



A Survey of Libya's Environmental Challenges

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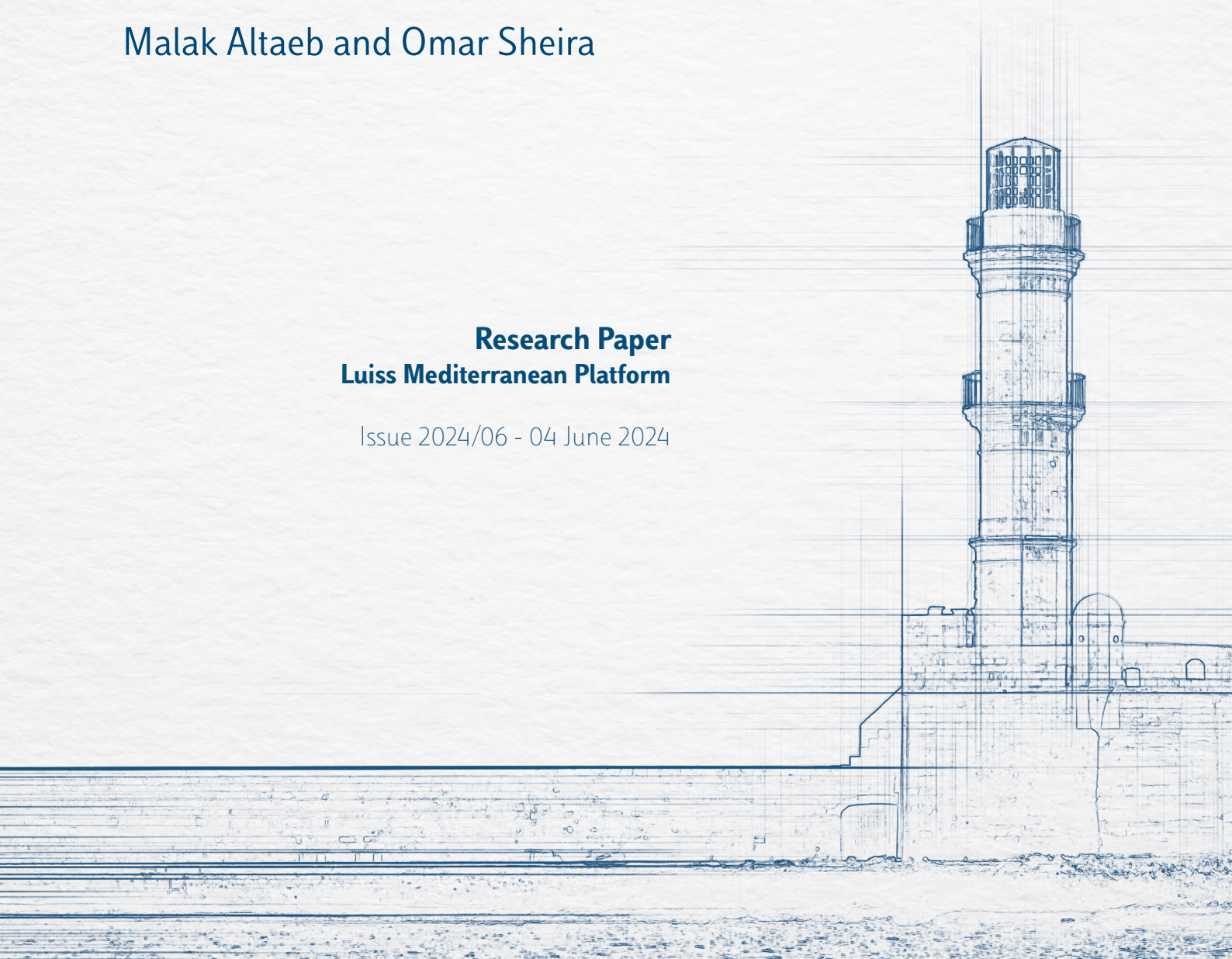


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Executive Summary

Libya stands at a critical juncture. It faces a broad range of environmental challenges that threaten its livelihood, economy, and public health. These range from water scarcity and climate change to urbanisation, desertification, and pollution.

The country is facing a serious **water crisis** due to overconsumption, mismanagement, and negligence rather than water scarcity. Libya uses more groundwater than it can replenish and does not have enough rainfall to refill its renewable aquifers. Water access and quality vary significantly across Libyan cities and municipalities. While most areas are connected to the Great Man-Made River Project network, either legally or through unauthorised connections, many others are not. To cope, residents have relied on private wells, water tanks, rainfall, or a combination of these. The frequent electricity outages in recent years have also had a negative impact on water availability, as water access is dependent on electric pumps.

Water quality varies just as much as water access; some regions enjoy good quality water, others contend with salty water, and some face issues with poor quality water that is unsuitable for washing never mind consumption. In addition, the years of conflict have seen the water pipeline network compromised by vandalism, theft, and neglect. This has led to significant water loss and, in some cases, contamination. Without enough desalination and wastewater plants, Libya will struggle to sustain its current consumption.

Human activity and climate change have had major impacts on the environment. Human factors, such as conflict, urbanisation, and desertification, have accelerated the loss of the vegetation cover and farmland. Over the past decade, a general lack of security and oversight allowed the unregulated expansion of Libyan cities. As a result, the green belt surrounding Tripoli and Benghazi faced numerous building violations and encroachment upon green spaces across the country has become routine. In areas affected by the conflict, military attacks have left farms deserted and led to crop losses.

These issues are compounded by **climate-induced threats**. Higher temperatures, reduced rainfall, and water scarcity strain water resources. They contribute to a dramatic decrease in agricultural productivity. In response, some farmers have shifted from traditional – now unsustainable – farming methods, to more water-efficient irrigation techniques. Others, in the absence of government support, have abandoned their farms to seek better opportunities in cities with more reliable services. Interestingly, some areas around Tripoli and Benghazi have reported stable or even improved agricultural productivity. However, this phenomenon depends on excessive water extraction.

With eighty percent of Libya's population concentrated in coastal cities, the rise in construction and vehicle use has made **water, land, and air pollution** a major concern. The country's sewage system is outdated and overstretched, with frequent blocks, breakages, and overflows. Moreover, coastal cities discharge wastewater directly into the sea polluting the marine environment or they use 'black wells' (waste wells polluting the land).

Most cities struggle with **poor waste management**, with solid waste piling up in landfills and residential areas. Residents frequently burn waste to eliminate its stench and unsightly appearance. This increases air pollution and the risk of respiratory illnesses. The energy crisis of the past years has worsened matters. The widespread use of diesel-run electric generators has further reduced air quality in urban areas and intensified the impact of climate change. Natural phenomena like sand and dust storms are now more frequent and intense, due respectively to climate change and desertification. Both carry pollutants across vast distances, affecting agriculture, the economy, and public health.

Environmental and climate change awareness in Libya is generally low. Most Libyans have only a superficial understanding based on personal observation. Individuals, particularly those in rural areas, may have more direct experience with environmental changes. However, there is a general lack of in-depth awareness about climate change's broader impacts and how human activities affect these issues. The absence of an environmental protection culture indicates that environmental concerns are generally not a priority for Libyan society or for the government. There is some recognition of climate change as a serious issue – especially following the Derna floods. But the overall response has tended to be reactive and short-term. There is no comprehensive strategy.

In the **absence of any government strategy**, there have been attempts by local initiatives and individual efforts to respond to environmental challenges. These grassroots efforts aim to raise awareness on issues such as plastic and marine pollution,

deforestation, decline in agriculture, and waste mismanagement. However, limited government support, restrictive laws, and financial constraints have hindered their impact on the ground. Local grassroots initiatives are usually short and lack coordination, making their long-term impact negligible. Their slow progress and weak focus, mainly appealing to the young, highlights the need for a more inclusive and broad-based form of engagement.

International organisations have focused their work in Libya on political issues, migration, female empowerment, and education. They have yet to focus on environmental issues. Future programs could support environmental awareness through educational programs and local media; raise awareness on storms and how to mitigate them; increase vegetation cover in Libya; and conduct research on the overall environmental situation and potential solutions.

1. Introduction

Over the past decade, a lack of security and political stability in Libya have significantly affected various sectors, with the environment arguably bearing the brunt. A narrow focus on political issues has widened the gap between an urgent diagnosis and effective solutions to address Libya's environmental challenges. Over time, this trend has led to a *status quo*, where the immediate political situation is always the priority. This has become a convenient excuse preventing or slowing the implementation of effective environmental measures.

In 2023, the environment itself became the immediate problem. In September of that year Libya's north-eastern coastline was hit by Storm Daniel, a tropical-like Mediterranean cyclone. The storm struck the eastern and central parts of the Mediterranean, including Greece, Turkey, Bulgaria, and Libya.¹ It brought strong winds and unprecedented torrential rains, ranging from 150 to 240 mm.² The heavy rainfall caused sudden flash floods, which severely hit many cities in eastern Libya including Benghazi, al-Bayda, Sousa, and Derna.³

Derna, a city located in a mountainous region along the eastern Libyan coast, was the most severely hit by the storm. The city's vulnerability to flooding during storms has been historically⁴ associated with its Wadi or valley. This had led to the construction of two dams as protective measures.⁵ Unfortunately, the intensity of Storm Daniel was greater than the capacity of both dams and saw their collapse. The ensuing floods destroyed critical infrastructure and residential buildings and led to a catastrophic human toll.⁶

Storm Daniel destroyed nearly a quarter of Derna,⁷ making it the deadliest storm in recorded African history.⁸ It is the deadliest storm globally since Super Typhoon Haiyan, which hit the Philippines in 2013.⁹ Official figures on human losses, including the total number of casualties, missing individuals, and displaced populations varied. However, the Libyan Red Crescent reported a death toll exceeding 11,000¹⁰, with an additional 2,000 people feared drowned.¹¹ The UN reported nearly 40,000 having been internally displaced,¹² while the International Medical Corps Organisation reported more than 8,500 people as missing.¹³

The extensive destruction extended to the rich biodiversity and landscape of the region. A situation report published by the UNICEF highlighted that the agriculture sector suffered major losses in poultry and livestock farmlands, as well as

- 1 Climate Diplomacy, "Conflict in Libya and the Derna Dam Burst", *Climate Diplomacy*, <https://climate-diplomacy.org/case-studies/conflict-libya-and-derna-dam-burst>.
- 2 WMO, "Storm Daniel Leads to Extreme Rain and Floods in Mediterranean, Heavy Loss of Life in Libya", *ReliefWeb*, September 12, 2023, <https://reliefweb.int/report/libya/storm-daniel-leads-extreme-rain-and-floods-mediterranean-heavy-loss-life-libya>.
- 3 Farah Najjar, "Libya Floods Updates: Hundreds Feared Dead as Storm Daniel Lashes Derna", *Al Jazeera*, September 11, 2023, <https://www.aljazeera.com/news/liveblog/2023/9/11/libya-floods-live-news-hundreds-feared-dead-as-storm-daniel-lashes-derna>.
- 4 Derna faced a sequence of flooding events originating from valley in the early 1940s, late 1950s and 1960s,. See Dave Petley, "The Failed Dams in Wadi Derna in Libya", *PreventionWeb*, September 13, 2023, <https://www.preventionweb.net/news/failed-dams-wadi-derna-libya>.
- 5 Due to the subsequent events and the following studies, the two dams al-Bilad and Sidi Abu Mansour Dams were constructed in the 1970s to protect the city from any potential flooding. The furthest dam, Sidi Abu Mansour, which was 14 kilometres from the city, had a storage capacity of 22.5 million cubic meters of water. Whereas the closest dam to the city, al-Bilad, had a capacity of 1.5 million cubic meters of water. See Samy Magdy, "Libya Was Mired in Chaos and Corruption. For Years, Warnings the Derna Dams May Burst Went Unheeded", *Associated Press*, September 18, 2023, <https://apnews.com/article/libya-derna-dams-collapse-floods-corruption-neglect-chaos-45f76d2ac76be634865539a27b518ada>.
- 6 Gaia Rigodanza and Fabjan Lashi, "Satellite View: Understanding the Impact of Storm Daniel", *UNDP Blog*, October 19, 2023, <https://www.undp.org/blog/satellite-view-understanding-impact-storm-daniel>.
- 7 Ayman Werfali and Ahmed Elumami, "Libya Floods Wipe Out Quarter of City, Thousands Dead", *Reuters*, September 13, 2023, <https://www.reuters.com/world/africa/more-than-1000-bodies-recovered-libyan-city-after-floods-minister-2023-09-12/>.
- 8 WMO, "Storm Daniel Leads to Extreme Rain and Floods in Mediterranean",
- 9 Bob Henson and Jeff Masters, "Eye on the Storm: The Libya Floods: A Climate and Infrastructure Catastrophe", *Yale Climate Connections*, September 13, 2023, <https://yaleclimateconnections.org/2023/09/the-libya-floods-a-climate-and-infrastructure-catastrophe/>.
- 10 Associated Press, "Flooding Death Toll Soars to 11,300 in Libya's Coastal City of Derna, Aid Group Says", *Associated Press*, September 15, 2023, <https://apnews.com/article/libya-floods-derna-storm-daniel-mass-graves-21b1a195d261a642e12dac13f0d19431>.
- 11 Patrick Wintour, "Up to 2,000 Feared Drowned after Libyan City Hit by 'Catastrophic' Storm Floods", *The Guardian*, September 11, 2023, <https://www.theguardian.com/world/2023/sep/11/storm-daniel-floods-libya>.
- 12 ReliefWeb, "Tropical Storm Daniel - Sep 2023", *ReliefWeb*, <https://reliefweb.int/disaster/fl-2023-000168-lby>.
- 13 International Medical Corps, "Libya Flooding: Situation Report #11 (December 19, 2023) - Libya", *ReliefWeb*, December 19, 2023, <https://reliefweb.int/report/libya/libya-flooding-situation-report-11-december-19-2023>.

destroyed orchards.¹⁴ For instance, in the Jabal al-Akhdar region damage to farmlands and villages, resulted in the loss of olive, apple, and fig trees.¹⁵ A preliminary analysis by the Conflict and Environment Observatory (CEOB) underlined the potential impact on marine and coastal biodiversity,¹⁶ emphasising that high volumes of polluted sediment and debris from flooding could threaten turtles, fish, and seabirds.¹⁷

The devastation caused by Storm Daniel serves both as a reminder of the escalating threats posed by climate change. There is clearly a need to build resilient systems tailored to the country for effective mitigation and adaptation. The storm also exposed three other issues. First, there are the vulnerabilities in Libya's infrastructure, early warning systems, response mechanisms, and administrative structures. These all failed to anticipate, manage, or mitigate the storm. Second, there has clearly been negligence in addressing the direct and indirect impacts of natural catastrophes on residents' lives.

Third, and most importantly, the storm highlighted how climate change can act as a threat multiplier, capable of causing extreme weather events that can transform the environmental landscape. Scientists at World Weather Attribution warned that climate change in the past years has made heavy rainfall 50 times more likely in Libya.¹⁸ Storm Daniel showed how inadequate management and accumulated neglect can turn weather events, amplified by climate change, into deadly disasters. Here we see the importance of recognising the impacts of climate change not as isolated incidents, but as mounting issues occurring in relation to imbalance in the seasons. Summers are now longer and warmer, and winters are shorter and drier. Rainfall rates have also drastically decreased in the past few years. All these changes are new to Libya.

Objective

This paper aims to survey the environmental challenges facing Libya, specifically water scarcity, agricultural decline and desertification, and water and air pollution. In addition, it investigates the awareness levels around these issues and climate change, assessing community perceptions and government responses towards them. The focus extends to the impacts of water scarcity, agricultural difficulties, and pollution on Libya's economy, public health, and society. These issues have already deeply influenced daily life and are expected to continue causing adverse effects in the future.

The first section of this paper outlines the people-centric approach adopted to conduct the research and explains why it was used to survey the environmental challenges in Libya. The second section provides an overview of the climate, and geography relating to each of the areas covered in our research. The third section explores water scarcity, agricultural decline and desertification, and water and air pollution. Each issue in this section is divided into two subsections with historical context; and, then, findings from the interviews. The fourth and final section discusses both community and government responses to these environmental challenges and reflects on the potential role of international organisations in helping to address them.

14 UNICEF, "Libya Humanitarian Situation Report 6 Daniel Floods", November 4, 2023, <https://www.unicef.org/media/147566/file/Libya-Humanitarian-SitRep-Daniel-Floods-November-2023.pdf>.

15 Madjid Zerrouky and Nissim Gasteli, "'We can lose everything but our souls': The forgotten victims of Libya's Storm Daniel", *Le Monde*, September 22, 2023, https://www.lemonde.fr/en/environment/article/2023/09/22/we-can-lose-everything-but-our-souls-the-forgotten-victims-of-libya-s-storm-daniel_6138605_114.html.

16 CEOBS, "The Environmental dimension of Libya's flood disaster" *CEOBS*, September 2023, <https://ceobs.org/the-environmental-dimensions-of-libyas-flood-disaster/>.

17 Ibid.

18 Jessica Corbett, "Climate change made Libya flooding up to 50 times more likely, 50% more intense", *Yale Climate Connections*, September 27, 2023, <https://yaleclimateconnections.org/2023/09/climate-change-made-libya-flooding-up-to-50-times-more-likely-50-more-intense/>.

2. Methodology

The present research adopts a people-centric approach, which focuses on people's personal experiences and observations through their daily interactions with their environment. This approach was used, in part, due to the limited availability and quality of the existing data. Despite several attempts to access information from governmental entities and ministries in the initial phases of the research, the data appeared to be difficult to access and was likely outdated. Therefore, we focused our efforts on a bottom-up approach which could explore the human-environment relationship and highlight the similarities and differences people face in the different regions of Libya. The approach also complemented the more quantitative ones found in other sources, offering a deeper insight into the Libyan community's understanding and awareness of its environmental challenges.

Field research was conducted through semi-structured interviews with residents on scheduled phone calls and online video calls *via* Zoom. These lasted between 45 minutes and an hour. The lightly structured format was optimum for both the respondents and ourselves. It gave them the opportunity to express their perspectives at length and allowed us to pursue a more specific line of questioning based on their responses. For example, when covering each issue, we would often ask respondents to reflect on the past. After that, we would prompt them to explain how things have changed.

In selecting the respondents, it was important to consider Libya's diverse landscape, which has varying climates, geography, and environmental conditions. Different regions of the country face different environmental challenges, based on their location, population density, state of infrastructure, economic activities, and access to resources. For instance, residents in Tripoli may not face the same water shortages experienced by residents in Sebha. Our selection of respondents aimed to capture this diversity. The interviews conducted covered both urban and rural areas in the north-western, north-eastern, and southern regions of Libya. In the northwest, interviews were conducted with residents in Tripoli and its suburbs, Bani Walid, and Jabal Nafusa; in the northeast with residents in Benghazi; and in the south, with residents in Sebha and Houn.

We encountered three main challenges while interviewing. First, the identification of potential respondents proved to be difficult. Contacting people and obtaining confirmations proved a lengthy process, with some residents not responding to requests for interviews. Second, there were often considerable delays and rescheduling of interviews due to technical issues such as weak or limited internet connections. Third, online interviews usually took longer to conduct for the same reasons. The constrained timeline, coupled with the slow pace of securing interviews, resulted in a lower number of interviews than initially anticipated. Additionally, in cases where the respondent's knowledge of the issues was below the desired level, there was the challenge of identifying, scheduling, and conducting another interview. However, despite these limitations, the validity of the obtained results is not in doubt.

3. Background on the Areas

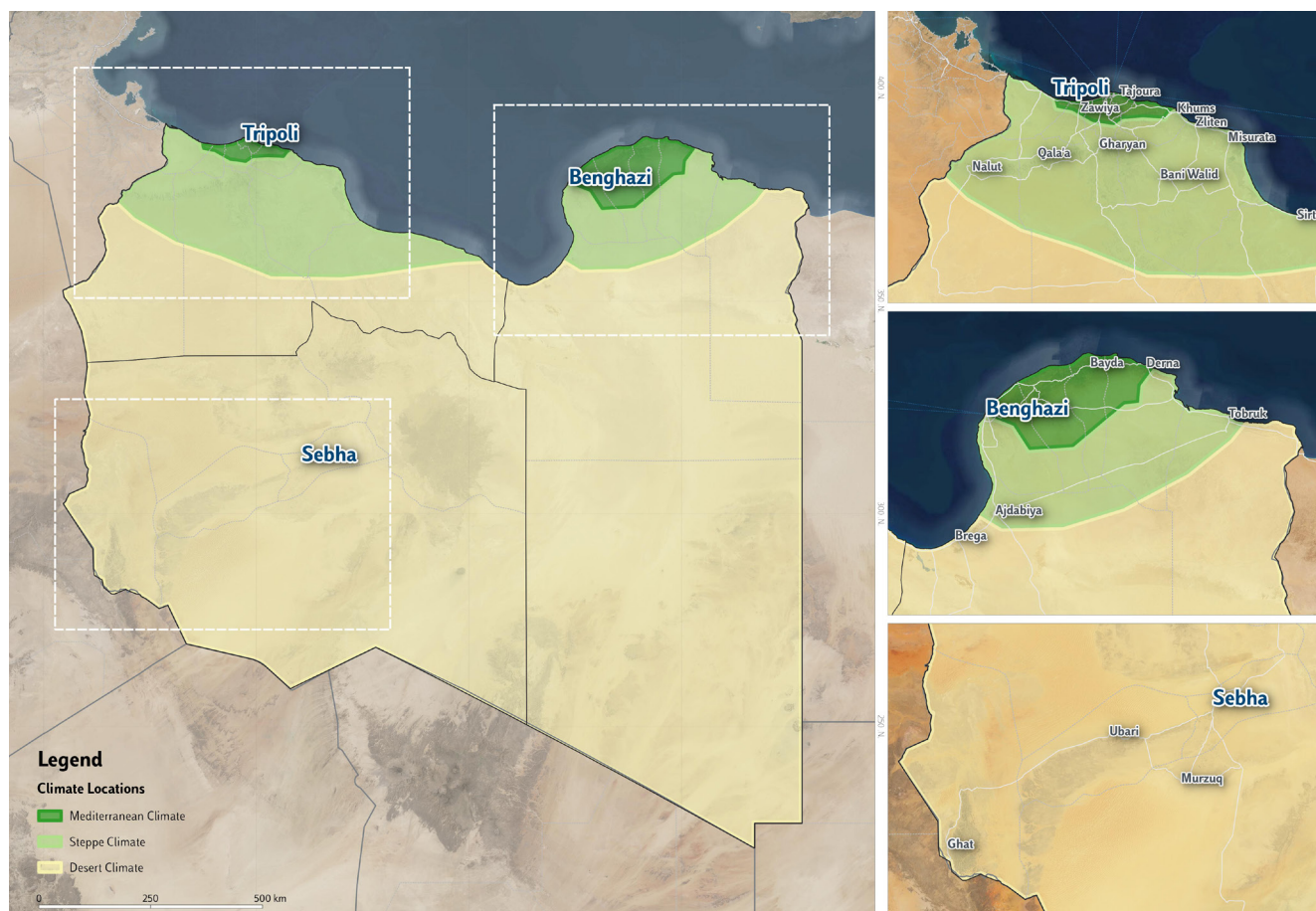
This study surveys the environmental challenges specific to each surveyed region, attempting to shed light on the climate conditions, geography, socio-economic characteristics, and behavioural patterns of each area. In doing so, it explains how these factors exacerbate certain environmental challenges in some areas over others. For instance, challenges related to water accessibility are largely shaped by geographic location. Therefore, in each specific case, it is key to highlight the distinct features of Libya's north-western, north-eastern, and southern regions and to provide examples on how their locations affects the daily lives of the residents.

Climate change is affecting the country significantly, with temperatures rising by 0.5 degrees Celsius since the 1970s. By 2050, temperatures are expected to increase by another 2 degrees Celsius, leading to more frequent heatwaves and more days of drought. Additionally, annual rainfall is projected to decrease by 7 percent by 2050, alongside an increase in the intensity of rainfall when it does occur.¹⁹

¹⁹ International Committee of the Red Cross (ICRC), "Terms of Reference used for the Benghazi Sanitation Masterplan", 2021, https://www.icrc.org/en/download/file/164845/tor_a_1_-_benghazi_technical_tor_sanitation_master_plan.pdf.

Below is an overview of each city included in this study, detailing its climate zone²⁰ and the specific environmental challenges it faces.

Figure I: Climate map



Visual realised by Ayoub Lahouioui.

Northwest Libya

Libya's northwest is a steppe climate zone that has an average annual temperature of 20.1 degrees Celsius and yearly rainfall between 100 and 350 millimetres, with very high humidity levels above 70 percent. The Mediterranean climate zone, found around Tripoli, has average temperatures of 16.5 degrees Celsius and more than 500 millimetres of annual rainfall. Humidity in this zone varies from 31 percent to 96 percent throughout the year, dropping to 39 percent on most days around 1 July and exceeding 94 percent around 12 January.²¹

Libya's capital, **Tripoli**, is the country's largest city and political and economic centre; it is home to 1.2 million²² people of the country's 6.8 million. Historically, the suburban areas around Tripoli had a significant vegetation cover that played a crucial role in forming the city's green belt.²³ However, a drastic change in the past years, driven by three factors, has contributed to the shrinkage of this cover. First, the rapid pace of urbanisation has transformed stretches of fertile agricultural lands into residential zones. This is especially noticeable in southern Tripoli. Second, the conflict led to a collapse in the role of regulatory agencies protecting the environment. The result was more building violations.²⁴ Third, climate change compounded the problem, decreasing rainfall and increasing drought frequency.

20 Libya has three climate zones: the desert climate, Steppe climate, and the Mediterranean climate.

21 ICRC, "Terms of Reference".

22 World Population Review, "Tripoli Population 2024", last accessed March 17, 2024, <https://worldpopulationreview.com/world-cities/tripoli-population>.

23 The country's green belt runs along the Mediterranean coastline, covering 200 kilometres between Tripoli and Misrata.

24 Le Monde, "In Western Libya, Deforestation, Drought and Urbanization 'Have Destroyed Everything'", *Le Monde*, May 4, 2023, <https://www.lemonde.fr/en/>

The gradual loss of the green belt that once encircled the city has had an impact on the quality of life of the residents in the city. Agricultural activity in the suburbs is in a state of stagnation. Local farmers are unable to satisfy the demands of the city.²⁵ Before 2011, the belt was maintained as a protective barrier against the annual dust storms. However, its shrinkage has made the city more susceptible to dust storms and other extreme weather conditions.

Tajoura is a coastal suburb located east of central Tripoli. Its proximity to the coast and its climate conditions makes it an important area for both fishing and agriculture, particularly strawberries. Although the GMMRP (Great Man-Made River Project) transports water to coastal cities, Tajoura is not included in the GMMRP network. This exclusion has compelled the residents to rely on groundwater, placing additional pressure on local water sources.

Bani Walid is another city in the northwest, located on the edge of the desert, between two valleys named Wadi Alblad. It relies primarily on its agricultural sector, which is supported by both rain-fed and irrigated systems, depending on rainfall and seasonal torrents. In the last decade, the city's main sector of agriculture has diversified, focusing on olive and vegetable crops, as well as on melons and cucurbits. Barley and alfalfa are also grown for fodder to support livestock farming, mainly sheep and camels.²⁶ The city is affected by seasonal changes, often resulting in either flash floods or droughts in the region.²⁷ Though much of Bani Walid's spending is allocated to solid waste management, the city continues to grapple with a major dumping problem.²⁸

Jabal Nafusa is a mountain range extending from the south of Tripoli to Tunisia. The residents of the region mainly rely on agriculture and sheep herding, with olives and olive oil being their primary products, followed by dried figs, almonds, and some seasonal fruits. Due to its mountainous terrain, the region is not connected to the GMMRP. Residents there rely on both water tanks associated with the river's network and rainwater. In the past years, climate change has reduced rainfall during the winters, negatively affecting agricultural activity and meaning increased dryness in summers, causing wildfires. The study covers Nalut and Qala'a, two areas in Jabal Nafusa.

Northeast Libya

Libya's northeast has a steppe and Mediterranean climate, with an average yearly temperature of 25 degrees Celsius. The city gets about 270–500 millimetres of rain each year, and humidity ranges from 55 percent to 61 percent. It experiences two main seasons: a hot and dry summer from April to September, with the hottest month being August, and a cold, wet winter from October to March, with January typically being the coldest and wettest month.

Benghazi is the second major city of the country and the capital of north-eastern Libya; it has a population of 800,000 people.²⁹ The city plays a major trade role in Libya despite the long closure of its port. Nearly 30 percent of the city was destroyed in the conflict of 2014–2017.³⁰ Benghazi is connected to the GMMRP. But there are major concerns. Sewage leakages into drinking water,³¹ increase the risk of water-borne diseases.³² The city's pre-conflict water network and water treatment infrastructure was already inadequate, but it is now in urgent need of maintenance.

25 Malak Altaeb, *Developing Agribusiness to Empower the Local Agriculture Sector in Tripoli*, 2021, North African Policy Initiative (NAPI), <https://napipolicy.org/wp-content/uploads/2021/01/NAPI-Jan-2021-Policy-Briefing-Paper-Malak-Altaeb.pdf>.

26 Abdelnaser Omeran, Salahaldein Alsadey, and Maria Gavrilescu, "Municipal Solid Waste Management in Bani Walid City, Libya: Practices and Challenges," *Journal of Environmental Management and Tourism II*, no. 2 (2011): 228-237, https://www.researchgate.net/publication/227599691_Municipal_solid_waste_management_in_Bani_Walid_City_Libya_Practices_and_challenges.

27 Fawzi Aghael and Özlem Özer, "Human Perception in the Libyan Built Environment: Al-Khums and Bani Walid Cities as Case Studies," *International Journal of Architectural Research II*, no. 2 (July 2017): 157-174, https://www.researchgate.net/publication/318876049_Human_perception_in_the_libyan_built_environment_Al-Khums_and_Bani_Walid_cities_as_case_studies.

28 Omeran, Alsadey, and Gavrilescu, "Municipal Solid Waste Management".

29 UN Habitat, *City Profile of Benghazi, Libya*, 2018, UN Habitat, https://unhabitat.org/sites/default/files/documents/2019-04/city_profile_of_benghazi.pdf.

30 Libya Initiative Team, "Delays in Rebuilding Benghazi: The Case of the al-Sabry Neighbourhood." *MEDirections Blog*, March 30, 2022, <https://blogs.eui.eu/medirections/delays-in-rebuilding-benghazi-the-case-of-the-al-sabry-neighbourhood/>.

31 Ibid.

32 CEOB, "The Environmental dimension".

South Libya

Libya's desert climate zone covers most of the country, including the southern areas and the Sirte Gulf region. Here, temperatures change significantly with the seasons, averaging 30 degrees Celsius in the summer and 14.5 degrees Celsius in the winter. The area receives fewer than 25 millimetres of rain annually, making it very dry. Humidity is also low, ranging from 30 percent in the summer to 45 percent in the winter.³³

Sebha is the largest city of southwestern Libya,³⁴ and the historical capital of the Fezzan region; it is home to over 250,000 people. It is a key trade and logistic hub for the south and historically had a strong agricultural sector, with most farms being on the outskirts of the city.³⁵ Over the past decade, a combination of security and climate problems have drastically reduced – and in many cases, completely shut down – agricultural activity in the city. Sebha faces severe water availability problems, as it is not connected to the GMMRP. Moreover, its sewage network requires significant development in all districts. Like many other cities in Libya, Sebha has a major waste dumping problem.

Houn is a small oasis town located in the northern Fezzan region; it is the capital of Jufra.³⁶ Houn has an agricultural sector that produces different types of dates and is also known for its traditional crafts using palm trees, livestock skins, and wool.³⁷ The town has seen an increase in water scarcity and a decrease in rainfall, which has, in turn, increased the desertification of what was before arable land. This has naturally reduced agricultural productivity and intensified the impact of dust and sandstorms on the town.³⁸

4. Environmental Challenges and Research Findings

Water Scarcity

Libya relies on six main aquifers for 96 percent of its water supply. They are divided into two types: renewable shallow aquifers that depend on rainfall and surface runoff;³⁹ and non-renewable deep aquifers that are not suited for the current, rapid pace of human consumption. The non-renewable aquifers pose long-term challenges for water supply and sustainability.⁴⁰

The Kufra and Sarir Basins are deep aquifers in the southeast, also known as the Nubian Sandstone Aquifer. The fossil aquifer is the largest in the world, extending some two million square kilometres across eastern and south-eastern Libya, Chad, Egypt, and Sudan. It has a capacity of over 150,000 cubic kilometres of groundwater; more than that discharged by the Nile in 500 years.⁴¹ The coastal Jifara and Jabal Akhdar Basins are, respectively, in the Jifara Plain to the northwest and Benghazi to the northeast. They are primary sources of water for the northern cities in the country.⁴² Al-Hamada Basin extends from the northern part of the southern Fezzan region to the Mediterranean coast and has a capacity of 4,000 cubic kilometres. Further south, the Murzuq Basin in the southwest of Libya has a capacity of 4,800 cubic kilometres.⁴³

33 ICRC. "Terms of Reference".

34 UN Habitat. *City Profile of Sebha, Libya*, 2018, UN Habitat, https://unhabitat.org/sites/default/files/documents/2019-04/rapid_city_profile_sebha.pdf

35 United Nations Development Programme (UNDP) and the Food and Agriculture Organization (FAO) of the United Nations, *The assessment and improvement of the value chains and added value of agricultural commodities in the south of Libya. With a special emphasis on women's livelihoods*, 2021, <https://www.fao.org/3/cb7634en/cb7634en.pdf>

36 Mohamed, "The City of Houn," *Libya Observer*, April 16, 2021, <https://libyaobserver.ly/culture/city-houn>.

37 Israa Khalil, "The City of Houn in Libya," *Arab Countries Guide*, March 20, 2023, <https://arabcountriesguide.com/>

38 Ali Salem Eddenjal. *Dust/sand storms over Libya: Spatial distribution, frequency and seasonality, technical report*, 2015, World Meteorological Organization. <https://library.wmo.int/records/item/37483-dust-sand-storms-over-libya?offset=40>.

39 Bashir Brika, "Water Resources and Desalination in Libya: A Review," *Proceedings* 2018, 2, no. 11 (August 13, 2018): 586, <https://doi.org/10.3390/proceedings2110586>.

40 Ibid.

41 Mary Caperton Morton, "Ancient Water Underlies Arid Egypt," *EOS*, June 18, 2019, <https://eos.org/articles/ancient-water-underlies-arid-egypt>.

42 ICRC, "Terms of Reference".

43 Ibid.

Over 90 percent of Libya's water is sourced from the GMMRP, which channels water from southern aquifers to the population residing in the northern coastal areas. The project provides water for agriculture, domestic, and industrial uses through a network of 1,300 wells and 4,000 kilometres of pipes. Only three of the project's five envisioned phases have been completed. It, nevertheless, transports 6.5 million cubic meters of water *per* day to the country's major cities including Tripoli, Benghazi, Tobruk, Sirte, and Zawiya.⁴⁴

The GMMRP project significantly improved water access from 1991 onwards, providing an alternative to coastal groundwater aquifers and desalination methods. However, by the onset of the revolution in 2011, 30 percent of the project was still incomplete.⁴⁵ The GMMRP has managed to operate under the challenging conditions created by the conflict, though it has yet to achieve nationwide coverage.

Libya's dependence on groundwater has made it susceptible to a water crisis, intensified by several factors. First among them is excessive well-digging and consumption. Annual consumption in Libya is estimated at one billion cubic meters, far exceeding the replenishment rate of 250 million cubic metres *per* year.⁴⁶ With an average rainfall of less than 100 mm of precipitation annually,⁴⁷ water consumption pressures groundwater sources at an estimated 1,550 percent, depleting supplies and increasing seawater intrusion. This is concerning as the country's population grows. There are no sustainable water resources such as desalination and wastewater treatment facilities.

Libya's protracted conflict has taken a heavy toll on the GMMRP. Work on its two final phases was disrupted by security concerns: international companies were not able to operate at network sites. Also, attacks on the GMMRP have put over 190 wells out of service.⁴⁸ As a result, water supply has been interrupted for multiple periods since 2011, sometimes for over six hours a day.⁴⁹ Water infrastructure is already in a poor state which, according to the General Company for Water and Wastewater, causes the loss of nearly 50 percent of transported water.⁵⁰ This has pushed residents to dig more private wells, which has further added to the pressure on water resources.

Finally, water is highly subsidised in Libya, rendering the current management model unsustainable. Libya's water institutions are weak and have no formal form of revenue generation. The average country in the MENA region charges at least five times as much as Libya; and the average country in the world charges nearly thirteen times as much.⁵¹ The problem is exacerbated by corruption at the administrative level and the lack of completion of water projects, such as the GMMRP, and even desalination and water treatment plants.⁵²

44 Achref Chibani, "From the River to the Sea: Water Management in Libya," *Tahrir Institute for Middle East Policy*, July 14, 2022, <https://timep.org/2022/07/14/from-the-river-to-the-sea-water-management-in-libya/>.

45 EPCM, "History and Long-Term Fate of the Great Man-Made River in Libya," *EPCM Holdings*, <https://epcmholdings.com/history-and-long-term-fate-of-the-great-man-made-river-in-libya/>.

46 Ahmad al-Khamisi, "Severe Water Crisis Looming in Libya," *The New Arab*, March 20, 2015, <https://www.newarab.com/news/severe-water-crisis-looming-libya>.

47 World Bank (WB) Climate Change Knowledge Portal, "Climate Change Overview Country Summary (Libya)," last accessed March 17, 2024, <https://climateknowledgeportal.worldbank.org/country/libya>.

48 Abdulkader Assad, "UNICEF warns of imminent water shortage in Libya," *Libya Observer*, February 2, 2021, <https://libyaobserver.ly/news/unicef-warns-imminent-water-shortage-libya>.

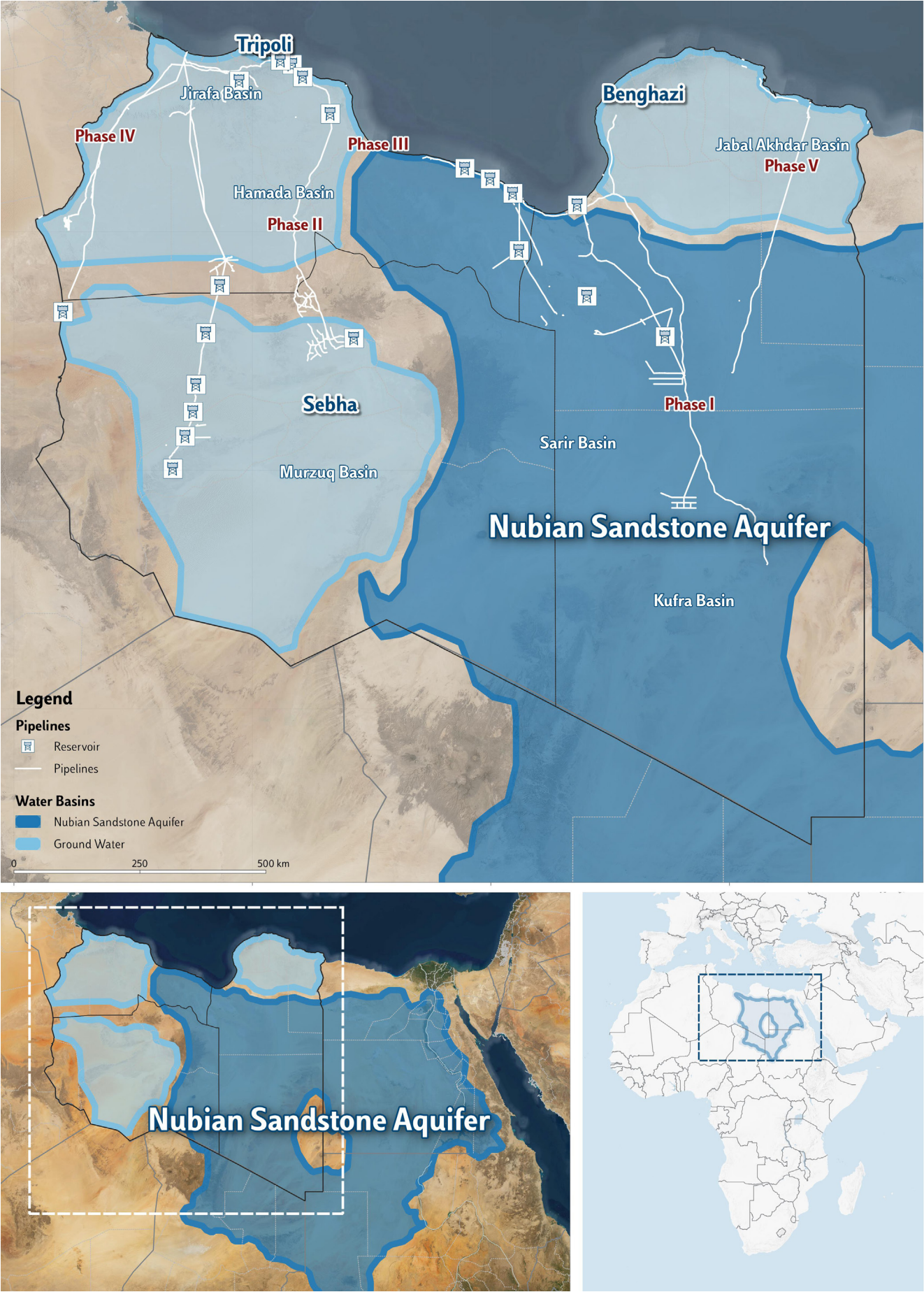
49 Ulf Laessing and Ahmed Elumami, "In Battle for Libya's Oil, Water Becomes a Casualty," *Reuters*, July 2, 2019, <https://www.reuters.com/article/idUSKCN1TXOKS>.

50 Assad, "UNICEF warns".

51 Samantha Kuzma, Marc F.P. Bierkens, Shivani Lakshman, Tianyi Luo, Liz Saccoccia, Edwin H. Sutanudjaja, and Rens Van Beek, *Technical Note: Aqueduct 4.0: Updated decision-relevant global water risk indicators*, 2023, World Resources Institute, https://files.wri.org/d8/s3fs-public/2023-08/aqueduct-40-technical-note.pdf?VersionId=G_TxTR2LAnlgXGzy7xtDUP_5lmkXJY7d.

52 Malak Altaeb, "Water Politics in Libya: A Crisis of Management, not Scarcity," *Arab Reform Initiative*, June 29, 2021, <https://www.arab-reform.net/publication/water-politics-in-libya-a-crisis-of-management-not-scarcity/>.

Figure II: Water resources and infrastructure



Visual realised by Ayoub Lahouioui.

Findings

Water accessibility and quality

The interviews showed that water accessibility and quality vary across Libyan cities. Tripoli relies on the GMMRP and independent wells for its water supply, which is fairly consistent in politically-stable times. Residents often use water filters to ensure that water is free of impurities. In the central Gwea'a area, well water is of good quality and consumed directly.⁵³ In contrast, the municipality of Tajoura is one of the least serviced areas in Tripoli in terms of public services. A resident noted that locals with no access to the GMMRP have adapted by resorting to well-digging. However, the water from their wells is of such poor quality that it is unsuitable for drinking or washing. To mitigate these water quality issues, the resident explained that some Tajoura households have installed filtration systems. Additionally, it is common for families in Tajoura to rely on water supplied by local mosques.⁵⁴

Interviews with the residents of neighbouring cities Zawiya and Nalut reveal a reliance on groundwater aquifers due to the limited and uneven distribution of GMMRP water, with many lacking direct access to the network. Despite some households being connected to the GMMRP, their access to the water is limited. They, therefore, mostly depend on water tanks.⁵⁵ In Zawiya, groundwater is typically salty, but residents have recently begun accessing water from the GMMRP. Nalut residents face the same issue of salty water from groundwater aquifers and are addressing it through desalination efforts.⁵⁶ To the east, in the city of Bani Walid, water is similarly sourced from tanks, as well as rainfall. Information about water availability from the GMMRP is often shared among community members to facilitate water access.⁵⁷

In Jabal Nafusa, the difficulty and expense of digging wells has led residents to rely on water tanks, a solution that poses its own financial challenges.⁵⁸ In response to these challenges, some residents of Yefren have resorted to making unauthorised connections to the GMMRP. This step was taken out of a belief that government action would not be influenced by any calls from the public.⁵⁹

A Benghazi resident reported that even though the GMMRP covers the area where he lives, his family still experienced water disruptions during the months of July and August, three years ago. To mitigate these interruptions, they installed a water tank and began sourcing water from outside Benghazi. However, the water they obtained was of very low quality. They had to search for water elsewhere. In contrast, eastern Benghazi has an uninterrupted water supply due to its reliance on groundwater aquifers.⁶⁰ The city faces a notable disparity in water quality. Some areas enjoy good quality water, while others have to treat salty well water using water filters.⁶¹

A resident from the Hawari district in Benghazi, who has lived in the city for five years, confirmed these observations. Living near the GMMRP network, he attested to the good quality of water in his area. However, he acknowledged that other areas of the city face difficulties with water quality, obliging them to either purchase bottled water or rely on filtration systems.⁶²

Toward the south, in Sebha, people used to rely on municipal water for their household needs, rarely requiring in-house tanks. However, in the mid-2000s, family tanks became a common feature in houses. With increased demand, people began to rely on shallow wells known as *faskiyahs* to extract more water.⁶³ In the neighbouring city of Houn, drinking

53 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

54 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

55 The resident noted of Nalut/Zawiya noted that families in the area sometimes have two tanks in the house, one for fresh water and another for wastewater.

56 Interview with a resident of Nalut/Zawiya, online call, 7 December 2023.

57 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

58 Ibid.

59 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

60 Interview with a resident of Benghazi, online call, 24 October 2023.

61 Interview with a resident of Benghazi, online call, 30 November 2023.

62 Interview with a resident of Benghazi, online call, 26 January 2024.

63 Interview with a resident of Sebha, online call, 1 October 2023.

water is generally available and of good quality, with filtration used when needed. However, there is concern regarding the sustainability of water supply, especially with the decrease in rainfall and the absence of sufficient connections to the GMMRP.⁶⁴

Factors affecting water and response efforts

The respondents highlighted different factors affecting water availability and access for each area, including consumption practices, electricity cuts, political and governance issues, and contamination.

Libya faces a significant challenge with the excessive use of water. It is underscored by a limited awareness of environmental concerns, particularly in relation to water consumption habits and culture.⁶⁵ Respondents from Tripoli, Benghazi, and Sebha have all specific patterns of water overconsumption. The value of water is further diminished by the fact that it is free in Libya. While some families overconsume water, others prioritise its conservation. However, these conservation practices vary depending on social status and financial capacity rather than on an awareness of the value of water.⁶⁶

During the past decade, water availability and access have been heavily affected by political and governance issues rather than by environmental factors. In the absence of effective management, extended power cuts across Libya lasted up to 20 hours, resulting in the interruption of water services (that depend on water pumps).⁶⁷ Consequently, residents from Tripoli, Benghazi, and Sebha noted that they would have to use water tanks or in some cases, search for water from different sources outside of the city.

The deteriorating water pipeline network, which suffers from a chronic lack of maintenance, has also been subjected to vandalism and theft. In recent years, criminals targeting the infrastructure have led to temporary water cut-offs in several cities, including Bani Walid, Sebha, Benghazi, and Tripoli.⁶⁸ A resident of Benghazi explained that the city's internal network is in a dire condition, noting intentional damage to pipes that resulted in water contamination.⁶⁹ Furthermore, in July 2021, the Misurata municipality reported a raid on a station, disrupting water supply to Bani Walid, Misurata, al-Khums, and Zliten.⁷⁰ Adding to the disruptions, the GMMRP Authority announced, in July 2023, that a water pipe in the town of Ajdabiya, close to Benghazi, was damaged due to the theft of air valves and protective copper cables.⁷¹

To address water shortages, a respondent in Sebha said that wells, along with the tanks, became essential, especially during extended electricity shortages. He noted that international organisations such as UNDP and IOM have supported well-digging efforts since 2016, often alongside the municipality, which has struggled with weak management.⁷²

A respondent from Nalut highlighted the importance of water tanks, mentioning that although prices have risen, the municipality has intervened to stabilise them. The average price is now between 50 to 70 LYD. However, in instances where fuel is not available, the price can escalate to 100 LYD. He explained that the efforts by the municipality have been ongoing, and that in Cabaw, a pump has been installed at a higher elevation to reduce the distance water must travel, enhancing efficiency.⁷³

64 Interview with a resident of Houn, online call, 3 October 2023.

65 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

66 Interview with a resident of Tripoli/Qala'a, online call, 6 October 2023.

67 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

68 Abdulkader Assad, "Vandalism in Libya's Man-Made River cuts water to Misrata and surroundings", *Libya Observer*, July 29, 2021, <https://libyaobserver.ly/news/vandalism-libyas-man-made-river-cuts-water-misrata-and-surroundings>.

69 Interview with a resident of Benghazi, online call, 8 December 2023.

70 Ibid.

71 Africa News, "Libya: Leakage in man-made river pipeline causes flooding", *Africa News*, July 21, 2023, <https://www.africanews.com/2023/07/21/libya-leakage-in-man-made-river-pipeline-causes-flooding/>.

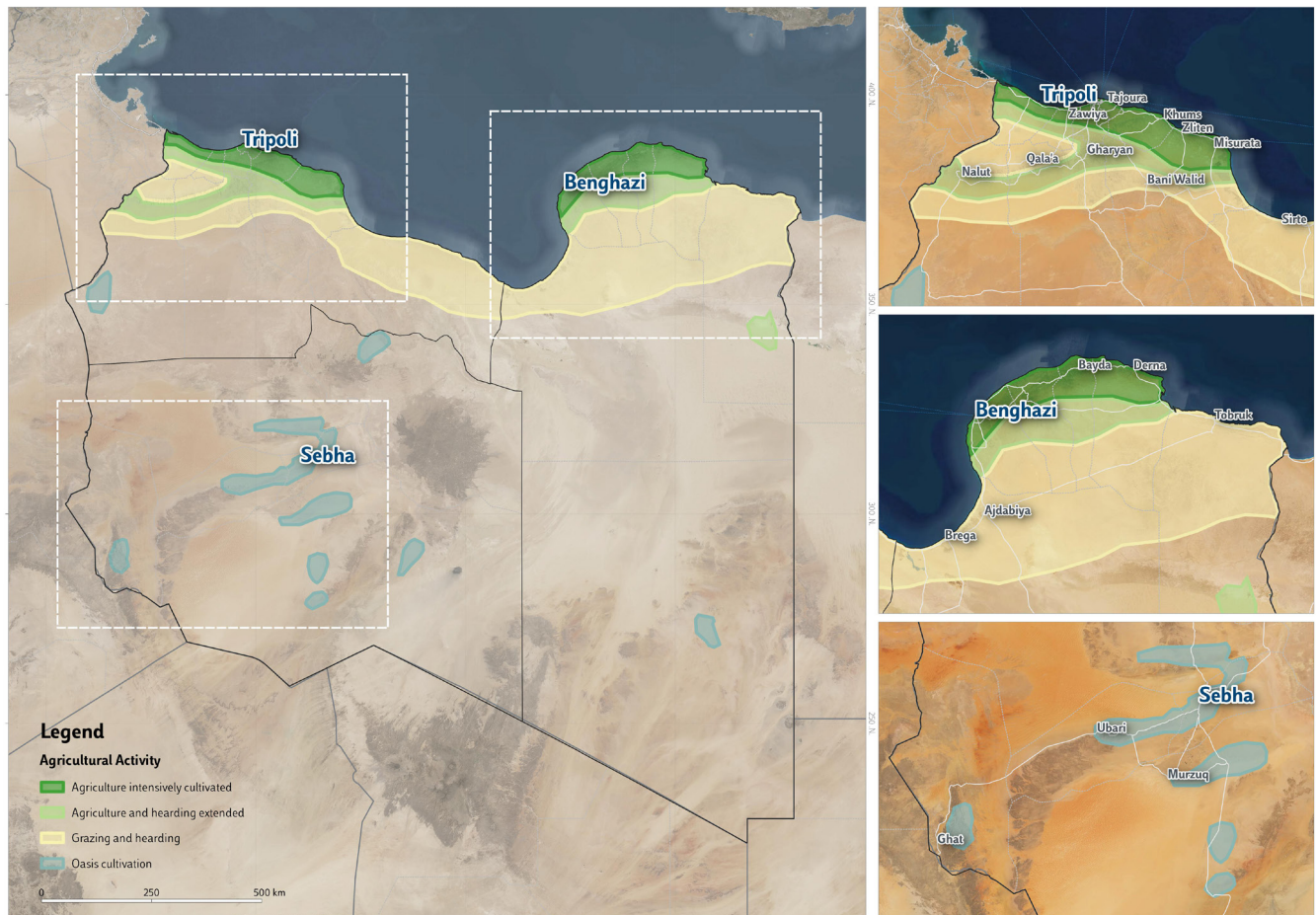
72 Interview with a resident of Sebha, online call, 12 October 2023.

73 Interview with a resident of Nalut/Zawiya, online call, 7 December 2023

Agricultural Decline and Desertification

Libya's extensive territory of 1.76 million square kilometres makes it larger than France, Spain, Germany, and the UK put together. Despite its vastness, only four percent of its land is arable and less than half of that is being used for agriculture.⁷⁴ Most of the country's agricultural activity is concentrated along the northern Mediterranean coast, in certain mountainous areas, and within the southern oases.⁷⁵ In addition, the Jabal al-Akhdar, in the northeast, and the suburbs of Tripoli and the Nafusa Mountains, in the northwest, have rain-fed farmlands. However, the reduction in rainfall in the past years has necessitated a shift towards relying on groundwater for irrigation, highlighting the environmental challenges faced in these agricultural areas.⁷⁶ While up to 470,000 hectares in Libya are suitable for irrigation, only half of them are being actively irrigated due to concerns about depleting the country's groundwater resources.⁷⁷

Figure III: Agriculture map



Visual realised by Ayoub Lahouioui.

In the 1950s, the agriculture sector accounted for 25 percent of Libya's GDP and employed 70 percent of its workforce.⁷⁸ The discovery of oil, however, significantly altered the country's economic landscape. With the largest oil reserves in Africa, Libya became one of the world's leading oil producers, with many new jobs in the public energy sector. This shift led to a marked

⁷⁴ Abdalla Bader Hamed Al-Hasse, *An Introductory Study on the Status, Challenges and Prospects of the Libyan Economy Part I of a Baseline Study for the Libya Socioeconomic Dialogue Project*, 2021, UNESCWA, https://archive.unescwa.org/sites/www.unescwa.org/files/publications/files/challenges-prospects-libyan-economy-english_0.pdf

⁷⁵ Hamdi A. Zurqani, Elena A. Mikhailova, Christopher J. Post, Mark A. Schlautman, and Azzeddin R. Elhaweij, "A Review of Libyan Soil Databases for Use within an Ecosystem Services Framework", *Land* 8, no. 5 (May 18, 2019): 82, <https://www.mdpi.com/2073-445X/8/5/82>.

⁷⁶ World Organisation for Animal Health (WOAH), Libya, *WOAH*, last accessed March 17, 2024, <https://rr-middleeast.woah.org/en/about-us/regional-members-of-woah/libya/>

⁷⁷ FAO, "SMIAR - Système mondial d'information et d'alerte rapide", FAO, December 6, 2023, <https://www.fao.org/giews/countrybrief/country.jsp?code=LB&lang=FR>

⁷⁸ Lisa Anderson, "Oil and Water: Agricultural Development in Libya. In: *Terroirs et sociétés au Maghreb et au Moyen Orient*", MOM Éditions, 1987, pp. 271-292, https://www.persee.fr/doc/mom_0295-6950_1987_act_2_1_3796

decline in agricultural employment, dropping from 7.2 percent in 1996 to less than 3 percent by 2011.⁷⁹ The agriculture sector's growth and productivity suffered, primarily due to a lack of skilled labour. Today, the energy sector dominates Libya's economy, representing over 70 percent of the GDP,⁸⁰ while agriculture has dwindled to just 1.3 percent.⁸¹

Although the Gaddafi regime focused on developing the energy sector, there were some attempts at agricultural self-sufficiency. In the 1970s to 1980s, the government launched three development plans called the Three-Year Plan (1973-1975), Five-Year Plan (1976-1980), and Five-Year Plan (1980-1985). These ambitious projects were to use massive strategic investments to achieve agricultural self-sufficiency, among other socio-economic development goals. They encompassed six key areas: land reclamation, groundwater use (GMMRP), livestock farming, crop cultivation, pasture improvement, and forestry expansion.⁸² However, upon completion, the three development plans failed to achieve self-sufficiency. This was due to poor management, insufficient specialisation, and priorities that did not align with the sector's needs.⁸³ In addition, they took a heavy toll on the environment by overexploiting groundwater for irrigation.⁸⁴

The decline in agriculture has made Libya heavily reliant on food from outside the country. For example, in 2018, only a quarter of Libya's agricultural demand was met domestically, while the rest was covered by imports. Today, the country imports nearly \$3 billion worth of food, feed, and fibre annually.⁸⁵ This accounts for about 80 percent of its food consumption needs and 90 percent of its cereal requirements.⁸⁶ Food security has also been negatively impacted both by the protracted conflict, which has resulted in long power cuts, the reduced availability of fertilisers, and ultimately, farm abandonment. Global conflicts, primarily the Ukraine-Russia War, have led to price increases for many food items. Russia and Ukraine are major suppliers, providing over half of Libya's wheat and grain supply.⁸⁷

Libya's vulnerability to desertification has intensified; it is compounded by rising temperatures, decreased rainfall, and extended droughts, alongside human activities like unchecked urban expansion, the overexploitation of water resources, and overgrazing. The acceleration of desertification presents four critical socio-economic challenges: first, it leads to the loss of arable land, thereby undermining agricultural productivity and food security;⁸⁸ second, it results in the loss of plant and animal species, which destabilises ecosystems; third, it increases atmospheric carbon dioxide levels, contributing to temperatures rising further; and finally, it heightens the severity of extreme weather events, such as dust storms, causing further land degradation.

Findings

All respondents observed significant changes in their cities in terms both of the impact of human activity and climate change on the environment. They highlighted key issues, such as conflict within Libya, increased urbanisation, reduced vegetation cover, desertification, higher temperatures, and reduced rainfall. These factors, they explained, brought about changes that have threatened people's livelihoods, local economies, and made their cities more prone to long-term sustainability challenges, such as water scarcity and food insecurity.

79 USAID, *USAID Country Profile: Property Rights & Resource Governance*, USAID, 2016, https://www.land-links.org/wp-content/uploads/2016/09/USAID_Land_Tenure_Libya_Profile-1.pdf.

80 Al-Hasse, *An Introductory Study*.

81 Chris Lyddon, "Focus on Libya", *World Grain*, January 26, 2018, <https://www.world-grain.com/articles/10295-focus-on-libya#:~:text=A%20chaotic%20political%20situation%20with,marketing%20sectors%20facing%20enormous%20challenges>.

82 Aman Ramali, "Agricultural Planning in Libya during Transformation Plans", *Al-Jameai Academic Journal*, (2020), <https://www.aljameai.org.ly/index.php/aljameai/article/view/272/230>

83 Ibid.

84 Anderson, "Oil and Water".

85 FAS Morocco, *Exporter Guide: Libya*, US Department of Agriculture and Global Agricultural Information Network (GAIN), 2020, https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Exporter%20Guide_Rabat_Libya_03-06-2020

86 Ibid.

87 FAO, "SMIAR".

88 Mert Bastas and Abu Azoum Abdelrahim, "Awareness of desertification of arable land among university students in Libya", *Religación*, No. 4 (March 3, 2019): 13, pp. 194-204, <https://www.redalyc.org/journal/6437/643768221017/html/>

The conflict created a context of unregulated urbanisation. Interviews from several cities revealed a shared concern over the rapid expansion of residential areas and its detrimental effect on public green spaces. In Tripoli, cutting trees before winter or Eid has become a routine practice, to the extent that people no longer conceal it from the authorities.⁸⁹ A resident of Tajoura recalled that he had observed the same problem from a young age. But he has noticed as he got older, that locals do not plant anymore and that they have completely abandoned farming.⁹⁰ He detailed how the absence of security and official oversight in both Tajoura and Jabal Nafusa has led to a significant shrinkage in the vegetation cover across Tripoli and along the road to the western mountains of Jabal Nafusa. On the roads he noted a drastic increase in plastic pollution and no action to clean up.⁹¹

In conflict zones, the same respondent noted that military attacks had an impact on green spaces as well, as farms were often abandoned due to maintenance and access challenges.⁹² Southern Tripoli, in particular, endured severe armed conflict and farmers left their lands unattended for extended periods. During Khalifa Haftar's 2019-2020 assault on Tripoli, some farms suffered crop losses due to shell fragments. The situation added another layer of difficulty to the farmers, who were already battling the effects of urbanisation, poor support, and droughts.⁹³

A Benghazi resident has witnessed the same trend in the past years. Significant green areas in the city have all but disappeared, and there has been a sharp decline in the number of parks.⁹⁴ Another resident confirmed this, highlighting how there are several building violations in the city, with green spaces being demolished to make way for urban development projects.⁹⁵ A similar tree cutting trend was reported in the southern city of Houn, which has reduced its vegetation cover.⁹⁶

The interviews also confirmed that Libya's already limited agricultural land is shrinking, contributing to environmental degradation and ultimately, desertification. A respondent from Sebha explained that agriculture was an integral part of life for the people of the city, with families tending to their farms and growing their own crops. These include onion, garlic, and tomatoes. However, from the mid-1980s, land use started to change, and building houses on farmland became more common, leading to a decline in the number of farms. In 2022, the Agriculture Office reported that approximately 358 properties in Sebha were transformed into urban areas in 2022.⁹⁷ This trend has increased due to two factors: first, a decline in farmer support, as agricultural associations stopped supplying materials and machinery at subsidised rates;⁹⁸ and second, an increase in desertification and high temperatures, which added to water scarcity.⁹⁹ The increasingly difficult circumstances have pushed families to abandon their farms, and in some cases, sell them and leave the city for Tripoli or Misurata, where there are better services.^{100 101}

The same problem was echoed in the southern city of Houn, where there are rising temperatures and reduced rainfall. A resident of the city observed that the environmental shift caused by desertification has led residents to over-extract water from aquifers, further exacerbating conditions. Moreover, until 2011, the agricultural project called Lode significantly contributed to storm management near Houn. Since its discontinuation, locals have reported an unusual increase in high winds.¹⁰²

89 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

90 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

91 Ibid.

92 Ibid.

93 Ibid.

94 Interview with a resident of Benghazi, online call, 30 November 2023.

95 Interview with a resident of Benghazi, online call, 8 December 2023.

96 Interview with a resident of Houn, online call, 3 October 2023.

97 Faraj M. Alhadar and Embarka S. Najem, "Problems and Obstacles facing agriculture in Sebha during the period (1984 – 2022)", *The 17th Geography Conference, Bani Walid, 2023*.

98 Interview with a resident of Sebha, online call, 1 October 2023.

99 Interview with a resident of Sebha, online call, 12 October 2023.

100 Ibid.

101 A few families remain in the small town of Fugha, despite the difficult living conditions, due to the strong connection they feel with the place. Interview with a resident of Houn, online call, 3 October 2023.

102 Interview with a resident of Houn, online call, 3 October 2023.

Although desertification poses a significant threat to Benghazi, a city resident highlighted a recent shift towards prioritising flood mitigation in the wake of the catastrophic floods in Derna. Communities residing near valleys have now redirected their attention to maintaining the dams as a precautionary measure against future flood events.^{103 104}

Climate-induced threats: Rising temperatures, reduced rainfall, and water scarcity

Several respondents observed that the factors highlighted above have accentuated the water and agriculture challenges in their cities. They also noted different, more intense climate patterns and reflected on how this has had a negative impact on agriculture productivity in the past years.

In the Jabal Nafusa town of Nalut, the once abundant rainfall that nourished diverse crops including figs, olives, oranges, lemons, and pears has dramatically decreased. A resident of the area observed that the last time it rained was in 2018. This decline in rainfall has led to less irrigation water, which has negatively affected agricultural yields. She recalled how her grandfather sold olive oil, tomatoes, onion, and dates but that both the quantity and quality of their agricultural produce has plummeted since 2015. For example, while her grandfather produced an average of 1,500 litres of olive oil *per* year in the past, he was only able to produce 60 litres by 2021, and 500 litres in 2023. Even the cost of animal fodder like barley and, by extension, the overall cost of herding, is affected by this decrease in productivity, marking a profound shift from her grandfather's time.¹⁰⁵

The respondent also shared how her family has tried to mitigate the issue of irrigation water scarcity by digging wells. She noted a stark contrast with the early 2000s, when they found water at a depth of five metres, to the current day, when it is found at a depth of 30 to 35 metres. They finally resorted to installing an irrigation system, requiring her father to make weekly trips to the mountains to operate the sprinklers. She reflected on how these irrigation methods differed from the past, when her grandfather relied on rainfall reserves to cover all their agricultural needs.¹⁰⁶

Similarly, in the mountainous region of Qala'a, the residents – who traditionally farm grapes, olives, and figs – have seen a significant decline in agricultural yield over the last five years, with no production at all in 2021. Water scarcity has aggravated these challenges, making irrigation both difficult and costly. It has particularly affected olive groves. The families of Qala'a have had varied responses to the situation; while some struggle to maintain their crops, others have explored alternatives such as shifting to coal production or selling portions of their land to alleviate financial pressures.¹⁰⁷

In the southwestern city of Sebha, desertification and irrigation water scarcity have led many residents to sell their lands or seek livelihoods in other cities.¹⁰⁸ Likewise, in neighbouring Houn, agricultural productivity has suffered from the effects of high temperatures and reduced rainfall, with groundwater aquifers – a crucial water source – becoming unsustainable.¹⁰⁹ Like the farmers in the mountains, farmers in Houn have shifted from traditional sprinkler systems to the more efficient drip irrigation as a way to addressing irrigation water scarcity.¹¹⁰

The decrease of agricultural produce in the south has affected families who once depended on agriculture for their income. Today, staple crops such as onions, garlic, and tomatoes, which were grown in the Sebha and sold in the local Friday market, all face competition from imported produce.¹¹¹ Some farmers have cultivated more water-intensive crops such as alfalfa in an effort to maintain their competitiveness. The produce is exported to other cities, primarily in the north, to be used as fodder.¹¹²

¹⁰³ Interview with a resident of Benghazi, online call, 8 December 2023.

¹⁰⁴ Sami Zaptia, "After the Derna dams disaster, dams in Benghazi and Sirte receive attention", *Libya Herald*, September 22, 2023, <https://libyaherald.com/2023/09/after-the-derna-dams-disaster-dams-in-benghazi-and-sirte-receive-attention/>.

¹⁰⁵ Interview with a resident of Nalut/Zawiya, online call, 7 December 2023.

¹⁰⁶ Ibid.

¹⁰⁷ Interview with a resident of Tripoli/Qala'a, online call, 6 October 2023.

¹⁰⁸ Interview with a resident of Sebha, online call, 12 October 2023.

¹⁰⁹ Interview with a resident of Houn, online call, 3 October 2023.

¹¹⁰ Interview with a resident of Sebha, online call, 12 October 2023.

¹¹¹ Interview with a resident of Sebha, online call, 1 October 2023.

¹¹² Interview with a resident of Sebha, online call, 12 October 2023.

Most of the respondents expressed concern about the deteriorating state of agriculture in their areas. However, in four interviews – conducted in either Tripoli or Benghazi – residents reported either increased or stable levels of agricultural activity. It is important to note that this turn to farming is more for personal consumption than to meet market needs.

Over the past three years, the suburbs of Tripoli have seen a growth in agricultural activity. The lack of leisure space and recreational activities in the city encouraged residents to turn to farming. Despite the sandy soil, better quality and variety of produce are being cultivated than before, including olives, palms, and different fruit trees.¹¹³ For example, papaya and cherries, which were previously not available, are now being grown in the region; moreover, strawberries and melon are also more readily available.¹¹⁴

A resident of Tajoura confirmed this trend. He reported an increase in his family's agricultural activities following retirement. Tajoura, renowned for its strawberries, provides the ideal setting for their cultivation, which his family takes advantage of, along with growing olive trees and seasonal vegetables. He highlighted that irrigation water is becoming an issue and that tanks replenish at a slower rate than before. However, this change in water availability has not greatly affected their farm's yield.¹¹⁵

Likewise, residents of Benghazi have embraced home farming in the past four years or so, cultivating mainly herbs and vegetables such as mint, basil, tomatoes, lemon, and peppers. This is done both for consumption and for the beauty of their homes.¹¹⁶ A respondent in the city said that her father maintains a small farm for personal use, where he grows a variety of vegetables and fruits, including olives, and even engages in beekeeping for honey. Although the water supply was initially weak, recent well-digging has improved water availability, despite some irregularities in water distribution.¹¹⁷

The increase in agricultural activity in some parts of Tripoli and Benghazi could be a promising development in local agriculture. However, it is worth noting that these changes do not reflect the overall state of the sector in the cities; instead, they indicate residents' personal interest in farming. The observations on decreasing irrigation water in Tripoli or irregular water distribution in Benghazi are a cause of concern. In Tripoli, for example, where there is relatively stable water supply, the increase in the availability and variety of fruit could also be an indication of potential water overconsumption, echoing sentiments expressed in many other interviews.

Water and Air Pollution

Libya is grappling with air, water, soil, and marine pollution. A multiplying factor for these issues is demographic concentration, with over 80 percent of the population residing in coastal urban centres. Cities like Tripoli and Benghazi have the highest urban density and have witnessed rapid urbanisation and population growth. From 1948 to 2008, the urban population surged from 40 to 80 percent.¹¹⁸ This meant a notable increase in vehicles, to make up for the absence of a reliable public transportation system; and an increase in construction activities, to accommodate housing and infrastructure needs. These developments have strained the cities' infrastructures, increasing water and air pollution and reducing vegetation cover.

Urbanisation has increased pressure on Libya's already inadequate sewage system, which struggles to cover many areas. The network is outdated and weak, with frequent blockages, breakages, and overflows.¹¹⁹ Rapidly expanding coastal cities like Tripoli and Benghazi rely on wastewater disposal methods that extract a heavy toll on the environment. They dispose sewage discharge into waste wells – called 'black wells' in Libya – or directly into the sea. The seawater was found to have a

113 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

114 Ibid.

115 Ibid.

116 Interview with a resident of Benghazi, online call, 24 October 2023.

117 Interview with a resident of Benghazi, online call, 30 November 2023.

118 Omar Elmansouri, Abdulmojeb Almroog, and Ibrahim Badi. "Urban transportation in Libya: An overview", *Transportation Research Interdisciplinary Perspectives*, No. 8 (September 2020): 1, https://www.researchgate.net/publication/344335840_Urban_transportation_in_Libya_An_overview

119 UN Habitat, *Benghazi*.

concentration of bacteria, 500 percent higher than normal. In addition, the shores are heavily polluted with cans and plastic bottles.¹²⁰ The Environment Ministry repeatedly closes these beaches due to escalating sewage and waste accumulation.¹²¹ The problem presents a health issue to people visiting the beaches, as well as a threat to marine and coastal wildlife: animals wash up dead on the shores or abandon the territory in high numbers.^{122 123}

The increase in waste across the country has led to most cities having a waste collection and disposal problem. Solid waste is accumulated in landfills, sometimes temporarily within cities or residential areas, further polluting the air and raising the risk of airborne diseases.¹²⁴ To illustrate the scale of the problem, in September 2019, a waste management crisis saw one of the landfills in Tripoli pile up to 25 meters, reaching over 250,000 tons of waste.¹²⁵ In the absence of waste management systems across the country, residents often resort to burning waste to get rid of its stench and unsightliness. But this adds to pollution and worsens air quality.¹²⁶

Air pollution is further aggravated by Libya's energy sector. Electricity generation in the country is the primary source of industrial air pollution as Libya has thirteen power stations. The electricity sector releases more carbon dioxide into the air than any other sector, increasing acid rain, poor urban air quality, and pushing climate change.¹²⁷ As a major oil producer, operations related to oil extraction have also inflicted considerable damage on the northeast's oases.¹²⁸ An assessment on air pollution in Benghazi highlighted that the air quality index was considered unsafe for children, the elderly, and individuals with respiratory conditions. The results also indicated that 61 percent of the overall quality index comes from human activities.¹²⁹

Finally, natural air pollution in Libya comes in the form of sand and dust storms. The country is located in the world's dustiest regions. As such it is susceptible to extreme weather phenomena that affect the entire country year round but particularly between January and June, peaking in March and April.¹³⁰ The sand and dust storms occur more frequently in the south, with 12.9 days annually in Houn and 11.1 days annually in Ghadames.¹³¹ Sandstorms transport pollutants and particulate matter thousands of kilometres, spreading dust, fungi, bacteria, and viruses.¹³² In the absence of environmental policies, climate change threatens to intensify the impact of sand and dust storms. This poses a considerable risk to agriculture and has a profound impact on public health and the economy.¹³³

120 Habib Tizi, "Libya: Tripoli's polluted beaches banned from swimming", *Afrik 21*, September 2, 2021, <https://www.afrik21.africa/en/libya-tripolis-polluted-beaches-banned-from-swimming/>

121 Africa News and AFP, "Pollution plagues Libya beaches", *Africa News*, August 26, 2021, <https://www.africanews.com/2021/08/26/pollution-plagues-libya-beaches/>

122 The New Arab, "Libya's polluted coastline is a symptom of state failure", *The New Arab*, February 13, 2024, <https://www.newarab.com/features/libyas-polluted-coastline-symptom-state-failure#:~:text=As%20Libya's%20duelling%20governments%20and,plastic%20bottles%2C%20and%20raw%20sewage.>

123 The New Arab, "Marine Life in Libya is Searching for a Way to Live", *The New Arab*, July 5, 2021, <https://www.alaraby.co.uk/society/>

124 Salahaldein Alsadey and Omran Mansour, "Environmental Impacts of Improper Solid Waste Management in Developing Countries: A Case Study of Bani Walid City", *Libya*, No. 7 (July 2021): pp. 108-111, https://www.researchgate.net/publication/353526561_Environmental_Impacts_of_Improper_Solid_Waste_Management_in_Developing_Countries_A_Case_Study_of_Bani_Walid_City_Libya

125 Rima Hamidan, *Waste management in Tripoli: A temporary crisis or a long-lasting imbroglio?*, EUI Middle East Directions, Policy Brief, Issue 2021/21, 2021, https://cadmus.eui.eu/bitstream/handle/1814/71655/PB_2021_21-MED-EN.pdf?sequence=1&isAllowed=y.

126 Ibid.

127 Yasser Nassar, Kaiss Rateb, and Samer Alsadi, "Air Pollution Sources in Libya", *Research & Reviews: Journal of Ecology and Environmental Sciences*, No. 6 (December 2017): pp. 63-79, https://www.researchgate.net/publication/323526028_Air_Pollution_Sources_in_Libya?fbclid=IwAR1hx0-J9OZ5KJhSVt13tx-lonas-KfyxAtwCr2-

128 Islam Alatrash, "Oil Pollution Threatens Libyan Oases", *Al-Monitor*, <https://www.al-monitor.com/originals/2022/12/oil-pollution-threatens-libyan-oases>

129 Fares Fares, Farag El-Oshebi, Elhadi Abogrean, and Khalid Glele, "Assessment of Air pollution in Benghazi City during February and March periods using Airvisual Outdoor Monitor", *Journal of Marine and Environmental Techniques*, No. 9 (June 2023): 15. https://www.researchgate.net/publication/373541668_Assessment_of_Air_pollution_in_Benghazi_City_during_February_and_March_periods_using_Airvisual_Outdoor_Monitor?fbclid=IwAR1YqrW2Jbb14PLUrTSCuPPFF0ECD0R7x4rt2YlrSdQ_Fbv_pvkY6rWok9s

130 Eddenjal. *Dust/sand storms*.

131 Ibid

132 Meo, Sultan Ayoub, Faris Jamal Almutairi, Abdulelah Adnan Abukhalaf, and Adnan Mehmood Usmani. "Impact of sandstorm on environmental pollutants PM2.5, carbon monoxide, nitrogen dioxide, ozone, and SARS-CoV-2 morbidity and mortality in Kuwait." *Journal of King Saud University - Science* 34, No. 5 (July 2022): 102109, <https://www.sciencedirect.com/science/article/pii/S1018364722002907>

133 Rima Hamidan, *Sandstorms in Libya: The Urgent Need for Policy Intervention*, Luiss Mediterranean Platform, Policy Brief, 2024, <https://mp.luiss.it/archives/sandstorms-in-libya-the-urgent-need-for-policy-intervention/>

Findings

Wastewater pollution and its impact

The information collected from the interviews on pollution provided a good entry point on this topic. But it lacked the depth to adequately explain how it is affecting the environment in Libya. Therefore, this section complements the findings of the interviews with a review of the most recent developments on pollution.

Wastewater disposal and sewage proved a common theme in interviews, across different cities. In Tripoli, the respondents highlighted that wastewater disposal in the sea is currently a major pollution issue, threatening both public health and marine life.¹³⁴ ¹³⁵ One of the respondents explained that the government often issues warnings against swimming¹³⁶ or fishing¹³⁷ in the sea, due to high contamination of the water. However, even though the residents are aware of these risks, they still use the sea because they lack alternatives.¹³⁸

In Tajoura, a resident confirmed that wastewater disposal amounts to a serious environmental and public health crisis. Disposal methods in the municipality include the direct discharge of wastewater into the sea and the use of thousands of unregulated black wells. He noted that in the absence of a sewage network, these black wells are a significant source of pollution, often resulting in the overflow of wastewater on the streets.¹³⁹ Temporary efforts to mitigate this issue – such as digging drainage holes, pumping away the sewage water, or burying swampy areas¹⁴⁰ – have failed to address the core issue.¹⁴¹ Moreover, due to the black wells' lack of proper insulation, water leaks occur, contaminating the groundwater used for drinking, risking the spread of water-borne diseases, killing trees and crops in agricultural land, and degrading the soil.¹⁴²

In Benghazi, the sewage network is outdated and inadequate, covering only 40 percent of municipality areas.¹⁴³ It has further deteriorated during the past decade due to four factors. The first is neglect; most of Benghazi's sewage network has not undergone any maintenance since 1988, resulting in its frequent interruption for short-term repairs.¹⁴⁴ The second factor is unregulated urbanisation. Coupled with over 40,000 people internally displaced by the conflict, Benghazi's rapid expansion has increased the pressure on the city's sewage network, often overloading it. Many municipalities in the city suffer from regular wastewater overflow, with entire streets sometimes being flooded.

Third, some residents have resorted to illegally connecting their sewage pipelines to the storm water network, which is a separate drainage system pumping water directly into the sea.¹⁴⁵ Unsurprisingly, these *ad hoc* solutions have polluted the sea, leading to large numbers of dead sardines washing up in the city port.¹⁴⁶ They have also compounded problems

134 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

135 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

136 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

137 Sami Zaptia, "Sewage Contaminated Tripoli Beaches Unfit for Swimming or Fishing", *Libya Herald*, June 12, 2019, <https://libyaherald.com/2019/06/sewage-contaminated-tripoli-beaches-unfit-for-swimming-or-fishing/>.

138 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

139 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

140 Al-Wasat, "Despite Attempts to Mitigate...Continuation of Rising Ground Water Levels in Zliten", *Al-Wasat*, January 17, 2024, <https://alwasat.ly/news/libya/426583>.

141 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

142 Ennajeh Rahil, Abdnasser Khalifa, and Tarek Abukreba, "Nitrate contamination of groundwater in the city of Janzour-Libya", Presented at the First International Libyan Water Conference & Exhibition 2018, April 2018, https://www.researchgate.net/publication/339727039_Nitrate_contamination_of_groundwater_in_the_city_of_Janzour-Libya

143 ICRC, "Terms of Reference".

144 Libya Initiative Team, "Delays in Rebuilding Benghazi".

145 Ibid.

146 Osama Ali, "Libya: Repeated Fish Deaths Indicate Increasing Marine Pollution", *The New Arab*, September 13, 2022, <https://www.alaraby.co.uk/society/%D9%84%D9%8A%D8%A8%D9%8A%D8%A7-%D8%AA%D9%83%D8%B1%D8%A7%D8%B1-%D9%86%D9%81%D9%88%D9%82-%D8%A7%D9%84%D8%A3%D8%B3%D9%85%D8%A7%D9%83-%D9%8A%D8%A4%D8%B4%D8%B1-%D8%A5%D9%84%D9%89-%D8%AA%D8%B2%D8%A7%D9%8A%D8%AF-%D8%A7%D9%84%D8%AA%D9%84%D9%88%D8%AB-%D8%A7%D9%84%D8%A8%D8%AD%D8%B1%D9%8A>

within the city. First, sewage has intruded into the drinking water network, infecting residents;¹⁴⁷ and, second, overlapping connections have blocked the drainage of rainwater, causing more frequent water overflows in the winter.^{148 149} Many of the city's residents are, in these circumstances, forced to stay at home.¹⁵⁰

Fourth, the conflict has also heavily damaged the sewage network of Benghazi, destroying many pipelines in several neighbourhoods. By 2020, all of the city's 28 wastewater lifting stations were out of service, many of their pumps having been destroyed after a shell landed on the General Company of Water and Wastewater in 2017.¹⁵¹ The neighbourhoods of al-Sabry and Downtown¹⁵² suffered particularly from sewage flooding that even posed a threat to the buildings. After the clashes had ended in 2017, draining the sewage water from the streets of al-Sabry took approximately one week.¹⁵³ Despite this effort, homes remained unsafe for residents, necessitating water contamination tests, house inspections, and street disinfections using fire trucks.¹⁵⁴

In the south, the sewage network has suffered from years of neglect. A respondent in Sebha who has previously covered the issue in depth recalled that the problems started in the 1990s and worsened after 2011.¹⁵⁵ Like Benghazi, the wastewater treatment plant was out of service due to pump stoppages.¹⁵⁶ In 2018, clogged sewage lines caused extensive flooding in the streets of al-Mahdia, Soukra, al-Jadid, and Abdelkafi, leading to traffic jams, shop closures. Some residents were obliged to relocate to areas with more reliable services.¹⁵⁷ A major part of the problem, however, lies beneath the surface, where the damaged sewage pipes means that only a quarter of water reaches the wastewater lift station.¹⁵⁸ The problem was compounded by power outages which lasted for several hours, despite attempts to mitigate the problem using electric generators.¹⁵⁹

Regarding water contamination, large water tanks in Sebha that were once connected to the general network are now out of service. This is primary due to a lack of maintenance. As a result, the tanks there became corroded, contaminating the water within them.¹⁶⁰ Another respondent in Houn similarly voiced concern about instances where wastewater mixed with groundwater, posing a heightened risk of contamination and water-borne diseases.¹⁶¹

Waste accumulation, power generators, and sandstorms

Air pollution is another environmental concern across Libya, compounded by poor waste management. For instance, during the 2019–2020 waste management crisis in Tripoli, landfills were shut down as they were at maximum capacity. The untreated organic matter in these landfills emitted large amounts of methane, a highly flammable gas, and posed risks of fires and explosions.¹⁶² As the crisis continued, waste piled up on the streets, polluting them and disrupting traffic.¹⁶³ In an attempt to get rid of its unpleasant odour and volume, residents burned the waste, releasing toxic gases and carcinogenic compounds into the air. This caused the operational failure of a power plant in southern Tripoli.¹⁶⁴ Similarly, a respondent in

147 Interview with a resident of Benghazi, online call, 30 November 2023.

148 Interview with a resident of Benghazi, online call, 24 October 2023.

149 Ibid.

150 Ibid.

151 ICRC, "Terms of Reference".

152 Interview with a resident of Benghazi, online call, 30 November 2023.

153 Libya Initiative Team, "Delays in Rebuilding Benghazi".

154 Ibid.

155 Interview with a resident of Sebha, online call, 12 October 2023.

156 Ibid.

157 Ibid.

158 Ibid.

159 Ibid.

160 Interview with a resident of Sebha, online call, 1 October 2023.

161 Interview with a resident of Houn, online call, 3 October 2023.

162 Hamidan, *Waste Management in Tripoli*.

163 Ibid.

164 Ibid.

Benghazi explained that the rapid urban expansion has outpaced the availability of waste dumping spaces, leading to waste accumulation and burning in landfills.¹⁶⁵ The situation in Sebha and Houn echoes this pattern, where waste mismanagement often culminates in the burning of garbage. Additionally, the storage of fuel in Sebha sometimes leads to warehouse fires, further worsening air pollution issues.^{166 167}

Libya's electricity infrastructure has been weakened both directly and indirectly by the conflict and has led to an energy crisis in the country.¹⁶⁸ As a result, there is a widespread use of electric generators which has significantly contributed to air pollution. A respondent from central Tripoli observed that due to a lack of public trust in officials' capacity to address the energy crisis, citizens turned to using diesel-powered electric generators. These came, though, at a personal and environmental cost. As opposed to operating in industrial areas, the generators are in the heart of densely populated areas like central Tripoli, emitting toxic fumes among residents.¹⁶⁹ There is an urgent need for sustainable energy solutions.

Climate change and pollution have changed the environment in Libya in the past years,¹⁷⁰ making it more vulnerable to extreme weather events such as sand and dust storms. The coastal cities of Zawiya, in the northwest, and Sirte, in the northeast, are among the areas most affected by this phenomenon.¹⁷¹ A resident of Tajoura confirmed that there has been a notable increase in sand on many local farms in the suburbs of Tripoli.¹⁷² Moreover, the eastern cities of Brega, Ajdabiya, and Sirte have witnessed sandstorms that have cloaked them entirely in sand and dust, with readings going past safety thresholds.¹⁷³ A respondent from Benghazi further confirmed that she noticed the increasing frequency of sandstorms in the city.¹⁷⁴ The previous year saw a similar phenomenon in the central and southwestern regions of Libya, including Ghat, Ubari, Sebha, and Jufra, where there was a severe sandstorm causing the loss of horizontal visibility.¹⁷⁵

Air pollution, the result of both climate change and human activity, also poses public health issues. Respondents in Sebha and Houn highlighted that the accumulation and improper management of waste has directly affected residents' health, particularly increasing reported cases of respiratory illnesses since 2011.^{176 177} Most residents living next to the industrial plants in Brega have also developed acute respiratory issues; sinus infections are widespread and there are numerous cases of lung cancer in the area.¹⁷⁸

The frequency of sand and dust storms in spring and early summer has also contributed to a noticeable surge in respiratory illnesses.¹⁷⁹ These health issues have been intensified by the drier and more unusual winters in Houn, transforming seasonal illnesses into chronic conditions.¹⁸⁰ A respondent from the city described these changes as an 'invisible problem' due to them having a direct, but often overlooked, impact on public health.¹⁸¹ Similarly, residents in Benghazi are experiencing an uptick in sinus infections, prompting some health professionals there to advise their patients to move to areas with cleaner air to alleviate their condition.¹⁸²

165 Interview with a resident of Benghazi, online call, 24 October 2023.

166 Interview with a resident of Sebha, online call, 12 October 2023.

167 Interview with a resident of Houn, online call, 3 October 2023.

168 Yusuf Abulkher, *Tripoli's Electricity Crisis and its Politicisation*, Clingendael, Policy Brief, 2020, <https://www.clingendael.org/sites/default/files/>

169 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023

170 Interview with a resident of Houn, online call, 3 October 2023.

171 Hamida, *Sandstorms in Libya*.

172 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

173 Ibid.

174 Interview with a resident of Benghazi, online call, 24 October 2023.

175 WMO, "Libya witnessed a severe sandstorm turning the sky yellow", WMO, March 24, 2021, <https://wmo.int/media/news-from-members/libya-witnessed-severe-sandstorm-turning-sky-yellow>.

176 Interview with a resident of Sebha, online call, 12 October 2023.

177 Interview with a resident of Houn, online call, 3 October 2023.

178 Interview with a resident of Nalut/Zawiya, online call, 7 December 2023.

179 Ibid.

180 Interview with a resident of Houn, online call, 3 October 2023.

181 Ibid.

182 Interview with a resident of Benghazi, online call, 30 November 2023.

5. Community Resilience, Government Policies, and Global Engagement

Environmental and Climate Awareness

Awareness about environmental and climate change issues is generally lacking, despite their heavy impact on Libya. A case in point are the interviews conducted for the present research. These indicate patchy awareness regarding the environment among Libyan citizens. Most respondents, admittedly, lacked the knowledge or capacity to elaborate upon the environment or climate change issues in any depth.

Respondents confirmed this finding, arguing that awareness of climate and environment issues is contextual, and tends to be more personal than collective in nature.¹⁸³ This suggests that most Libyans' awareness is rather observational than informed by direct sources or educational efforts.^{184 185} Residents of different areas are generally aware of the issues that directly affect their daily lives, but they may not fully grasp the range of environmental challenges faced by the country.¹⁸⁶ For example, farmers in rural areas may have a keener understanding of the environmental changes than their urban counterparts,¹⁸⁷ yet they may not be aware of the impact that climate change plays in this process.¹⁸⁸ Furthermore, they are less likely to have a comprehensive understanding of how human activities amplify the effects of climate change.¹⁸⁹

Several respondents voiced concern about the general lack of environmental protection culture among Libyans. They underlined the numerous issues mentioned above, such as the unregulated expansion of urban developments that reduce a city's vegetation cover;¹⁹⁰ tree cutting;^{191 192} overconsumption of water;¹⁹³ improper waste disposal and poor waste management;^{194 195} sewage being discharged into the sea and black wells;^{196 197} plastic pollution;¹⁹⁸ and the burning of waste in landfills or streets.¹⁹⁹ While some issues stem from a lack of government services, others reveal a basic disregard for the environment. This disconnect between observation and action suggests that awareness is often superficial, not embedded in the community or government priorities.²⁰⁰

In the wake of the catastrophic flooding of Derna, there seems to be a general acknowledgment that climate change is a reality and not 'international propaganda'.²⁰¹ All respondents noted that they observed a noticeable change in the climate in the past years. They highlighted the rising temperatures and reduced rainfall,^{202 203} desertification,^{204 205} the disproportionality

183 Ibid.

184 Interview with a resident of Benghazi, online call, 30 November 2023.

185 Interview with a resident of Sebha, online call, 1 October 2023.

186 Interview with a resident of Sebha, online call, 12 October 2023.

187 Interview with a resident of Houn, online call, 3 October 2023.

188 Interview with a resident of Tripoli/Qala'a, online call, 6 October 2023.

189 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

190 Interview with a resident of Benghazi, online call, 30 November 2023.

191 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

192 Interview with a resident of Houn, online call, 3 October 2023.

193 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

194 Interview with a resident of Nalut/Zawiya, online call, 7 December 2023.

195 Interview with a resident of Sebha, online call, 1 October 2023.

196 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

197 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

198 Ibid.

199 Interview with a resident of Benghazi, online call, 8 December 2023.

200 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

201 Ibid.

202 Interview with a resident of Tripoli/Qala'a, online call, 6 October 2023.

203 Interview with a resident of Benghazi, online call, 26 January 2024.

204 Interview with a resident of Sebha, online call, 1 October 2023.

205 Interview with a resident of Benghazi, online call, 8 December 2023.

of seasons;^{206 207} extreme weather events such as sand and dust storms and rainstorms;^{208 209} and rising and falling sea levels.²¹⁰ However, there is an indication that this awareness may be reactive and issue-specific rather than proactive and comprehensive.²¹¹ According to the interviews, there are more likely to be immediate responses to threats such as flooding.²¹² It is important to note that these efforts are usually short-term solutions. They lack comprehensive planning and therefore, any long-term strategy that could mitigate deep-rooted problems.

Community Resilience

Community resilience is predominantly driven by local initiatives and individual efforts. Many local programs were conducted by numerous organisations until 2011. However, they have drastically decreased since then.²¹³ The current grassroots efforts in Libya come as a direct response to governmental inaction in facing environmental challenges.²¹⁴

In Tripoli and Zletin, a few organisations are raising awareness of plastic pollution and promoting protection of the sea. There is also a company that collects used oil from restaurants to prevent sea dumping.²¹⁵ In Sebha, locals are countering the decline in agriculture by attempting to reintegrate the young into agricultural production. There are also some efforts to address the growing problem of waste management.²¹⁶ Similarly, in Yefren, a local initiative called ‘Mountain Friends’ was launched by the young to increase vegetation cover on the mountains and in Tripoli.²¹⁷

In Benghazi, the Earth Organisation is working on increasing green spaces in the city, and teaching locals how to plant and maintain trees.²¹⁸ There were also many Red Crescent and scout initiatives focused on environmental education. Another organisation called Tanmia 360 has been engaged in addressing sustainability and climate change issues.²¹⁹ The Marine Biology Society of Libya, a non-profit organisation, studies marine biology and raises awareness on endangered species in Libyan waters.²²⁰ On an individual level, individuals in Benghazi have collaborated with the local municipality in organising volunteer beach clean-up campaigns. Students have undertaken environment-focused graduation projects in their studies.²²¹

Community efforts, whether through civil society organisations or individuals, face several challenges in mitigating environmental issues in Libya. A significant obstacle is the lack of government support. The Government of National Unity has passed regulatory laws that have restricted the work of environmental organisations in Libya.²²² In regions such as Sebha, governmental policies not only fail to support these efforts, they actively impede resilience initiatives. Local families attempting to reintegrate younger members into agriculture encounter difficulties due to the government’s heavy reliance on importing agricultural products rather than supporting local production. This reduces local farmers’ competitiveness and threatens their capacity to continue farming.²²³

206 Interview with a resident of Nalut/Zawiya, online call, 7 December 2023.

207 Interview with a resident of Benghazi, online call, 30 November 2023.

208 Interview with a resident of Benghazi, online call, 8 December 2023.

209 Interview with a resident of Benghazi, online call, 24 October 2023.

210 Interview with a resident of Benghazi, online call, 30 November 2023.

211 Interview with a resident of Benghazi, online call, 8 December 2023.

212 Interview with a resident of Houn, online call, 3 October 2023.

213 Ibid.

214 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

215 Ibid.

216 Interview with a resident of Sebha, online call, 1 October 2023.

217 Interview with a resident of Houn, online call, 3 October 2023.

218 Interview with a resident of Benghazi, online call, 24 October 2023.

219 Interview with a resident of Benghazi, online call, 26 January 2024.

220 Marine Biology Society of Libya, last accessed March 29, 2024, <https://mb.org.ly/>.

221 Interview with a resident of Benghazi, online call, 8 December 2023.

222 Hamidan, *Sandstorms in Libya*.

223 Interview with a resident of Sebha, online call, 1 October 2023.

Additionally, environmental initiatives are often poorly funded, short-lived, and lack the necessary support to achieve a long-lasting impact.^{224 225} For example, initiatives aimed at increasing vegetation cover may fail in the absence of sustainable irrigation systems, unless the volunteers have sufficient knowledge on how to care for the seedlings.²²⁶ Furthermore, these initiatives are fragmented; there is a clear absence of coordination between various local organisations and individuals.²²⁷ Without a collective strategy or shared resources, addressing environmental issues becomes daunting.

Finally, the pace of these efforts is slow, and their target groups are limited. Interest in environmental challenges is more prevalent among specific individuals, particularly among the younger generation.²²⁸ This narrow focus limits the potential impact of these initiatives, highlighting a need for broader engagement and a more inclusive approach to raise awareness.

Government Responses and Global Engagement

Throughout the past decade or so, there has been a consistent pattern of government negligence toward the environment. Since the end of the Gaddafi era in 2011, successive administrations have focused on political and security challenges²²⁹ at the expense of environmental issues. The lack of prioritisation of environmental issues is underscored by the absence of media statements or governmental attention to escalating environmental issues.²³⁰ The departure of foreign companies due to the security situation has further complicated matters, leaving a void in efforts to tackle these challenges.²³¹ A respondent from Tripoli noted that the Government of National Unity often announces initiatives as public relations stunts. They ultimately lack any tangible consequences. He further explained that the only understanding of environmental issues is centred on waste collection.^{232 233}

Respondents agreed that governmental institutions have not taken any serious action to address environmental issues. The Ministry of Environment has made somewhat more vigorous efforts in the past: including awareness programs and campaigns.²³⁴ However, it is currently perceived as being ineffective in tackling environmental challenges.²³⁵ Additionally, ministry-affiliated offices, which are supposed to execute its policies on the ground, operate primarily at the central rather than the local level. This creates a disconnect between the ministry and its offices.²³⁶

Respondents gave several examples pointing to the inaction of environmental bodies, such as unregulated urbanisation in Tripoli, Benghazi, and Sebha; decline in subsidised machinery and material for farmers;²³⁷ pollution of the beaches and sea water in coastal cities; and the proliferation of black wells.²³⁸ A respondent in Benghazi noted that the Derna floods have further revealed the government's poor response, leaving the population uncertain about environmental consequences and the next steps for reconstruction.²³⁹ The people displaced by the floods have no understanding of what happened to their homes, and whether to return to them or to stay outside of the city.²⁴⁰

224 Ibid.

225 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

226 Hamidan, *Sandstorms in Libya*.

227 Interview with a resident of Tripoli/Qala'a, online call, 6 October 2023.

228 Ibid.

229 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

230 Interview with a resident of Tripoli/Qala'a, online call, 6 October 2023.

231 Interview with a resident of Benghazi, online call, 24 October 2023.

232 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

233 A research report on the waste management crisis of 2021 confirms this, "the General Services Company-Tripoli, for example, believes that it is not responsible for reducing waste, or establishing facilities to treat and recycle waste. Instead, it considers its role to be limited to collecting, transporting, and disposing of waste in landfills, whether permanent or interim." See Hamidan, *Waste Management in Tripoli*.

234 Interview with a resident of Sebha, online call, 12 October 2023.

235 Interview with a resident of Tripoli/Qala'a, online call, 6 October 2023.

236 Interview with a resident of Sebha, online call, 12 October 2023.

237 Interview with a resident of Sebha, online call, 1 October 2023.

238 Interview with a resident of Nalut/Zawiya, online call, 7 December 2023.

239 Interview with a resident of Benghazi, online call, 30 November 2023.

240 Ibid.

In the absence of strong government policies, respondents reflected on the potential role of international organisations. They highlighted that while international organisations have centred on political issues, migration, female empowerment, and education, they have yet to focus on environmental issues.^{241 242} They further suggested that future international programs could: support environmental awareness through educational programs and the local media;^{243 244} raise awareness on storms and how to mitigate them; increase vegetation cover in Libya;²⁴⁵ and conduct research on the overall environmental situation and potential solutions.²⁴⁶

International support should also involve forming partnerships with local entities, such as the Ministry of Higher Education, and conducting projects as part of broader development programmes. This approach would help ensure that research developed locally is effectively implemented at the national level, thereby bridging the gap between research and practical application.

6. Conclusion

Libya stands at a critical juncture. It faces a broad range of environmental challenges that threaten its livelihood, economy, and public health. These range from water scarcity to desertification.

Water is the common thread running through all Libya's environmental challenges, as it is mismanaged at all points. The GMMRP network, intended to provide national water coverage, reaches many areas. However, its infrastructure is outdated, and it has suffered significant damage in the past decade, with major leakages and, in some cases, contamination. In areas outside of the GMMRP network, there has been an unregulated proliferation of private wells, which exacerbates water scarcity and salt intrusion. After the water is used, the absence of wastewater treatment plants means that neither wastewater nor sewage gets recycled. Instead, they are often discharged directly into the sea, polluting the marine environment, or into poorly insulated black wells, which lead to sewage overflows and the contamination of ground water.

Water mismanagement, urbanisation, and the adverse effects of climate change have severely impacted agricultural productivity. Government support for farmers has stopped and most farmers have not been able to adapt to water-efficient irrigation techniques. Many families traditionally relying on farming for their livelihoods have abandoned their farms to seek better opportunities in cities where there are more reliable services. The consequences are far-reaching, affecting not just the economic stability of farming communities, but also leading to less locally grown food. This situation threatens food security, making the population more dependent on imports, which are susceptible to global market fluctuations and disruptions in supply chains.

Climate change has already increased water scarcity, heat waves, and desertification in the last years. Urbanisation has compounded these problems as tree cutting, overextraction of water, and air pollution continue to increase. These climate- and human-induced factors are likely to erode the soil and create more dust in the country, meaning Libya can expect more frequent extreme weather events. Sand and dust storms will particularly have a heavy toll on the economy, agriculture, and public health, not just in Libya, but also in Europe. As we enter the season of sand and dust storms, it will be important to closely monitor this issue.

We began conducting this research in the wake of the Derna floods in September 2023. As we write the conclusion, a new crisis is unfolding in Zliten, east of Tripoli, where rising groundwater, mixing with sewage, has led to widespread overflows in the city. The streets are flooded, water contamination is rampant, and the foundations of buildings are at risk. Many families have reportedly left their homes and relocated to nearby cities and a major health crisis could be underway. Although international support from the Netherlands, the UK, and the UN is being provided, the full scope of the problem has yet to be understood.

241 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

242 Interview with a resident of Sebha, online call, 12 October 2023.

243 Ibid.

244 Interview with a resident of Tripoli/Tajoura, online call, 23 October 2023.

245 Interview with a resident of Tripoli/Bani Walid, online call, 18 October 2023.

246 Interview with a resident of Benghazi, online call, 30 November 2023.

There is an important trend to highlight here. Residents from cities hit by extreme weather events or service infrastructure failures are moving to larger cities in search of more reliable services. This migration increases pressure on these larger cities, accelerating their expansion, population growth, and straining service infrastructure and the environment. The result is a potential compounding of crises in urban centres due to the failures of smaller, peripheral cities. The floods in Derna, for example, resulted in the displacement of over 40,000 people to Benghazi and Tobruk. Similarly, agricultural decline and water scarcity in Sebha has driven migration to Tripoli and Misurata. The current crisis in Zliten is responsible for similar forms of migration.

The government has not taken any serious action in the face of these crises. Instead, there are mostly reactive, short-term fixes which reflect the absence of a long-term strategy. The lack of prioritisation of environmental issues will have far-reaching consequences. There is an urgent need for a paradigm shift towards a more integrated, inclusive, and strategic approach to mitigating these crises in Libya. First, the government will need to demonstrate the political will to tackle these challenges by creating a vision of how to address their root causes. Second, it will also need to prioritise the maintenance and expansion of service infrastructure, leveraging the expertise and resources of partner countries or international organisations. Third, there should be support for environmental governance structures that can withstand political fluctuations. These will be key for sustainable resource management, development, as well as creating and monitoring a framework of environmental policies and regulations. Finally, investing in education and awareness-raising initiatives will be crucial for cultivating a culture of valuing the environment among Libyans.

7. Topics for Further Research

Water-related topics

- Excessive water consumption practices
- Excessive private well-digging
- Impact of urbanisation on water sources
- Impact of electricity on water availability
- Seawater intrusion
- Desalination and wastewater treatment facilities
- Role of companies in water-related projects
- State of water infrastructure
- Water management models
- Survey of areas connected to the GMMRP (legal and unauthorised)
- Reasons for disparity in water distribution
- Water conservation practices
- Vandalism and theft of water infrastructure
- Maintenance of water infrastructure

Agriculture and desertification-related topics

- Impact of urbanisation on agriculture
- Impact of climate change on agricultural land
- Impact of rising temperatures on crops
- Impact of shrinking agriculture on migration
- Groundwater extraction for irrigation in previously rain-fed farmlands
- State of agricultural sector and productivity
- State of olive oil production
- Impact of shrinking agriculture on food security
- Impact of wars in other regions on food security
- Survey of agricultural projects
- Role of foreign labour in reviving agricultural sector
- Reforestation of the Green Belt
- Reclaiming lost arable land in the era of climate change
- Impact of loss of plant and animal species on ecosystems
- Impact of war on the agricultural sector
- Support of government to farmers
- Water-efficient irrigation techniques
- Climate- and human-induced reasons for desertification

- Impact of climate change on quantity and quality of agricultural products
- Impact of decline in green spaces on society
- Economic impact of decreasing agricultural produce on livelihood of farmers
- Growing interest in personal farming
- Food imports in Libya
- Impact of sand and dust storms on agriculture
- Reintegrating youth into agricultural production

Pollution-related topics

- Impact of population growth on pollution
- State of sewage and wastewater treatment facilities
- Maintenance of sewage and wastewater treatment facilities
- Impact of poor sewage infrastructure on public health
- Impact of sewage dumping on marine environments
- Impact of dynamite fishing on marine environments
- Impact of sewage pollution on fishing
- Impact of black wells on land degradation
- Impact of black wells on public health
- Impact of sewage overflows and floods on infrastructure
- Addressing the increasing proliferation of black wells
- Contamination of groundwater
- Countering plastic pollution
- State of solid waste management sector
- Impact of solid waste on air quality
- Impact of solid waste on airborne and respiratory illnesses
- Impact of waste burning on public health
- Development of a waste management model in Libya
- Impact of electricity generation on air quality
- Impact of sand and dust storms on neighbouring regions

Community resilience, government policies, and global engagement topics

- Awareness raising initiatives in Libya
- Integrating environmental awareness with educational curriculums
- Improving governmental policies and oversight
- Development of partnerships between government and civil society
- Development of a long-term strategy for mitigating climate change
- Development of a long-term strategy for improving infrastructure

- Development of community and civil society initiatives
- Development of a list of environment-related priorities for policy-making
- Raising awareness on recycling and plastic pollution

Other topics

- Migration from the peripheral cities to the centres
- Resilience measures against future climate-induced events
- Alternative sources for electric generators

Mediterranean Platform

Founded in 2022, and directed by Prof. Luigi Narbone, the Mediterranean Platform is a research, dialogue, and educational programme at the School of Government, Luiss Guido Carli. It offers a space for collective reflection on the opportunities and challenges of the Mediterranean region and promotes informed policymaking and advocacy at the national and transnational levels.

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