CLIMATE-FRAGILITY RISK BRIEF

LIBYA

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Climate-Fragility Risk Brief: Libya

AUTHORED BY

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Murzuq desert | © Audrius Sutkus/unsplash.com

INTRODUCTION

Libya has the largest oil and gas reserves on the African continent and the 9th largest in the world, as well as substantial natural gas exports (Worldometer, n.d.). Although production rates fluctuate due to multiple conflict-related factors, in 2021 Libya exports an average of 1.2 million barrels per day, giving the country approximately US $22-24 billion of revenue annually.[1] Despite this enormous wealth, however, Libya's basic infrastructure has steadily eroded and its electricity and water systems are both unsustainable and teetering on collapse.

These shortcomings are due to the current conflict as well as the legacy of the former regime, which created a complicated web of highly subsidised state-owned monopolies that have little capacity to reform or improve their cost effectiveness. As a result, Libya continues to rely on burning its primary export to produce electricity at exorbitant cost and relies on fossil water as its primary water source. This is not only expensive and unsustainable but contributes to Libya ranking top in Africa in per capital greenhouse gas emissions, emitting two to four times more greenhouse gas than any other country in North Africa (EDGAR Database, 2019).[2]

[1] In 2018, Libya acquired approximately US$24 billion in oil revenue and in 2019 US$22 billion (Saleh, 2021). During both of these years Libya did not suffer major interruptions in production.
[2] In 2013, Libya's carbon emissions per capita measured 9.96 metric tons. See (WorldData.info, n.d.).

While the fast-evolving political context in Libya continues to absorb both national and international attention, the impacts of climate change create several risks that demand the attention of policymakers. Two risks in particular pose existential threats to the country, namely: (1) the economic impact of reaching peak oil, and (2) the risk of exhausting fresh water sources. This climate fragility risk brief therefore analyses the following dynamics as they threaten long-term peace and stability in Libya.

1. Libya's reliance on global market prices for hydrocarbons makes it extremely vulnerable to peak oil demand.

2. Rising temperatures and a lack of an integrated water policy or strategy make Libya highly water stressed and potentially unable to provide water to its population. This is already causing inter-communal competition over water resources.

3. The prospect of water exhaustion threatens the agricultural sector which employs a quarter of the population in the south.

4. Rising temperatures complicate efforts to stabilise Libya's electrical system as it increases demand and inhibits production.

Addressing these threats requires long lead times and, given the gravity of their impact, necessitates higher prioritisation. Fortunately, provided there is sufficient political will, these issues can be addressed even while peace in Libya remains fragile. In fact, some of the current failures in the electricity and agriculture sectors could be utilised to incentivise structural change that would make these sectors more efficient and cost effective. Solutions include the following:

- Libya needs to diversify its sources of public revenue to make it less reliant on hydrocarbon exports. This requires investment in vital infrastructure, expanding and tightening the tax and customs base, improving the governance of its sovereign wealth fund, and enhancing conditions for private sector and foreign investment. It also needs to reduce spending particularly on its bloated payroll, which employs over a third of the population, but also in its subsidy regime including fuel subsidies.

- Libya needs an integrated water policy to ensure that its management of water resources is sustainable. This requires a basket of interventions, including ensuring that access to fossil water through the Man Made River (MMR) is secured. However, this should only be a temporary measure to allow for investment in more sustainable options, including water rationalisation, wastewater treatment and desalination.

- The efficacy of Libya's large-scale agricultural experiment in the desert needs to be reviewed to use less water-intensive crops and more water-efficient technologies.

- Libya must stabilise its electricity grid by investing in critical maintenance as well as energy efficiency interventions and subsidy reform. It must also create the conditions for private sector investment in renewable energy. Once the quality of service improves, the electricity tariff needs to increase to reduce consumption, make Libya's utility company, GECOL, more cost effective, and give private sector renewables the chance to become competitive.

POLITICAL CONTEXT AND SOCIO-ECONOMIC DEVELOPMENT

Political context

In 2021, after a costly two-year conflict which brought in foreign mercenaries on an unprecedented scale and created a costly oil blockade that lost the state some US $11 billion in revenue, a new Libyan government was formed under UN facilitation. On 5 February, the 75-member Libyan Political Dialogue Forum (LPDF) group, which was to represent the array of political interest, voted on lists of candidates to form the Government of National Unity (GNU). The mandate of this transitional government was short with its main purpose to unify the two competing government polities and prepare for elections by 24 December 2021.

The new Prime Minister, a former businessman named Abdel Hamid Dbeibah, formed a large government and, on 10 March, received a nearly unanimous vote of confidence from the House of Representatives. The GNU then moved quickly to unify the ministries and embark on an ambitious reconstruction plan. The devaluation of the Libyan Dinar on 3 January 2021 in combination with the resumption of oil production and the rise of global oil prices, incentivised the government to spend generously. However, support from the House of Representatives waned and the government was unable to pass its budget. Political elites who profit from the status quo soon re-established themselves as spoilers to the process, and progress to agree on a constitutional basis for elections faltered.

Complications in the political process were reflected in the security sector. Differences over who should occupy the position of Minister of Defence, and which authority should receive funds for the military, combined with a lack of progress in withdrawing mercenary forces to generate mistrust, particularly in the east where the Libyan Arab Armed Forces (LAAF) began sending signals of its consternation.

The diplomatic community is coordinating efforts to address this situation through the Berlin Process which, in January 2020, established three tracks including the political, security and economic. These tracks continue to work together to maintain the momentum toward national elections on 24 December 2021.

Algeria Square, Tripoli | © Moayad Zaghdani/unsplash.com

Social and economic development

With nearly all its foreign currency and 85% of its public revenue deriving solely from hydrocarbon exports, Libya is an archetypal rentier state. Since becoming an oil export country in 1964, Libya invested little in diversifying its economy. Instead, as all exploitation of oil was nationalised, the state became the primary mechanism for the distribution of wealth. While this system could be managed with a strong central government, after the 2011 revolution factions began competing for control of state institutions in order to secure access to public financing. As the effective control exerted by the national government remains weak, this competition exacerbates local, sub-regional and tribal tensions. When interests are not addressed or revenue distribution is perceived as unfair, factions often resort to shutting down the modes of production.

Although social entitlement levels were already high before 2011, after the revolution Libya's tax base narrowed further while its expenditures on salaries and subsidies increased. By 2020, 61% of expenditures went to the salaries, with some 1.8 million people on the payroll, and 16% went to subsidies, giving Libya the cheapest gasoline, electricity and water in the world (World Bank, 2021). Although entitlements increased, state investment in basic infrastructure including electricity, water and education declined. After 2014, only 1-5% of government expenditures went to vital infrastructure. As these services remain controlled by integrated state-owned enterprises who are unable to recuperate expenses by tariffs, Libyan institutions became rigid and unable to address increasing demands. Only 13 of Libya's 27 thermal power plants are operational, reducing electricity production capacity from 10 GW to less than 5 GW, well below demand, resulting in frequent power outages. Similarly, water infrastructure has degraded with only five of the seven aging desalination plants remaining operational and almost no capacity for recycling wastewater.

As the private sector remains small, Libya's population of 6.5 million has become highly dependent on entitlement and salaries. The majority of the youth population, which is projected to grow by 13% in 2030, is expected to enter the public sector. With a population growth rate of 2.1%, Libya remains highly dependent on migrant labour which, due to the conflict, it has difficulty retaining (UNICEF, 2019; UNFPA, n.d.).

Arch of Marcus Aurelius and Gurgi Mosque, Tripoli | © Ziyad El Baz/unsplash.com

NATIONAL SECURITY OVERVIEW

After the 2011 revolution that toppled the regime of Muammar Gaddafi, the Libyan security services became fragmented and localised. Although efforts have been made to consolidate the security services, and while most revolutionary and post-revolutionary armed groups are integrated into national systems, most continue to recruit locally and are responsive to the interests of that group or set of interests. This dynamic creates frequent turf battles, some of which have inter-communal dimensions.

Nationally, due to the 2014 civil war and the bifurcation of national government, most security actors identified with either the internationally recognised Government of National Accord based in Tripoli, under Prime Minister Serraj, or the Interim Government and the Libyan Arab Armed Forces (LAAF) under General Haftar, both of whom worked to expand their influence and size of their forces.

In 2019, while the UN prepared for a National Conference to decide on the way forward to elections, the LAAF launched an attack to take control of the country by force. The attack revived alliances from the 2014 conflict with security actors from Tripoli, Misrata and other western coastal cities setting aside differences to repel the attack. As the conflict intensified, both sides began to rely increasingly on the support of foreign forces, thereby embroiling Libya in regional and international conflict dynamics. On 23 October 2020, after two years of fighting with no side having a prospect of winning, a ceasefire was agreed upon with the armistice line located just west of Sirte. Although internationally there is pressure to expel the foreign forces, today there continue to be some 20,000 foreign fighters in Libya, with some having control over vital infrastructure.

While the election and installation of the GNU in 2021 created momentum to unify the government and economic institutions, there was little progress in agreeing on an integrated command structure. As such, the security situation froze, with security actors remaining in the positions they had acquired during the conflict. If the political track does not progress, particularly in regards to agreeing on a constitutional basis for elections, tensions may increase.

Although the national conflict suppressed local conflict dynamics, they are rarely far from the surface. Inter- and intra-communal conflicts in Libya are numerous, and many are unresolved. Conflicts often overlap with local rivalries, competition over access to resources, and manipulation by national actors and political networks.

One of the sub-regions most prominently affected is the south. The sparsely populated region has the bulk of Libya's most valuable resources, namely oil and fossil water, and many resent the extraction of these resources for the benefit of the north. While the LAAF has recently expanded its influence, much of the territory is controlled by tribal groups, including the Tuareg and Tebu who identify themselves as indigenous, non-Arab populations. These communities operate their own security services and their allegiance to national authorities is often defined by how well they serve their local interests.

The south is marginalised economically and politically. Being far from the coast, the price of goods is higher and there are often shortages in basic goods and services, including electricity. One conflict that has national implications is the contest over water resources in the Hassawna well fields. As Libya's northern groundwater is penetrated by sea water, and with the declining capacities of desalination and water treatment, the country now relies on the Man Made River (MMR) to bring fossil water from deep under the desert to the north. This creates the perception of a limited common resource which contributes to acts of sabotage on the well field, which by mid-2020 had destroyed 157 wells, some 36% of its capacity. This is already creating water shortages in the north and the emergence of a fresh water market.

Villa Celine, Al-Khums | © Moayad Zaghdani/unsplash.com

CLIMATE CONTEXT

Libya is located in the southern Mediterranean, a 'hot spot' in climate change impacts as the Mediterranean is a relatively shallow sea surrounded by large land masses on all sides. While global temperatures have already increased 1.02˚C by 2020 above pre-industrial levels in 1880, temperatures in the southern Mediterranean have increased by 1.5ºC (NASA, 2021; Union of the Mediterranean, 2019). This faster-than-average warming trend is set to continue. By 2040 the increase of temperature will likely be 2.2ºC and could reach approximately 4ºC by the end of the century (IPCC, 2007b).

As temperatures rise, air pressure and circulation patterns are affected, resulting in dryer summers with more intense rains in the winter (Tuel and Eltahir, 2020). Due to the interaction with the Sahel circulation systems in the upper atmosphere, high pressure is decreasing Libya's precipitation levels at an incremental rate of approximately -1.95 mm per year (Ageena, 2013). That rate, however, is rising and Libya may lose another 7% of its rainfall by 2050 (World Bank, 2018)[3]. The decrease in precipitation will be accompanied by longer periods between rains which will become heavier.

Rising temperature causes the Mediterranean to expand. While global sea levels rose between 20 and 24 cm in the 20th century, the rate of sea level rise in the Mediterranean is two to three times faster than global averages (IPCC, 2019). Whereas global sea levels rise 2.5 mm a year, in the Mediterranean it is 6.8 mm per year (Nichols et al., 2021). Depending on how quickly climate change occurs, the sea could rise another 2.5 m by the end of the 21st century (Lindsey, 2021). As the vast majority of Libyans live on the coast, most of the population will be affected. Approximately 5.4% of urban areas will be under water with a one-meter sea level rise (World Bank, 2018). The areas most vulnerable to sea level rise will be the oil crescent and low-lying cities such as Benghazi (Raey, 2010). A much larger area will be affected by stronger storm surges which could cause infrastructural damage, including to Libya's vast network of oil infrastructure.

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[3] See also (Zeleňáková, et al., 2013)

As will be explained in more detail below, these impacts will progressively complicate a number of critical services. Higher temperatures will contribute to increasing both electricity and water demand. However, just as temperatures increase demand, they also decrease the ability of the government to provide these services. Ambient heat decreases both power generation and transmission. As a general rule, the ideal temperature for thermal power generation is 8°C; any higher and efficiency in production is lost[4]. Although performance in 2021 improved due to repairs of existing infrastructure, summer temperatures decrease production levels by 30% resulting in frequent and extended power outages (LEGSP, 2020). As temperatures increase so will the level of technical losses which, when left unaddressed, result in street demonstrations that threaten the legitimacy of the government (Abulkher, 2020).

Similarly, water demand also increases with rising temperatures. Agricultural irrigation, much of which occurs in desert conditions already, will require more water but so too will demand from industry and thermal power generation (IPCC, 2007a). As demand increases, supply will also become increasingly problematic. Most of Libya's potable water comes from the MMR which stores fossil water in large open reservoirs outside the cities. As temperatures rise, evaporation losses, which are currently at around 4 million cubic meters annually, will increase.[5]

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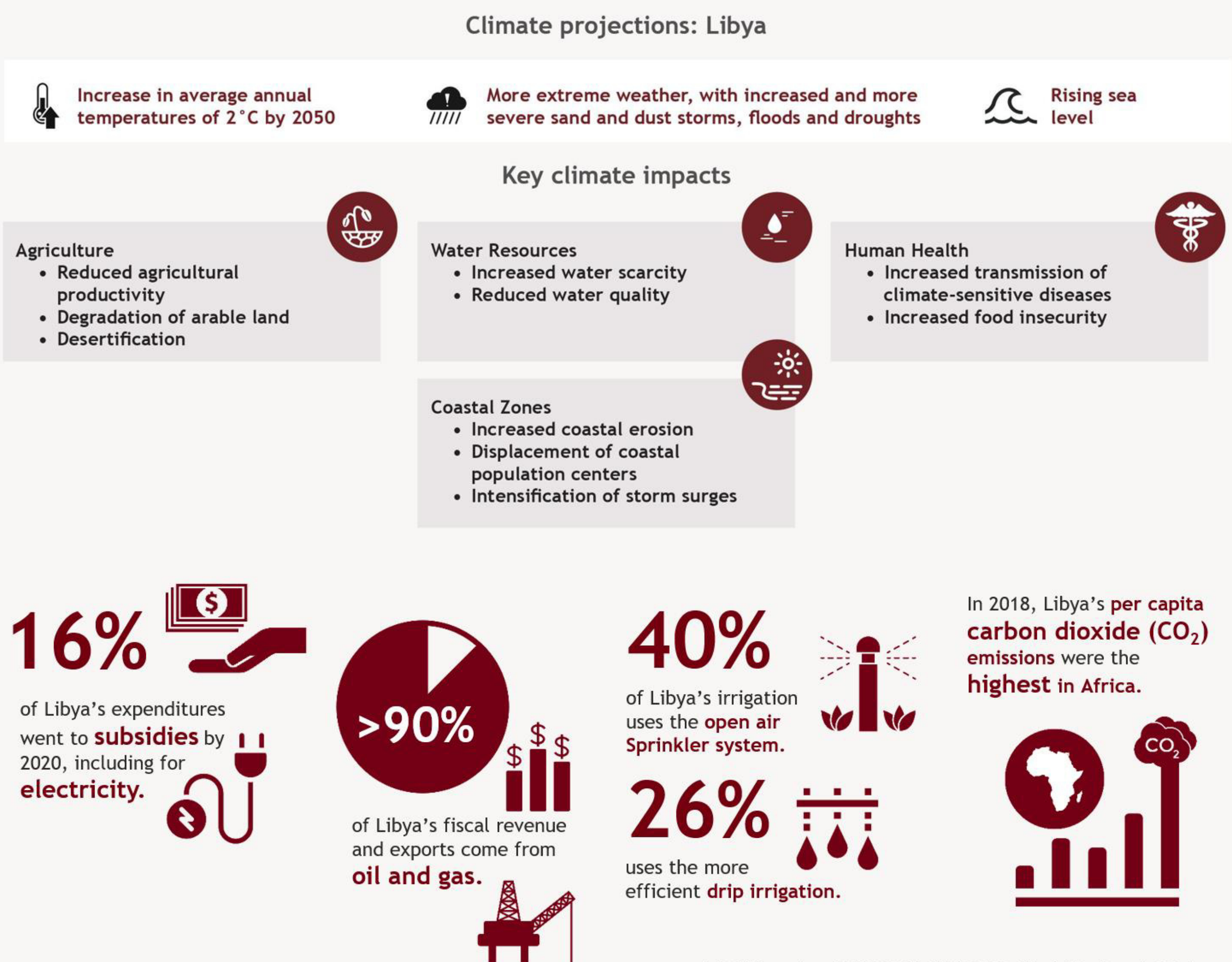
[4] Temperatures above 15°C lose approximately 0.7% of efficiency with every additional degree Celsius. Similarly, the capacity of power lines drops 1.5% and their efficiency another 0.5% with every degree. This is why Libya's power supply reduces by as much as 30% at the height of summer. See (Şen et al., 2018).

[5] UNEP Preliminary estimates for water loss by evaporation, 2021.



CLIMATE-FRAGILITY RISKS

Due to the inherited legacy of weak institutions and high public spending, Libya is ill-equipped to manage the impacts of climate change. The re-occurring conflict and the resulting institutional fragmentation add another level of challenges. Although there are multiple threats to stability, there are four that if left unaddressed will significantly impact the viability of basic state functionality in the medium term. The speed at which these threats occur is increasing due to climate change. These threats include the financial stress that will be created by peak oil, finite water supply, inefficient agricultural production and the inability of Libya to reform its electricity sector.

The impact of peak oil

Due to its dependence on oil exports, Libya, along with Iraq, has the highest exposure to global oil price fluctuations and is one of the least prepared to deal with its effects (Raval et al., 2021). As a result, Libya's ability to finance its inflated budget is highly dependent on oil prices remaining above US $50 per barrel. Peak oil, a term which refers to the time when global production reaches its maximum rate after which it will decline, is therefore a major threat to the Libyan polity.

Although there are uncertainties as to when peak oil will occur, the timeline estimates of the major actors have all moved forward following the COVID-19 pandemic. The reason for this is not because oil reserves are nearing exhaustion, but rather because of the confluence between the lower costs of renewables and increasing political commitment to reach zero emissions by 2050, a date viewed as critical if global warming is to remain under 2ºC relative to pre-industrial levels.

In 2020, the International Energy Agency (IEA), created initially to develop the hydrocarbon sector, took the unprecedented step of calling for an end to the dominance of hydrocarbons. It called for an end to any new oil, gas and coal exploration, and warned countries that, as the world transitions to net-zero emissions by 2050, income from oil and gas sales could already drop by as much as 75% by 2030.[6]

Energy companies themselves, including Shell and BP, also published their roadmaps to net zero. Both Shell and BP believe that peak oil was likely reached in 2019, with BP warning that demand could fall rapidly in reaction to calls for stronger climate action, including by as much as 10% this decade and 50% over the next 20 years (Shell, 2021; BP, 2020). The Organization of Petroleum Exporting Countries (OPEC) also expects demand among developed countries to never return to pre-2019 levels, and that demand could fall by as much as 27% over the next 25 years (Hodari and Elliott, 2020).

As oil prices diminish, supply will concentrate in a smaller number of countries who are able to access the fuel at the cheapest cost. Given the size of its reserves, the quality of oil, its low marginal cost and its proximity to export markets in Europe, Libya may well be among the most competitive.[7] That stated, even though the price of oil has rebounded as global markets open, Libya can no longer rely on oil as its primary revenue source. As stated by the World Bank, although there is uncertainty as to the pace of the decline of oil and gas, governments cannot afford to wait but must begin diversifying their economies and investing in the low-carbon transition (Peszko et al., 2020).

Unfortunately, although Libya's National Oil Company is beginning to sound the alarm and take steps to lower the carbon intensity of its oil and gas production, Libya continues to run a budget deficit and appears unable to diversify its sources of revenue, including its tax

[6] According to IEA, hydrocarbons will fall from composing four-fifths of total energy supply today to one-fifth, with most going to the production of products such as plastics. See (IEA, 2021b)

[7] In 2014, about 84% of Libya's crude oil exports were sent to Europe and, since 2004, most Libyan natural gas has been transported to Italy via the Greenstream pipeline. See (US Energy Information Administration, 2015)

base. Libya's tax base remains below 5% and, together with customs and other revenues, only covers 14% of its budget. Instead of investing in the energy transition, the GNU purchased six new thermal power stations in 2021, each with a lifespan of 20 to 30 years and with little forward movement to more efficient and cost-effective modes of production.

Libya has a sizeable sovereign wealth fund that was created in 2007. However, nearly half of its assets remain frozen due to UN sanctions, and a substantial part is embroiled in litigation. Asset valuations in 2013 and 2021 show that its value has remained static at US $87 billion. Although there have been advances made to improve the governance of the Libyan Investment Authority (LIA), including improving its compliance with the Santiago principals, overall governance of the LIA remains in question, and requests to unfreeze the assets have so far been rebuffed by the UN Sanctions Committee.


Kufra oasis | © NASA

Water resources

In the desert conditions of Libya, one of the most valuable public common goods is fresh water. Libya is one of the most water-stressed countries in the world, and is one of the only countries that does not have any rivers (Gassert et al., 2013). Only 2% of its land is arable and only slightly more is suitable for livestock. Despite the lack of water, the Libyan government invested heavily in agriculture in the 1970s, tapping into coastal aquifers to boost production. With water being used at rates hundreds of times beyond what could be replenished, it only took a few years for sea water to irreversibly enter the coastal aquifers, making the water unusable (El Asswad, 1995; Zurqani et al., 2019). As rents were already entrenched, instead of changing course, the government found larger sources of water in the deep southern fossil aquifers. To exploit this resource, a colossal pumping system called the Man Made River (MMR) was built to lift fresh water located 500 m below ground and transporting it hundreds of kilometers to the population at the coast. With this seemingly limitless resource, the state created massive circular state farms in the desert, growing everything from wheat to watermelons.

The MMR, which is now Libya's primary source of water, extracts fossil water from the Nubian Sandstone Aquifer System (NSAS) in the east and the Murzuq Aquifer in the west (Alker, 2008). While these aquifers have better natural defenses against sea water intrusion, the lower the water levels become, the worse its quality and the higher the chances of intrusion.

Fortunately, the NSAS is vast, covering over 2 million km^2. Due to its size, the NSAS is estimated to deliver water to Libyans for up to 200 years, provided that neighbouring states, including Egypt, do not increase their extraction rates (Maxwell, 2011). The western Murzuq Aquifer, which lies principally in Libya, is much smaller. One study estimates that it may only last until 2037 (Mazzonia et al., 2018). This is the same lifespan, approximately 50 years, that the MMR was engineered to operate. MMR engineers state that the lifespan of the MMR was designed to coincide with the exhaustion of the Murzuq Aquifer.[8]

The actual drawdown rate from the aquifers is, however, uncertain. While the MMR is estimated to extract 7,000 million m^3 per annum, most agricultural projects and south-western municipalities operate their own wells autonomously (Aqeil et al., 2012; Lagwali, 2008). Despite the uncertainty, however, current extraction rates are estimated to be between four to ten times the amount of water that is renewable.[9] With little to no collection of water tariffs and increasing water leakage due to poor infrastructure, Libya's rate of water consumption is well beyond what is sustainable.

Besides depletion, the more immediate threat to Libya's water supply is the lack of security in the MMR well fields, particularly in the south-west. Communities there resent the MMR pumping its water to the north because they understand that the amount of water in the aquifers is limited and because the MMR continues to work when they do not have electricity to run their own pumps. As a result, since 2018 over 170 wells, approximately 36% of its capacity, were sabotaged. This lowers the volume of water flowing to the north-west, creating fresh water shortages.

It is important to note that the reason Libya relies so heavily on the MMR is because its two other sources of fresh water, desalination and wastewater treatment, are so underdeveloped. At the moment, only 10 out of the 23 wastewater treatment facilities are operational and none are capable of making the water potable (Brika, 2018). Only 11% is treated and used for agriculture while the rest is pumped into the sea or artificial lagoons

[8] Interviews with the author of MMR engineers, 2020-2021.

[9] The current rate of abstraction from the various groundwater aquifers is estimated at 7,000 Mm^3/yr. The available water supply of safe yield is estimated at about 3,200 Mm^3/yr from non-renewable water from the basins, plus 650 Mm^3/yr is attributed to direct recharge from rainfall. One report estimates that annual groundwater recharge in Libya is around 250 million m^3, while consumption is estimated at one billion m^3. See (Al-Khamisi, 2015) and (USAID, 2016).

in the desert. Despite significant advances in the region, desalination in Libya is similarly underdeveloped with only seven plants still operational. These only operate at a quarter of their capacity, with nearly all using the energy-intensive thermal process rather than the more energy-efficient reverse osmosis (UNICEF, 2021). The reasons for this lack of performance reflect the perennial problematic in Libya, namely that the fully integrated state-owned enterprises have a monopoly to provide the service despite the high operational losses which consume their limited development budgets.

Agriculture production

The lifespan of Libya's fossil aquifers may inadvertently have been extended as the conflict depressed the agricultural sector. Since its peak when 470,000 ha were irrigated, the heavily subsidised agricultural sector has suffered, with production declining by up to 70% since 2011, and with 30% of the reduction occurring after the civil war in 2014. Despite the drop in production, however, the number of Libyans employed in this sector remained broadly constant, with 6% of Libyans nationally and 22% of Libyans in the south continuing to claim employment in the agricultural sector (REACH Initiative, 2018).

This sector consumes well over 80% of Libya's water, and there is high potential to rationalise water use. Unfortunately, there has been very little investment to improve the efficiency of agricultural water use since 2011. The most common form of irrigation, some 40%, continues to be open air sprinkler systems. The more water-efficient drip irrigation accounts for only 26% (WFP, 2020). The intensive use of water for agriculture is due in part to the cost of water not being integrated into its production. Water remains an essentially free resource for most farmers in Libya, thereby providing them little incentive to rationalise water use.

Man Made River (MMR) in the 1980s | © Jaap Berk/wikimedia.com

Pressures from the conflict stress the agricultural sector and create significant costs. Farmers find it increasingly difficult to get basic supplies, including fertilisers and spare parts. The main purchaser of agricultural products, the Libyan government, switched to imports after 2014, leaving the produce of many Libyan farmers stranded. Additionally, electricity shortages have interrupted production, forcing farmers to operate their own autonomous energy sources and therefore increase costs.

Energy

Once the envy of the continent, Libya was one of the first countries in Africa to become 100% electrified. Despite its vast size, Libya's electrical grid is highly centralised, with 14 large power stations built along the coast near the population centres. It has one of the cheapest prices in the world at 20 LYD/KWh, or about US $0.08, well below the global price average of US $0.14.[10] The utility company, GECOL, is a fully integrated state monopoly that manages all aspects of the sector from production to distribution and retail. Although there has been a drift towards natural gas which now produces 63% of Libya's power, Libya's remaining power is produced by oil (Almaktar et al., 2021). Despite efforts, no utility scale on-grid renewable capacity exist as Libya continues to lack several of the enabling conditions. First, the existence of a fully integrated utility with heavily subsidised electricity price crowds out innovation and makes private sector power generation uncompetitive. Relatedly, there is also no satisfactory way to provide a guarantee to reimburse capital expenditures.

There are also governance problems within the incumbent utility. Given the low tariff rates and the fact that GECOL receives constant subsidy streams regardless of performance, the company has always operated at a significant loss. As long as there was a centralised government, the system was able to provide reliable electricity. The structural weaknesses inherent in the incentive systems, in combination with the lack of oversight, however, became evident after the collapse of a unified central government.

In the euphoric chaos that followed the revolution, Libyan consumers stopped paying their electricity bills and consumption rates soared. Between 2011 and 2013, Libyan per capita electricity consumption doubled from 17 TWh to 30 TWh in 2013 (IEA, 2019). As demand rose, the ability of GECOL to recuperate its operating expenses dropped to 13%. GECOL did not help its predicament, as instead of cutting costs, its wage bill soared as staffing increased to well over 45,000, even though only a third of this number was required.[11]

This unbalanced system held together for the first few years following the revolution, but it soon started to unravel. As of 2021, only half of Libya's 10,236 MW of installed capacity, some 5,300 MW, is functional. In the summertime, production drops further to 3,700 MW due to inefficiencies created by heat. Unfortunately, the drop in production during summer coincides with Libya's peak demand, which in August 2019 was 7,639 MW. With the supply-demand gap nearing 50%, blackouts became frequent and long. To make the situation worse, in an effort to demonstrate their value, local militia disabled emergency breaker systems and forced local operators to turn the electricity back on. By the summer of 2020, the stress on the system became too heavy and grid-wide blackouts started to occur. This fomented civil unrest, which often resulted in more damage to electricity infrastructure.

The burgeoning electricity crisis directly affects water security. At the distribution level, Libya has a relatively low amount of elevated water reserves, so electricity cuts quickly result in low pressure or empty taps. Upstream, the lack of electricity interrupts the operation of Libya's seven remaining desalination plants who use the energy-intensive process of thermal evaporation to produce fresh water rather than the more energy-efficient reverse osmosis.

[10] The tariff has not been raised since 2005 (Global Petrol Prices, 2020).
[11] GECOL has not been publishing any annual reports since 2010.

POLICY AND INSTITUTIONAL CONTEXT

Unlike other conflict settings such as Somalia, Yemen and the Sahel, little attention has so far been given by either international or national actors on the impacts of climate change in Libya. This is likely due to prioritising immediate issues related to the conflict and the perception that Libya's oil wealth gives the country a higher degree of resilience. The Libyan state has also given little attention to the issue. Although Libya signed the Paris Agreement in 2016, the country has not ratified the convention and, more importantly, has not submitted any communications to the UNFCCC. This leaves Libya with the undesirable status of being the only country in the world not to have done any carbon inventory or a Nationally Determined Contribution.

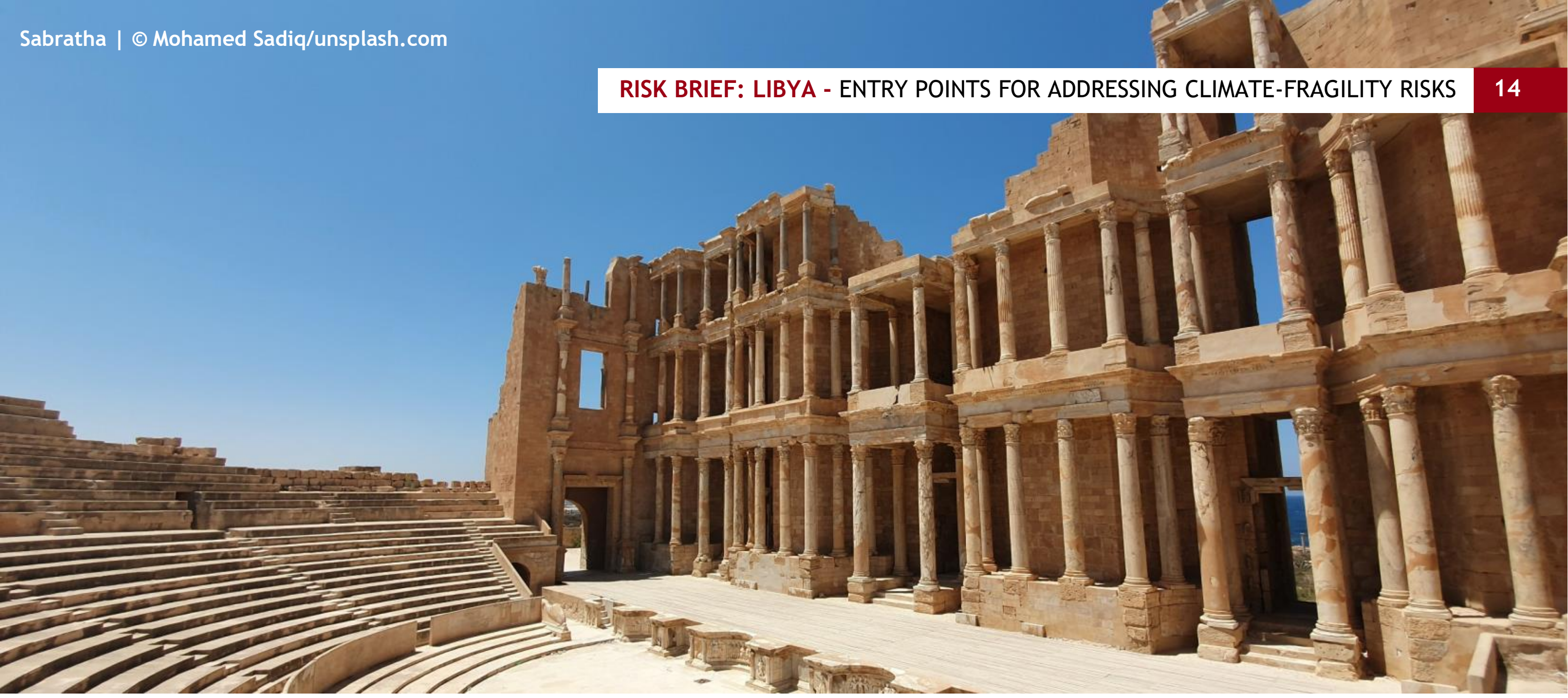
The Libyan Environment General Authority (EGA) has attempted to work with international partners to improve its reporting capacity and, in 2020, former Prime Minister Serraj established the first inter-ministerial climate change committee. However, inter-ministerial coordination in the Libyan state is complicated due to institutional weakness and fragmentation as well as the changes in leadership. In 2021, the current Prime Minister Abdel Hamid Dbeibah, summarily upgraded the EGA to a ministry and changed its leadership, albeit without any change to mandate. The new leadership has yet to re-establish relations with climate finance organisations which have to date been complicated by competing focal points.

Similarly, Libya has had difficulty introducing solar energy. In 1997, the Renewable Energy Authority of Libya was created and quickly developed plans to make Libya a leader in renewable energy. However, the institution has found it difficult to find its space due the size of the fully integrated utility company GECOL, and the lack of enabling conditions for renewable energy projects.

Although technically competent, the water sector is similarly affected by rigid and opaque financing systems and weak inter-governmental collaboration. The sector is dominated by state-owned companies including the Man Made River Authority, the General Company of Water Desalination and the General Water Supply and Sewerage Company. The smaller General Water Authority was nominally in charge of providing oversight of these companies, but this was expunged in 2019 when all institutions were made independent. In 2021, the current GNU tacitly reversed this decision by upgrading the General Water Authority to a Ministry but, again, with little guidance as to its new mandate or authority.

The main challenge in both the electricity and water sectors is that both have a low tariff rate well below their operating costs, and the sectors are dominated by fully integrated monopolies that provide little space for the private sector. As a result, these institutions run recurring financial losses, and most of the subsidies go to cover operating costs rather than infrastructure investment. Irregularities in the promulgation of the national budget has further complicated the ability of these companies to access development spending.

The National Oil Corporation is Libya's only main for-profit company. It provides the country with the majority of its revenue and is the sole authority mandated to sell or buy hydrocarbon products. It has introduced an increasing amount of solar to operate its oil and gas production sites. As no Ministry of Energy exists, however, it is difficult for the National Oil Corporation to collaborate effectively with GECOL and other authorities to develop efficient and on-grid renewable energy, despite the immense financial potential.



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ENTRY POINTS FOR ADDRESSING CLIMATE-FRAGILITY RISKS

Although the conflict in Libya is endemic and the institutions weak and fragmented, there are multiple opportunities to mitigate the risks associated with climate change. These opportunities create numerous co-benefits and are mutually reinforcing, particularly if done simultaneously. If approached skillfully, the conflict itself often creates unique circumstances and incentives that allow for the implementation of reforms that can enhance the resiliency of state services and set Libya on a low carbon recovery pathway. This pathway can not only reduce emissions but improve the efficiency and sustainability in the management of its natural resources.

As with COVID-19, armed conflict tends to reduce carbon emissions as it depresses the economy, lowering consumption and productivity rates. Carbon emission rates in Libya dropped by half in the first years after the outbreak of conflict in 2011 (Rother et al., 2016). This reduction, however, tends to be short-lived as the economy recovers (Organski and Kugler, 1981). To ensure that economic recovery does not return to business-as-usual growth patterns, several “build back better” interventions are required.

The imperative of subsidy reform

There is a high degree of consensus in Libya on the need for subsidy reform, but the vested interests created by these subsidies have so far curtailed most efforts. Although often touted as a wealth redistribution policy, subsidies are by nature regressive as the benefits tend toward the wealthy. They create market distortions and rents that are exploited by traffickers and crowd out innovation. They increase consumption rates and divert resources from more productive sectors of the economy. In Libya, the legal price of gasoline since 2005 is 0.15 LYD or US $0.03 per liter, making it among the cheapest in the world. As a result, some 30-40% of Libya’s refined fuel is smuggled, costing the state approximately US $750 million annually (Assad, 2017) The smuggling rackets are so pervasive that they contribute to domestic fuel shortages, forcing Libyans to often pay well beyond the legal price (Eaton, 2018).

While policy proposals exist for phased price increases with revenues going to social benefits to offset the cost to the public, pressure from rent seekers, in addition to potential public criticism, has thwarted most efforts (Zapita, 2020). That stated, in 2019, price distortions were so pronounced that the Minister of Economy cut subsidies on lubricants and kerosene completely. To address the much larger gasoline and diesel subsidies, as well as those in the electricity and water sectors, however, requires more concerted political effort as well as public sensitisation.

Incentivising the energy transition

Reducing fuel and electricity subsidies are also critical to incentivising Libya's energy transition. Given the low tariff rate and low collection rate for electricity, creating a private sector market for electricity or any other critical service is difficult. The country's publicly run electricity infrastructure is aging, and the lack of maintenance results in technical losses of up to 30% as well as an increasingly unstable grid. Creating a market for distributed solar would not only assist in stabilising the grid but would reduce the need to burn Libya's primary export. Given Libya's high radiance levels, only a small fraction of Libya's solar potential is needed to power the country.

The fact that Libya's electrical system is failing creates pressure on authorities, including GECOL, to innovate. As in most countries, the most cost-effective way to improve the electrical system and lower cost is to improve the way electricity is used. Implementing a programme that changes all of Libya's incandescent light bulbs for LED light bulbs would cost approximately US $200 million and save 500-750 MW of electricity. This is as much power as one of Libya's large thermal power stations which costs billions to construct and operate. Another policy is to improve maintenance, restoring some of the 5,000 MW of production capacity that is already installed, and improving the way electricity moves through the grid. Ultimately, Libya, like the rest of the world, will need to transition to cheaper and cleaner ways to produce energy. This will require not only reform in the subsidy regime but the introduction of independent power producers and ways to guarantee that their capital investments can be reimbursed.

Reducing flaring and fugitive gas emissions

Until Libya diversifies its economy and advances in its energy transition, oil production will remain central to its energy system and state revenue. Here also, however, there is room for improvement. The flaring or venting of gas during the production of oil is a wasteful and extremely harmful practice, as it contributes some 350 million tons of carbon a year (World Bank, 2017). Libya is among the higher polluters in terms of its barrel to flare ratio, which increased from 2.3 to 5.9 million m^3/year between 2016 to 2019 (GGFR, 2020). Although the National Oil Corporation has taken some steps to reduce flaring, including by harnessing the gas for Liquid Petroleum Gas, there is much room for improvement. The IEA proposes a number of cost effective measures to reduce fugitive gas emissions in Libya that could reduce emissions by up to 71% at no net cost (IEA, 2021a).

The National Oil Corporation has multiple opportunities to finance these measures. Not only would there be interest among its partner corporations who are seeking to reduce their carbon footprints but the EU Commission itself should have an interest in supporting these efforts. Libya exports some 60% of its oil and nearly all of its natural gas to the EU (OEC, 2019). The EU significantly ratcheted up its emission reduction ambitions by adopting the Climate Law in 2021 commiting itself to go carbon neutral by 2050. To do so will require the EU to significantly reduce its upstream methane emissions which are between three to eight times higher than the domestic EU gas supply chain (Mohlin et al., 2021). Beyond using carbon offsetting schemes, the EU could extend its Oil and Gas Methane Partnership to upstream countries creating incentives to reduce flaring and fugitive emissions including improving leak detection (European Commission, 2020).

Rationalising water use in the agricultural sector

As described above, Libya has a major water problem. It will need to invest heavily in desalination and wastewater treatment to have any chance of managing its future water needs. This will take time and the country first needs to stabilise its electrical grid. Until then, fossil water will remain Libya's primary source of water and its lifespan needs to be lengthened. The most effective way to do so is to rationalise water use in agriculture and reduce evaporation in its open water reservoirs through the use of floating solar panels.

Although it is widely reported that the agricultural sector consumes 80-85% of Libya's fresh water supply, there is little updated information on the rate of water use. A study currently being conducted by FAO and the Water Ministry should not only provide this information but also identify areas where water can be most effectively rationalised. Some 40% of Libyan agriculture uses open air sprinkler systems rather than the more efficient drip irrigation (WFP, 2020) Also, many Libyan farmers continue to grow water-intensive crops such as wheat, despite the high cost of production and there being few markets for its sale. Investments in agricultural technology and support to improve the viability of agriculture commodity markets would go a long distance to improving water management and livelihoods.

After expending so much energy extracting fossil water from 500 m below ground and transporting it 400 km to the coast, nearly half of it is lost to evaporation while it sits in open reservoirs waiting to be consumed (Friedrich et al., 2018; Zhao and Gao, 2019). To reduce water loss and create electricity, covering the reservoirs with floating solar panels is an inexpensive way to conserve water and generate electricity (Farfan and Breyer, 2018). Each of Libya's main reservoirs in Ajdabiya, Tripoli, Gharyan, Ghardabiya and the Grand Omar Muktar could each produce up to 36 MW of electricity and 10-20% water loss by evaporation. Introducing other evaporation reduction techniques, such as filling the reservoirs with inexpensive shade balls or floating disks, are easy and inexpensive ways to reduce evaporation by as much as 80%.

International support to mitigate climate impacts

As described above, the international community is supporting several projects that include climate mitigation and adaptation components, but more is needed to ensure that these are implemented as part of an integrated response. For this to occur, it would be helpful if a comprehensive risk assessment and risk management strategy is conducted to inform international programming and create synergies. The specialised capacity of a climate security advisor could assist in developing and implementing this strategy. Support is also needed to create more awareness within Libya of the impacts of climate change. To that end, Libya needs support to comply with its international reporting obligations, including completing its first carbon inventory and communication to the UNFCCC. There is also a growing awareness, particularly among the youth, of the impacts of climate change. It is important that this dialogue within civil society be reinforced and expanded to include relevant local and national authorities.

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