Climate Centre

Climate fact sheet | 2024

Lebanon

This climate fact sheet summarizes the available information on the climate of Lebanon and the impact of climate change on humanitarian activities in-country. Each fact sheet in the series was written using information from peer-reviewed academic papers, government publications, and other documentation from international non-governmental organizations.

1. Climate overview

Average temperature: Seasonal temperatures range from an average of 25°C in the summer (June to September) to an average of 7°C in mid-winter (November to March) (World Bank, 2021).

Average precipitation: Annual precipitation is unevenly distributed, with 70 per cent of rainfall in November to March, occurring mostly on a limited number of intense rain days (MoE, 2016).

Short overview

Although the El Niño–Southern Oscillation (ENSO) has a marginal impact over annual variability, the North Atlantic Oscillation (NAO) – consisting of air pressure anomalies between the North Atlantic and Western Europe – is the prominent climatic driver in the region, with dominant influence on surface temperature and precipitation (Verner *et al*., 2018). A positive phase of the NAO is associated with a decline in winter rainfall in Lebanon (Verner *et al*., 2018)..

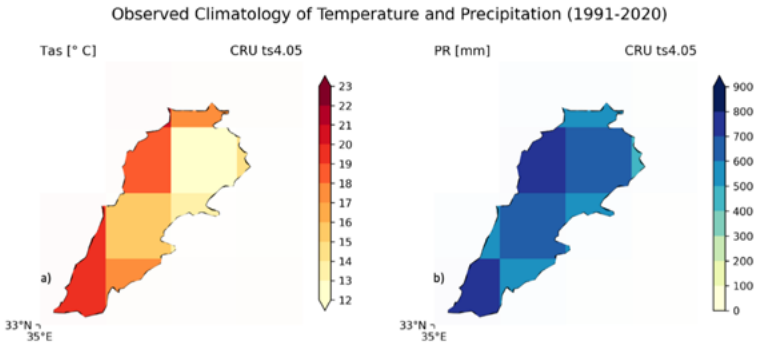

Figure 1. Observed climatology of (left to right) mean temperature and annual mean total precipitation from 1991–2020. (Adapted from World Bank, 2021).

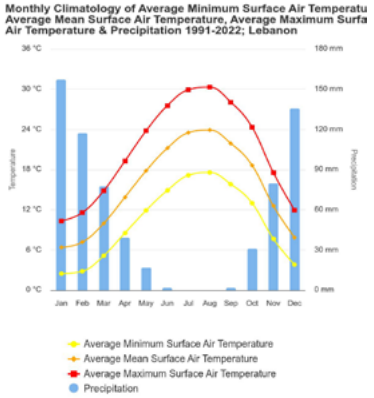

Figure 2. Observed average monthly climatology of temperature and precipitation between 1991–2020 (from World Bank, 2021).

Located on the eastern shore of the Mediterranean Sea, Lebanon is a small country with a coastline of 200km running north–south and an average width of 50km. Two parallel mountain ranges run north-east to south-west and are separated by the Bekaa Valley. This mountainous topography creates a multitude of microclimates (Verner *et al*., 2018). According to the Köppen–Geiger climate classification, these microclimates can be categorized into two major zones:

- Along the coast and in the southern half of the country there is a hot-summer Mediterranean climate. Seasonal temperature here can reach as high as 35°C along the coast in August and as low as 4–5°C in winter. The region receives a mean annual rainfall of 700–1,000mm (World Bank, 2021). The coastal plain along with major cities, including the capital Beirut, are home to 90 per cent of the population (MoE, 2016; Netherlands Ministry of Foreign Affairs, 2018).
- North and inland, located between the mountain ranges, the Bekaa Valley is classified as a warm-summer Mediterranean climate or pre-steppe Mediterranean (World Bank, 2021; USAID, 2016; Verner *et al*., 2018). Here, temperatures are slightly cooler than along the coast, and rainfall varies dramatically by altitude. The Bekaa Valley receives 200–450mm of precipitation annually, while higher altitude areas receive 1,600mm in snowfall each year (MoE, 2016; Verner *et al*., 2018).

1.1 Climate change in Lebanon

Historical climate change	Projected climate change
Temperature	
Lebanon has experienced an annual mean temperature increase of 0.3°C per decade since 1970, well over the global average of 0.15°C (World Bank, 2021). Higher temperature increases have been observed in the summer and spring (World Bank, 2021; USAID, 2016; Verner *et al.*, 2018). For instance, there has been a 7 per cent increase in the number of hot nights since 1960, mostly in the summer months (World Bank, 2021). In addition to increasing air temperatures, the surface water temperature of the Mediterranean Sea has increased by 1.3°C since 1982 (Netherlands Ministry of Foreign Affairs, 2018).	The most recent Coupled Model Intercomparison Project (CIMP6) suggests a temperature increase of 1.9°C by 2100 under best-case sustainability scenarios, a 3.1°C increase in a middle-of-the-road scenario, or a 5.52°C temperature increase should global carbon emissions continue to increase unchecked. This could mean 11–21 very hot days (over 35°C) per year in Lebanon by mid-century (World Bank, 2021). These changes will be particularly acute in urban areas, as the urban heat island effect leads to greater heat stress on urban populations (Climate Centre, 2020).

Historical climate change	Projected climate change
Precipitation	
Since 1950, monthly mean rainfall has reduced by 11mm per decade (World Bank, 2021). This precipitation reduction has neither been gradual nor predictable; rather, it has resulted in increases in both drought and heavy rainfall. Droughts occur with more frequency and intensity, with a "most extreme drought", such as occurred in 2014, now 45 per cent more likely to occur (Verner *et al.*, 2018). One-day rainfall events are increasingly likely and with more intensity too, leading to higher flood risk, even as overall precipitation has decreased (Abdallah, 2019).	According to Lebanon's Third National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), rainfall is projected to decrease by 4–11 per cent by 2100 (MoE, 2016). These changes are projected to increase the frequency and severity of droughts, affecting agriculture, electricity production and water systems. Changes in precipitation patterns and decreases of annual mean precipitation will disrupt groundwater recharge and snow cover storage, reducing annual water availability by 29 per cent by 2080 (higher during the summer season and droughts), as well as increasing the risk of winter floods by 30 per cent (MoE, 2016). In addition, the maximum length of dry spells or consecutive days with less than 1mm of rainfall, is projected to be on average 1–6 days longer by 2100, depending on emissions scenario (MoE, 2016). Adding to this stress on the water system is likely to be a decrease in snow cover of 40–70 per cent as temperature and precipitation changes inhibit this important source of water for the country (MoE, 2016).
Sea level rise	
Sea level rise of the Mediterranean Sea has been recorded, increasing approximately 20mm per year since 1960 (USAID, 2016). This has had several impacts, perhaps most notably salination of key aquifers along the coast and the Greater Beirut area. This trend is exacerbated by high levels of groundwater depletion due to demand for water (El Moujabber & Bou Samra, 2002).	Projected sea level rise of the Mediterranean Sea under a 'business as usual' emissions scenario is between 30–60cm from 2020–2050. The majority of Lebanon's population and significant portions of infrastructure are located along the Mediterranean coastline and are projected to be impacted by sea level rise (USAID, 2016). These potential impacts include saltwater intrusion into aquifers – made more likely as freshwater precipitation decreases – as well as coastal flooding and inundation (MoE, 2016).

2. Priorities of the Red Cross Red Crescent Movement under climate change

2.1 Scale up climate-smart disaster risk reduction (DRR), early action and preparedness

Lebanon is one of the medium risk countries in the world for humanitarian crises and disasters; ranked 49th out of 191 countries by the 2022 Inform Risk Index (DRMKC, 2022).

Existing hydrometeorological hazard	Projected risks
Floods	
Flooding poses a significant threat to Lebanon and a significant flood event occurs 1–2 times per year. This is particularly true in the winter months (World Bank, 2021). Areas especially at risk are in northern Lebanon in urban regions such as Al Fakeha and Ras Baalbek, both of which are surrounded by mountainous terrain which increases the risk of flash flooding (ODI, 2019). These floods can have significant impacts on agricultural production and infrastructure, especially roads. Flooding is estimated to cause 15 million US dollars' worth of damage annually, and often sets off subsequent landslides (Abdallah, 2019; World Bank, 2021).	While consistent long-term data about flooding is unavailable, a combination of urbanization and climatic changes is theorized to have increased flood risk in recent years (Abdallah, 2019) and this is expected to continue into the future.
Droughts	
Drought is an increasing risk in all Middle East and North Africa (MENA) countries, including Lebanon. Approximately 10 per cent of the Lebanese population is currently vulnerable to drought, although its implications for agriculture and infrastructural damage are much broader (World Bank, 2021). In 2013–2014, for example, Lebanon faced a record low level of precipitation, affecting agricultural production and causing the depletion of groundwater resources (Verner *et al.*,2018).	Lebanon's Third National Communication to the UNFC, projects rainfall to decrease by 4–11 per cent by 2100 (MoE, 2016). Changes in precipitation patterns and decreases of annual mean precipitation will disrupt groundwater recharge and snow cover storage, reducing annual water availability by 29 per cent by 2080.

Wildfires have recently affected large swathes of the northern part of the country. Around 16,000ha – or 1 per cent of the country's forested area – burned in a 2007 wildfire, and subsequent fires in 2019 and 2021 have threatened villages, cropland and wildlife (AP, 2021; World Bank, 2021).

Extreme winter storms, including in 2012 and 2019, lead to flash flooding, cold temperatures and heavy snow (Bibbo, 2019; NASA, 2012). Such events have the capacity to lead to landslides and prevent access to remote areas of the country. Winter storms were selected as a priority hazard following the feasibility study ahead of introducing a Forecast-based-Financing programme in Lebanon in 2021 (Anticipation Hub, n.d.).

It is important to note that many of these hazards are interrelated and produce compound risks in the same areas and communities. In addition, risk must be understood as the interplay between hazard, exposure and vulnerability which makes certain individuals, communities and sectors more impacted by the hazards. All project design should take such compounding risks into account.

Disaster risk management strategy

Lebanon's Disaster Risk Reduction/Disaster Risk Management (DRR/DRM) strategy is embedded into its climate change policy documents, such as the updated Nationally Determined Contribution (MoE, 2020). The NDC highlights DRR as part of a comprehensive adaptation strategy and suggests ways forward, such as by enhancing resilience in both rural and urban areas through early warning systems and information sharing. As yet, there is little evidence to indicate how this will be implemented, however.

The country also has a detailed crisis and emergency response, including the Lebanon Crisis Response Plan 2017–2020 – a joint document between the Lebanese Government and national and international partners to ensure the protection of vulnerable populations (ReliefWeb, 2018).

The Lebanese Red Cross (LRC), prioritizing climate change adaptation, is involved in implementing Forecast-based Financing in Lebanon, alongside other projects that feature adaptation initiatives (Anticipation Hub, n.d.). Additionally, the LRC is working closely with the country's Disaster Risk Management Unit (DRMU) as well as with the National Council for Scientific Research in Lebanon (CNRS-L) and a multi-hazards early warning system is in development.

2.2 Reduce health impacts of climate change

Climate change will have significant health impacts in Lebanon. As mean annual temperatures rise, 65 per cent of the days could be 'hot days' by the end of the century (WHO & UNFCCC, 2022). Consequently, heat-related health risks – including cramps, death, dehydration, heat exhaustion heatstroke and rash – will increase (WHO & UNFCCC, 2022). The risks of heat stress are higher in urban areas due to the urban heat island effect (Badaro-Saliba *et al*., 2021). In addition, the elderly and those with underlying health conditions are more likely to be at risk (Kenney *et al*., 2014; WHO & UNFCCC, 2022).

Increases in the variability and intensity of precipitation are causing growing flood and drought risks, associated with increased caseloads of water- and vector-borne illnesses such as diarrhoea (Habib *et al*., 2010; WHO & UNFCCC, 2022). Other ongoing health impacts linked to climate change include rising levels of malnutrition from increased food insecurity due to disrupted agriculture and fisheries practices as well as more vector and rodent-borne disease (Netherlands Ministry of Foreign Affairs, 2019). Climate change consequences such as increasing temperatures and changing rainfall patterns, along with effects of globalization, influence the spread of vector and rodent-borne diseases (Beermann *et al*., 2023).

In addition, droughts and desertification will lead to more frequent sand and dust-storms that result in air pollution, increasing the risk of respiratory and cardiovascular diseases and death (WHO & UNFCCC, 2022). This contributes to the already severe pollution driven by various anthropogenic and environmental factors. For instance, extensive use of diesel generators, which are used to supply electricity, emit significant amounts of nitrogen oxides, particulate matter and sulfur dioxide – all of which are known pollutants that harm urban air quality and public health. Furthermore, Lebanon's transport system relies heavily on older, inefficient vehicles and lacks comprehensive public transit solutions, making it a major contributor to urban air pollution. This sector's sustainability is compromised by inadequate regulatory frameworks and the slow adoption of cleaner technologies (Baayoun *et al*., 2019; Loffreda *et al*., 2021).

Climate change is projected to continue exacerbating existing challenges to Lebanon's healthcare infrastructure and system. The healthcare system is already affected by significant shocks, including civil unrest and shortages of critical medical equipment (Meyers, 2020; MoE, 2016). A combination of influences – including government corruption, the COVID-19 pandemic and the Beirut port explosion – have led to the most severe financial crisis in the history of Lebanon. In June 2023, the inflation rate hit 254 per cent, causing 80 per cent of its population to live in multidimensional poverty. At the same time, Hezbollah – a multifaced Lebanese organization that conducts militant operations – has been involved in both the Syrian civil war and the latest Israel–Gaza conflict (CFR, 2024). Furthermore, climate change shocks and impacts could exacerbate mental health issues in Lebanon, described by Farran (2021) as tomorrow's silent epidemic.

2.3 Ensure sustainable water supplies

Water, Sanitation and Hygiene (WASH)

In Lebanon, precipitation is projected to decrease while droughts will increase due to climate change (WHO & UNFCCC, 2022). These, in addition to inadequate management, inefficient usage, insufficient storage capacity, and increasing pollution, impair water quality and quantity (Abd El Al, 2018; Halwani & Halwani, 2022; WHO & UNFCCC, 2022). Increases in the frequency and duration of drought events and dry spells will escalate the pollution levels and bacterial activity in Lebanon's groundwater and surface water bodies (Amacha & Baydoun, 2018). Furthermore, higher temperatures will lead to the decline of snow cover, which is the main source of groundwater recharge (Farajalla *et al*., 2018). Higher temperatures will also increase the rate of evaporation in surface water bodies and reservoirs, further contributing to water shortages (USAID, 2016). Water shortages during dry months already affect water accessibility for three-quarters of the population in Beirut, forcing them to rely on unauthorized groundwater pumping or water storage in tanks (Walnycki & Husseiki, 2017).

Sea level rise and increased salination of aquifers threaten the freshwater supply, especially in coastal areas (Saadeh & Wakim, 2017; USAID, 2016). Currently, 80 per cent of potable water in Lebanon comes from groundwater (GVC, 2016), which will be impacted by aquifer depletion, salt intrusion and existing contamination (Saadeh & Wakim, 2017). In addition, salinity increases water strain on households and leads to high coping costs (Alameddine *et al*., 2018).

Water distribution systems are not prepared to face additional climate-induced pressures caused by decreasing water availability and infrastructure damage. Of the population, 3.7 million people are already in water need and, by 2030, demand is projected to increase by 41 per cent compared to the 2005 baseline (MoE & UNDP, 2011). Decreases in water accessibility will have disproportionate impacts on vulnerable populations living in informal settlements. Currently, 28 per cent of refugees lack access to clean water and 39 per cent lack access to sanitation facilities (World Vision International, 2020).

Infrastructure and electricity

Lebanon's ambition to expand hydropower capacity is threatened by projected changes in the hydrological cycle. Water resources in reservoirs were reduced by half during recent droughts, and production capacity is projected to decrease by 29 per cent by 2080 (Heinrich Böll Stiftung, 2019; Verner *et al*. 2018). In addition, the cost of electricity used for cooling, due to climate-related increases in temperature, is anticipated to increase to 34.8 billion US dollars in 2080, putting significant pressure on municipal power infrastructure which already faces regular power outages during summer months (MoE, 2016; Walnycki & Husseiki, 2017).

2.4 Enable climate-resilient livelihoods and economic security

The tourism sector, which employs 38 per cent of the country's workforce, will be impacted by increased temperatures, reduced precipitation and sea level rise (Netherlands Ministry of Foreign Affairs, 2019). The sector will also be impacted by a reduction in the snowpack, resulting in a shortened ski season, reduction in biodiversity and an increase in heat stress due to rising temperatures (USAID, 2016). In addition, sea level rise, coastal erosion and occasional intense rainfall events will damage coastal tourism infrastructure and key tourist hotspots (USAID, 2016).

Increased droughts, increasing temperatures and the resultant water shortages affect agricultural production and agroindustry, which are important livelihood and economic sectors in Lebanon, especially in rural areas (Verner *et al*., 2018). Although agriculture only contributes 4 per cent of GDP, the agricultural sector employs 20–30 per cent of the active workforce and constitutes up to 80 per cent of local GDP in rural areas (MoE *et al*., 2015). The Bekaa Valley accounts for 43 per cent of national cultivated land and is the most important production area for seasonal crops and livestock. Here, yields are highly dependent on rainfall, as only 31 per cent of the land is irrigated (MoE, 2016; Verner *et al*. 2018). Water shortages will limit irrigation, while higher temperatures and reduced precipitation will decrease soil moisture, all leading to yield reduction and crop failures (Loffreda *et al*., 2021; Verner *et al*., 2018). In addition, the increasing intensity of winter storms is likely to generate floods and frost, causing crop failure (Netherlands Ministry of Foreign Affairs, 2019). Amongst important national cereal crops production, maize yield is projected to decline by 40 per cent by 2040 and 64 per cent by 2080, whereas wheat will decline by 16 per cent by 2040 and 30 per cent by 2080 (MoE *et al*., 2015).

Increasing temperatures and decreasing rainfall will lead to changes in grazing periods and the quality of pastureland, affecting livestock production (MoE *et al*., 2015; Netherlands Ministry of Foreign Affairs, 2019). Recent harsher winter storm conditions have been causing significant livestock loss (Haddad *et al*., 2014). Further impacts on both crop and livestock production include increases in more severe storms and floods as well as the impacts of the climate-related spread of diseases and pests (MoE *et al*., 2015).

2.5 Address climate displacement and protection

Current and future displacement challenges

Lebanon has been deeply impacted by the Syrian crisis. Although Syrian forces withdrew from Lebanon in 2005, the country has become host to approximately 1.5 million Syrian refugees along with hundreds of thousands of refugees from other countries (UNHCR, n.d.). Indeed, Lebanon hosts the largest number of refugees per capita globally (UNHCR, 2022). This brings the number of people in need to more than half of the country's population (Al-Arian & Sherlock, 2019). Lebanon's trade and tourism industries have also been deeply impacted by the neighbouring conflict (US EIA, n.d.).

- Climate-driven impacts will cause significant protection challenges, particularly affecting informal and refugee settlements. Lebanon's population has a recent history of experiencing conflict and displacement. As of March 2023, the number of Palestinian refugees in Lebanon was around 490,000 living in the country's 12 refugee camps (UNRWA, 2023). In total, the influx of refugees has increased Lebanon's population by 30 per cent in two years, putting significant additional pressure on natural resources and service supply already facing climate-induced stressors (e.g. farmland, groundwater, energy demand, solid waste etc.) (Cherri *et al*., 2016).
- Displaced people already face higher vulnerability to climate impacts due to precarious living conditions in both urban settlements and informal rural settlements (Al-Arian & Sherlock, 2019). Half of the refugees from Palestine live in 12 main camps that experience overcrowding, poverty and poor housing conditions. No formal camps were established to respond to the Syrian crisis. Refugees have, therefore, settled in precarious urban and rural housing (73 per cent) or informal settlements and non-residential structures such as makeshift tents or farm buildings (27 per cent) (UNHCR, 2022). Heavy winter storms in 2019 destroyed makeshift shelters and caused floods in 151 informal camps, and more than half of the 2,000 informal settlements are vulnerable to future winter storms (Abdallah & Hdeib, 2016, Al-Arian & Sherlock, 2019). An increase in the number of extremely hot days will likely disproportionately impact vulnerable people in urban settlements, who frequently lack reliable power supply to meet their cooling needs (Abi Ghanem, 2020).
- The increased population due to refugee settlement combined with hydrologic changes will increase the number of people without adequate water resources. Syrian refugees have increased domestic water use by 20 per cent. When coupled with the projected climate changes, this paints a grim picture of Lebanon's ability to address these dual threats (Jaafar *et al*., 2020). The most severe impacts thus far have been felt in key agricultural areas such as the Bekaa Valley, which faces both the most acute rise in water demand from refugees – up to an 89 per cent increase – in tandem with the most severe projections of reduced water availability – a 29 per cent reduction by 2080 (Jaafar *et al*. 2020; Verner *et al*. 2018).

Potential needs of displaced people

Assessing and addressing water management challenges will be essential to support displaced people as well as the wider population of Lebanon. In urban areas, in particular, decreasing water availability will disproportionately affect refugees relying on external providers (Walnycki & Husseiki, 2017). Competition over limited water resources is already increasing tension, contributing to further displacement and relocation of vulnerable populations (Human Rights Watch, 2019; Verner *et al*., 2018).

Migration law and policies

- The Government of Lebanon has not signed the 1951 Refugee Convention and, since 2015, has restricted the right for refugees to seek asylum and suspended the registration of Syrian refugees (Janmyr, 2017) in the country.

Protection

Prisoners frequently have heightened vulnerability to natural disasters due to spatial marginalization resulting from prison locations on hazard-prone land and/or isolation from emergency evacuation services; limited to no connections to social networks, which are crucial aspects to hazard resilience; and political marginalization, including lack of policies and services to prevent disaster impacts on imprisoned populations (Gaillard & Navizet 2012). While specific information is not available for Lebanon, these types of vulnerabilities, coupled with more frequent and intense disasters due to climate change, may leave prison populations in especially precarious positions to hazards such as extreme heat, extreme cold and floods.

2.6 Policy

Relevant information from the Nationally Determined Contribution (NDC) (2021)

Emission target: A conditional greenhouse gas emission reduction of 31 per cent compared to the 'business as usual' scenario by 2030, focusing on energy.

Area of focus on adaptation: DRR, food and water security, infrastructure, public health, nature-based solutions and desertification. The leave no one behind principle is at the centre of the NDC.

Inclusion of DRR: Yes, it is one of the priorities, with a focus on multi-risk assessment and early warning systems; mapping on droughts, floods and wildfires; forest fire management; and mainstreaming priorities.

National designated entity: Ministry of Environment

Other national policies on climate

- The Lebanon Green Investment Facility (LGIF) will be created to increase investment in climate-smart projects and coordinate an approach to the implementation of the NDC (Green Mind, 2022) by providing 'climate and green finance through accessible and affordable finance instruments for both the public and private sectors, as well as to provide needed technical assistance to various entities to create bankable projects' (MoE, 2020).
- Non-state actors and the private sector play a large and growing role in climate action in Lebanon, as evidenced by the creation of the Lebanon Climate Act (LCA). The LCA is composed of Green Mind (a non-governmental organization), the Central Bank of Lebanon, Ministry of Environment and the United Nations Development Programme, and the approach has been to encourage companies to create and embrace value from climate change (Green Mind, 2022; Green Mind & UNDP, 2017). Since its creation in 2016, the LCA has grown to include over 150 non-state actors and has been lauded as a 'good practice of robust stakeholder engagement' (UNDP & GIZ, 2019).
- Further adaptive strategies to mitigate the health impacts of climate change were outlined in the 'Economic costs to Lebanon from climate change' report – an element of Lebanon's Third National Communication to the UNFCCC (MoE, 2016). These policies are complemented with the WHO's Eastern Mediterranean Region Climate Change and Health: Framework for Action 2017–2021, which includes Lebanon (WHO, 2017).

Climate finance

Green Climate Fund (GCF) preparedness activities are being implemented in Lebanon (GCF, 2022). National Societies cannot apply directly for climate finance from the GCF, but they can be an implementing partner for an accredited entity (Climate Centre, 2022a).

National Societies can explore options for accessing climate funds through smaller funds, such as the GEF's Small Grants Programme or the FFEM's Small Scale Initiatives Program. These grants range from 20,000–50,000 US dollars and are intended to support community-level initiatives. The Global Environment Facility's Small Grants Programme sits under the United Nations Development Programme and has a National Coordinator in each country. Some countries have National Climate Funds, which may be accessible to the National Society. Other funding from bilateral donors, national climate funds, or multilateral climate funds like the Adaptation Fund, CREWS, or GCCA+ could be explored (Climate Centre, 2022a).

Engaging in national climate adaptation planning is vital for accessing climate finance.

Additional resources

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