP is implemented by the United Nations Development Programme (UNDP) and Health Care Without Harm (HCWH). As part of their participation in SHiPP, 54 health institutions in the country to date have formally signed a commitment to leverage their purchasing power to reduce the damage to people and the environment caused by the manufacture, use, and disposal of products used in health care and the implementation of health programs.

Local and state governments that manage health care systems, as well as groups of hospitals and individual facilities, have developed plans, policies, and/or regulations for sustainable procurement. The state of Cundinamarca, for instance, issued an ordinance that establishes a cross-sectoral strategy for sustainable procurement, which specifically targets the health care sector and promotes implementation in the sector. Health care institutions have played an active role in the strategy’s development and the implementation of initiatives to achieve its replication in other parts of Colombia and the Latin American region.

With the outbreak of COVID-19, health care systems in Colombia and the world over found themselves facing a severely disrupted supply chain, shortages of essential goods and devices, along with constantly changing and inconsistent protocols and purchasing standards put in place to address the pandemic. In contrast, the hospitals and health care systems participating in the SHiPP project found themselves in a stronger and more prepared position because they were able to apply the principles of sustainable procurement to the pandemic response.

Developed within the framework of the SHiPP project, Fundación Valle del Lili in Cali and Hospital Pablo Tobón Uribe in Medellín are both not-for-profit institutions of high levels of complexity. Regional leaders in the health care sector, they have cohosted the regional sustainable procurement workshops that were held in 2018 and 2019 in Cali and Medellín, respectively. These two health care institutions have developed initiatives that involve avoiding the use of toxic chemicals and promoting...
the purchase of reusable products. They stand out as leaders in their efforts to minimize the negative impacts of their operations. Both institutions have a sustainable procurement policy, a program, a committee, and criteria developed for sustainable procurement. All of these elements have allowed the hospitals to effectively adapt and implement changes in their procurement to better cope with the health emergency generated by COVID-19.

**PRIORITIZATION OF REUSABLE PPE**

One way that sustainable procurement in the health sector strives to reduce waste is to promote the purchase of reusable products.

The Fundación Valle del Lili in the city of Cali applied this sustainable procurement approach as a strategy to overcome the shortage of PPE. For example, Fundación bought washable antifluid, chlorine-resistant, and antimicrobial gowns for health care workers. This measure reduced their monthly gown purchase by 36,000 per month, biological waste from the disposable gowns by 3.6 tons a month, and CO$_2$ emissions by 5.43 tons of CO$_2$eq$^a$ per month. It also resulted in monthly financial savings of USD82,700.

Similarly, the Pablo Tobón Uribe Hospital of the city of Medellín, incorporating criteria from its sustainable procurement program, mandated the purchase of antifluid fabric masks for the administrative staff and non-COVID-19 patients, along with antifluid gowns for non-COVID-19 patient care and cloth caps. The hospital also extended the life cycle of medical N95 masks properly by safely decontaminating them. This 500-bed hospital estimates that it is avoiding the disposal of more than half a million PPE items and nearly nine tons of biological waste per month.

**DETERGENTS**

The adoption of reusable PPE presented a new challenge: how to clean a suddenly much larger load of contaminated gear. The adoption of reusable gowns and the increase of patients with high biological risk contributed to a 25-percent increase in the volume of contaminated clothes at Fundación. Using the sustainability criteria from its sustainable procurement program and building cross-departmental collaboration, Fundación put in place a strategy to address the increase in the volume of hospital laundry. Fundación’s team included members of occupational health and safety, biosecurity, infection control, general services, laundry, nursing, process engineering, and more. The team created a new formula to use natural resources efficiently for washing the clothes of COVID-19 patients. The new formula allowed for shorter laundry cycles at higher temperatures. This effort averted the collapse of the laundry service at the facility. The new formula is also saving Fundación more than 3,000 m$^3$ of water per month, translating into approximately USD3,500 in savings in the water consumption bill every month.

**TELEMEDICINE**

The COVID-19 pandemic has also accelerated the adoption of telemedicine all around the world. While telemedicine is not directly a procurement strategy, it is fostering more resilient health systems that, through a more decentralized approach, can withstand the impacts of large-scale disasters on their operations. It is also an important tactic for reducing health care’s carbon footprint, while promoting adequate access to health care.

On September 30, 2020, the Ministry of Health of Colombia reported a 192-percent$^6$ increase in telemedicine services offered in the country. The
example of one hospital illustrates the broader-scale impact of this accelerated change.

In addition to promoting sustainable procurement strategies to combat COVID-19’s impacts, the E.S.E Hospital San Antonio de Arbeláez and its associated primary health care centers that serve an average of 10,918 patients annually in the department of Cundinamarca has maintained a far-reaching telemedicine approach. The hospital now provides telemedicine services in 14 specialties to facilitate access as well as improve the opportunity and resolution in patient care, while preventing the exposure of non-COVID-19 patients. Over the first nine months of the pandemic, the hospital and its health care centers carried out 982 teleconsultations, as well as 307 Tele-EKG and 2,527 deliveries of X-ray results. Using HCWH’s carbon footprint calculation tool, the hospital estimated that the reduction in patient travel reduced carbon emissions by 418 tons of CO$_2$ eq.

LESSONS LEARNED

In the case of these Colombian hospitals, having a clear environmental policy on sustainable procurement in place made it easier for them to respond to COVID-19 and continue with a safe environmental approach as part of that response.

Throughout the pandemic, the leaders and collaborators of assistance units and support services have expressed preferences for reusable supplies and measures, thus extending the life cycle of the products necessary for the provision of health services.

The leadership from the ShiPP program and the leadership within each hospital and the health system’s sustainable procurement program have helped to drive this change. Most importantly, they have developed attitudes of commitment to natural resources across the hospitals and their systems. This has, in turn, promoted commitment and innovation among staff, resulting in a resilient pandemic response, significant cost savings, and reduced environmental harm. Without a doubt, the embedded nature of sustainable procurement inside these health institutions, which has been a fundamental support in enabling them to face the pandemic, will allow these institutions to have a more resilient and sustainable recovery.

2. THE GAMBIA: MOVING FROM INCINERATION TO SUSTAINABLE HEALTH CARE WASTE SOLUTIONS

SUMMARY

The Republic of The Gambia, located in West Africa, consists of dense woodlands, wetlands, and savannahs. This topography makes the country vulnerable to the effects of climate change — flooding, rainfall, rising sea levels, droughts, and heatwaves, with concomitant impacts on economic development, food security, and health. Against this backdrop, the COVID-19 pandemic has exposed weaknesses in the health system and public health infrastructure. In response to the mounting rate of COVID-19 cases in The Gambia, the government took the initiative to address the infectious health care waste generated by the COVID-19 pandemic, among various other initiatives that include enhancing case detection, contact tracing, disease surveillance, and diagnostic capacity. While responding to the public health emergency, the government has shown that it is possible to also maintain a low carbon footprint by using the latest technology developed in health care waste management.
COVID-19 SITUATION IN THE GAMBIA

The Republic of The Gambia is the smallest country in continental Africa. Bordered by the Republic of Senegal and the Atlantic Ocean, it lies on the west coast of Africa. The coastal region is densely populated, with the capital city, Banjul, sitting on an island where the Gambia River reaches the Atlantic.

On March 17, 2020, The Gambia reported its first confirmed case of the novel coronavirus disease, COVID-19. As there was no public health facility equipped to treat COVID-19 cases and no public health laboratories for COVID-19 testing, the first confirmed cases were treated at a private facility. At that time, the first set of cases was imported, though local transmission was also on the rise. As of December 11, 2020, there were 3,779 confirmed cases in the country, with 123 confirmed deaths.

While The Gambia has performed poorly on public health emergency preparedness and response, it has had an integrated disease surveillance response implementation process in place since 2003. Additionally, the National Health Emergency Committee was activated to ensure and oversee the overall coordination and implementation of the COVID-19 Response Plan. This implementation has been aligned with other regional responses, including the Regional Disease Surveillance Systems Enhancement and the Africa Centers for Disease Control and Prevention.

However, despite the support and coordination, challenges remain. Support for innovative country-wide risk-communication strategies has been suboptimal, with declining compliance on wearing masks. A lack of reliable internet connectivity has hindered the implementation of electronic surveillance at the National Public Health Laboratories in the country. There has also been a notable uptick of COVID-19 cases among health care workers.

Additionally, droughts and floods, accounting for 13 percent and 60 percent of climate-related hazards in the country, respectively, have impacted food security, and public health, as well as subjected the population to life-threatening injuries and property damage.

CLIMATE PROFILE OF THE GAMBIA

The Gambia, a narrow strip of land surrounding the Gambia River, consists of dense woodlands, wetlands, and savannas. It has a long, dry season from November to May and a short, wet season from June to October. Average temperatures in the country range from 18°C to 30°C during the dry season and 23°C to 33°C during the wet season.

However, temperatures have noticeably increased since the 1940s in West Africa, and during the period from 1970 to 2010, temperatures have risen with even greater magnitude over the last 20 years. Specifically, in The Gambia, mean annual temperatures that have been rising by 1.0°C since 1960 are expected to continue to increase. Climate projections indicate that mean annual temperatures will rise by between 1°C and 3°C by the 2060s. This indicates a substantial increase in the frequency of “hot” days and nights in the country in the not-too-distant future. Additionally, The Gambia experiences several climate hazards, including torrential rainfall, storms and flooding, droughts, heat waves, sea level rises, and unseasonal rains. Of these, the most significant climate-related hazards are river flooding, coastal flooding, and water scarcity. Floods constituted 60 percent of climate-related hazards in The Gambia during the 1990–2014 period, with storms accounting for 27 percent during the same period. Around 20 percent of the country is covered by wetlands and swamps. Flood-prone areas are hit by life-threatening floods annually after heavy rains,
subjecting populations to injuries, waterborne disease outbreaks, and losses of life, as well as property damage. Additionally, climate-sensitive diseases, such as malaria that are endemic in the region, compound the current public health crisis, along with threats from other diseases, including COVID-19.

On November 7, 2016, The Gambia ratified the Paris Agreement and submitted its contributions to the Agreement, despite being one of the countries contributing the least to climate change though it is particularly vulnerable to its impacts. Additionally, The Gambia began developing its Strategic Plan for Climate Resilience in November 2016, outlining key climate priorities that included developing climate-resilient food and landscapes, a low-emission and resilient economy, health, education, equitable social development, along with managing the coast in a changing environment, as well as infrastructures and waste. The infrastructure and waste management included developing climate-proof infrastructure, sanitation, and solid waste management.

**TRANSITIONING TO SUSTAINABLE WASTE MANAGEMENT DURING THE PANDEMIC**

Noting the poor maternal and child health as well as nutrition outcomes, combined with laboratory, drug, and equipment shortages, within the country, the government of The Gambia, with financing from the World Bank, implemented the Maternal and Child Nutrition and Health Results Project (2014–20) to increase the use of community nutrition along with primary maternal and child health services.

In addition to increasing the utilization of maternal and child health as well as nutrition services in regions with the worst health outcomes, incinerators were installed in 35 health facilities to address the public health concerns of health care waste. Health care waste management was one of the key constraints health care workers noted in addition to insufficient ward space and consultation rooms, the lack of basic drugs and equipment, along with inadequate electricity supply. Moreover, when health care waste is not managed properly, it could lead to surface and groundwater pollution as well as the spread of diseases. Generally, incinerators have drawbacks that include the release of pollutants into the air, which are hazardous, particularly when used in populated areas. In Banjul that is densely populated, smoke from burning debris has impacted the quality of life of residents. However, the lack of access to international markets to procure less polluting incinerators during the implementation of the project posed a great challenge.

In light of the COVID-19 response, the government pursued the recommendation to reduce the impacts of air pollution from health care waste and embarked on a more sustainable practice. Its decision also took into account climate considerations and their alignment with the government’s commitment to the Paris Agreement. As a result, under the World Bank-financed COVID-19 operation — The Gambia COVID-19 Preparedness and Response Project (P173798), the government provided an environmentally friendly, a state-of-the-art health care waste treatment machine to the Sanatorium treatment center in the western region of the country, where most of the confirmed cases would be treated, in July 2020. An AMB Ecosteryl 75 Plus is currently under production and will be delivered in 2021. These health care waste management technologies use microwave disinfection technology as a cleaner method in the management of medical waste treatment and recycling, thereby providing an environmentally friendly, simple, and reliable solution for the health care waste management industry, particularly in
urban areas. Additionally, the technology is energy-efficient, requiring little energy, few staff, no water, steam, and no production of toxic waste.

Laboratories and relevant health facilities, which are used for the diagnostic testing and isolation of patients, generate biological waste, chemical waste, and other hazardous bioproducts from COVID-19. Therefore, the management and handling of highly infectious biomedical waste are also critical under the COVID-19 response. Additionally, biohazard bags and plastic pedal bins were procured for all health facilities as part of a comprehensive response.

LESSONS LEARNED AND WAYS FORWARD

Throughout the process, the government of The Gambia was engaged in determining initiatives that would reduce public health hazards and address its climate change commitments. In taking the initiative, the government was the driving force behind the process — researching the options available as well as considering environmental and social safeguards to maintain the health of the population and the environment. In order to move forward on addressing climate change while responding to COVID-19 and future outbreaks, the government’s commitment will be vital for ensuring climate-resilient and environmentally friendly approaches.

COVID-19 SITUATION IN GHANA

Ghana is a country in West Africa that is bordered by Togo, Côte d’Ivoire, and Burkina Faso. It has made significant progress in poverty reduction, with a fast-growing economy and solid social capital. However, the emergence of the novel coronavirus — COVID-19 — has brought on additional challenges that the country has had to address.

On March 12, 2020, the Ghanaian Ministry of Health confirmed its first two cases of COVID-19, where by two individuals had returned to Ghana from Norway and Turkey. In response to the outbreak, the country has adopted an all-of-government approach with high political commitment. The Inter-Ministerial Coordination Committee — made up of the Ministries of Finance; Health;
Local Government; Gender, Children and Social Protection; Information; Transport; Interior; and Defense; along with the Office of the President — is acting as the apex coordinating body for the COVID-19 response. For vaccine deployment and the cold-chain process, the National Technical Coordination Committee (NTCC) and the National Technical Working Group (TWG) on Vaccine Readiness and Deployment are providing oversight and coordination. Additionally, the government has activated activities under the Emergency Operations Center and set up emergency response teams in all 16 regions and districts of the country. As of December 6, 2020, Ghana had 52,738 COVID-19 cases, with 326 deaths.

One of the reasons for the country’s success in managing the COVID-19 outbreak has been its aggressive roll out of contact tracing and testing as well as a quarantine program. The country is currently assessing its readiness to deploy COVID-19 vaccines to its population, especially to the vulnerable and those at risk. This process will assist the country in identifying existing gaps in its cold-chain and vaccine-delivery systems in order to address them ahead of the COVID-19 vaccine delivery.

**CLIMATE PROFILE OF GHANA**

Ghana has a tropical climate that is influenced by the West African monsoon. Its mean annual temperature has risen by 1.0°C, with the rate of increase being higher in the northern regions of the country than in the south. Additionally, the average number of “hot” days per year had increased by 48 days between 1960 and 2003. In fact, its mean annual temperature is projected to increase by 1–3°C by the 2060s, with the estimated rate of warming to be the most rapid in the northern inland regions of Ghana. Annual precipitation is expected to increase by 3.46 mm. Therefore, Ghana is most at risk from floods, coastal erosion, and droughts, with injuries to human health from flooding and waterborne diseases, including climate-induced waterborne diseases.

Additionally, flooding and precipitation are likely to contribute to outbreaks of human and animal diseases, the displacements of human populations, the destruction of property and infrastructure, as well as losses of livelihoods. These climate events are also likely to compound the challenges in the delivery of vaccines to the population and hinder the logistics of the vaccine cold-chain supply. Each of these climate-related health threats is also expected to hit the poorest households and communities hardest, with income and health shocks driving them deeper into poverty. Overall, the effects of climate change are predicted to increase the number of Ghanaians living below the poverty line by 2–6 percent by 2030.

Since the 1980s, the government of Ghana had considered the use of fuel-efficient and environmentally friendly cold-chain systems and vaccine-deployment processes. One of the assessments of Ghana’s cold-chain system, conducted as far back as 1986, recommended the replacement of obsolete cold-chain equipment with energy-efficient ones. In fact, solar refrigeration was pilot tested in the 1980s. The plan had been to deploy solar refrigerators, especially to areas lacking access to the national grid.

The Ghanaian government approved its first comprehensive national climate change policy in 2013 that focused on low-carbon growth, adaptation, and social development. In 2015, Ghana’s NDCs presented a comprehensive mitigation and adaptation plan to address key sectors and areas, including energy, transport, waste, forestry, agriculture, water, and health.
A significant challenge had been the lack of adequate resources for the government to procure climate-friendly options due to the associated extra costs. With financing support from the World Bank, engaging in a climate-considerate vaccine cold-chain has now been enabled, thus also contributing to the country’s commitments under the NDCs in mitigating global emissions.

**DESCRIPTION OF INNOVATION**

In anticipation of the potential challenges from climate change, the government of Ghana engaged with the World Bank to receive additional financing for the vaccine cold-chain delivery process. It entered into agreement with the World Bank Board on November 28, 2020, under the Ghana COVID-19 Emergency Preparedness and Response Project Additional Financing. In this effort, the provision of off-grid solar electricity for rural and peri-urban government health facilities, which will avert GHG emissions from them, will be financed. This effort will reequip primary health care facilities to be energy-efficient; enhance existing cold-chain facilities and other logistics infrastructure; provide vehicles that have high fuel efficiency, or run on low-carbon fuels or electric power; and train health care delivery workers to support the deployment of low-carbon technologies through the cold-chain. While the operation will not finance the purchase of COVID-19 vaccines, it will provide support for preparatory activities, including technical assistance to access the policy environment as well as the immunizations systems capacity and infrastructure for any future vaccine delivery.

In preparation for vaccine delivery, NTCC and TWG for Vaccine Preparedness and Delivery have convened key donor agencies, such as WHO, the World Bank, and UNICEF, as well as private-sector players, for collective decision-making on the COVID-19 response, including on COVID-19 vaccine delivery. These platforms could also provide the opportunity for collective discourses on climate mitigation and co-benefits among major partners as part of their COVID-19 cold-chain and vaccine-delivery support.

Additionally, there is a health development partner group that meets regularly to discuss various aspects of the health sector in Ghana, share good practices, and adopt a collective stance on key health sector issues. Specifically, for vaccines, the group also provides an avenue for discussions revolving around the procurement and deployment of vaccines and cold-chain-related matters, which are crucial for a coordinated response to COVID-19. This group also provides an additional opportunity for discourses and collective actions on climate mitigation measures among key development partners involved in COVID-19 vaccine delivery in Ghana.

**LESSONS LEARNED**

The recognition and ownership displayed by the government of Ghana in establishing a sustainable vaccine cold-chain has been enabled to address both COVID-19 and the nation’s commitment to the Paris Agreement. The World Bank’s financing of the vaccine cold-chain process and infrastructure to ensure solar energy and sustainable practices will complement the country’s response to meeting its NDCs and mitigating its emissions, while also enhancing the resilience of the health system in providing care to its population and tackling the COVID-19 outbreak.
While the leadership of the government is key, the engagement of development partners to work together with the government is also important for effective implementation. Ensuring the success and sustainability of the vaccine cold-chain requires coordination and engagement between the government and development partners working collaboratively in the country. Engaging each other’s strengths, as has been done in Ghana, with technical support from development partners and financing from the World Bank, as well as the services of NTCC in the day-to-day coordination, will ensure the successful implementation of the vaccine cold-chain to address COVID-19 and the country’s long-term resilience to climate change.

4. INDIA: HEALTH FACILITY ENERGY RESILIENCE FOR CLIMATE AND COVID-19 RESPONSE

Energy security is key to better and uninterrupted health services, given that it helps in improving equipment functionality, enhancing delivery systems, ensuring more functional neonatal care units, and finally promoting the retention of staff. In light of the COVID-19 outbreak, the solarization of health centers has not only saved money but also provided energy security, and thus, quality health care to the communities. It has also strengthened the existing health infrastructure so that it can be prepared to face and deal with future health challenges, epidemics, outbreaks, or any climate change-induced adversity.

As the following examples from two of the lowest-income states in India — Chhattisgarh and Bihar — attest, needs-based solarization can result in the reliable management of cold-chains for medicines and vaccines as well as efficient care services for vulnerable populations like pregnant women, newborns, and the elderly, while also maintaining the internet, data sharing, communication, and information systems.

STATE OF CHHATTISGARH: TIMELY ACTION ON COVID-19 AND STRENGTHENING HEALTH CENTERS TO MAKE THEM LOW-CARBON, PANDEMIC-PREPARED, AND CLIMATE-RESILIENT

Formed in 2001, Chhattisgarh is a small and relatively young state in Central India. The southern part of the state is hilly, underdeveloped, and tribal-dominated. The state, as a whole, has very limited human resources dedicated to health, including relatively few doctors, nurses, medical professionals, and specialists. For several years, the state has striven to integrate most of the 10 components of the operational framework of climate-resilient health systems, as prescribed by WHO. These principles include leadership and governance; a health workforce; vulnerability, capacity, and adaptation assessments; integrated risk monitoring and early warning; health and climate research; climate-resilient and sustainable technologies and infrastructure; management of environmental health determinants; climate-informed health programs; emergency preparedness and management; as well as climate and health finance.

Outlining the COVID-19 response strategy of the State, former Secretary of Health, Ms. Niharika Barik Singh, stated that the health department took charge of planning for tackling the COVID-19 crisis early on. They focused on the following elements:

• analysis of the health and infrastructure availability in the state;
• training and preparedness of the first responders in the community;
• early warning system and health infrastructure preparedness — the procurement of supplies, the training of personnel, and the setting up of additional infrastructure;
• use of an information technology platform for contact tracing, data management, and the tracking of data on supplies — PPE kits, oxygen supply, hospital beds, etc.; as well as
• vulnerability mapping in the community to identify the populations who would need additional care.

COVID-19 vulnerability mapping was done through the state’s non communicable disease clinics in order to identify people with diabetes, hypertension, other comorbidities like cancer, and any other previous illnesses. Vulnerability mapping was also undertaken through the analysis of geography and climatic conditions. In the case of COVID-19 regions with high air pollution, vulnerability mapping led to the close monitoring of people with a history of respiratory illness.

Through its handling of COVID-19 despite being low on resources, Chhattisgarh was able to demonstrate that the pandemic was not a mere medical issue, but similar to building health-sector climate resilience, it required leadership, commitment, institutional participation, efficient coordination with various departments, and the support of the citizens for the success of the program.33,34 Nowhere is the connection between Chhattisgarh’s COVID-19 response and climate change clearer than in its program for the solarization of its health centers.

**SOLARIZATION OF HEALTH CENTERS**

For the past decade, the State of Chhattisgarh has been deploying solar energy to power its health centers in order to provide resilient, continuous services to the population it serves. Energy security is key to delivering better health services by providing a stable delivery system, helping improve equipment functionality and ensuring more functional neonatal, intensive-care, and high-dependency units, while contributing to the retention of staff. Recognizing this objective, the state, through its agency, the Chhattisgarh Renewable Energy Development Authority (CREDA), has been implementing the solarization of health centers throughout the state since 2012. Between 2012
and 2019, CREDA installed off-grid solar PV rooftop systems at 906 health centers across the state.\textsuperscript{35}

According to the former health secretary, Ms. Niharika Barik Singh, “Solarization has increased the institutional delivery of health in the State. It has ensured that mothers stayed for at least 48 hours at the facility, which decreased the maternal mortality rates, newborn care corners and newborn stabilization units in the centers have been functioning better and thus quality of care has improved. There is better cold-chain maintenance to ensure smooth execution of the immunization program. Solarization has increased the footfall of patients and generated trust in the public health systems.”\textsuperscript{36}

The Council on Energy, Environment and Water (CEEW) conducted a first-of-its-kind quantitative and qualitative study\textsuperscript{37} on the impacts of electricity access via distributed solar energy on rural health care services in Chhattisgarh. The study found that solar-powered primary health care centers (PHCs) in Chhattisgarh admitted over 50 percent more patients and conducted almost twice the number of child deliveries in a month compared to power-deficit PHCs that lack a solar system. The ability of solar-powered PHCs to operate cold-chains, store vaccines and drugs, as well as run newborn care equipment also improved significantly in Chhattisgarh.

It is clear that overall solarization has increased the status of most health care indices in the state. Based on these outcomes, in the midst of the COVID-19 pandemic in 2020, the state ramped up its commitment. It now aspires to solarize an additional 705 health centers, which would allow it to achieve 100-percent renewable electricity in the government health centers. This redoubled initiative aims to prioritize the Health Sub-centers\textsuperscript{b} in geographically remote areas and regions. These areas regularly experience power supply problems, such as power failures and voltage fluctuations, making it difficult to address the health care needs of the community, while also undermining the retention of health care staff.

In addition to the resulting strengthening of the health system, thus ensuring that Chhattisgarh is more prepared for the pandemic and more capable of delivering a COVID-19 vaccine, the aim of the solarization effort is to design solar solutions based on the specific needs of the health centers, including their vulnerabilities with respect to prevalent extreme climatic events, such as floods, droughts, heat waves, and air pollution. This approach fits into the state’s more comprehensive plan to tackle the health impacts of climate change, as described in its State Action Plan for Climate Change and Human Health (based on the guidelines of the National Program on Climate Change and Human Health, as prescribed by the National Center for Disease Control, Ministry of Health and Family Welfare).\textsuperscript{38}

As part of this initiative, Chhattisgarh also aims to set up model climate-resilient Health and Wellness Centers (HWCs) throughout the state, with at least one in each district. These climate-resilient HWCs will include solar-powered electricity, cool roofs for heat management, rainwater harvesting, solar

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\item[A Health Sub-centre is the most peripheral and first point of contact between the primary healthcare system and the community. A Sub-centre provides interface with the community at the grass-root level, providing all the primary healthcare services. It is the lowest rung of a referral pyramid of health facilities consisting of the Sub-centres, Primary Health Centers, Community Health Centres, Sub-Divisional/ Sub-District Hospitals and District Hospitals. The purpose of the Health Sub-centre is largely preventive and promotive, but it also provides a basic level of curative care. As per population norms, there shall be one Sub-centre established for every 5000 population in plain areas and for every 3000 population in hilly/tribal/desert areas.” Directorate General of Health Services, 2012. Indian Public Health Standards (IPHS) Guidelines for Sub-centres, revised 2012. Ministry of Health & Family Welfare, Government of India. https://nhm.gov.in/images/pdf/guidelines/iphsg/plhs-revised-guidlines-2012/sub-centers.pdf.]
\end{itemize}
pumps for drinking water, solar heating for water, efficient biomedical waste management systems, and a mechanism for the sustainable procurement of medical goods and equipment.

The COVID-19 pandemic highlights how powering health with renewable energy can build resilience not only for strengthening the health system and climate resilience but also for pandemic preparedness. For instance, by making this public-health infrastructure investment in resilient renewable energy, Chhattisgarh is positioning itself to manage cold-chains more reliably for medicines and vaccines. Overall, the state’s focus on solarizing health centers in remote areas will not only provide energy security, and thus, quality health care to the communities but also strengthen the existing health infrastructure so that it can be prepared to face future health challenges that will not only include climate change-induced adversity but also epidemics, other outbreaks, and/or disasters, and deal with them.

**MASARHI, BIHAR: A CLIMATE-RESILIENT COVID-19 CARE HOSPITAL WITH STAFF QUARTERS**

Bihar is a state in eastern India. The third largest state by population and 12th-largest by territory, Bihar is amongst the poorest states in India, with poverty incidence of 42.6 percent. Its per capita net domestic product has been estimated to be USD446 — about one-third of the corresponding national average (USD1,220) and less than one-fourth of that of Haryana (USD2,052), one of the richest states in India. Bihar generally ranks weakest in health outcomes in comparison to other Indian states. Bihar relies heavily on privatized hospitals to provide health care to the public and has the second-highest ratio among Indian states for private-to-public spending and high levels of corruption. As a result, there are also slower health care delivery and steep health care costs. Given the high population density of the state, Bihar lags behind other states in the number of health care professionals who should
be employed for adequate care. The Ministry of Health estimates that the biggest shortfall in the state, almost up to 75 percent, is in physicians and specialists.

Masarhi is a rural region in Bihar, about 25 km south west from the state capital, Patna. The village is so steeped in grinding poverty that its people are known to hunt rats in their fields and eat them. The government-run PHC that is meant to serve Masarhi is ill-equipped to handle patients. Although Patna, located just 25 km away, has hospitals, getting there means a difficult journey of more than an hour because of broken roads and the absence of ready transportation.

Implemented by the Indian NGOs, the SELCO Foundation and Doctors for You (DFY), the Masarhi hospital is a new solarized COVID-19 Care facility in Bihar with a six-bed inpatient department (IPD), two procedural rooms, and 15 staff accommodation rooms. It is built with sustainable materials and powered 100 percent by renewable energy. It is a potentially scalable example of how the COVID-19 response, climate resilience, cost savings, and achieving greater access to care can be embodied by a single health facility.

Built in August 2020, the hospital building itself is a greenfield construction, that is, new construction unconstrained by prior work. The construction incorporated the special needs of the hospital staff and personnel. For instance, the COVID-19 pandemic disrupted systems around the facilitation of health care, with the lockdown hindering the mobility of the health care staff and requiring more in-residence staff to tend to COVID-19 patients. This presented a need for staff accommodations, along with beds dedicated for other non-COVID-19 care needs.

Lockdown measures had also limited markets, workforces, and transport for building materials. The crisis of manpower and resources was further exacerbated by the increasing number of cases of COVID-19 and the urgency of providing specialized infrastructure for COVID-19 care. The circumstances necessitated innovations, particularly for tackling the lack of materials and labor supplies essential for building construction.

A prefabricated construction solution was developed where the entire facility was built in a warehouse and assembled on site. This innovation allowed for the construction of a 5,000+ square-foot building in only two months, cutting construction time by half.

**SYNERGY OF 100-PERCENT RENEWABLE ELECTRICITY AND ENERGY-EFFICIENCY MEASURES**

As mentioned before, energy security is essential for uninterrupted health services. In times of climate crisis, the health center needs to be the last building standing with its functioning unhampered. Energy resilience in the health center does not come with the installation of renewable energy solutions alone but also through the incorporation of energy-efficient measures in the design and building of the facility itself.

In the Masarhi hospital model, a holistic approach to climate resilience has been adopted wherein energy-efficiency measures have been deployed in combination with the renewable energy infrastructure. Given the precarious situation of the electricity supply in the region, the hospital is fully powered by a 15-kilowatt (KW) Solar PV array with battery...
backup. Though it is connected to the grid, it can continue to operate fully, even in the event of grid power disruptions. In addition, the hospital has incorporated diverse innovative measures that have enabled it to reduce its energy footprint and minimize energy needs.

The facility has ecofriendly walling and flooring made from compressed Agri Fiber panels that are manufactured by using crop residue. The walling infills in this innovative approach insulate the building and protect it from heat stress. According to the field data, these panels provide better insulation than conventional walling and flooring panels. Better insulation will lead to a reduced requirement of air conditioning during the summer months. Other incremental building solutions were added to improve the quality of the space, with respect to natural lighting, ventilation, and the thermal comfort, thus leading to the early recovery of patients:

- addition of skylights and turbo ventilators to the roofing;
- windows with exhaust fans; along with
- cool-roof solutions, such as cool-roof paints, Mod roof, and false ceilings to reduce the heat gained through roofing.

The Masarhi facility saves about 58 percent in energy by shifting to solar. The table offers a comparison of the energy savings that the hospital has been able to achieve with its efficient appliance and green building efforts.

According to Dr. Ravikant Singh, founder of DFY, “solarization of the health center has helped cut electricity costs by almost 58 percent in the facility. Given the unknowns around COVID-19 especially about how long the pandemic would last, cost uncertainties are plaguing health facilities. To top this, COVID-19 care itself is an expensive proposition. Solarization of health center helps reduce and balance the costs for a COVID-19 Care hospital.”

### Energy savings at Masarhi Hospital

<table>
<thead>
<tr>
<th>System</th>
<th>Efficient appliances with green building design</th>
<th>Inefficient appliances with green building design</th>
<th>Inefficient appliances with standard typical building designs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Load Connected</td>
<td>4,290 W</td>
<td>5,749 W</td>
<td>5,749 W</td>
</tr>
<tr>
<td>Total Units Required</td>
<td>21.8 Units</td>
<td>30.63 Units</td>
<td>52.34 Units</td>
</tr>
<tr>
<td>Solar Panel Capacity</td>
<td>12 kWp</td>
<td>16.2 kWp</td>
<td>26 kWp</td>
</tr>
<tr>
<td>% of Energy Savings</td>
<td>28.82% (Solution without energy-efficient appliances and with green building design)</td>
<td>58.34% (Savings with both energy efficiency and green building design)</td>
<td></td>
</tr>
</tbody>
</table>

*Energy savings at Masarhi Hospital. Photos courtesy of SELCO Foundation.*
Dr. Singh also points out that the biggest advantage of stable solar power in the facility is its ability to keep equipment safe. Fluctuating voltage from an unstable grid in rural India is one of the major causes of equipment damage. The CEEW study in Chhattisgarh revealed that more than 21 percent of the PHCs reported medical equipment damage due to voltage fluctuations. According to Dr. Singh, equipment once damaged are often left unattended due to the scarcity of trained biomedical engineers and their hesitation to travel long distances in rural areas. Dr. Singh observes that one of the biggest advantages of a solar-powered hospital is the safety of expensive medical equipment worth hundreds of thousands of rupees, which is critical to the provision of patient care.

Solar PV at the Masarhi hospital is powering, among other things, ventilators for COVID-19 care, a laboratory for testing and analysis, and a water pump for the facility. Solarization has ensured 24-7 power to the hospital, therefore resulting in better staff retention and more trust from the public; women patients are more willing to stay back at the hospital for care because they feel safe there.

**CROP RESIDUE: CLOSING THE LOOP ON POLLUTION TO HEALING**

In addition to its energy-efficient properties, the Agri Fiber panel provides an alternative use for crop residue. The common practice of burning this residue is a major cause of air pollution in India (especially in the Indo-Gangetic Plains during the onset of winters). Research indicates that air pollution is likely to exacerbate morbidity and mortality from COVID-19. Exposure to air pollution in the long term reduces the capacity of organs to function fully and makes it more vulnerable to infections and diseases. Given that the COVID-19 virus also enters the body via the lungs, such individuals are likely to face greater complications and experience more susceptibility to severe forms of COVID-19. The use of Agri Fiber panels to build health facilities providing care and healing from COVID-19 and other diseases is also an effort to close the loop on air pollution and use the material for healing diseases, rather than causing them.

The climate-resilient COVID-19 care hospital at Masarhi is a small example of what health facilities could look like in the climate-uncertain future. However, such initiatives come with inherent limitations: they are dependent on donors for resources and sustained purely through the public spirit of physicians associated with NGOs, in this case, DFY. It is important that governments see this initiative as a good practice that could be scaled up and institutionalized in larger health care systems. Ultimately, it is only the government that can provide the holistic foundation for a sustainable health care system that a country with a diverse patient load like India requires. The Masarhi hospital shows that it is indeed possible to provide health care to those who need it the most, if the solutions have innovation, futuristic thinking, dedication, and commitment.

**5. NEPAL: SUSTAINABLE HEALTH CARE WASTE MANAGEMENT TO REDUCE COVID-19 RESPONSE POLLUTION**

The COVID-19 pandemic has caused concern about waste being generated in homes and hospitals. Careless disposal is causing it to litter the streets and beaches, and nervous governments are resorting to burning it, despite the pollution and carbon emissions as well as the fact that there
are better alternatives. Vaccine delivery will bring another stream of waste — much of it potentially at small, remote vaccination centers.

As this case study from Nepal demonstrates, investments in safe and environmentally sustainable health care waste management systems can safely deal with COVID-19 waste, while bolstering long-term waste management capacities and health system resilience. Investments in integrated systems, based on careful waste segregation, the autoclave disinfection of waste, and the recycling of as much waste as possible, offer the greatest all-round benefits. The bio digestion of organic waste completes the portfolio of climate-smart and resilient waste treatment technologies for health care facilities in low- and middle-income countries.

Investments in these systems can now address COVID-19 waste treatment and vaccination waste challenges, while developing the infrastructure that can continue to be useful once the pandemic abates, thereby presenting potential long-term benefits from actions taken to counter the spread of the virus.

THE COVID-19 WASTE CRISIS

The knowledge that SARS-CoV-2 can be spread by contaminated articles (fomites) has led to considerable concern about the potential hazards of waste from hospitals and similar facilities, despite a lack of evidence of waste acting as a route of infection. During the first wave of the coronavirus pandemic, some countries (for example, Spain, Italy, and China) changed their health care waste classifications to categorize all health care waste as infectious. This overloaded their management systems and decision-makers turned to environmentally unsustainable techniques, particularly incineration.62

When the COVID-19 vaccine becomes available, a surge of vaccination waste is also anticipated. Although almost all of it is recyclable, vaccination waste is often burned as well. Burning waste emits significant amounts of CO₂ and other pollutants, including dioxins and furans as well as carcinogens and endocrine disruptors. These pollutants that persist in the environment for hundreds of years and build up in the food chain can be passed from mother to child.63,64,65

SUSTAINABLE HEALTH CARE WASTE MANAGEMENT

Untreated or improperly managed, health care waste can cause injury, infection, and chemical poisoning to patients, health care professionals, and the community, as well as interfere with human rights,66 pollute the environment, and contribute to climate change. In contrast, sustainable health care waste management can help protect people from health care-associated infections, reduce the number of needlestick injuries, and contribute to the delivery of SDG, including Goal 3 on health, Goal 6 on safely managed water and sanitation, Goal 7 on climate change, along with Goal 12 on sustainable consumption and production.67

AN EMERGING MODEL IN NEPAL

A multiparty partnership in Nepal is demonstrating that climate-smart health care waste management is the best approach, both for carrying out normal operations and taking on COVID-19 waste issues.

The Sukraraj Tropical and Infectious Disease Hospital in Kathmandu — the nation’s capital — is Nepal’s only dedicated infectious disease hospital. Operated by the government of Nepal, it has 100 beds, with half of them now dedicated to COVID-19. It is the country’s first COVID-19 hospital, serving more than 1,000 Outpatient Department (OPD)
cases per day, while also collecting and handling more than 900 swabs per day for COVID-19 tests.

The Sukraraj Hospital has a small waste management center, with an autoclave provided to help treat COVID-19 waste through a project under the Management Division of the Department of Health Services and WHO Nepal. This project is supported financially by the Support to Health Sector Program/GiZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) Nepal and technically by the Health Environment and Climate Action Foundation (HECAF360). This autoclave is only large enough to cope with the COVID-19 waste; so the other infectious waste from the hospital is not yet being treated.

Nearby, spread across the Kathmandu Valley are five drop-in-centers (DICs) offering harm reduction services, including Human Immunodeficiency Virus (HIV) testing and syringe exchanges to persons who inject drugs. The DICs are operated by diverse Nepali community-based organizations and NGOs, with financial support from the Global Fund to Fight AIDS, Tuberculosis and Malaria as well as Save the Children Nepal, along with technical support from HECAF360 and HCWH. The DICs have been searching for a safe way to dispose of their waste. With neither the space nor resources for the equipment and personnel to treat the HIV test kits and used syringes from their clients, the DICs have accumulated substantial stockpiles of waste, while awaiting a solution.

In response to this situation, the facilities, their backers, and technical support teams are now cooperating to create a system that meets the needs of both the hospital and the DICs. This sustainable health care waste management system has the following three characteristics:

**Segregation:** At each of the participating facilities, waste will be strictly segregated to minimize the amounts requiring treatment. Needle cutters (also called hub cutters) destroy syringe needles so that they cannot cause injury and cut the tips off the syringes so that they can never be reused.
**Treatment:** Autoclaves that use high-temperature, high-pressure steam to kill pathogens will disinfect the waste.

An expanded health care waste management center at the Sukraraj Hospital will include an autoclave for the DICs’ waste that has been provided by the development partners supporting the DICs. Cut syringes from the DICs will be transported to the Sukraraj Hospital in lockable aluminum containers designed to fit directly into the autoclave. The new autoclave will not only be able to treat all the DIC waste but also add much-needed capacity for the Sukraraj Hospital itself.

This “hub-and-cluster model” is effective in locations where there is no centralized waste management facility. Larger health care providers with the technical expertise to treat waste safely also treat that of smaller facilities nearby. They provide a valuable service and, in turn, can subsidize the use of their staff and equipment by charging waste treatment fees.

**Recycling:** Much of the waste from the Sukraraj Hospital can be recycled. Noninfectious waste, including paper, plastics, and glass, which have been segregated at source, will be brought directly from the Sukraraj Hospital’s wards to the “green” section of the waste treatment center, and then sent for recycling. After treatment in the “red” section, some of the previously infectious waste can also be recycled. In previous research, HCWH and HECAF360 were able to recycle immunization waste, including vaccine vials and packaging; the only exception was the cut needles.

**CLIMATE-SMART HEALTH CARE WASTE MANAGEMENT**

Autoclaving vaccination waste in Nepal, where much of the electricity is derived from renewable (hydroelectric) sources, has carbon emissions 3,000–4,000 times lower than burning it. If the power is from fossil sources, autoclaving still has CO$_2$ emissions 15–20 times lower than burning it.

While the partnership between the Sukraraj Hospital and the DICs is focused on syringes and the so-called “soft” infectious waste, other facilities generate large quantities of pathological waste (placentas) and kitchen/food waste. HCWH and HECAF360 have been assisting them to install biodigesters to complement the autoclaves. Biodigestion uses bacteria (often derived from cow dung) to break down organics in underground chambers, whereby the methane generated is captured for use as a fuel. Since methane has high GWP, burning it has a lower carbon footprint than allowing it to be released into the atmosphere.
At the Tribhuvan University Teaching Hospital, Nepal’s largest teaching hospital, two autoclaves disinfect waste, and the biogas plant treats 27 tons of organic waste yearly, which would otherwise be sent to landfills, thereby avoiding methane emissions of 1,386 m³ per year.

As well as being safe and climate-smart, the system has proven to be resilient. Hospitals with these systems were able to continue treating their waste, even after the magnitude-7.8 Gorkha earthquake in 2015, when patients were moved outdoors for safety, and waste quantities trebled. It is highly scalable because expertise and national government support are available.

The primary barrier is resource limitations: only around one percent of Nepal’s hospitals have integrated systems of this type. Of these, most are designed for a facility to treat its own waste. Thus, the “hub/cluster” model being created at the Sukraraj Hospital, where one hospital treats waste from smaller facilities nearby, is a valuable option that deserves more attention. Standalone “centralized” systems can also be viable in larger cities.

COVID-19 has increased pressure on waste management systems at hospitals like the Sukraraj Hospital around the world. It is overloading facilities that are already challenged in dealing with existing health care waste streams. The integrated response in Nepal shows the potential of a system that could be scaled, with support from donors and development partners to strengthen the national capacity, particularly projects on water, sanitation and health (WASH) at health care facilities, immunization campaigns, as well as initiatives on maternal health, HIV, tuberculosis, and malaria.

6. THE PHILIPPINES: LEVERAGING MULTIHAZARD DISASTER PREPAREDNESS FOR COVID-19 RESPONSE

The Philippines, one of the first countries to report cases of COVID-19, has enforced what was described as one of the strictest and longest lockdowns in the world. Despite its myriad challenges in containing the spread of the coronavirus, the Philippines is no stranger to emergency situations. Its experience with disaster responses has thus allowed it to mount a multi-sectoral and multilevel response to the COVID-19 pandemic.

Visited by approximately 20 typhoons each year, the Philippines is one of the world’s most climate-vulnerable countries. In 2020, the think tank, German Watch, ranked the Philippines as number 2, in terms of losses in human lives and the gross domestic product (GDP) resulting from extreme weather events.²² For instance, in 2013, the country was hit by Typhoon Haiyan, considered to be the strongest ever to hit land in recorded history. The typhoon claimed more than 6,000 lives and affected nearly 16 million people.²³ The years spanning 2011 to 2020 saw a much higher number of typhoons (91 versus 63) and deaths (12,376 versus 6,198) than in the previous decade.²⁴ These extreme weather events are in addition to the slow-onset, long-term changes expected in the country, such as sea-level rises exceeding the global average rate in certain parts of the Philippines.²⁵ These slow-onset events will generate a wide range of health effects, including climate-sensitive infectious diseases, such as dengue and malaria,²⁶ along with heat-related illnesses.²⁷
DISASTER PREPAREDNESS AND CLIMATE CHANGE ADAPTATION

Given the country’s vulnerability to climate change, particularly the extreme weather events and the slow-onset health effects, the Philippines instituted several national policies, such as the Climate Change Act of 2009 — once lauded by the UN as one of the best climate laws in the world— and the Philippine Disaster Risk Reduction and Management Act of 2010.

The country’s framework for disaster risk reduction and preparedness adopts an all-hazard approach. While the Philippines is frequently beset with climate-related typhoons, flooding, and storm surges, there are other types of natural and human-made hazards addressed by the Disaster Act and its associated mechanisms. For instance, being in the Pacific Ring of Fire, the Philippines faces the perennial threats of earthquakes, landslides, and volcanic eruptions. The same disaster infrastructure is mobilized when human-made emergencies, such as armed conflicts or stampedes, occur. Nonetheless, while not all disasters are related to climate change, there has been an increasing effort to harmonize disaster risk reduction and climate change adaptation activities, including in the health sector, by recognizing the conceptual, technical, and operational synergies between the two.

Since the Philippines has a devolved system of governance, both laws highlight not only the roles
and responsibilities of the national government but also those of local governments. For instance, the Disaster Act requires municipalities to establish a Local Disaster Risk Reduction and Management Office that is tasked to develop, implement, and coordinate local disaster risk management programs, including conducting risk assessments, setting up a multihazard early warning system, training first responders, and coordinating response and recovery efforts, among others. Meanwhile, the Climate Change Act requires municipalities to formulate and implement Local Climate Change Action Plans prioritizing local climate-related issues that are consistent with the provisions of the National Climate Change Action Plan. While the law requires municipal mayors to appoint one municipal staff member to lead the design and implementation of the climate plan, many municipalities across the country have also created task forces. They comprise various relevant appointed officials (for example, disaster officer, agriculturalist, environment and natural resource officer, planning officer, and health officer) to develop local climate plans.

**SPRINGBOARD FOR COVID-19 RESPONSE**

The COVID-19 pandemic exposed the weaknesses of the Philippines’ devolved health system, as well as a lack of explicit programs for enhancing pandemic preparedness and the management at the local level. Nonetheless, the local governments were able to take advantage of the local emergency response systems designed for climate-related disasters, such as typhoons and extreme flooding, by utilizing these existing capacities to organize multisectoral responses to the COVID-19 pandemic. Having been sensitized to previous emergency situations related to climate change, local government staff and communities alike were thus quick to shift to disaster mode in their enforcement of strict COVID-19 protocols in local communities. Pre-pandemic disaster mechanisms were activated. For instance, the Local Disaster Risk Reduction and Management Council is composed of the municipal mayor; all relevant appointed officials (including the municipal health officer); the chiefs of police, fire protection, and military; along with sectoral representatives from the civil society and the private sectors.

Since national mandates compel local governments to invest in disaster preparedness, local governments were also quick to realign local budgets and mobilize initial financing for COVID-19-related activities. The Disaster Act requires municipalities to allocate at least five percent of their annual revenue for a Local Disaster Risk Reduction and Management Fund. Thirty percent of this fund must be allocated as a “Quick Response Fund” that can be immediately mobilized when a calamity strikes. The rest of the fund (70 percent) is used for preparedness and risk-reduction activities, such as awareness raising, the purchasing of rescue equipment, and the payment of premiums for calamity insurance. These disaster funds were mobilized in response to the pandemic, complementing the budget increase already allocated by local governments for health services. However, overall, these funds remained limited, and additional assistance was needed from the national government.

While certainly not adequate for the magnitude and long duration of the COVID-19 pandemic, these multisectoral governance and anticipatory budgeting mechanisms helped local communities to mobilize early in response to the pandemic.
RESPONDING TO THE COMPOUND EFFECTS OF COVID-19 AND CLIMATE CHANGE

While tackling COVID-19, the Philippines was also hit by three major typhoons, further complicating the pandemic response. On May 14, 2020, while the Philippines was still struggling to contain the virus and under a nationwide lockdown, Typhoon Vongfong slammed the Eastern Visayas region, displacing approximately 150,000 residents. Then in November, the country was hit by two major typhoons back to back. Super Typhoon Goni struck Luzon — the country’s biggest island — on November 1 killing at least 20 people and displacing more than 517,000 people. Local governments reported that approximately 170,000 houses were either damaged or destroyed. The typhoon left substantial damage in the order of USD230 million. Not much more than a week later, Typhoon Vamco wreaked havoc across the same island with more than three million people affected and another 283,656 people seeking refuge in 2,205 evacuation centers. By the time the second typhoon arrived, more than 82,000 people remained displaced in the provinces affected by the first typhoon. In all these disaster events, residents had no choice but to break quarantine and relocate to makeshift evacuation centers for fear of possible landslides, storm surges, and floods.

The capacity and resources of both national and local governments were put under tremendous stress by the joint occurrences of both the pandemic and the climate-induced disasters. Climate-related disasters are not new to emergency responders, but responding to a disaster during the time of a pandemic is certainly a new experience that governments in a number of developing and developed countries (such as India, Bangladesh, and the United States) have had to endure during COVID-19. In the Philippines, government officials recognized the complexity of evacuating thousands of people and relocating them to temporary shelters while observing physical-distancing measures to prevent the spread of the virus. Meanwhile, families affected by climate-related disasters were faced with a dilemma — either stay at home and protect themselves from the coronavirus, while their houses were inundated if not destroyed, or move to cramped evacuation centers, usually in public schools or other public buildings, to escape flooding at the expense of breaking physical-distancing measures, and worse, contracting the virus.

One part of the country that experienced the compound effects of COVID-19 and climate change is Albay — one of the provinces highly vulnerable to both climatic and geologic hazards. For the past two decades, the province has largely achieved its goal of zero casualties from disasters, such as typhoons, storm surges, earthquakes, and volcanic eruptions. Its innovative approaches to tackling disaster risk reduction and climate change adaptation have been lauded both nationally and internationally, including by UN and the World Bank. Some of its pioneering efforts in mainstreaming climate change adaptation into disaster risk reduction include the introduction of climate change and disaster preparedness modules into the curriculum of K-12 students, hence enhancing disaster and climate awareness among the populace. The province has also invested in strengthening its capacity to use modern technology for climate forecasting, early warning, and land use planning, as well as established programs for resilient livelihoods as part of climate change adaptation.

Facing the Pacific Ocean, Albay and its adjacent provinces are on the typhoon track. Since the beginning of the pandemic, Albay, despite being the 20th-biggest province (out of 81) in the country, has maintained some of the lowest incidence of
COVID-19 cases in the country. When the three major typhoons hit the Philippines during the COVID-19 pandemic, local governments were already mobilized for the continued provision of COVID-19-related services. As a result, advanced risk communication and preemptive evacuations were easily deployed in a timely manner. While Albay managed to keep its zero-casualty target intact in the aftermath of Typhoon Vongfong, Typhoon Goni resulted in at least 10 reported deaths, as of November 10. While the existing disaster preparedness and response systems certainly contributed to minimizing mortality, whether due to COVID-19 or typhoons, COVID-19 has shown the limitations of pre-pandemic mechanisms when multiple emergencies occur at the same time.

LESSONS LEARNED

The early experience of the Philippines in tackling COVID-19 has demonstrated that pre-pandemic investments in disaster risk reduction and climate change adaptation can be harnessed for mounting an immediate response to an unprecedented viral pandemic. While the physical manifestations of climate-related disasters and infectious disease epidemics may vary, there are principles, capacities, and resources common to both. However, the Philippine experience also showed that disaster preparedness and climate adaptation plans do not often take into consideration infectious disease outbreaks, whether they are climate-related or not.

As climate change accelerates, climate-related disasters, such as typhoons and extreme flooding, are expected to continue afflicting the Filipino people in the future, even before the pandemic is over. Lessons from epidemic control should, therefore, be incorporated into existing emergency response systems in preparation for future shocks. Disaster risk reduction and response plans can be revised to incorporate epidemic control, for instance in preemptive evacuations before the typhoon arrives. Such anticipatory planning will ensure safe and orderly relocation that will eventually save lives from both the infectious disease and the calamity.

The relationship between climate- and pandemic-resilience building is bidirectional. As countries like the Philippines are able to leverage climate adaptation and resilience efforts for tackling COVID-19, lessons from the pandemic response can also potentially inform their climate adaptation and resilience strategies in return.

7. THE REPUBLIC OF YEMEN: STRENGTHENING DISEASE SURVEILLANCE TO COMBAT COVID-19 AND CLIMATE IMPACTS

SUMMARY

Globally, violent conflict has spiked dramatically since 2010 according to the World Bank, with climate change compounding the world’s fragility. Against this backdrop, the COVID-19 pandemic has added even greater stress to the already complex situation in the Republic of Yemen. Despite the challenges and the first confirmed COVID-19 case reported on April 10, 2020, the electronic integrated disease early warning system (eIDEWS) — the only surveillance system in the Republic of Yemen to detect disease outbreaks, including cholera — has been utilized effectively for the COVID-19 response.

The functionality, utility, and universality of the surveillance system have been shown to not only respond to disease outbreaks from escalating conflict and climate vulnerabilities in the Republic of Yemen, but also in its ability to capture relevant
data in its COVID-19 detection and response. This has enabled rapid response mobile teams in the country to investigate and rapidly respond to the outbreak and monitor disease trends across various levels — district, governorate, and national.

COVID-19 SITUATION IN THE REPUBLIC OF YEMEN

The Republic of Yemen—one of the poorest countries in the Middle East—has experienced increasing violence that has disrupted millions of lives, resulting in mass casualties and massive displacement. Twenty-four million civilian Yemenis are in need of humanitarian assistance, according to the United Nations Office for the Coordination of Humanitarian Affairs. A 2019 Humanitarian Needs Overview Report estimated that two million children under the age of five years along with more than one million pregnant and lactating women were suffering from acute malnutrition. Additionally, 17.8 million people lack access to safe water and sanitation, while 19.7 million are unable to obtain adequate health care. Compounding the situation, the coronavirus outbreak has impacted the fragile health system and infrastructure, which are heavily reliant on foreign aid.

The first confirmed case of COVID-19 in the Republic of Yemen was reported on April 10, 2020. As of November 5, 2020, there have been 2,063 COVID-19 cases in the Republic of Yemen, with 601 deaths. However, the actual number of
cases is unknown due to the low levels of both testing capacity and sharing of information. WHO is supporting 37 isolation units (out of 59) through the Republic of Yemen Emergency Crisis Response Project, with partners supporting or running other isolation units throughout the country. In May 2020, WHO commenced the monthly mapping of COVID-19 measures in non-COVID-19 health facilities through other partners.96

By the end of July 2020, more than 19,680 community-based volunteers were mobilized to educate the community on the coronavirus, its transmission, along with the ways of suppression and protection. Additionally, UN procured more than 14,300 metric tons of medical equipment and supplies, with a total of 11,380 metric tons already present in the country and another 2,936 metric tons in the pipeline.97

CLIMATE PROFILE OF THE REPUBLIC OF YEMEN

Despite the ongoing conflict, the Republic of Yemen submitted its climate action plan to the United Nations Framework Convention on Climate Change (UNFCCC) in 2015.98 The plan outlined its intended nationally determined contributions (INDCs). It is important to point out that the economy of the country is largely dominated by the oil sector.99 However, the ensuing war in 2015 destroyed the economy across various sectors, subsequently disrupting supplies of food, fuel, and medicines, which are dangerously low or not available.

In addition, nearly 10.6 million, or 41 percent of the population, are food insecure. This can be partially attributed to the country’s geographical location. Located at the southern end of the Arabian Peninsula, the Republic of Yemen is a Middle Eastern country with a largely tropical and subtropical desert climate. The country experiences extreme heat of up to 40°C, floods, droughts, sea-level rises, and landslides, which are compounded by climate change.100 These climate events threaten food security, water, agriculture, development, and adversely affect human health by increasing the likelihood of diseases, including cholera, dengue, malaria, and others.101 Additionally, water resources are scarce with rapid groundwater depletion.

The Republic of Yemen has experienced at least one natural disaster every year for the last 20 years.102 Climate variability is likely to increase, leading to negative impacts on agriculture, while intense rainfall events increase the risk of floods that will, in turn, heighten the risk of waterborne diseases, thereby weakening the health of the population. For example, heavy rains, occurring earlier than usual in mid-February 2019, resulted in a resurgence of cholera in the country.

Susceptibility to disease further weakens the resilience of the population to future outbreaks, including pandemics, such as COVID-19. It was recognized that strengthening the national disease surveillance system — eIDEWS — would be key to enhancing the ability of the health system to detect future outbreaks and target interventions, particularly in a humanitarian emergency. Public health surveillance systems can become fragmented or overwhelmed in times of a humanitarian emergency, thus impacting the timeliness and quality of data. This is exacerbated in the Republic of Yemen that is also vulnerable to the effects of climate change and disease outbreaks, thus further impacting the health of the population.

STRENGTHENING DISEASE SURVEILLANCE

Under World Bank financing, eIDEWS was expanded in 2017 to cover 1,991 sites consisting of 22 governorates and 333 districts in 2019.103 An additional 450 new sites have been planned
for 2021. Initially designed as an early warning system, eIDEWS was established to strengthen routine disease surveillance, predominantly in the early detection of epidemic-prone diseases.\textsuperscript{104} eIDEWS collects data on 28 diseases from health facilities, vector control, and disease outbreaks, including cholera, dengue fever, and malaria. It is directly implemented by the Republic of Yemen’s Ministry of Public Health and Population at various levels (health facility, district, governorate, and central), with the close support of WHO.\textsuperscript{105} The aim of eIDEWS is to reduce morbidity and mortality through early detection and rapid responses to disease outbreaks. It does so by generating alerts that flag the need for epidemiological investigations to take place in affected districts and through the issuance of weekly eIDEWS bulletins that are published and shared among health partners and other stakeholders. This has allowed for the reporting of notifiable diseases in a timely manner. For example, in 2017, a total of 134,456 alerts were generated by eIDEWS; 128,190 alerts were verified as true alerts, with the detection of five disease outbreaks, indicating a positive predictive value of 95 percent.\textsuperscript{106}

eIDEWS has now been galvanized in the COVID-19 response. In anticipation of the second wave, the health care staff in 21 COVID-19-specific facilities were trained on case management. In addition, surveillance trainings (such as contact tracing and case definition) were conducted. Further, Governorate Rapid Response Teams and Rapid Response Teams (RRTs) were mobilized through the World Bank financing to respond to COVID-19. These RRTs function at different levels (district, governorate, and central) as firstline responders for the investigation and rapid response to any outbreak. COVID-19-specific RRTs were activated in 84 priority districts, based on the criteria that included districts declaring confirmed and/or probable coronavirus cases and/or districts where contact tracing and contact follow-ups needed to be initiated. While the main district rapid response teams (DRRTs) have been deployed in the past to contain outbreaks, such as cholera, and continue to be deployed for both COVID-19 and other disease outbreaks, they have been initiated to supervise and deploy mobile-specific COVID-19 teams in the affected districts. It has been decided that once additional mobile teams are activated, the governorate rapid response teams (GRRTs)/main DRRTs will conduct on-the-job training for the additional mobile teams. In those governorates and districts where the GRRTs/main DRRTs are unable to train the recruited mobile team, the central RRTs and the eIDEWS team have been requested to provide support.\textsuperscript{107}

**LESSONS LEARNED**

Under extremely tenuous circumstances, involving multiple outbreaks, including cholera and COVID-19, the eIDEWS disease surveillance system in the Republic of Yemen has kept the fragile health system of the country functioning. Based on the scientific literature assessing its functionality, it was reported to be stable and able to collect and manage data without any major disturbances.\textsuperscript{108} Even with unstable internet connectivity, data can still be received via phone calls, with focal points trained to input the data received, thus allowing for the flexibility of the surveillance system.\textsuperscript{109} Additionally, it is available 24/7, with access available any time when needed. Despite the global pandemic of COVID-19 causing severe disruptions, eIDEWS has continued to follow other disease outbreaks, including cholera, while being utilized in the COVID-19 response. Disease trends can be monitored and changes to the number of cases easily observed. The system can also generate...
short message service (SMS) alerts if the number of cases exceeds predetermined thresholds.

These key findings indicate that eIDEWS is a robust and resilient system, and despite the humanitarian crisis, the system is still functioning. It is the only surveillance system in the Republic of Yemen that provides early warnings to trigger investigations, along with containment or control, which are vital for the early detection of disease outbreaks in a country vulnerable to the negative effects of climate change and the COVID-19 pandemic. The utility of a national surveillance system for disease detection, such as eIDEWS in a conflict zone, indicates the value of investing in such infrastructure, not just for the strengthening of health systems or solely for the monitoring of disease outbreaks due to a changing climate but also for its universality.
ENDNOTES


3 UN Informal Interagency Task Team on Sustainable Procurement in the Health Sector, 2021, https://savinglivessustainably.org/.


27 Republic of Ghana, 2015, Ghana’s Intended Nationally Determined Contribution (INDC) and Accompanying Explanatory Note, https://www4.unfccc.int/sites/n_dcstaging/PublishedDocuments/Ghana%20First%20INDC_235%202015.pdf.


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