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Macro-Fiscal Implications of Climate Change: The Case of Djibouti

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Macro-Fiscal Implications of Climate Change: The Case of Djibouti

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Abstract

This paper reviews the significant macro-fiscal challenges posed by climate change in Djibouti and the costs of mitigation and adaptation policies. The paper concludes that Djibouti is susceptible to climate change and related costs are potentially large. Investing now in adaptation and mitigation has large benefits in terms of reducing the related costs in the future. Reforms to generate the fiscal space are therefore needed and investment for mitigation and adaptation to climate change should be built into the long-term fiscal projections. Finally, concerted international efforts and stepping up regional cooperation could help moderate climate-related macro-fiscal risks.

JEL Classification Numbers: D90, E25, I32.

Keywords: climate change, Djibouti, inclusive growth, climate warming.

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I. INTRODUCTION

1. Djibouti is a small state in the Horn of Africa, faced with an arid climate. The country is located in an area of tectonic plate separation, and the landscape is largely made up of volcanic formations. Its climate is arid, with limited rainfall and groundwater reserves. Arable land (0.1 percent by area) is minimal, and there is almost no agriculture. The hinterland, for example, an extension of the deserts of Ethiopia and Somalia, is not arable and beyond some cattle has virtually no other agricultural potential. Djibouti is at a continuous risk of water stress and desertification, which can be compounded by climate change. Water is scarce, and changes in the hydrological regime, combined with sea level rise, aggravate the ongoing process of aquifer salinization and water quality degradation. The country cannot sustainably cover about 95 percent of its needs in fresh water from its own sources and has to import water from Ethiopia.

2. Most Djibouti's production capacity is located in coastal and other low-lying areas. Djibouti's economy is mainly driven by service activities in coastal areas (76 percent of GDP and 53 percent of total employment), dominated by port and transport-related services, reflecting the country's strategic location overlooking the strait of Bab el Mandeb. Several deep-water port facilities serve as entry points into East Africa and landlocked neighbor Ethiopia for goods from China and other Asian countries. Also, Djibouti city is the landing point for several underwater internet cables connecting Asia to Africa and Europe. The authorities are currently investing in large-scale infrastructural projects, mainly new ports, the railroad and water pipeline, free-trade zones, all of them in the coastal areas (Figure 1). The authorities see these debt-financed projects as the driving force for growth in the long run.

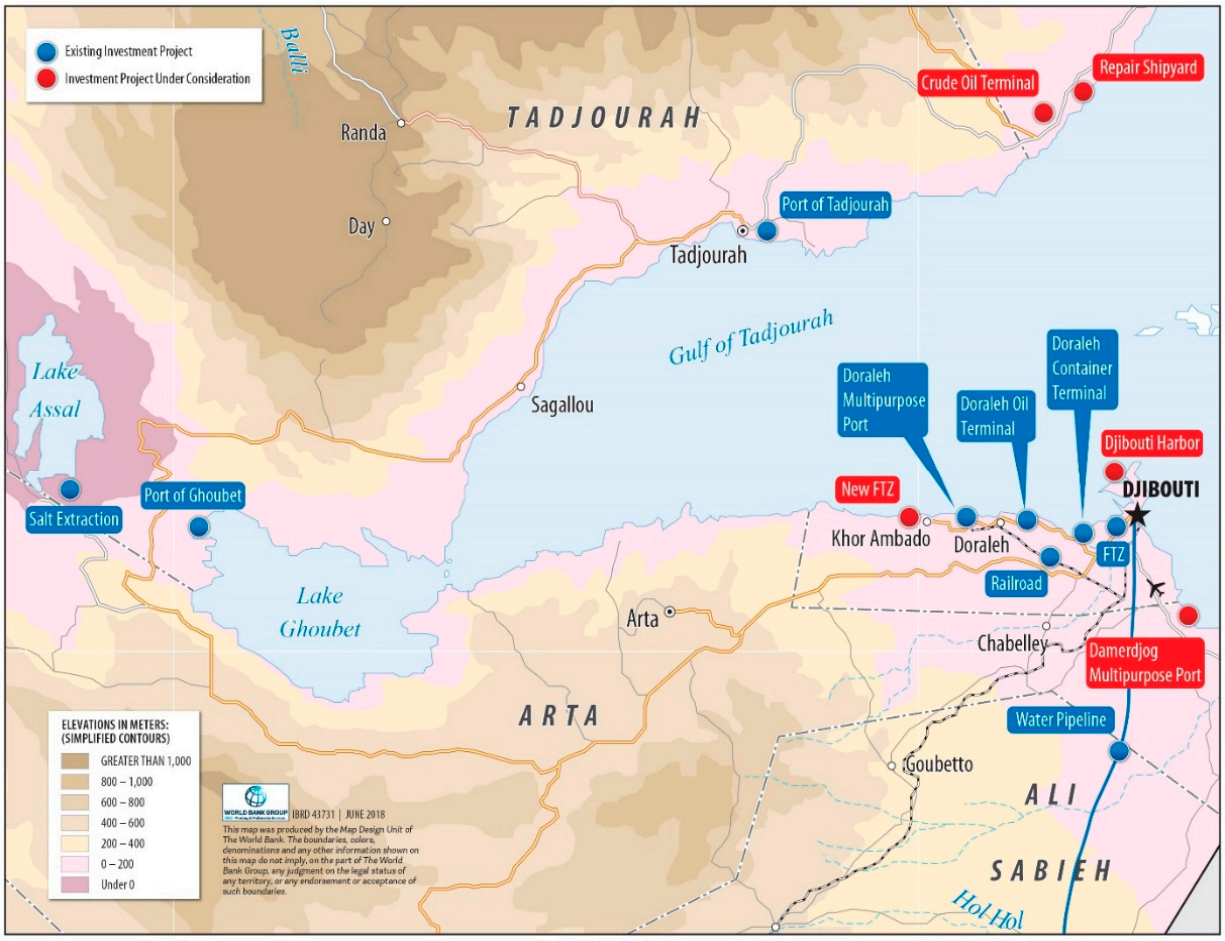
3. Djibouti is ranked seventh on the vulnerability to climate change among small developing states (MapleCroft, 2018).[2] Vulnerability to climate change is enhanced by deficiencies in the water resources management, land use planning, building codes, social-environmental and financial protection schemes, risk management public policies and by environmental degradation and contamination.

4. Climate change have been shown to be linked to the growing severity of natural disasters. Although the extent to which climate change influences an individual weather or climate event is still difficult to determine, a relatively new area of science—called event attribution—is rapidly advancing (NAP, 2016). Its purpose is to estimate how much climate change has affected an individual event's magnitude or probability of occurrence. For example, as sea levels continue to rise due to global warming, the risk of storm surge, i.e., the dangerously high floods caused by a storm pushing water onshore, was found to increase.

[2] Climate change vulnerability index assesses the combined risk of exposure to extreme climate-related weather events and changes in major climate parameters (temperature, precipitation, sea-level), and sensitivity to exposure in life supporting sectors of food, water, health, infrastructure, and ecosystems services.

Those floodwaters are responsible for much of the damage left by hurricanes—particularly in highly populated coastal areas.

Figure 1. Djibouti Investment Projects and Sea Elevation

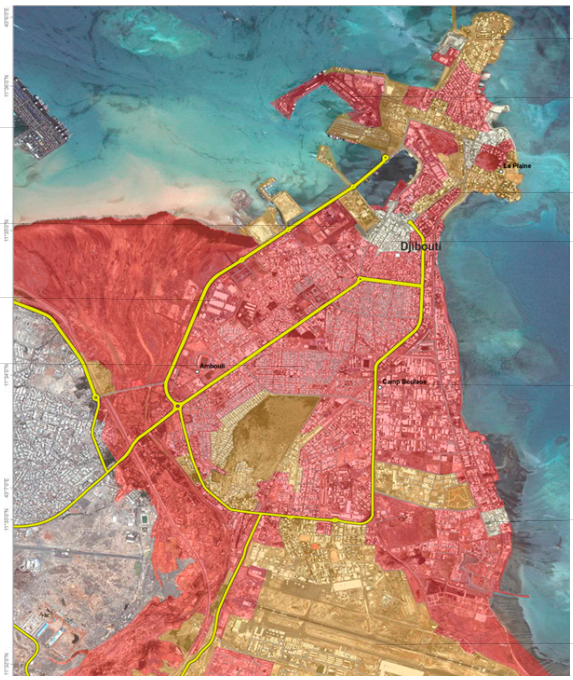


Source: World Bank Map Unit.

5. One of such natural disasters – a tropical cyclone - has affected Djibouti just recently. Tropical Cyclone Sagar made landfall in Djibouti May 19–20, 2018 and left a trail of widespread flooding, destruction of infrastructure, homes and livelihoods. Based on satellite imagery, about 50 percent of Djibouti City was severely affected by flash floods and heavy rainfall (Figure 2).

6. The purpose of this paper is to quantify potential macro-fiscal implications for Djibouti from climate change. Climate change usually refers to the long-lasting shifts in weather patterns. Global warming, the observed century long rise in the average temperature, is of one immediate manifestations of climate change. Given the vulnerabilities noted above, Djibouti may be strongly affected by climate change in the form of global warming.

Figure 2. Djibouti City: Flooded Areas, May 2018



Source: UNITAR (2018). Severely affected areas are shown in red, partially affected areas are shown in yellow.

7. The analysis in the paper is based on the data included in the Djibouti's Intended Nationally Determined Contribution (INDC). The INDC is a set of commitments the government of Djibouti has made to the international community in the context of the 2015 United Nations Climate Change Conference. The INDC identifies the post-2020 policy measures in the area of climate change, including mitigation and adaptation measures. For example, Djibouti voluntarily committed to reducing green gas emission by 40 percent by 2030 through a combination of mitigation measures and the development of renewable sources of energy (INDC, 2015).

8. The paper concludes that global warming resulting from climate change may have severe macro-fiscal implications for Djibouti. In particular, (i) Djibouti is susceptible to climate change and related costs are potentially large; the overall cost of mitigation and adaptation to climate change by far exceeds the resources currently available to the authorities from internal and external sources; (ii) the authorities need to factor in expenditure related to the mitigation and adaptation to climate change in their medium- and long-tern fiscal projections; (iii) investing now on adaptation has large potential benefits in terms of reducing costs down the road, while further inaction on the climate change may lead to the structural and human resource losses; and (iv) policy options to address climate change include promoting strong growth, building fiscal space to finance climate-related investment.

9. The rest of the paper is structured as follows. Part II reviews climate change-related risks and vulnerabilities for Djibouti. Part III focuses on the macroeconomics of climate management, including mitigation and adaptation. Part IV assesses fiscal costs of climate change for Djibouti and offers policy recommendations drawing on the result of the analysis for Djibouti and best international practices.

II. Climate-Related Economic Risks

A. Projected Climate Warming Trends

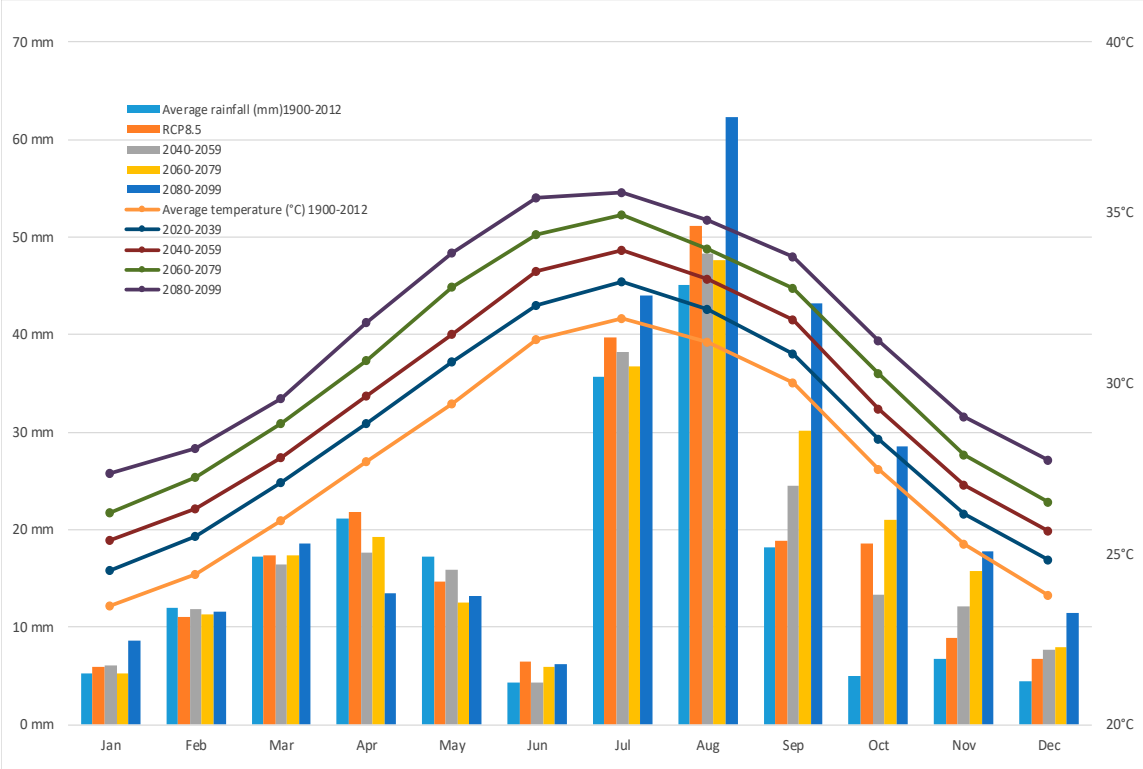
10. In Djibouti, global warming may lead to rising average temperatures, severe droughts, and rising sea levels, and risks of a further worsening in weather conditions are significant. The following insights into a changing climate, which are derived from several climate models used by the Intergovernmental Panel on Climate Change, help illustrate key trends for Djibouti (World Bank, 2018).

11. Air temperature in Djibouti may increase by 1°C every two decades. With regards to average temperatures, Djibouti is already one of the hottest locations on Earth. The average temperature in the country is currently 28°C and in the past decade have already been higher than normal. Heat levels are projected to increase further, potentially worsening living conditions in Djibouti. In the past three decades, the absolute maximum monthly temperatures have already increased by 1.3°C across the country, in particular in June and July. Based on different climate models, by 2100 average temperature would rise to 32°C (Figure 3).

12. Monthly rainfall would increase from 16 to 23 mm, with higher seasonal variability. Reflecting mainly broader El Niño and La Niña effects, climatic events that disrupt air movements in the tropics, wet months will become wetter and dry months will become drier. They typically recur every 2–7 years and persist for 9–12 months. As a result, the traditionally dry areas in Djibouti are becoming drier and traditionally wet areas are becoming wetter. This trend is prevailing across all areas of Djibouti (Wang et al., 2014).

13. The probability of severe droughts will increase by 20 percent by 2050 reflecting broader regional trends. Over the past two decades, almost every year devastating droughts occur in HoA because of a persistent lack of rainfall. Such periodic droughts represent a climate-related natural disaster, which may become more pronounced with the evolving climate change (Sippel, Walton, and Otto, 2015).

Figure 3. Djibouti Temperature and Rainfall Forecast
(Degrees Celsius, RHS; mm per month, LHS)



Source: World Bank Climate Change Knowledge Portal. Changes relative to 2010.

14. Finally, with global warming the sea level may rise by to about 1 meter or even more by 2100[3]. About 88 percent of Djibouti's populations live in coastal areas and are concentrated in main residential areas of Djibouti-ville, Arta, and Tajourah. Substantial other parts of Djibouti's territory are just slightly above the sea level. All scenarios suggest that sea level increase would inundate coastal arears and would affect up to a half of the population, economic activities and a third of the existing capital stock. The economic impact of the rising sea level will ultimately depend on by how much the water level increases. The INDC scenarios for Djibouti suggest that an increase of the sea level by one meter to 2.8 meters would almost double the number of people affected, as most of the population lives in coastal areas (Figure 4). However, the impact on economic activities and capital stock, although likely severe, would not change much with an additional one-meter water level increase. About half of economist activities and almost a third of capital stock would be affected. Moreover, some coastal parts of the country, where important industries are located, are already below the sea level. For example, Djiboutian lake Assal, the site of industrial salt production, is located 155 meters below sea level. This is the lowest and the hottest point in

[3] Depending on the underlying assumptions and the geographical location, the estimates of the impact of global warming on sea level vary. For the period 2081–2100, compared to 1986–2005, global mean sea level rise is rise by 0.26-0.98 meters. Only the collapse of marine-based sectors of the Antarctic ice sheet could cause global mean sea level to rise substantially above these likely range (Church et al, 2013).

Africa, where productive activities or even life are already broadly impossible during summer months. Local population usually leaves low-sitting areas in summer, where an average temperature can exceed 50°C and at times can reach 60°C, for higher elevations.

Figure 4. Impact of Rising Sea Level

Water level increase		Affected population		Affected economic activities		Affected capital stock	
Meters		Percent		Percent		Percent	
1.9	2.8	26.0	45.5	47.1	52.0	25.4	30.0

Source: CPDN, 2015.

15. Potential macroeconomic implications of climate change for Djibouti can be severe. Fund research suggests that an increase in the average temperature by 1°C can reduce per capita GDP by nearly 1.5 percent in sub-Saharan African countries, such as Djibouti (IMF, 2017). Earlier analysis (Cashin, Mohaddes, and Raissi, 2017; Hallegatte et al., 2016) also shows that extreme weather events have an impact on economic activity. In particular, heat may have devastating effects on people, in particular in rural areas, by worsening physiological conditions of the body. During extreme heat levels, impacts on the human health range from fatigue to sunstrokes, and heat strokes. Temperature levels have been shown to have negative impact on agricultural output, industrial output, labor productivity, energy demand, health, conflict, and economic growth (Dell et al., 2014). The Djiboutian authorities already have to deal with an exodus of people to urban areas because of more difficult living conditions in rural areas. Affected households rely increasingly on international food assistance and government transfers. In addition, refugees from neighboring countries arrive in Djibouti fleeing not only political instability but also environmental crises there, such as the 2017 droughts and famine in Yemen and Somalia. Chaotic settlements of refugees exacerbate the impact of the climate adverse effects on Djibouti.

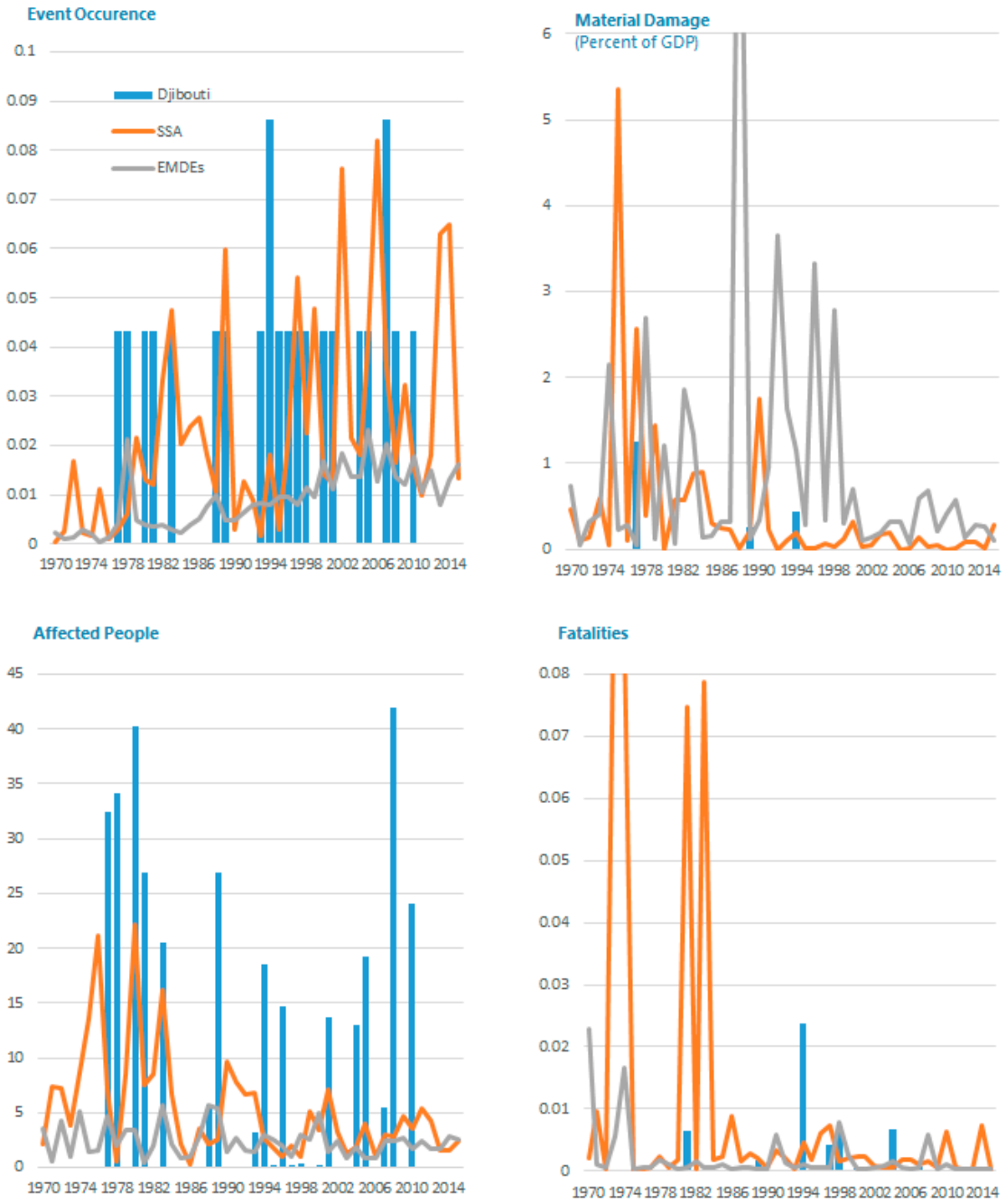
16. On the structural side, the projected climate-related temperature increase could have vast and devastating impacts. Heat stress could alter livestock's feed intake, growth, and production. With increasing temperatures, water consumption will rise while water availability will decrease causing additional water stress. High rainfall variability and predicted more intense wet extremes pose a significant threat to the southern regions, whose sandy soils are already vulnerable to episodic floods. Flood-induced infrastructure damage can render critical water pumps and other delivery infrastructure unusable, leading to further water shortages. Climate warming may lead to the loss of about a half of the coral shelf by 2050, the source of major tourist attraction and potential additional source of growth. Finally, rising sea level might increase coastal erosion, affect marine ecosystems along the coasts, and can also lead to saline intrusion affecting the rivers and the groundwater (Patricola and Cook, 2010).

B. Climate-Related Natural Disasters

17. As a result of climate change, Djibouti has become more prone to climate-related natural disasters. Such disasters have been frequent (Figure 5). Since 1970, climate-related disasters occurred in Djibouti on average as often as in the sub-Sharan African (SSA) countries, and 2.3 times more often than other emerging markets and developing economics (EMDEs). The most recent natural disasters (droughts) occurred in 2007–8, 2010, and 2017–18. The average material damage caused by natural disasters in Djibouti was only about 0.1 percent of the damage caused by natural disasters in SSA and 0.05 percent in EMDEs. However, the average number of people per square kilometer affected by natural disasters in Djibouti was 1.4 times higher than in SSA and 3 times higher than in an average EMDEs. At the same time, mean fatalities in Djibouti were only 0.1 of SSA and 0.5 of EMDEs, suggesting on average stronger early warning and disaster preparedness. Also, the reported material damages in Djibouti were virtually zero, which most likely reflect deficiencies in data collection.

18. The latest natural disaster happened in Djibouti in May 2018. Cyclonic storm Sagar was the strongest tropical cyclone to ever make landfall in Djibouti in recorded history. It caused flash floods across the country, impacting up to 30,000 people. Sagar dropped a year's worth of rainfall, totaling 110 mm, which caused rivers to swell. Flooding damaged about 2,000 homes in Djibouti city alone, destroyed infrastructure and businesses, and killed a number of people.

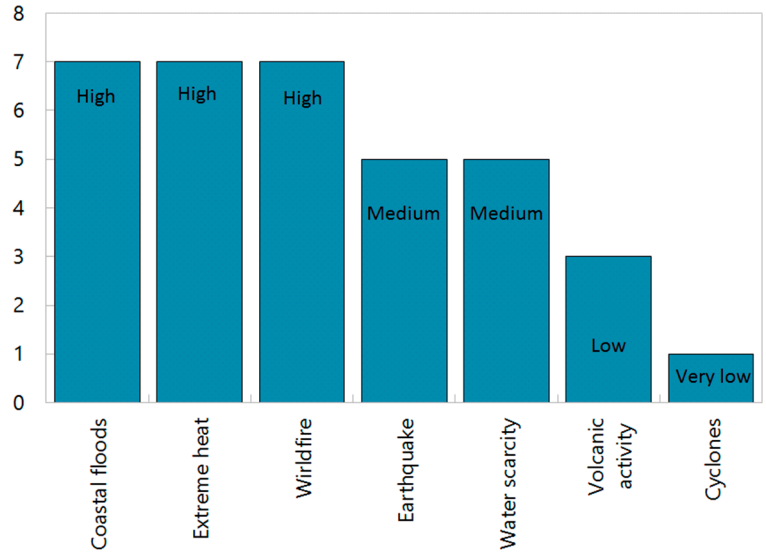
Figure 5. Climate-Related Natural Disasters
(Per year, country, and square kilometer)



Source: Staff calculations based on CRED-EM DAT.

19. For the immediate future, Djibouti is considered a risky location because of a high probability of natural disasters. While some of them are not directly related to climate change (earthquakes and volcanic activities), intensity of most others (coastal floods, water scarcity, and cyclones) reflect at least in part the impact of global warming. The Global Facility for Disaster Reduction and Recovery (GFDRR, 2018) rates Djibouti's risk as high in coastal floods, i.e., potentially-damaging waves are expected to flood the coast at least once in the next 10 years, extreme heat and, as a result, wildfires (Figure 6). The water scarcity hazard is also classified as medium, i.e., there is up to a 20 percent chance that droughts will occur in the coming 10 years.[4] Other climate-related hazards, such as the cyclone (hurricane or typhoon) hazard, is classified as very low, i.e., there is less than a 1 percent chance of potentially-damaging cyclone-strength winds in Djibouti in the next 10 years. The 2018 tropical Cyclone Sagar was one of these relatively low-probability hazards.

Figure 6. Climate-Related Hazards
(Incidence and magnitude, expert score)



Source: GFDRR, 2018.

III. Cost of Climate Change

A. Model Estimates

20. The estimates of adaptation costs for Djibouti have been derived from broader studies on the costs of climate change for Africa. Such estimations are based on global climate models (Box 1). The economic costs of climate change in Africa are likely to be significantly higher in relative terms than in many other world regions and that they could be significant even in the short-term, reflecting mainly the relatively low level of development of the tools and infrastructure that could be used to address climate change challenges, the already high average temperature, extended coastal line, and the overall vulnerability to natural disasters, such as floods and droughts. The models indicate that the central net

[4] The US$ 320 million China loan financed project of a water pipeline aiming at bringing clean drinkable water from Ethiopia is not yet operational.

economic costs of climate change could be equivalent to 1.5–3% of GDP each year by 2030 in Africa. Also, these models suggest that investing today in climate mitigation and adaptation can help reduce costs over time.

Box 1. Integrated Climate Assessment Models

Integrated climate assessment models, including global and regional, use empirical, statistical and mathematical techniques for rigorous descriptions of physical and chemical processes governing climate, including the role of the atmosphere, land, oceans, and biology. Several global integrated assessment models, the Climate Framework for Uncertainty, Negotiation and Distribution (FUND), Policy Analysis of the Greenhouse Effect (PAGE), and Regional Integrated Climate-Economy model (RICE), provide results for Africa.

The FUND model estimates that under a business as usual scenario, net economic costs could be equivalent to 2.7% of GDP each year in Africa by 2025. The model reports large costs from water resources, health impacts, and energy costs for cooling, but some potential benefits from agriculture. Positives and negatives are combined in the results. They show relatively similar levels of economic costs in future years through to 2100. A separate analysis with the FUND national model has provided net estimates for each African country.

The PAGE 2002 model estimates that economic costs could be equivalent to around 2% of GDP each year in Africa by 2040 (central value, market and non-market sectors, A2 scenario), with a 5–95% confidence interval of 0.4–4%. The model shows that economic costs rise rapidly in future years, so that by 2100, they could be equivalent to 10% of GDP each year, i.e. too high for a sustainable economy.

The RICE model explicitly includes the role of adaptation in climate change policy. RICE calibrates the costs and benefits of three forms of adaptation, namely autonomous adaptation, anticipatory adaptation, and sea-level rise adaptation.

- *Autonomous adaptation* describes adaptation where the benefits of adaptation are felt immediately, i.e. the use of air-conditioning or the changing of crop planting times. This form of adaptation is often considered private due to the relative low costs of these adaptation options, the absence of upfront investments and the private nature of the benefits.

- *Anticipatory adaptation* refers to adaptation where investments are made to reduce climate change damages in the future, i.e. investments in irrigation infrastructure. This form of adaptation is considered public due to large scale investments needed and the public nature of the benefits.

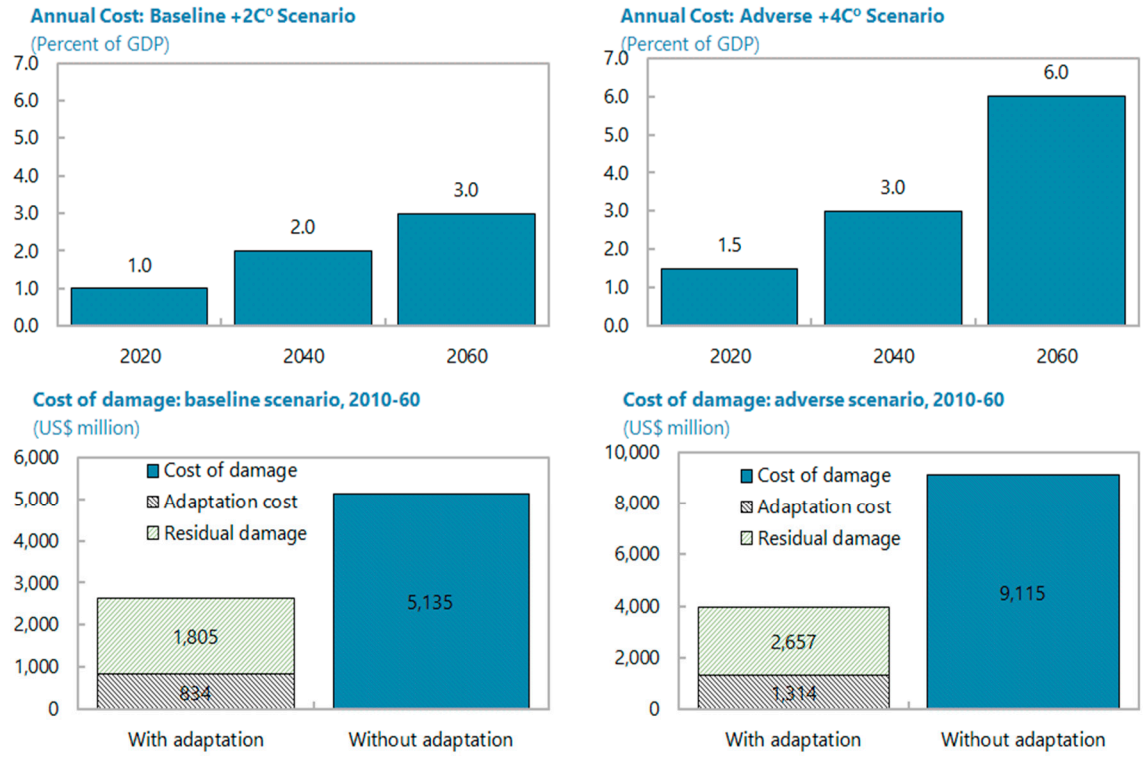
- *Sea level rise adaptation* is a special form of anticipatory adaptation.

Sources: Watkiss et al. (2010); AAGr2 (2015).

21. The cost of climate change for Djibouti can be relatively high. Estimates based on the PAGE model suggest than in the case of the baseline scenario of a temperature increase by 2°C, the total costs for Djibouti could be linearly increasing from 1 to 3 percent of GDP in 2020–60. In an adverse scenario of a +4°C temperature change, the potential cost for Djibouti of climate change may reach 6 percent of its GDP.

22. The overall cost of potential damage will also depend on whether the government's adaptation measures and their scope. In the baseline scenario of the RICE-type model adapted to Djibouti (CPDN, 2015; AAGr2, 2015), with 2C° temperature increase, cumulatively in 2010–60, if the government invests in the next 50 years about US$ 1.8 billion in adaptation (90 percent of the 2017 GDP), it will still have to offset about US$ 800 million (40 percent of 2017 GDP) of residual damage (Figure 7). The model indicates that without adaptation, the overall cumulative damage may exceed US$ 5 billion (250 percent of 2017 GDP). In the adverse scenario of the 4C° temperature increase, if the government invests US$ 1.3 billion in adaptation (65 percent of 2017 GDP), it will still face about US$ 2.7 billion (135 percent of 2017 GDP) of residual damage. Without adaptation, the overall cumulative damage under the adverse scenario may exceed US$ 9 billion (450 percent of 2017 GDP). The scenarios also suggest that even with adaptation efforts residual damages may be large, up to twice as large as adaptation costs.

Figure 7. Cost and Structure of Potential Damage



Source: CPDN, 2015; AAGr2, 2015.

23. These estimates of climate-related costs for Djibouti should be treated as indicative. They provide some insight into signals, size and patterns of effects, and on the potential economic costs. They are useful for the calculation of adaptation financing requirements. However, the models only reflect a partial coverage of the effects of climate change, and do not capture extreme events (including flooding and droughts), cross-sectoral links and socially contingent effects, or the cumulative effects on adaptive capacity, all of which may be important for Djibouti.

B. Past Experience

24. The model-based assessment of climate change costs is broadly consistent with the actual damage inflicted by the recent climate-related natural disasters in Djibouti. The annual cost calculated post-factum, consisting of damages and losses, has amounted to about 1 percent of GDP annually (Box 2).

25. Past experience also suggests that some sectors of the Djiboutian economy may be relatively resilient to climate changes. The overall reliance on port services, virtually non-existent agriculture, and strong dependence on the state of the Ethiopian economy, made Djibouti only indirectly dependable on the state of nature. During the 2008–11 drought, for example, real GDP per capita growth dropped and inflation accelerated (Figure 8). But revenue and grants remained broadly stable, as did current expenditure, while capital expenditure increase financed mainly by external loans. The fiscal deficit expanded sharply in 2009 but the current account also increased mainly because of the surge in international food and fuel prices. Finally, external public debt and debt service remained relatively stable as most aid was financed by grants.

Box 2. Macro-Fiscal Impact of the Drought in the Horn of Africa on Djibouti

Djibouti is being hit hard by the 2008–11 drought. Of a total population of 818,000, about 120,000 citizens, mostly in the rural areas, and about 20,000 refugees from Somalia and Ethiopia suffered from the food insecurity caused by the drought.

Because of the drought, the 2008–11 macroeconomic performance was mixed. The impact of the drought on growth was limited, as port business and trade were not affected. To the contrary, activity is estimated to have increased from 3½ percent in 2010 to almost 4½ percent in 2011, mainly due to the recovery of transshipment and of trade to Ethiopia. Inflation is estimated to have risen from 4 percent in 2010 to 5 percent in 2011.

The drought had a significant effect on the fiscal position. Collection of direct and indirect taxes suffered from the indirect impact of the drought on households. Expenditure increased because of transfers to family members, often residing in neighboring countries, and the contribution of private operators to solidarity efforts. On the expenditure side, the government broadly maintained spending discipline but also had to bear unprogrammed drought-related spending of about 0.2 percent of GDP.

The international community has responded to the authorities' appeal for additional external assistance over the next three years. The government has stepped up spending on wells, water extraction and transport, and food distribution, but alone it is not able to address the needs created by the drought and has therefore launched during the summer an appeal for help to the international community. So far, the government has received pledges for US$47 million from bilateral and multilateral donors. The government intends to use the funds for immediate response to urgent needs, but also for medium-term projects for food and water access, agricultural improvement, and disaster prevention.

The overall impact of the drought was much wider:

- *Water:* The drought has exacerbated the endemic lack of water, which has damaged or made unusable most of the existing wells. The drought has also reduced the levels of groundwater.

- *Agriculture*: Domestic agricultural production has fallen by about 40 percent, boosting food imports and increasing the population's dependency on international organizations and NGOs. The drought has led to exceptionally high mortality rate of cattle. More than half of the cattle stock is affected through weight loss or disease. The loss of cattle and fall in its market value are leading to severe income loss for farmers.

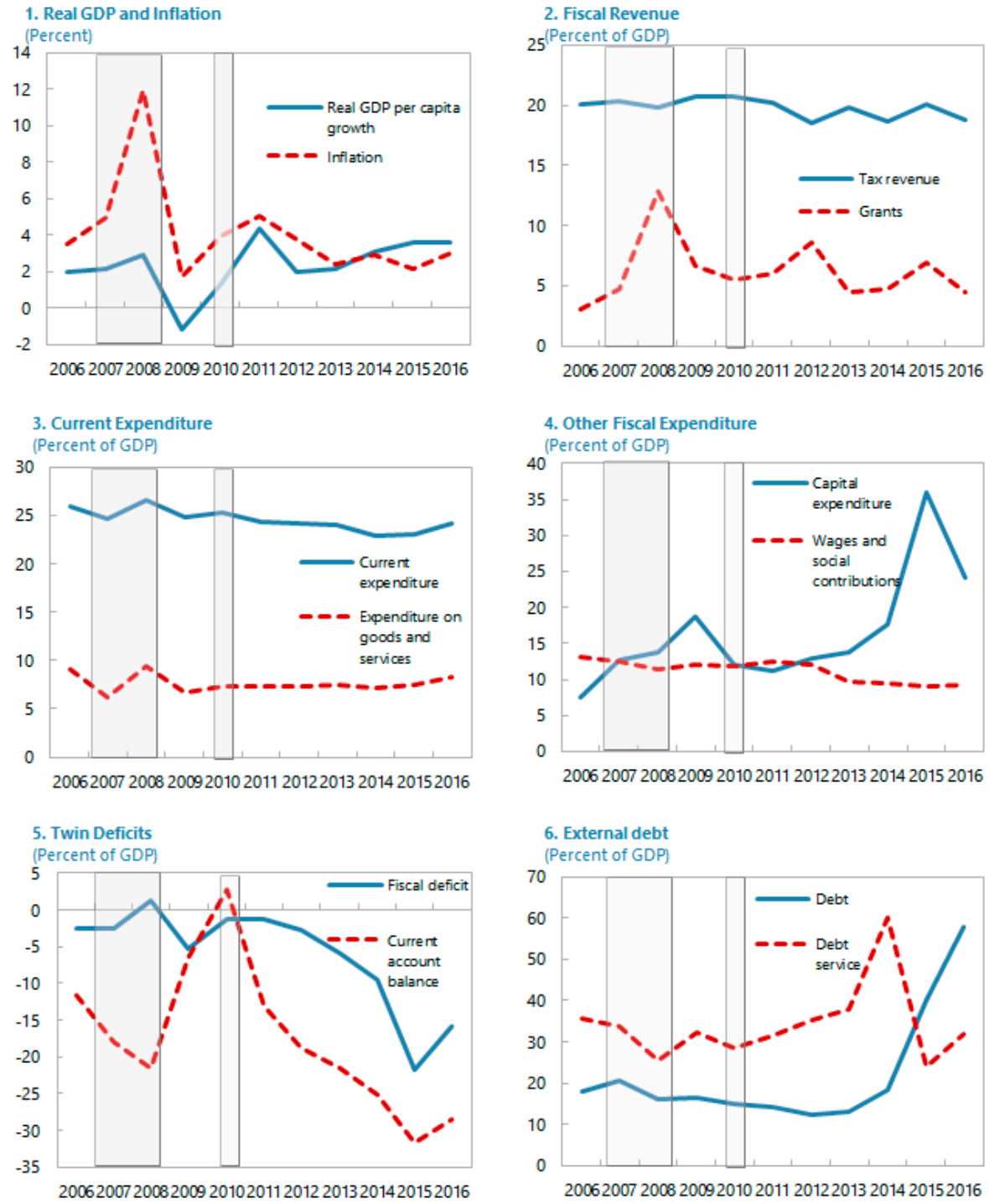
- *Energy*: The demand for energy has increased because the fuel is needed to pump water from deeper wells, transport food and water, and meet the higher demand for air conditioning and refrigeration.

- *Refugees*: The drought has accelerated the inflow of refugees from Somalia and Ethiopia to Djibouti, raising their number from about 15,000 before the summer to over 20,000 in September, and increasing the associated spending on food and services, partly borne by the budget.

- *Financial contributions of the population*: Households and businesses have contributed to public initiatives to help the population affected by the drought. Moreover, many families have stepped up transfers to family members in the countryside and abroad (mainly Somalia and Ethiopia).

Sources: IMF Country Report, No.12/197, World Bank, European Union, and UNDP needs assessments.

Figure 8. Macroeconomic Implications of Climate-Related Disasters



Source: WEO, staff estimates.

27. The authorities of Djibouti maintained macroeconomic stability in 2008–11. Supported by the Extended Fund Facility, the World Bank and other donors, the economy saw a massive inflow of foreign direct investment, expanded port activity, transit trade to Ethiopia soared, the banking system boomed, and the country started playing an increasingly important geopolitical role. The authorities have also made progress toward economic reform, job creation, and poverty reduction. Competitiveness of the economy strengthened through cost-reducing structural reform and an improved business climate, but much remains to be done in this area to support private sector development. However, without massive foreign assistance, the impact of past natural disasters on the Djiboutian economy could have been extremely damaging, pointing to the urgent need to build resilience and financial buffers to address climate change-related challenges.

IV. CLIMATE CHANGE MANAGEMENT

A. Mitigation

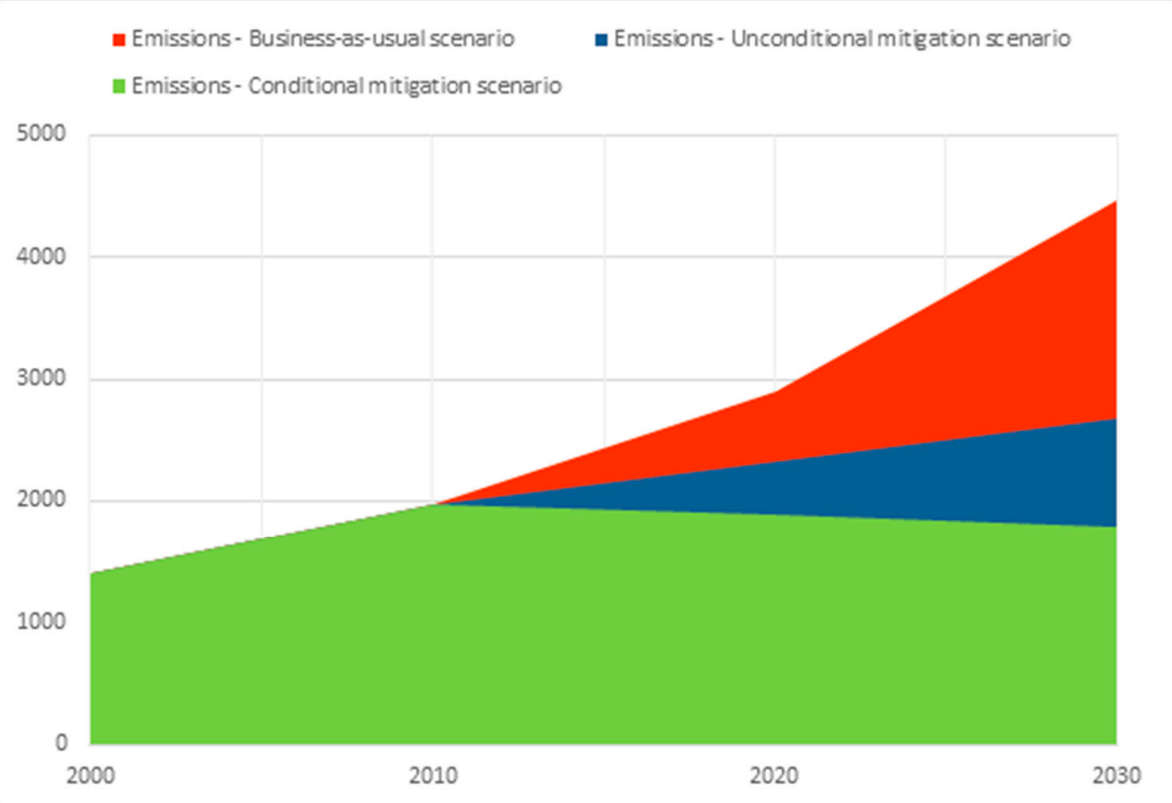
28. Mitigation is a commitment of a country to reduce greenhouse gas emissions. Djibouti's government can respond to climate change by reducing greenhouse gas (GHG) emissions and enhancing sinks and reservoirs. Mitigation is essential to meet the UNFCCC's objective of stabilizing GHG concentrations in the atmosphere. It requires all parties to formulate and implement programs containing measures to mitigate climate change.

29. Djibouti has developed a climate action plan and submitted it to the UN Framework Convention on Climate Change (UNFCCC). The Intended Nationally Determined Contribution (INDC) of Djibouti was prepared in advance of the universal climate change agreement reached at the UN climate conference in Paris, in December 2015. The Paris agreement is scheduled to come into effect in 2020, empowering all countries to act to prevent average global temperatures rising above 2 degrees Celsius and to reap the opportunities from clean and sustainable development (UNFCCC, 2017). Further to the negotiations, the Conference of the Parties (COP) invited all Parties to communicate their climate mitigation and adaptation plans through their INDC.

30. Mitigation measures are divided into unconditional and conditional. Djibouti committed to implement a set of unconditional measures, i.e. those financed by its own resources. Conditional measures, i.e., those financed by donors, can be also implemented subject to resource availability. Regarding developing countries, the UNFCCC explicitly states that the extent to which developing countries will implement their commitments will depend on financial resources and transfer of technology (UNFCCC, 2017). In the case of Djibouti, the unconditional measures have been already financed by the government's budget. Financing for the conditional measures, although these measures have already been identified, still needs to be found.

31. Djibouti's contribution to mitigation consists of reducing emission and developing renewable energies. The goal is to keep in the long term its greenhouse gas emission roughly at the level of 2010 (Figure 9). To achieve this goal, Djibouti has committed to reduce its emissions by 40 percent relative to the baseline scenario, unconditionally and financed from its own resources. To fulfil that level of ambition, Djibouti will need to invest more than US$3.8 billion (almost 200 percent of the 2018 GDP) to reduce its emissions by a further 20 percent by 2030. An additional US$1.6 billion (77 percent of GDP) financed by international donors may reduce emissions by further 10 percent by 2010 relative to the baseline scenario (INDC, 2015).

Figure 9. Projected Greenhouse Gas Emissions



Source: INDC (2015).

32. Climate models do not provide direct estimates of possible mitigation costs for Djibouti. But depending on assumptions, mitigating costs could amount to 1–4 percent of a median country's consumption and may be of a comparable magnitude in Djibouti (Figure 10). The cost-effective scenario assumes immediate mitigation in all countries and a single global carbon price. If the introduction of mitigation efforts is delayed to 2030, the cost of mitigation can reach up to 44 percent of a country's consumption (Edenhofer et al., 2014 and IPPC, 2015).

33. Mitigation measures in Djibouti include several projects. The unconditional and already financed projects include the recently opened railway and an electricity line with Ethiopia, the planned geothermal and solar power plants, energy efficiency projects in public buildings. Conditional projects awaiting financing include an additional electricity pipeline to Ethiopia, improving of energy efficiency and reduction of energy consumption of existing buildings, distribution of low voltage bulbs, reforestation and reduction of wood fuel consumption. Additional conditional measures include accelerated replacement of air conditioners and refrigerators, construction of an additional power plant and wind turbines, import restrictions on old cars, improving energy efficiency of mosques, and the installation of agroforestry systems.

Figure 10. Mitigation Costs

	Consumption losses in cost-effective scenarios[1]						Increase in total discounted mitigation costs in scenarios with limited availability of technologies				Increase in medium- and long-term mitigation costs due to delayed additional mitigation until 2030			
	[% reduction in consumption relative to baseline]			[percentage point reduction in annualized consumption growth rate]			[% increase in total discounted mitigation costs (2015–2100) relative to default technology assumptions]				[% increase in mitigation costs relative to immediate mitigation]			
Concentration in 2100 [ppm CO_2eq]	2030	2050	2100	2010 –2030	2010 –2050	2010 –2100	No CCS	Nuclear phase out	Limited Solar/ Wind	Limited Bioenergy	≤55 $GtCO_2$eq		>55 $GtCO_2$eq	
											2030–2050	2050–2100	2030–2050	2050–2100
450 (430–480)	1.7 (1.0–3.7) [N: 14]	3.4 (2.1–6.2)	4.8 (2.9–11.4)	0.09 (0.06–0.2)	0.09 (0.06–0.17)	0.06 (0.04–0.14)	138 (29–297) [N: 4]	7 (4–18) [N: 8]	6 (2–29) [N: 8]	64 (44–78) [N: 8]	28 (14–50) [N: 34]	15 (5–59)	44 (2–78) [N: 29]	37 (16–82)
500 (480–530)	1.7 (0.6–2.1) [N: 32]	2.7 (1.5–4.2)	4.7 (2.4–10.6)	0.09 (0.03–0.12)	0.07 (0.04–0.12)	0.06 (0.03–0.13)	N/A	N/A	N/A	N/A				
550 (530–580)	0.6 (0.2–1.3) [N: 46]	1.7 (1.2–3.3)	3.8 (1.2–7.3)	0.03 (0.01–0.08)	0.05 (0.03–0.08)	0.04 (0.01–0.09)	39 (18–78) [N: 11]	13 (2–23) [N: 10]	8 (5–15) [N: 10]	18 (4–66) [N: 12]	3 (–5–16) [N: 14]	4 (–4–11)	15 (3–32) [N: 10]	16 (5–24)
580–650	0.3 (0–0.9) [N: 16]	1.3 (0.5–2.0)	2.3 (1.2–4.4)	0.02 (0–0.04)	0.03 (0.01–0.05)	0.03 (0.01–0.05)	N/A	N/A	N/A	N/A				

Sources: Edenhofer et al. (2014) and IPPC (2015).

34. Given the size of the country, Djibouti's mitigation efforts would have only marginal contribution to the overall climate change. Djibouti's emission represents only 0.005 percent of global emissions. The overall cost of mitigation alone is twice Djibouti's current GDP and clearly cannot be financed only from domestic resources. Given the relative magnitude of the country, the implementation of Djibouti's commitment to reduce its emissions should be designed in such a way so that not to significantly affect its economic and social development.

B. Adaptation

35. Adaptation is an adjustment of a country to the impact of climate change. Adaptation is needed for ecological, social, or economic systems and refers to changes in processes, practices, and structures to moderate potential damages from climate change (UNFCCC, 2017).

36. For Djibouti, adaptation to climate change is an important priority given the vulnerabilities discussed above. Its own water resources are scarce, the arable land is minuscular and is shrinking because of deforestation, and half the coral cover is likely to disappear. The need for adaptation also reflects the country's social priorities: reduction of vulnerability to drought, protection against rising sea levels, improvement of access to water, protection of biodiversity, reinforcement of the resilience of rural populations.

37. To adapt to climate change, Djibouti has already undertaken several measures. The adaptation projects currently being implemented amount to about US$100 million (5 percent of GDP) or only about 12 percent of the total investment needed for adaptation under the 2°C scenario. Available funding covers several small projects, such as rehabilitation of rural coastal communities, a desalination plant fueled by renewable energies, building of water tanks, experimental dams, water pumping, sanitation, and a solar electricity plant. Additional projects under consideration include a second desalination plant, repairs of water sources, and construction of new dykes and dams. These projects are being financed by Djibouti's own resources and by development partners. Key donors include the World Bank, the European Union, and UN institutions (UNDP, UNEP, UNICEF), ADB, IFAD, etc.

V. Fiscal Costs of Climate Change

A. Fiscal Implications

38. Currently, Djibouti's fiscal space to finance additional climate-related expenses is extremely limited. The concept of fiscal space - the room for discretionary, yet sustainable, fiscal policy - has been central to the debates on policy trade-offs facing Djibouti. With the overall public debt level increasing from 60 to over 90 percent of GDP just in the past few years, reflecting the debt-financed investment boom, the sources for additional climate-related financing are extremely limited.

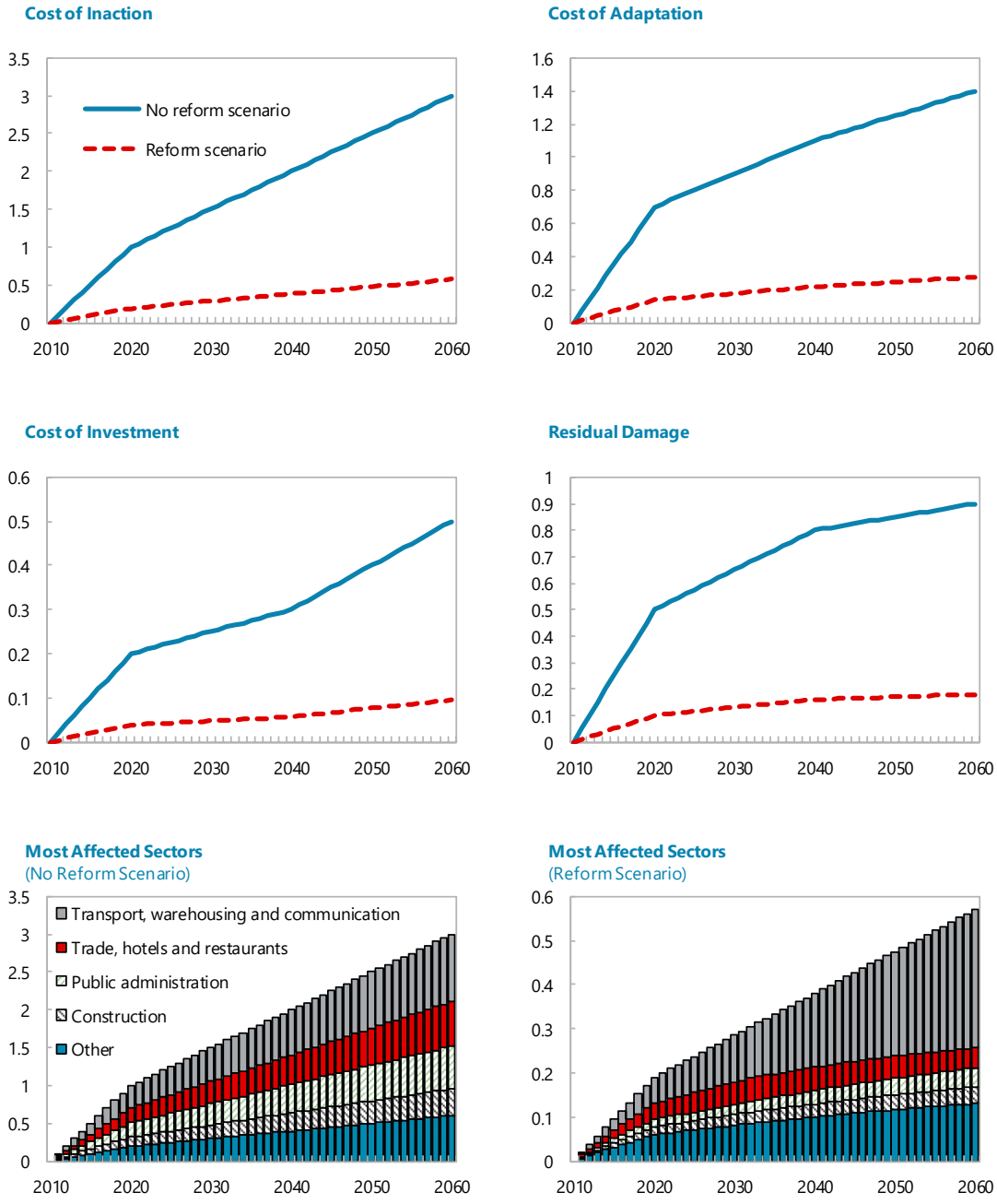
39. The macroeconomic impact of adaptation to climate change depends on the growth scenario, which would materialize in the future. The authorities have been realizing an ambitious debt-financed investment program aimed to transforming Djibouti into a middle-income economy within the next 20 years. Recent research suggests that this goal is ambitious, yet achievable (Kireyev, 2017). Achieving it would require a sustained annual GDP growth rate of about 7 percent—higher than in recent years. Experience of comparator countries suggests that doubling and even tripling per capita GDP requires persistently sound

macroeconomic policies accompanied by strong business environment reforms to unlock new private sector activity.

40. By way of illustration of the fiscal impact of adaptation, two scenarios can be considered. The scenarios are based on the INDC potential damage assessment and IMF baseline macroeconomic projections for Djibouti. The no-reform scenario assumes latent growth of about 3 percent historically observed in Djibouti in the pre-investment boom period. The reform scenario assumes that the authorities implement all reforms included in their *Visions Djibouti 2035* development plan, including major tax reforms to reduce exemptions, at least two-fold improvement in the business climate from the current Doing business rating of 154 to the 70–80 range, and prudent debt management policies to avoid debt distress. In this scenario, Djibouti's growth could accelerate to 7 percent in the medium term and remain in the 5–6 percent range in the long term.

41. In the no-reform scenario, fiscal implication of climate change can be substantial and frontloaded. Based on the 2017 IMF Article IV baseline projections for Djibouti (IMF, 2017) and climate change costs estimates (in Figure 7), if the authorities do not take any measures to adapt to climate change, the overall cost of inaction would be increasing from about 1 percent of GDP currently to 3 percent of GDP by 2060 (Figure 11). This amounts to subtracting about US$ 20 million from Djibouti's current GDP, a sum broadly comparable to the current government expenditure on housing subsidies for teachers. The budget will have to finance a substantial part, but not all, of this cost. Some costs would need to be absorbed by the private sector. Direct cost for the budget in case of adaptation to climate change would be about 0.7 percent of GDP in 2020 and not more than 1.4 percent of GDP in 2060. These direct fiscals cost would consist of two components – additional public investment of about 0.2 percent of GDP in the short run and 0.5 percent of GDP in the long run, and residual damage, i.e., the cost, which cannot be avoided even with additional investment. This residual damage would amount to 0.5 percent and 0.9 percent of GDP, respectively. In this scenario, transport and trade will be the most affected sectors, as rising sea level may incapacitate older port and free trade zone facilities built without due regard to the potential flood damage.

Figure 11. Fiscal Cost of Inaction and Adaptation
(Percent of GDP)



Source: INDC (2015); IMF staff projections.

42. In the reform scenario, the overall fiscal implications of climate change would still be visible but substantially lower. If the authorities do not take any measures to adapt to climate change, they may lose about 0.5 percent of GDP in the long run, which is still comparable to current expenditure on maintenance of the public capital stock. The cost in case of adaptation would amount to 0.3 percent of GDP, of which 0.1 will be needed for investment and 0.2 will constitute residual damage. In the case of reforms, transport, warehousing and communication still will be the most affected sectors, but on a much lower scale compared to the no-reform scenario. Higher GDP growth does not nullify the need for actions to adapt to climate change but makes the financing needs more manageable.

43. Several factors explain different fiscal implications under the two scenarios. First, higher investment needs in the no-reform scenario relative to the reform scenario suggests that structural reforms make climate mitigation and adaptation more affordable. For example, if Djibouti succeeds in reforming the business climate, the single most important factor to accelerate its growth (see Kireyev, 2017), its growth will accelerate but the cost of adaptation and mitigation of climate change would remain the same, therefore reducing both in terms of GDP. Second, the difference in the underlying GDP growth rates between the no-reform and reform scenario would help mitigate part of the costs, as the economy would be able to generate higher tax resources to finance the unchanged level of adaptation costs. Finally, under the reforms scenario, the structure of the budget would be set to take into account additional climate change-related expenditure, including on investment. The cost of mitigation and adaptation would be embedded in the budget. But, as the growth rate would be substantially higher than in the no-reform scenario, the cost of mitigation and adaptation would be substantially lower in percent of GDP relative to the no-reform scenario. Therefore, the budget would require less ad-hoc cuts in other expenditure items, than in a no-reform scenario, once the need to finance climate-related shocks becomes unavoidable.

44. Illustrative calculations suggest that climate adaptation investment can alter significantly the medium-term macroeconomic framework of Djibouti. Currently, climate adaptation expenditures are not built into Djibouti's long-term fiscal and debt projections. With the exception of a few current investment projects that can be considered contributing to climate mitigation, other financing needs will have to be covered with own resources, grants from external donors or borrowing. In the reform scenario, assuming that growth will remain steady at 5-6 percent in the long run and all climate adaptation investment will be financed by new public borrowing, the overall fiscal deficit may worsen by about 0.5 percent of GDP relative to the current baseline. After several large-scale repayments on large public investment contracted in 2013-16, the fiscal deficit is expected to stabilize at about 3 percent of GDP or 3.5 percent of GDP if climate adaptation investments are included. The trajectory of public debt in this case would not be decreasing, as in the baseline, but would rather hover at about 60 percent of GDP.

45. In the no-reform scenario, additional climate adaptation investment may lead to worsen macroeconomic imbalances. If the projected high and sustained growth does not

materialize and Djibouti fall again into a period of latent growth at about 3 percent, the fiscal deficit would almost double relative to the reform scenario to about 7 percent of GDP. As a result, the debt level would exceed 100 percent of GDP and would stay on an explosive path in the long run.

B. Policy Options

46. Strong growth is the single most important precondition to generate resources needed to adapt to climate change. The authorities' debt financed reform program, if successfully accomplished can deliver the required growth rate. In this regard, fiscal policy has to walk the narrow path between supporting growth and preserving debt sustainability. To preserve growth in a high-debt environment, the authorities need to implement growth-friendly tax reforms that increase revenue, reduce the burden on the poor, level the playing field across businesses, while rebalancing expenditure toward items with high growth multipliers, such as capital expenditure.

47. The authorities need to generate fiscal space sufficient to start financing adaptation to climate change. As part of a broader envelope, which would include also financing for climate change mitigation and disaster response programs, a substantial fiscal space should be built into the budget on an annual basis. Investment in adaptation starting now is key given the potential costs. These resources should be spent on addressing climate-related macroeconomic vulnerabilities and promoting disaster-resilient infrastructure, transport and energy generation, public health capacity, risk-informed spatial planning, building standards, and payment systems.

48. Investing in mitigation and adaptation to climate change now would save resources down the road. Model estimates suggest that costs for ad-hoc reactions to climate change effects and induced natural disasters may be substantially higher relative to the predetermined investment path that would allow to address such effects in more systematic manner. Delays in adaptation investment would not only rise adaptation costs but may also affect negatively growth.

49. In Djibouti, investment in adaptation seems particularly crucial. Djibouti's contribution to global climate change mitigation is relatively small but still should be delivered. However, with scarce resources their better prioritization on adaptation measures would allow use the generated fiscal space more efficiently and with a long-lasting effect.

50. Contingency planning and fiscal risk management should be improved. Climate change mitigation and adaptation should be incorporated as an integral part in a broader fiscal reform and the regular fiscal management procedures should be complemented with disaster risks management. The government needs to explicitly identify and adequately integrate climate-related risks into the medium-term fiscal framework and debt sustainability analysis. Substantial fiscal buffers are needed to mitigate unforeseen implications of climate change and associated natural disasters. In this context the role of the National Natural

Disaster Management Fund (NNDMF), especially as to its mandate, governance structure, budget linkages, and relations should be clarified.

51. Djibouti's success in adaptation to climate change depends on attitude to this problem of other countries. Their action or inaction in these areas create an incentive problem for the Djiboutian authorities. The above analysis assumes that other countries would follow good policies on adaptation to climate change. If so, Djibouti would have a strong incentive to follow the suite and contribute its part. If not, Djibouti would have a strong disincentive to invest alone. In this case, a large part of the cost for Djibouti of not doing anything could be because of others.

52. Finally, Djiboutian authorities should improve coordination of climate change response with neighboring countries in the Horn of Africa. As all countries in the Horn of Africa are prone to broadly similar climate-related shocks, their joint attention to mitigation and adaptation strategies would create additional regional synergies and would help mobilize financing. Climate mitigation strategies in the Horn of Africa include both short-term approaches, such as distributing food to those already affected by climate change, and long-term approaches, such as planting drought-tolerant crop varieties that can withstand insufficient rainfall.

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