Climate Centre

Croix Rouge Libanaise

Country-level | Climate fact sheet

Lebanon

The following climate factsheet summarizes available information on the climate of Lebanon, climate change and impacts of these changes on humanitarian activities in country. Each of the factsheets were written as a compilation of information from peer-reviewed academic papers, government publications, and INGO documentation.

1. Climate overview

Average temperature: Seasonal temperature ranges from a mean of around 25°C in the summer (June-September) to a mean of about 7°C in mid-Winter (November-March) (CCKP, 2021).

Average precipitation: Annual precipitation is unevenly distributed, with 70 per cent of rainfall in November–March and occurring mostly in a few 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 of winter rainfall in Lebanon (Verner *et al.*, 2018).

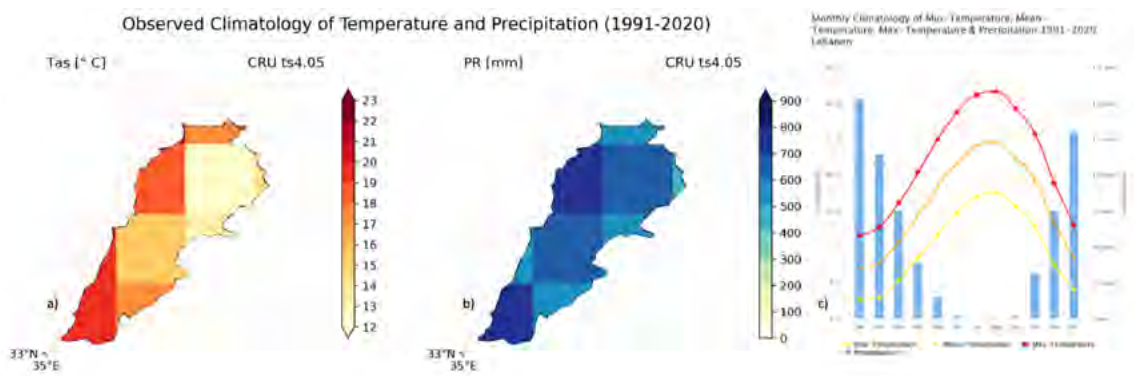

Figure 1. Observed Climatology of mean Temperature (a), annual mean total precipitation (b) and monthly climatology (c) over 1991-2020. (Adapted from World Bank, 2022)

2022

Located on the eastern shore of the Mediterranean Sea, Lebanon is a small country with a coastline of 200 kilometres (km) 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 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 or 5°C in winter. The region receives a mean annual rainfall of 700-1000 millimetres (mm) (CCKP, 2021). The coastal plain is home to 90 per cent of the population and the main cities, including the capital of Beirut (MoE, 2016; Ministry of Foreign Affairs of the Netherlands, 2018).
- North and inland, between the mountain ranges, the Bekaa Valley is classified as Warm-summer Mediterranean climate or pre-steppe Mediterranean (CCKP, 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 1600mm 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 (CCKP, 2021). Higher temperature increases have been observed in the summer and spring (World Bank, 2022; USAID, 2016; Verner *et al.*, 2018). For instance, there has been a seven per cent increase in the number of hot nights since 1960, mostly in the summer months (CCKP, 2021). In addition to increasing air temperatures, the surface water temperature of the Mediterranean Sea has increased 1.3°C since 1982 (Ministry of Foreign Affairs of the Netherlands, 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. This could mean the number of very hot days (over 35°C) reach between 11 and 21 by mid-century (CCKP, 2021). These changes may be particularly acute in urban areas, as the urban heat island effect leads to greater heat stress on urban populations (RCCC, 2019).

Precipitation

Since 1950, monthly mean rainfall has reduced by 11mm per decade (CCKP, 2021). This precipitation reduction has not been gradual nor predictable; rather, it has resulted in increases in both drought and heavy rainfall. Droughts occur with more frequency and intensity, with "most extreme drought", such as occurred in 2014, now 45% more likely to occur (Verner *et al.*, 2018). One-day rainfall events are increasingly likely and intense as well, leading to higher flood risk, even as overall precipitation has decreased (Abdallah, 2019).

According to Lebanon's Third National Communication to the UNFCC, rainfall is projected to decrease 4 to 11% 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; BZ, 2018).

In addition, the maximum length of dry spells or consecutive days with less than 1mm of rainfall, is projected to be on average 1 to 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 by 40-70% as temperature and precipitation 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. 90 per cent 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 and floods (BZ, 2018). These potential impacts include saltwater intrusion into aquifers—made more likely as freshwater precipitation decreases—and coastal flooding and inundation (MoE, 2016).

2. Priorities of the Movement and climate change

2.1 Scale up climate-smart DRR, early action and preparedness: DRR portrait

Ranked 49 out of 191 countries by the 2022 Inform Risk Index (DRMKC, 2022), Lebanon is part of the medium risk class.

Existing Hydrometeorological Hazard	Projected Risks
Floods	
Flooding poses a significant threat to Lebanon and significant flood events occur 1-2 times per year. This is particularly true in the winter months (CCKP, 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 USD annually, and often set off subsequent landslides (Abdallah, 2019; CCKP, 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 African (MENA) countries, including Lebanon. Approximately 10% of the Lebanese population is currently vulnerable to drought, although its implications for agriculture and infrastructural damage are much broader (CCKP, 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 UNFCC, projects rainfall to decrease 4 to 11% by 2100 (Government of Lebanon, 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 swaths of the northern part of the country. Around 16,000 hectares, or 1% of the country's forested area, burned in a 2007 wildfire, and subsequent fires in 2019 and 2021 have threatened villages, crop land and wildlife (Associated Press, 2021; CCKP, 2021).

Extreme winter storms, including in 2012 and 2019, lead to flash flooding, cold temperatures and heavy snow (Bibbo, 2019; National Aeronautics and Space Administration, USA [NASA], 2012). Such events have the capacity to lead to landslides and prevent access to remote areas of the country. Winter Storms was selected as a priority hazard after the feasibility study that's done for Forecast based financing program in Lebanon (Anticipation Hub, n/a).

It is essential to note that many of these hazards are interrelated and produced compound risks to the same areas and communities. In addition, risk must be understood as the interplay between hazard risk, exposure, and vulnerability which make certain communities, individuals, and sectors more impacted by the hazards. Capacities play a critical role in the risk and impact severity.

Disaster Risk Management Strategy

Lebanon's DRR/DRM strategy is embedded into its climate change policy documents (such as the Updated Nationally Determined Contribution (NDC) (2020) and greater crisis and emergency response. One example is the Lebanon Crisis Response Place 2017-2020. This is a joint plan between the government of Lebanon and national and international partners to ensure the protection of vulnerable populations. Another example is Lebanon's Updated NDC (2020) which outlines reducing disaster risk as part of the most notable updates in the NDC in 2020. This is proposed to be done through enhancing the resilience in both rural and urban areas. The NDC highlights DRR as part of a cohesive adaptation strategy and suggests ways forward such as enhancing early warning systems and information sharing. Little exists yet to indicate how this will be implemented going forward.

Lebanese Red Cross (LRC) is prioritizing working climate change adaptation has a developed LRC the implementing forecast-based financing in Lebanon and other projects that take into consideration climate change (Anticipation Hub, n/a). Additionally, LRC is working closely with the Disaster risk management unit (DRMU) at the government level and with the National Scientific Research Centre in Lebanon (CNRS-L) and a multi hazards early warning system is being developed. Moreover, LRC is implementing the community based- disaster risk management approach.

2.2 Reduce health impacts of climate change

Climate change will have significant health impacts in Lebanon. As mean annual temperature rises, 65% of the days could be hot days by the end of the century (WHO & UNFCCC, 2022). Consequently, heat-related health risks, including heatstroke, dehydration, death, rash, cramps and heat exhaustion, 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 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 increases in malnutrition from higher food insecurity and increases in rodent-borne disease (Netherlands Ministry of Foreign Affairs, 2019). Disruption of food systems through climate impacts on agriculture and fisheries causes significant health risks, such as malnutrition (WHO & UNFCCC, 2022). 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). These will add to the widespread pollution due to an array of anthropogenic and environmental conditions, for example, environmental degradation, extensive use of diesel generators and an unsustainable transport sector (Baayoun *et al.*, 2019; Loffreda *et al.*, 2021).

Climate change is projected to continue exacerbating rapidly expanding challenges to Lebanon's healthcare infrastructure and system. The health care system is already affected by significant shocks, including civil unrest and shortages of critical medical equipment (Meyers, 2020; Ministry of Environment (MoE) *et al.*, 2016). Furthermore, climate change shocks and impacts could exacerbate mental health issues in Lebanon, described by Farran (2021) as tomorrow's silent epidemic.

2.3 Sustainable water: resources management, infrastructure and access

Water, Sanitation and Hygiene

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 frequency and duration of droughts 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 (USAD, 2016). Water shortages during dry months already affect water accessibility for three-quarters of the population in Beirut and force the population to rely on unauthorized groundwater pumping or water storage in tanks (Walnycki & Husseiki, 2017).

Sea level rise and increased salination of aquifers threaten the fresh water 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 *et al.*, 2017). In addition, salinity increases water strain on households and leads to high coping costs to reduce salinity (Alameddine *et al.*, 2018).

Infrastructure, Power and Electricity

Water distribution systems are not prepared to face additional climate-induced pressures caused by decreasing water availability and infrastructure damage. 3.7 million of the population are already in water need and by 2030, demand is projected to increase by 41 per cent compared to 2005 baselines (MOE & UNDP 2011). Water shortages during dry months already affect water accessibility for three-quarters of the population in Beirut and force the population to rely on unauthorized groundwater pumping or water storage in tanks (Walnycki & Husseiki 2017). With increasing temperature, changes in bacterial contamination of water storage is an increasing concern, and reliance on groundwater will be impacted by aquifer depletion, salt intrusion and existing contamination (Walnycki & Husseiki 2017). 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 2020).

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, electricity use for cooling due to climate-related increases in temperature is anticipated to increase to 34.8 billion US dollars by 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% of the country's workforce, will be impacted by increased temperatures, reduction in precipitation and sea-level rise (Netherlands Ministry of foreign affairs, 2019). The sector will be impacted by a reduction in the snowpack, 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 to 4 percent of the 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.*, 2016). 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). 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). High temperatures and sea-level rise also increase salinisation, especially in coastal areas (USAID, 2016). Droughts impact the poorest communities the most as agriculture is their main economic activity (Verner *et al.*, 2018). In addition, the increasing intensity of winter storms is also 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 2030 (MoE 2015).

Increasing temperatures and decreasing rainfall will lead to changes in grazing periods and the quality of pastures land, affecting livestock production (MoE *et al.*, 2016; Netherlands Ministry of Foreign Affairs, 2019). Recent harsher winter storm conditions have been causing significant livestock loss (Haddad *et al.*, 2014). In addition, livestock is facing the dual threat of climate-driven change and increases in the numbers of goat and sheep herders due to the Syrian crisis, which adds additional stress to Lebanon's rangelands (MoE *et al.*, 2016).

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, Lebanon has become host to approximately 1.5 million of Syrian refugees 1.5 and 13,715 refugees of other nationalities (UNHCR, n/a) and its trade and tourism industries have been deeply impacted by the neighboring conflict (US EIA 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 the country's population (Al-Arian & Sherlock 2019).

- Climate-driven impacts will cause significant protection challenges, particularly as these impacts affect informal and refugee settlements. Lebanon's population has a recent history of

experiencing conflict and displacement: 1.5 million Lebanese continue to be impacted by years of civil unrest, and an additional 470,000 refugees fleeing the Arab–Israeli war have arrived, as have the Syrian refugees. This recent influx of Syrian refugees increased Lebanon's population by 30 per cent in two years, putting significant additional pressures 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).
- 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 – at the same time as the most severe projections for water availability reduction – a 29 per cent reduction by 2080) (Jaafar *et al.* 2020, Verner *et al.* 2018).

Potential needs for migrants and displaced people

Assessing and addressing water management challenges could potentially have a positive impact on displaced people. Among other challenges in urban areas, decreasing water availability will disproportionately affect refugees relying on external providers (Walnycki & Husseiki 2017). Competition over limited water resources is already increasing tensions, 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 by UNHCR.

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 and 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 National Determined Contribution (NDC) (2021)

Emission target: A conditional GHG emission reduction of 31% compared to the Business-As-Usual scenario in 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 priority, with a focus on multi-risk assessment and early warning system, mapping on droughts, floods and wildfires, forest fire management and mainstreaming priorities.

National Designated Entity: Ministry of Environment

Other National Policies on Climate

- Lebanon Green Investment Facility (LGIF) will be created to increase to increase investment in climate-smart projects and coordinate approach to the implementation of the NDC (Green Mind, n/a) 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' (Government of Lebanon, 2021).
- 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), Central Bank of Lebanon, MoE and UNDP, and the approach has been to encourage companies to create and embrace value from climate change (Green Mind NGO, 2022; Green Mind NGO & 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 and regional countries are taking place in Lebanon (GCF, 2022). National societies cannot directly apply 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 about $20,000 to $50,000 USD and are intended to support community-level initiatives. The GEF Small Grants Programme sits under UNDP 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 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

Climate Centre. (2022a). Factsheet on Climate Finance. https://www.climatecentre.org/wp-content/uploads/Fact-Sheet-on-Climate-Finance.pdf

Climate Centre. (2022b). Entry points for National Societies on Climate Finance partnerships. https://www.climatecentre.org/wp-content/uploads/Entry-Points-for-Climate-Finance-Partnerships.pdf

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