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Climate Change and Conflict in Hadhramawt and Al Mahra

Helen Lackner

About this report

This report was written by Helen Lackner. The findings and conclusions reflect the author's own research, which is enriched by the contributions of the many colleagues who have participated in this work in different capacities, including Katharina Jautz and Joshua Rogers at Berghof, Khamis Ali Saeed Mubarak and Eman bin Selm in Al Mahra, Abdullah Dukail in Mukalla, and Salem Karamah Awadh Khabah in Seyoun, Wadi Hadhramawt. Abdul Rahman Fadhl Aleryani and Dr Fathia Bahran, Director of Mojiti in Sana'a, made helpful comments on an earlier draft. None of them are responsible for the views expressed here, which remain the author's responsibility, as is customary.

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Auswärtiges Amt

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Contents

Executive Summary

The Yemeni governorates of Hadhramawt and Al Mahra have been hit hard by the effects of climate change. Formerly exceptional droughts, floods and typhoons have become common phenomena over the past years. Such disasters, and other environmental concerns, represent additional stressors on communities, local administrations and existing institutions for managing and resolving conflict and are complicating the relationship between recent arrivals to the governorates, fleeing violence elsewhere, and established communities.

Based on interviews conducted in Hadhramawt and Al Mahra, this paper identifies the key environmental issues facing the populations of Hadhramawt and Al Mahra today. It shows how they are connected to conflict in the two governorates, and explores what local authorities, communities and international actors are doing and can do in the future to mitigate the impacts of climate change and better manage the conflicts that derive from it.

The key environmental challenges in these governorates are heavy rains and storms, the water crisis, degradation of agricultural and pasture lands, tree cover and the marine environment, air pollution, and oil and other chemical pollution.

These challenges are directly affecting people's livelihoods, as floods, for instance, destroy houses and wells, contaminate water sources, kill livestock, damage fishing boats, and wash away topsoil and the boundaries between holdings, creating confusion between owners and leading to more local disputes over land after the floods.

Increasing water salinity, declining water table levels, and desertification, especially in combination with the influx of internally displaced people fleeing the front lines of the war in Yemen, are also increasing tensions between landless people and the landowners who try to prevent them from cultivating or using their traditional pasture lands. Other environmental challenges are likewise increasing tensions, putting additional strain on weak and under-resourced local authorities and challenging established community self-help mechanisms.

In terms of state and community responses to these challenges, interviews, including many with local government officials, recognised that local authorities and institutions are doing what they can, while highlighting the inadequacy of their responses. Many interviewees were personally involved in helping others at the time of the cyclones, and others also explained that community solidarity and mutual support kick in systematically in response to local climate-related emergencies, mainly heavy destructive rains and floods.

Community leaders and citizens encouraged a more active role for the local authorities in urban planning, solid waste disposal, sewerage infrastructure and operation, water management, regulating pollution from oil and other chemicals, and responding to natural disasters. The report closes with recommendations for local authorities, (environmental) community organisations and international (non-governmental) organisations on how they can more efficiently address and mitigate environmental issues and their impacts.

Introduction

The Yemeni governorates of Hadhramawt and Al Mahra have been hit hard by the effects of climate change. Formerly exceptional droughts, floods and typhoons have become common phenomena over the past years. Such disasters, and other environmental concerns, represent additional stressors on communities, local administrations and existing institutions for managing and resolving conflict and are complicating the relationship between recent arrivals to the governorates, fleeing violence elsewhere, and established communities.

This paper adopts a political economy approach, examining the interaction between physical environmental phenomena and social/human factors, assessing their connections and mutual causality. As such, it begins with a short introduction to the historically developed political, economic and social features of Hadhramawt and Al Mahra, as these features provide the essential context for how key environmental issues affect local populations. The study goes on to describe the environmental crisis in Yemen today, before focusing on the ways in which environmental changes in the two governorates are connected to conflict. Environmental issues are of major importance to the population and are affecting their lives on a daily basis. Many of them cause social tensions between neighbours, people competing over scarce resources, or with conflicting uses of resources. In some cases, wealthier and poorer members of the community find themselves on opposing sides.

These incipient issues can escalate into serious problems and conflicts within and between communities on various scales in the short term, especially where the influx of IDPs and returnees from Saudi Arabia has already stretched established formal and informal institutions. Finally, this paper explores what local authorities, communities and international actors are doing and can do in the future to mitigate the impacts of climate change and better manage the conflicts that derive from it[1].

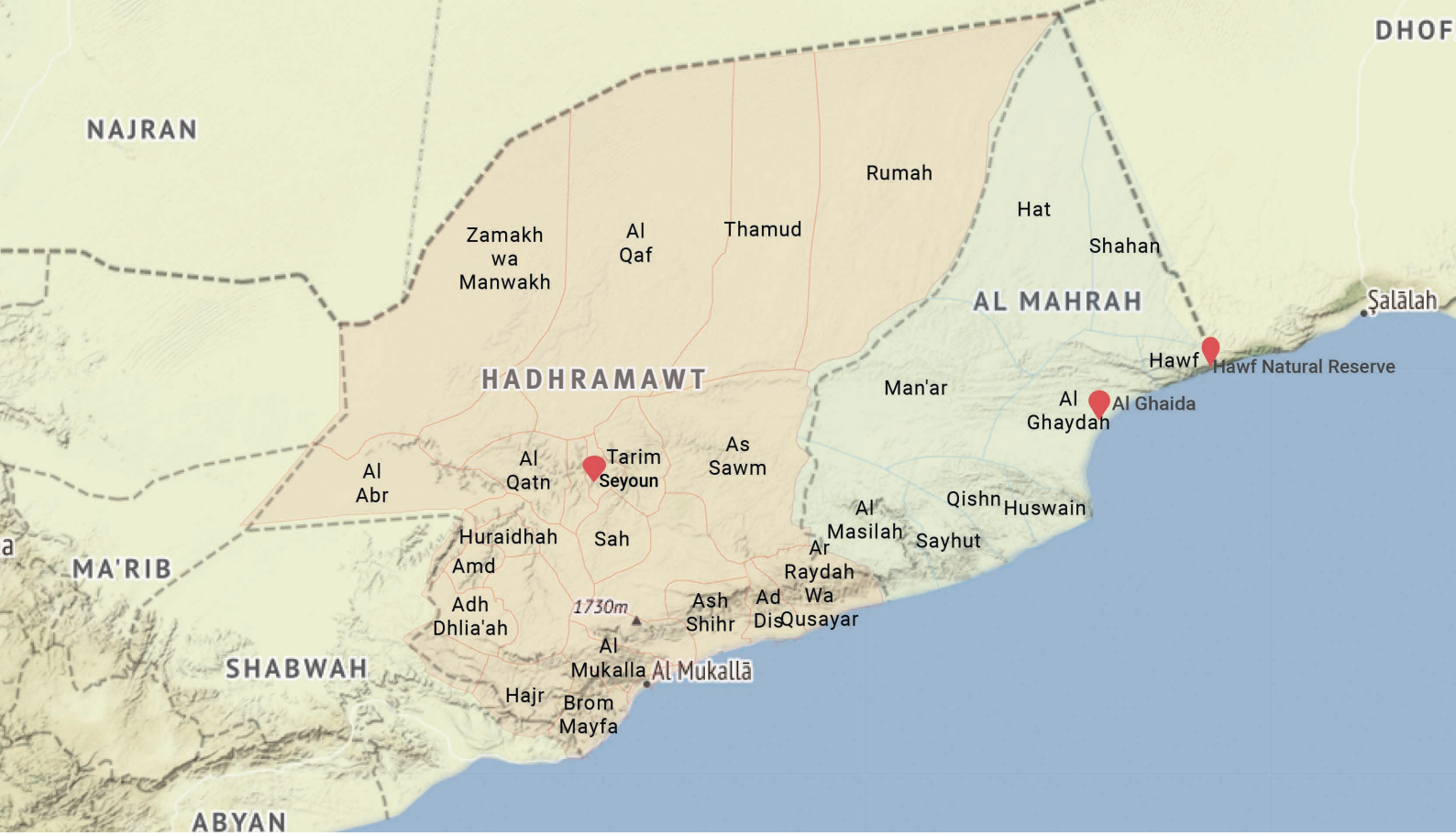
Throughout, it focuses on all the environmental issues faced by the populations of Al Mahra and Hadhramawt, irrespective of how directly they are linked to climate change. Environmental problems are not always easy to classify with respect to their origins and causes, and from the perspective of the social impact of environmental concerns, the important thing is to address these problems regardless of their cause.

This study was authored by Helen Lackner based on desk research and interviews conducted in Hadhramawt and Al Mahra[2]. Its findings were complemented by consultation meetings with local officials, civil society representatives and environmental experts conducted by the Berghof Foundation and PDF in Seyoun (Wadi Hadhramawt) and Al Ghaida (Al Mahra)[3].

1 While this report focuses on local aspects and the activities of community members and local government, the absence of an effective national government is an important factor in the inadequate response both to disasters and to routine environmental problems.

2 Interviews were carried out in the two governorates between 15 June and 31 July 2021 by a team of experienced interviewers: a total of 14 men and six women were interviewed in Al Mahra, 21 men and two women in Wadi Hadhramawt, and seven men and one woman in Coastal Hadhramawt. They included 21 local government officials and eight members or leaders of civil society organisations.

3 Consultation sessions took place in parallel in Al Ghaida and Seyoun on 26 August. In Al Ghaida, the consultation session brought together nine local officials and activists working on environmental issues (seven men and two women). In Seyoun, 15 local officials and activists participated in the session (13 men and two women).



Governorates in Yemen. Berghof Foundation, May 2018.

The Berghof Foundation and the Political Development Forum (PDF) have been working in the three governorates of Dhamar, Hadhramawt and Al Mahra to strengthen inclusive local governance and peacebuilding efforts. In 2020, during a meeting of local government officials from Hadhramawt and Al Mahra, the issue of environmental disasters and their effect on local disputes was brought up by local officials.
The urgent need for improved responses to disasters, coordination on risk mitigation, and the need to pay attention to the more long-term local disputes arising from the impacts of climate change was expressed.

Social, political and economic specificities of Hadhramawt and Al Mahra

Until the formation of the People's Democratic Republic of Yemen (PDRY) in 1967, both Hadhramawt and Al Mahra had limited relations with the official capitals in Aden or Sana'a. Given their geographical position and the importance of international migration routes, people's connections were focused elsewhere. Hadhrami migration, an important factor in local society and culture, historically focused on the Indian Ocean, but shifted in the 20th century from South-East Asia to the Kingdom of Saudi Arabia. Some of the main commercial and

industrial families in Saudi Arabia today are of Hadhrami origin from early migration waves, when the Kingdom's first oil revenues enabled it to finance infrastructure. This includes the bin Mahfouzh, bin Laden and al Amoudi families[4]. Hadhrami-owned industries brought workers from Hadhramawt during the socialist period when the Saudi government supported dissent in the PDRY. Mahris are more focused on the United Arab Emirates (UAE) and Oman. People from both governorates also have long-standing migration connections with East Africa.

During the PDRY period, citizens from both governorates benefited from the PDRY's positive features, such as free and reasonable quality education and medical services, full employment and very limited social differentiation, thus ensuring improved living standards for poorer people, particularly the lower- status cultivating groups who did not own land. Nationalisation of assets, particularly agricultural land, was an important factor in reducing social differentiation, but also laid the basis for future tensions. The PDRY's negative features, in particular the lack of political freedoms and restrictions on private investment, limited the development of sectors such as industry, tourism and fish processing. In its early years, the PDRY suffered from the emigration of many members of the formerly powerful and wealthier social groups, who took their movable assets with them. Political dissent was severely repressed, partly because the regime was under siege from its neighbours.

Unification in 1990 reversed these features: exiles returned, many of them planning revenge on those they perceived as 'usurpers' of their property. Public sector education and medical services deteriorated and became less accessible. Private investment expanded, mainly by wealthy people of Hadhrami origin [with or without Saudi Arabian nationality] based in Saudi Arabia and the UAE. They financed expected growth sectors: tourism, transport and fisheries [including boat building and canning] as well as private medicine and education. Low-status and other poor people returned to their earlier status, losing land through the reversal of the agrarian reform, and once again becoming casual labourers or sharecroppers with livestock holdings their main assets. Tribal leaders and *sada*[5] returned from exile and, provided they supported the Saleh regime, were encouraged to re-assert authority over others.

As elsewhere in the country, social differentiation worsened, and egalitarian ideology was largely abandoned. Combined with rapid population growth and environmental deterioration, the overall situation was one of impoverishment, leading to increased popular dissatisfaction and the rise of opposition: in particular, many lower-status agricultural communities in Wadi Hadhramawt shifted their political allegiance from the Yemeni Socialist Party to the Islamist element of the Islah party [electing four Islah Members of Parliament out of a total of 10 MPs in the last elections in 2003].

4 See Walker, Iain (2015). 'Hadrami Identities in Saudi Arabia'. In: Noel Brehony and Saud Al-Sarhan (eds.), *Rebuilding Yemen: Political, Economic and Social Challenges*, Berlin: Gerlach, pp. 42-60.

5 *Sada (sg. sayyed)* is the term used in Yemen to describe the social group claiming descent from the Prophet, which is the top-ranking group in the ascribed social hierarchy prevailing in Yemen.

The environmental crisis in Yemen

The environmental crisis has been a lived daily reality for Yemenis for several decades, although awareness of the causes of these problems has only become widespread recently as climate change impacts have accelerated. Its main features are

- the increasing unpredictability of rainfall patterns, particularly the timing and severity of precipitation, disrupting expected seasonal patterns
- the deterioration of terracing, which is used to protect soils and agricultural fields and help infiltration of water into shallow aquifers, a phenomenon which has been ongoing since the 1970s
- the exhaustion of deep aquifers [fossil and others] through the introduction of increasingly powerful pumps and deeper wells for irrigation, which mainly benefited a minority of wealthier larger landholders; this process has accelerated since the 1980s
- desertification, with the country losing about 3% of its already very limited cultivable surface annually
- air and water pollution as a result of poorly managed oil and gas exploration and extraction and increased road traffic
- solid waste pollution, due to changes in diet and the introduction of metal and plastic single-use containers, which has worsened since the late 1970s
- mostly in rural areas, the construction of domestic water supply schemes without sanitation, resulting in stagnant used-water ponds, which are breeding grounds for mosquitoes and other vectors of disease.

The worldwide acceleration of climate change is expected to significantly worsen many features of this situation: overall, the World Bank forecast of 2010 remains valid[6], with three main scenarios for Yemen, the most likely being 'hot and dry' and 'warm and wet.' Regardless of which actually materialises, 'Yemen will be getting warmer, most likely at a faster rate than the global average … there will be more variability of rainfall patterns within years … There will probably be an increased frequency of intense rainfall events and therefore possibly an increased risk of floods'[7].

Yemen's water crisis

Water scarcity is by far the most acute and best-known environmental problem in Yemen. Per capita renewable water dropped to 75 m^3 by 2017, barely more than 1% of the global average[8], while nationally one third more water is used annually than is replenished, with 3.5 billion m^3 extracted while only 2.1 billion m^3 are replaced, the 1.4 billion m^3 shortfall coming from deep fossil non-renewable aquifers.

There are three main reasons for this scarcity: rapid population growth (still close to 3% per annum) has increased demand and thus reduced per capita availability. The rapid expansion of diesel, electric and now solar-operated pumps and tube-well technology has enabled farmers to

6 And has not, to my knowledge, been superseded by any new local study.

7 World Bank (2010). *Yemen – Assessing the Impacts of Climate Change and Variability on the Water and Agricultural Sectors and the Policy Implications*, Report No. 54196-YE, p. 20.

8 See Aklan, Musaed and Helen Lackner (2021). *Solar-Powered Irrigation in Yemen: Opportunities, Challenges and Policies*. Sana'a Center for Strategic Studies, https://devchampions.org/publications/policy-brief/Solar-Powered-Irrigation-in-Yemen/.

reach deeper aquifers and use more water than is replenished, thus extending irrigated areas and increasing the cultivation of thirsty high-value crops. Finally, climate change has transformed rainfall patterns, reducing replenishment of the aquifers and thus the total amount of water available.

The drop in water tables is almost universal and has a profound impact on people's living standards, particularly in the rural agricultural areas, as it is responsible for

- forced emigration when local water sources have completely dried up and there is no nearby substitute
- reduced crop output when farmers' shallow wells dry up and they no longer have access to supplementary irrigation
- longer and more difficult journeys on foot or with draft animals to collect water in remote rural areas; this mainly affects women and children whose time could otherwise be spent in production or education
- lack of urban water through networks which do not have enough to supply customers daily [even in the main cities of Sana'a and Taiz, only about 40% of urban households are connected to official urban networks]
- longer waits and increased prices for those depending on water tanker deliveries in urban and rural areas.

The expansion of well-irrigated agriculture in the past decades has been impressive, from 37 000 ha in the 1970s to more than 400 000 ha in the 2000s. During this period, as irrigated areas increased by a factor of 15, rain-fed agriculture declined by 30%[9]. Although many irrigated areas are very small holdings of poorer farmers, the main beneficiaries of irrigation, and particularly tube-well irrigation, are the larger wealthier landowners.

With respect to the water crisis, it is important to note that the situation differs geographically, with those areas with the highest population densities having the smallest water reserves and least access to large deep fossil aquifers. In this respect, Hadhramawt is reasonably well-served, insofar as it might eventually be possible to access the Umm al Rudhuma aquifer which is vast, but fossil and very deep, as well as being shared with Saudi Arabia.

Immediate impact of climate change: droughts, floods, storms

Changes in rainfall patterns directly impact water availability and indirectly result in reduced crop yields and soil retention. Yemen's climate is arid: most of the country has less than 50 mm rainfall per annum. Much rainfall is lost by evaporation: only 6% ends up in spate flows, amounting to about 2 billion m^3 annually[10]. Worsening irregularity of rain episodes and of the timing and duration of rainy seasons prevents people from planning their agricultural cycle for rain-fed agriculture, which is still practised on 60% of cultivated land. More violent downpours reduce the infiltration that replenishes aquifers, as well as destroying agricultural and other infrastructure, from *wadi* banks to terraces, creating a snowball effect that accelerates deterioration[11].

9 Closas, Alvar and François Molle (2016). *Groundwater Governance in the Middle East and North Africa*. IWMI Project Report No. 1, p. 76.

10 Taher, Taha, Bryan Bruns, Omar Bamaga, Adel Al-Weshali and Frank van Steenbergen (2012). 'Local groundwater governance in Yemen: Building on traditions and enabling communities to craft new rules'. *Hydrogeology Journal*, p. 1177.

11 The author has addressed these aspects in greater detail in Hamid Pouran and Hassan Hakimian (eds.) (2019). *Environmental Challenges in the MENA Region: The Long Road from Conflict to Cooperation* (London: Gingko) and 'Climate Change and Security: Major Challenges for Yemen's Future', in: Troy Sternberg (ed.) (2017). *Climate Hazard Crises in Asian Societies and Environments*. Abingdon: Routledge, pp. 103-19.

Recent decades have witnessed increasing frequency and length of droughts as well as more episodes of heavy rains leading to destructive floods. The frequency and intensity of 'unprecedented' floods are symptomatic of climate change. Starting in 2015 when two major cyclones, Chapala and Megh, hit Yemen within a week, the trend continued with Sagar and Mekunu in 2018 and the devastating floods of 2020, whereas 'normally' the country does not suffer more than one cyclone or major event a year. At the time of writing, in mid-2021, a further series of floods is causing yet more havoc. All of these particularly impacted Hadhramawt and Al Mahra.

Desertification and soil deterioration

Other than the direct impact of violent downpours, top soil and wadi bank deterioration also occurs through being washed away by floods. This further reduces areas available for agriculture, which already account for less than 3% of the country's surface area[12]; annually, the additional loss is estimated at an average of 3% of agricultural land. Soil is also lost from wind erosion, worsened when pasture grasses and shrubs are eaten by livestock which have no access to other fodder. Landless rural people are particularly dependent on livestock but cannot afford to purchase cultivated fodder [which is also irrigated and uses up water] and remain dependent on pasture.

In addition, when there is a shortage of cooking gas or when people cannot afford it, women collect brushwood, cacti and anything growing to use as fuel, causing further soil deterioration and desertification. Difficulties in enforcing pasture management by temporarily protecting areas to allow regeneration is one example of the weakness of the state and government to address sustainable long-term economic development in the interests of the population at large.

Sea-level rise

Rising sea levels are one aspect of climate change which has not yet had a major impact on living conditions, only becoming noticeable in coastal areas at times of major storms. However, it is expected to soon affect three of the country's major cities, Aden, Hodeida and Mukalla, as well as, of course, the dozens of small artisanal fisher settlements along the Arabian and Red Sea coasts.

Another less obvious, but already perceptible, outcome of sea-level rise is the impact it has on coastal plain soft water aquifers as seawater intrusion increases the salinity of the water, making it too brackish for human consumption and affecting the quality and quantity of crops cultivated in these areas, which include some of the most fertile and large cultivable areas.

Pollution from oil exploitation

Prior to the war, other than the clearly inequitable management of water discussed below, the main environmental damage was caused by hydrocarbon exploitation in Hadhramawt, Shabwa and Marib, the oil-producing governorates. Little, if any, attention was paid to mitigating measures to protect the environment with respect to both the air people breathe and the water they use. Dangerous chemicals were re-injected with precious water into oil wells to increase pressure, and gas was flared. People in the affected areas complained of increased incidences of cancers as well as 'new' diseases. Many have suffered ill-health and probably death as a result of the carelessness or indifference of profit-oriented oil companies that were unwilling to reduce their profits by providing the necessary environmental protection[13].

12 https://blogs.lse.ac.uk/mec/2017/12/30/the-once-happy-land-economic-prospects-for-yemen-after-the-war/

13 In the course of fieldwork in Shabwa and Hadhramawt between 1998 and 2000, the author met many villagers and others who complained, but had no expectation of redress in the dysfunctional Yemeni legal system.

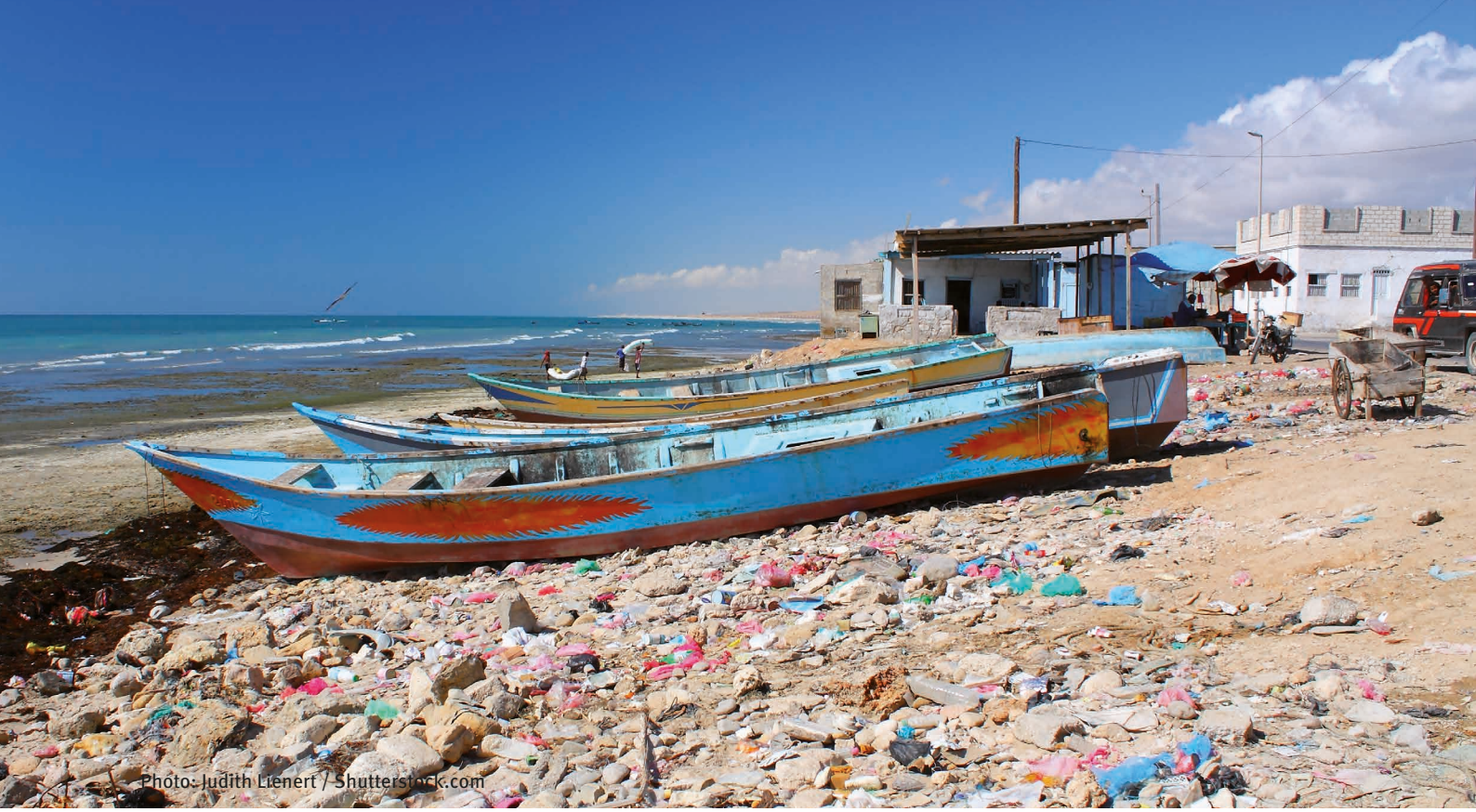


Photo: Judith Lienert / Shutterstock.com

As is often the case, the victims failed to prevent damage or obtain any compensation as the oil exploration companies were supported by the Saleh regime, and people's complaints were officially ignored. It has been demonstrated elsewhere how difficult it is to prove in court that energy production [whether oil or nuclear] is directly responsible for increased incidences of diseases primarily caused by the environmentally damaging side-effects of energy production[14]. Companies hire expensive legal advisers, while communities are poorly represented and usually lack the technical evidence necessary over decades, for example being unable to provide comparative health data between pre- and post-oil exploitation.

Land and air pollution from inadequate solid waste management

Solid waste management has emerged as a major problem throughout Yemen with the introduction of factory-produced tinned and packaged processed foods and drink, as well as single-use plastic bags. While domestic waste from fresh food is naturally recycled over time and can be used as fertiliser or fuel in homes, this is not the case for cans, plastic bags and other items. Since the 1970s, their use has massively increased throughout the country, where they have been thrown out and dumped in streets, outside houses and in fields.

Domestic waste management has developed in recent decades in the cities and towns, but remains inadequate; waste is either not collected regularly or is dumped nearby where it remains for decades. When burned, it produces noxious fumes and therefore causes further health hazards. Specially designed landfill sites with good management barely exist. Although local authorities give the issue some attention, it is far from sufficient to address the scale of the problem. There is no

14 In the UK, the numerous and lengthy public and legal struggles over the pollution caused by the Sellafield nuclear plant are one of many examples.

doubt that Yemenis are largely unaware of the problems of plastic waste in their communities, let alone further afield and in the seas. Until recently, no attempt was made to reduce plastic waste or indeed packaging in general, or even to separate biodegradable waste. In August 2021, the Environmental Protection Authority (EPA) issued a decree[15] banning the manufacturing, import and marketing of non-biodegradable plastic bags, repeating a decision of the Saleh era of 1999. Given the fate of earlier decrees, whether it is able to enforce this decision remains to be seen. The only widespread activity is the collection of empty plastic water bottles and tin cans for resale, providing an income for a few hundred poor people around the country, and the quantity of plastic water bottles used is vast, so this has some impact on the situation.

Mismanagement of specialised waste is another issue where the lack of state intervention can be the cause of major health problems, through the pollution caused by dangerous items abandoned in areas where children play and livestock roam: medical waste near hospitals and medical centres, industrial and workshop waste are the most prominent examples.

Land mines

The current war is seriously worsening a problem which already existed after earlier military clashes within the country, mainly the 1994 'separatist' attempt at secession which led to the presence of unmapped land mines in various parts of the former PDRY, including Coastal Hadhramawt. In the current war, land mines are widespread in some parts of the country; however, the governorates of concern here appear to have been spared this problem.

Elsewhere, land mines have been spread along numerous existing and potential front lines, causing injury and death on a daily basis, mostly among children and livestock herders. They also prevent farmers from growing crops in areas which are covered in land mines, further reducing their incomes and worsening poverty. This problem will take decades to solve, even once the war is over, despite the heroic efforts of mine clearance volunteers and organisations specialising in this work.

15 https://www.26sep.net/index.php/local/21353-2021-08-07-15-50-22 During the Saleh regime, Yemeni Law No. 39 of 1999 prohibited the sale and manufacture of non-biodegradable plastic bags. It was ignored, according to an article in Masdaronline in 2012, https://almasdaronline.com/article/36920

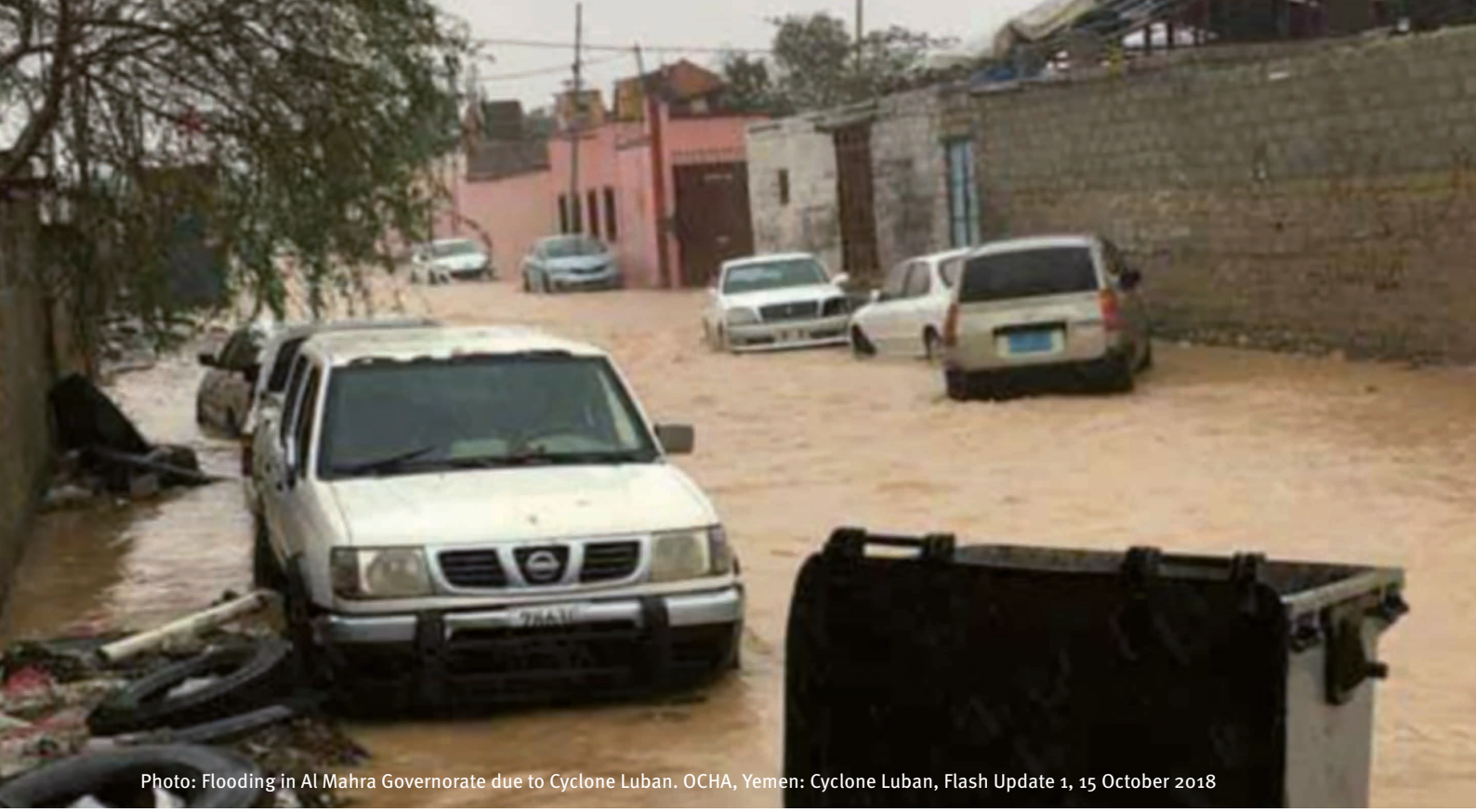


Photo: Flooding in Al Mahra Governorate due to Cyclone Luban. OCHA, Yemen: Cyclone Luban, Flash Update 1, 15 October 2018

Major environmental issues in Hadhramawt and Al Mahra

Most of the environmental issues discussed above are present in Hadhramawt and Al Mahra, and the differences reside mainly in the agro-ecological conditions prevailing in the areas, rather than the administrative distinctions. This section focuses on fieldwork for this study.

The impact of heavy violent rains and storms

Both Al Mahra and Hadhramawt were the main victims of the cyclones of 2015 and 2018 which hit their coasts and caused damage well into the interior. The main damage came from Chapala in 2015 and Luban in 2018[16] in the areas around Al Ghaida and coastal villages in Al Mahra, as well as in Fuwa and other coastal villages around Mukalla. In each case, rain equivalent to decades of 'normal' annual rainfall fell within 24 hours, hundreds of buildings as well as infrastructure and crops were damaged or destroyed, and livestock killed, with Al Mahra affected far more severely than Hadhramawt. On each occasion, the cyclones were described as 'unprecedented', 'one in a century', etc., indicating that they were completely outside previous experience. In May and July 2021, very heavy rains and floods affected Wadi Hadhramawt and coastal Al Mahra yet again.

Giving some details of their experience, the Director (f) of Women's Affairs in the coastal region, as well as the Director (m)[17] of the EPA

16 See OCHA flash updates for each of these cases.

17 The gender of interviewees is indicated by (f) for female and (m) for male.

explained that houses in Al Ghaida were damaged and destroyed, leaving people to take refuge with neighbours; many people's livelihoods were affected as their livestock were killed and their agricultural and other economic infrastructure damaged. The tsunami-like waves on the coast damaged buildings, including houses and fish landing facilities. Inland, water from the rains caused strong flash floods in the wadis near to homes, destroying roads and blocking access. Heavy rainfall inland also led to flooding as the wadi beds overflowed and worsened the destruction in the interior and the towns. A student (f) in Muhayfeef [a coastal village two kilometres from Al Ghaida] also mentioned the high waves caused by Chapala, Luban and Mekunu, and the losses suffered by fishers and agriculturalists.

The impact on agriculture was described in detail by both a male and a female farmer from Al Abri [six kilometres from Al Ghaida] who pointed out that wells and houses were destroyed, agricultural soil washed away and their livestock killed. Moreover, the cyclones reduced the cultivable areas by washing away the wadi banks near the fields and diverting the wadi courses; this destroyed the boundaries between holdings, creating confusion between owners and leading to disagreements between landholders who were unable to restore the earlier boundaries. These points were confirmed by consultation session participants in Seyoun and an environmental engineer (m) who additionally mentioned how, on the coastal plain, drinking water wells were destroyed or polluted by the water coming down from the wadis, which contained animal corpses and other waste.

In fisheries, the problems mentioned were similar in both governorates. In Al Mahra, the cyclones caused small-scale fishers to lose their livelihoods as their boats, engines and fishing gear were washed away or destroyed, leaving them dependent on replacement equipment from the state and international assistance. A fisherman from Al Ghaida and others reported cases of diversion of compensation away from victims of the cyclones, leaving them in worsened poverty and forced into casual labour. He also explained how Luban changed the coastline, destroyed fish landing sites and washed away boats, engines and fishing gear, leaving him destitute. The Director (m) of Ports and Fisheries Landing Sites in the governorate explained how toxic chemicals from ships and from broken fibreglass boat debris spread to the coast and destroyed fish feeding grounds, reducing the catch in the long term and causing worse seawater pollution, an additional danger for fish and other marine wildlife.

Participants in the consultation session in Seyoun highlighted the immense economic impact and costs involved in the rehabilitation of infrastructure, homes, agricultural land and water streams. Participants in the consultation session in Al Ghaida, Al Mahra, expressed their concern about the lack of dams around Al Ghaida and the change of landscape in the wadis: wells have been buried by previous floods and the wadis have become narrower and deeper, making devastating impacts of future floods even more likely.

The cyclones, as well as the [not yet perceptible] rise in sea level, alongside over-extraction of water from coastal aquifers, are also responsible for the salinisation of the spring, stream and well water in the coastal plains, affecting the supply of both drinking and agricultural water. In the Ghayl Bawazir area of Coastal Hadhramawt, which was famous for its hot springs and sink holes with freshwater, this has become an acute problem, as the leader (m) of a local environmental NGO explained; it has increased prices of purchased water which comes from further away as local water is no longer suitable for human consumption. The impact of this increase is causing additional suffering as lower agricultural yields reduce household incomes for landowners and sharecroppers alike.

Downpours have also become heavier and more destructive in the interior. Wadi Hadhramawt is famous for its mud brick palaces and skyscrapers, whose longevity is ensured by the infrequency of rains and limited protection of their upper floors and roofs. The governorate's Director-General of Culture (m) mentioned how recent years have

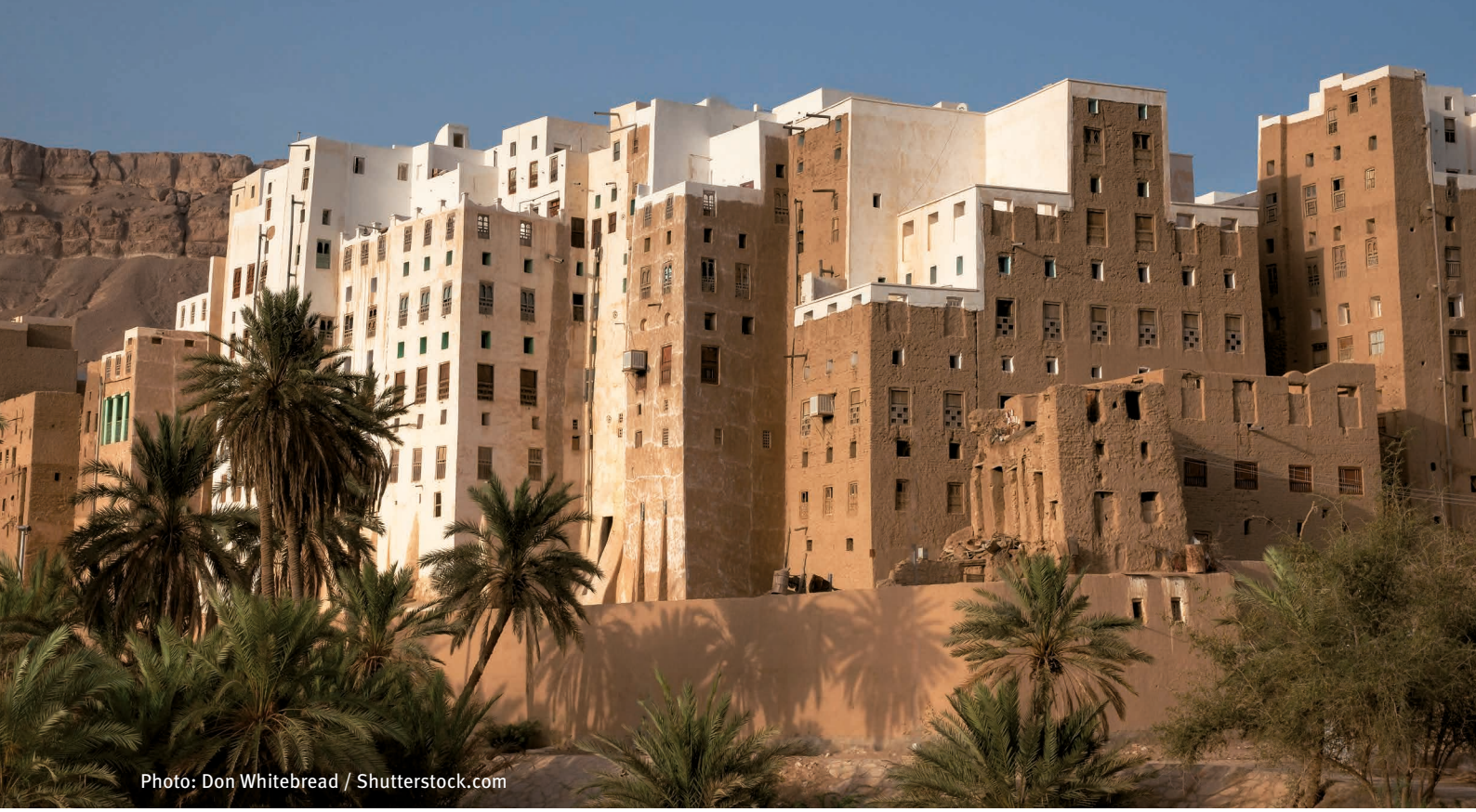


Photo: Don Whitebread / Shutterstock.com

witnessed some major violent and long rains which are causing significant damage, primarily in the most famous of the towns, Seyoun and Shibam, resulting in the collapse of some of the skyscrapers in 2020, and Tarim, which has suffered similarly in May and July 2021.

The Hawf Protected Area

The Hawf Protected Area is the only nature reserve in the two governorates and was added to the Tentative List for natural protected areas by UNESCO in 2002. It is in the far east of the Al Mahra governorate, extending from the sea for about 20 km inland and is part of the same agro-ecological areas as Dhofar on the other side of the Omani border, benefiting from considerable monsoon rains and unique vegetation and fauna. State investment in its management has been minimal, but there is an active local association attempting to protect it and prevent widespread damage. Members of the 'Association of the Sons of Hawf' identified serious threats to the protected area and the need for external intervention to assist the community to save the area, listing the following threats:

- infringement on the protected area by tribespeople claiming ownership, then selling plots for construction, followed by building and dumping of building rubble within the reserve
- human damage and destruction of the trees and other flora
- hunting of wild 'protected' fauna
- increased presence of livestock herds which eat the 'protected' flora
- damage to the fisheries along the coast
- landslides due to rains and storms, particularly Luban and Mekunu
- construction of illegal tracks and roads
- encroachment by Coalition forces in 2019, who built a base within the area; they did not respect the agreement reached with the community, and the (Saudi) forces are preventing the local communities from using their traditional rights to cross the border
- visitors dumping rubbish throughout the protected area, polluting soil and water

- in May 2021, a fire broke out in the protected area, which the community successfully controlled on their own

- climate change events caused landslides which affected both the protected area and farms elsewhere; the Association does not have the means to repair the damage.

Some of these actions are worsening relations within the community, while others are improving them: the response to the fire was an opportunity for solidarity and people working together, while the dumping of waste, construction and other activities are causing problems between citizens committed to protecting the environment and promoting indigenous flora and fauna and those privatising it and damaging it.

A Hawf human rights and climate activist (m) mentioned the appearance since 2019 of *parthenium*, a new invasive species which is spreading rapidly; it is poisonous to animals and causes skin and breathing problems in humans. It was originally found on the Omani side of the border and is believed to have emerged as a result of climate change. Flash floods contribute to its proliferation. Members of the local council in Hadhramawt who participated in the consultation session in Seyoun added that, generally speaking, areas of rare biodiversity and the habitats of endangered species were not being protected as they should and, as they are not formally declared natural reserves, are often turned into sites for industrial or petroleum companies. Also, coastal areas were endangered, particularly by landfills which destroy coral reefs.

The water crisis

As is the case throughout the country, access to water for domestic and agricultural purposes is the foremost environmental problem experienced by the majority of the population. Despite being richer in fossil water sources, Hadhramawt coastal and interior areas are badly affected by this problem. However, the people of Al Mahra have a far worse experience: for decades, they have suffered some of the worst water scarcity in the country, except in the Hawf protected area which benefits from the monsoon seasons, giving its summers an attractive cool and foggy atmosphere. The rest of the governorate suffers extreme water shortages. Even two decades ago, villages and towns along the coastal plain depended on water trucked from remote wells and springs. A lack of dams or reservoirs to collect and make use of rainwater for agricultural purposes, as well as a lack of means to recycle waste water, exacerbates the problem.

Domestic water problems come in two main forms: absolute shortage, requiring the purchase and trucking of water over long distances, and pollution of the water sources. Both are relevant everywhere and were widely mentioned: in particular, both a farmer (m) from a Wadi Hadhramawt village and the President (m) of the Wadi Friends of the Environment complained about the pollution of their drinking water from agricultural and other chemicals, livestock faeces and the seepage of sewage and drainage waters into the aquifers from which they extract their domestic water. The same farmer, the Governorate Director of Agriculture (m) and an agricultural engineer (m) also complained about the unregulated increase in the number of water wells, which is worsening water shortages and lowering water tables. Participants in the consultation session in Al Ghaida complained about the lack of standards and quality control of bottling companies in the governorate of Al Mahra, affecting the quality of bottled drinking water.

Obstruction of watercourse flows: Blockages of watercourses force them to divert into agricultural or housing land, causing problems as people's houses are damaged or destroyed, even when built in originally 'safe' areas, while agricultural holders see their land simply disappear, with no prospect of compensation or replacement. Unsurprisingly, these cause problems within and between communities. In Hadhramawt, this is exacerbated by long-term tensions between the landowning social groups [tribes and *sada*] and the lower-status cultivating group and artisans, etc. The recent influx of IDPs and returnees from

Saudi Arabia is another source of social stress and tensions, as mentioned by many interviewees in Hadhramawt[18].

Throughout these areas [with the notable exception of parts of Wadi Masila, and Wadi Hajr in Hadhramawt governorate, both with very small populations], watercourses are dry and only flow when it rains. Droughts in the region are frequent, and the rare rains are usually violent downpours, sometimes lasting days and causing flooding of fields and areas near the watercourses. Historically, this rarely caused major problems because of wider wadi beds, shorter and less violent downpours, lower population densities and the absorption of much of the water in fields. Any serious rainfall causes these problems throughout the two governorates: the impact of the cyclones has already been discussed and affected Al Mahra more than Hadhramawt, but other rain episodes affect both areas.

Rapid population increase has worsened the situation, even more so since the war started, with the influx of IDPs from other parts of the country and the return of many households from Saudi Arabia (as a result of its new regulations imposing high fees for dependents, many Yemenis who work there have sent their families home to save the cost). As mentioned by the Hadhramawt Directors-General (m) of Water, of Planning, and many other departments, a common problem is the construction of housing on the edges of wadi beds with added 'protection' walls encroaching into the wadi bed. The rains and floods affecting Wadi Hadhramawt in May and July 2021 are examples of the worsening situation, with more than 1000 houses damaged in the Wadi in May, mostly in Tarim[19].

As mentioned by the Director of Environmental Affairs (m) in Al Mahra and the Director of Agriculture (m) in Wadi Hadhramawt, some of these problems have been endemic for decades, including the uncontrolled spreading of *prosopis juliflora* [known locally as *seiseban*] which grows fast, has long and resistant roots, and obstructs wadi beds. These bushes were introduced in Yemen by sand dune stabilisation projects in the 1980s but their long-term impact was not considered. They have become a pest throughout the country: due to their deep roots and easy dispersal of seeds when consumed by livestock, as well as their drought resistance, they have spread uncontrollably. In the past, some projects included their periodic uprooting and removal, but this needs to be done frequently and regularly as re-growth is rapid, but is not done due to lack of funding and prioritisation of this issue.

The Director (m) of the Health Office in Wadi Hadhramawt, the Director (m) of Environmental Protection, a farmer and an environmental engineer (m) in Al Mahra, among many others, mentioned another important cause of obstruction, namely the dumping of waste [domestic, construction and other] in wadi beds. Initially, the waste is washed along the wadi bed when the rain comes, but as the waste accumulates and builds up downstream, the wadi beds get blocked and overflow, damaging agriculture and residences.

Poorly planned road construction in recent years has worsened the situation in both Wadi Hadhramawt and the interior of Al Mahra, with asphalted roads blocking wadi beds and therefore causing damage and destruction as soon as there is heavy rain. With the roads to Oman becoming major routes for the import of basic necessities into the country, air pollution from truck emissions is a

18 Issues such as ascribed social status are sensitive and difficult to address in formal interviews. For example, due to the difficulties of accessing building land, the construction of houses in or along wadi beds may be done mainly by poorer local people of low status, internally displaced persons (IDPs) or returnees from the Kingdom of Saudi Arabia. While the majority of interviewees blamed both IDPs and returnees for most problems, in the absence of statistically valid data, it is impossible for this study to assess whether this is an accurate reflection of reality or the expression of prejudice against new arrivals and increased demographic pressure.

19 See OCHA Yemen flood snapshot as of 30 05 21, https://reliefweb.int/report/yemen/yemen-flood-snapshot-30-may-2021

Photo: Sergey-73 / Shutterstock.com

further problem, posing a risk to respiratory health in local communities.

Illicit and uncoordinated digging of wells by individuals and unregulated use of groundwater were mentioned by consultation session participants as further factors contributing to water scarcity.

Reduction of agricultural land, pasture and tree cover; impacts on marine environments

Farmers, the Director (m) of Forestry and Pasture and the President of Young Agricultural Engineers in Wadi Hadhramawt all pointed out that an increased population means greater importance and significance of livestock for the landless, putting pressure on the available pasture. Land is also converted into housing land, particularly on the outskirts of existing villages and towns, reducing the space available for pasture and agriculture and depriving rural people of employment opportunities in agriculture. The overuse of fertilisers and chemicals has impacted the soil, rendering some land unsuitable for agricultural use.

In Al Mahra, male and female members of the Hawf Association and the Director of Environmental Affairs (m) in the governorate complained about worsening desertification and reduction of pasture and other flora throughout their area. In both governorates, many interviewees, including a university teacher (m), a climate activist (m), an environmental teacher (m) and the Secretary (m) of the Environmental Protection Office in Al Mahra, as well as the President (m) of the Young Agricultural Engineers and the President (m) of the Beekeepers Association in Wadi Hadhramawt all pointed out that tree cutting has a seriously detrimental impact on the climate and is one of the causes of the overall increases in temperature, as well as depriving livestock of fodder.

These problems are increasing tensions between the landless people and the tribes which claim ownership of lands and try to prevent people from cultivating or using the pasture lands for livestock herding and beekeeping. There are two types of trees locally known as *sidr* [*zizyphus spina-christi*] and *sumr* [*acacia tortilis*] which are particularly prized by beekeepers for the famous and high-value Hadhrami honey. These trees are felled for building and other purposes, and their leaves used as soap by local women, reducing the availability of food for the bees. An additional problem for

beekeepers is the planting of decorative bushes and flowers by the municipality in Seyoun and other towns, as the bees feed on them, resulting in low-quality honey.

Officials, environmental activists and teachers in both governorates also mentioned encroachment of large trawlers into coastal waters as a major problem. In addition to depleting fish stocks, many of these trawlers also 'scrape' the sea bed, thus destroying the corals and other sources of nutrition for the fish and gradually depleting the resource. A case in point is that of rock lobsters, which were plentiful along the Al Mahra coast half a century ago and have now almost disappeared due to overfishing for export[20]. In addition to blaming foreign trawlers, participants in the consultation session in Al Mahra raised the issue of overfishing by the local industrial fleet. They felt that large boat owners aim to fish the highest quantities possible, not taking fish breeding seasons and stock management into account, and that lack of enforcement of laws and regulations allows this practice to continue, even though the Ministry of Fish Wealth has spoken repeatedly with the boat owners.

Air pollution

Air pollution is now perceived as a really significant issue by people throughout the two governorates, particularly urban residents. This was mentioned by many interviewees, in particular the President (m) of the Friends of the Environment in Wadi Hadhramawt, the Directors-General (m) of the Cleanliness Fund and of the Health Department and citizens in Wadi Hadhramawt. They pointed out that the main sources of air pollution are the burning of various types of waste, its unregulated dumping due to the lack of official landfills, and vehicle exhaust fumes. The Director (m) of the Cleanliness Fund emphasised the local authorities' inability to find areas for official landfills due to resistance from landowners, whether tribespeople or *sada*. The polluting items they listed include

- domestic waste, much of which now consists of plastics [bags, soft drink and other liquid containers], mixed indiscriminately with compostable items such as food remnants
- medical waste, which is not sorted and disposed of separately, thus putting people at risk from infection; burning this waste fraction spreads noxious and dangerous gases
- used lubricants and other items from vehicle maintenance and other commercial sources [e.g. paint from furniture makers] which are burnt (causing air pollution from fumes) or dumped in the ground where they pollute the water, affecting drinking water and agriculture.

In Tariba, a village near Seyoun, a resident (m) complained about the pollution resulting from livestock pens near houses, where animal excrement accumulates, dispersing hazardous dust and particles in the air when there is wind and penetrating into houses through the air coolers[21], spreading bad smells as well as bacteria to people. This problem also illustrates tensions within a community where livestock keepers share residential areas with people who have other sources of income.

Oil and other chemical pollution

Altamimi et al. have analysed the role of oil extraction in causing pollution in the Hadhramawt oil fields. They state that 'the Masila block14 oil-production operation might be more accurately described as a waste production operation with an oil by-product'[22]. The author clearly remembers conversations in the early 2000s in Sah [Wadi

20 Prior to independence in 1967, the population of Al Mahra considered lobsters inedible and therefore did not fish for them.

21 The types of air coolers used in this area use far less electricity but have weaker filters to prevent polluted particles entering homes.

22 https://hrmars.com/papers_submitted/6831/impact-of-oil-wells-drilling-process-on-human-health-in-hadhramout-yemen.pdf p. 929.

Idim, near the Hadhramawt oil fields] and in Shabwa with communities who complained about increased human and livestock diseases as a result of air and water pollution resulting from the oil extraction process.

The Director-General (m) of Water in the governorate, the President (f) of the Women's National Committee for Wadi Hadhramawt and a citizen (m) from Sah all pointed out that chemical pollution comes in different forms, ranging from the pollution associated with the burning of gas as a by-product of oil extraction to seepage of oil by-products into the aquifer, a problem mainly affecting the Sah area near the oil wells.

The environmental engineer from Al Mahra (m), Hadhramawt governorate Directors-General (m) of Water, Agricultural Protection and Environmental Protection and the Head (m) of Forestry in the Wadi discussed other forms of chemical pollution which are found everywhere. They focused on waste chemicals from agriculture, artisanal workshops and used vehicle lubricants dumped where used, which seep into the aquifers, eventually re-emerging in domestic and other water supplies. This is caused by a combination of factors ranging from the import of agro-chemicals which are banned in other countries, to the lack of precautions when using them and cleaning containers. The victims are workers who do not take the appropriate precautions and residents who use and drink polluted water. With respect to agro-chemicals and industrial use, ignorance is certainly one cause, both among traders of these products and their purchasers. All these products are recognised as causing and worsening a wide range of diseases, including cancer, renal failure, eye problems, asthma and ear, nose and throat (ENT) issues.

In Wadi Hadhramawt, the governorate's Director-General (m) of Agricultural Protection and the President (m) of the Beekeepers Association focused on the issue of beekeeping. Hadhrami honey is world-famous and sells at exorbitant prices; therefore, beekeepers are extremely concerned about the spreading of chemicals on crops and throughout the environment, as many of their bees have been killed and their productivity has also dropped considerably, affecting one of the area's main sources of income.

Oil pollution from ships dumping their lubricant waste in the sea is a problem both in Al Mahra and in Hadhramawt. The Director (m) of Ports and Landing Sites and the environmental engineer (m) in Al Mahra, and, in Hadhramawt, the Head of Forestry and Pastures (m), the Secretary (m) of the Environmental Protection Office, and the teacher (m) of environmental issues at the university all complained that ships have been dumping toxic chemicals and waste in the sea, which spread to the coast and not only kill the fish but also pollute their feeding grounds. The environmental engineer and seafood expert (m) from Al Mahra also mentioned the 2002 attack on the tanker *Limburg*, which caused a significant oil spill along the coast.

Urban areas

Many of the problems discussed above are equally relevant to rural and urban areas, but some of them are more marked in towns and cities because of the scale involved. Consultation session participants in Hadhramawt underlined that many local disputes had their roots in migration from rural to urban areas after the destruction of homes or land by floods, heavy rains or cyclones. Rural populations bring their sheep and other livestock with them to the cities, causing tension with the urban population. Moreover, disputes arise over the increased competition for humanitarian aid – both food and health services.

Solid waste management is affected by the increased number of city dwellers; here, the problems include the lack of managed landfills and irregular collections due to shortage of vehicles. Insufficient funding is a major issue, leading to unpaid salaries and the inability to finance equipment or purchase sites for landfills. Careless dumping of solid waste between houses in residential neighbourhoods, near the towns and villages, and on beaches is a major issue, encouraging pests which spread disease to local livestock. When burnt, this waste fraction

produces air pollution through the chemical reactions of plastics and other items.

Fieldwork produced a multiplicity of complaints and discussions of the topic in Hadhramawt, from the Directors-General (m) of Cleanliness, Water, Health, Environmental Affairs and Agriculture, as well as from the President (m) of the Wadi Friends of the Environment, a medical doctor (f), and a citizen (m). In Al Mahra, the President (m) of the Sons of Hawf Association, the woman in charge of water and environment in the Association, the human rights activist (m), and in Al Ghaida the seafood expert (m) and the Director-General (m) of Environmental Protection for the governorate, as well as others, mentioned this issue. It can be considered to be a universal problem in the towns. Disposal of waste water and other liquids is a major problem in urban areas. Problems with sewerage were brought up in Al Mahra by the Director (f) of Women's Development, the environmental engineer (m), the seafood expert (m), and the Secretary (m) of the Environmental Protection Office; in Wadi Hadhramawt, sewerage issues were raised by the governorate's Director-General (m) of the Cleanliness Fund, a community leader (m) in Seyoun, and a citizen (m), while in Coastal Hadhramawt it was mentioned by a community leader (m) in Fuwa (on the outskirts of Mukalla), the environmental teacher at the university (m), the Director-General (m) of Mukalla district, the Director-General (m) of Environmental Affairs and some citizens. All of them pointed out that available sewerage structures where they exist, for example in Mukalla, are inadequate and dangerous as they are damaged or have insufficient capacity, thus allowing overflows of polluted waste into the streets when it rains.

As pointed out by the governorate's Director-General (m) of the Cleanliness Fund, the Wadi Hadhramawt President (f) of the Women's National Committee and a neighbourhood *aqil*[23] (m), the situation is different in Seyoun and other towns, where there is no sewerage network. There, domestic waste is collected in cesspits constructed for individual houses or apartment blocks. The landowner is responsible for organising their regular emptying with the local authority, which has contracted a private entrepreneur who must be paid directly by the building owners. One problem is that there are not enough tankers. However, the main difficulty comes from the fact that many owners refuse to pay, so the pits overflow and soiled water collects in stagnant pools in the street, causing health hazards due to the breeding of insect vectors of disease [dengue, malaria etc.], and producing noxious smells which penetrate into the houses through the air cooler systems used in the region. Overflowing cesspits also cause sewage pollution of the groundwater in these areas.

As pointed out by the Director (m) of Information and Public Relations in Sayhut district and the Director (m) of Environmental Affairs in Mukalla, the domestic water supply network was built using asbestos pipes, a known carcinogen which is banned in most parts of the world and causes significantly higher cases of cancer and renal failure. Elsewhere, as pointed out by a geography school teacher (f) and a university teacher (m) in Al Ghaida, the environmental engineer (m) and the Secretary (m) of the Environmental Protection Office in Al Mahra, the Hadhramawt governorate Directors-General (m) of Water, Environment and Health, and an environmental university teacher (m) in Mukalla, the problem of storing water in plastic containers is causing serious health problems. Both water pipes and large storage tanks are affected when temperatures rise. High temperatures cause melting and deterioration of the plastic, producing poisonous emissions which affect anyone drinking the water.

23 *Aqil* is the term used to describe an officially appointed and recognised community leader in towns; each *aqil* is responsible for a neighbourhood.

Finally, a problem arises with the use of leisure areas and the ways in which different generations spend their spare time. In Mukalla, a doctor (f) pointed out that youths chewing qat [and dumping the plastic bags and other waste carelessly] on the beaches at weekends come into conflict with families with children wanting to enjoy the seaside, thus revealing a generational conflict which may well exist elsewhere in similar forms. In most areas, qat users are seen by some as problematic and setting a bad example to children and others who witness their activities.

State and community responses

State interventions and constraints affecting local and central government

The interviews, including many with local government officials, almost universally recognised the inadequacy of local government responses. Community leaders and citizens alike commented on the lack of action by local authorities in dealing with the main problems they were encountering and identified the issues which should be addressed by government: urban planning, solid waste disposal, sewerage infrastructure and operation, water management [whether supply of domestic water, disposal of waste water, or protection of water sources and allocation to domestic or agricultural uses], pollution from oil and other chemicals, and disaster preparedness.

With respect to these issues, local government institutions were blamed for having done very little. Some people, including officials themselves, focused on the lack of available financing, technical skills and training. Lack of funds is a problem both for recurrent [salaries, consumables, operations] and investment costs [acquisition of land for landfills, maintenance and construction of quality sewerage networks and water reservoirs, large equipment].

Consultation session participants in both governorates also mentioned the following issues:

- Lack of a joint working mechanism, or sometimes overlapping responsibilities, between government bodies working in the environmental and climate areas and the local authority
- Governorate-level decision-makers' lack of awareness of the importance of linking environmental and climate policies with agricultural and infrastructure development
- Lack of adequate early warning systems
- Lack of studies to inform decision-makers about potential climate-related impacts of decisions on land sales and water projects
- Lack of enforcement of existing regulations

The overwhelming impression is that local authorities and institutions are doing what they can, given the constraints under which they operate. The interviews were clearly perceived as an opportunity to appeal for more material and technical support.

There was outspoken criticism of the compensation mechanisms following the major cyclones and other floods and disasters. Many interviewees felt that compensation involved favouritism and corruption. These interviews confirm local and international media coverage in the months following the cyclones in 2015 and 2018. Other concerns relate to a perceived lack of regulations and their enforcement, as well as perceived opaque tendering for local projects.

Central government was rarely mentioned in interviews. Although both governorates officially fall under the internationally recognised government (IRG) of Yemen, its administrative, financial and managerial authority over governorates is very weak. Financially speaking, although Hadhramawt should now receive 20% of the income from the Masila oil field, and both governorates receive income from the ports, border crossings and other local institutions, none of this is sufficient to finance adequate services.

Community responses

Many interviewees were personally involved in helping others at the time of the cyclones and others also explained that community solidarity and mutual support kick in systematically in response to local climate-related emergencies, mainly destructive rains and floods. This is done either on an individual basis or through community voluntary groups or the intervention of local leaders such as neighbourhood *aqils* or sheikhs.

Given the nature of the other environmental issues identified, community responses were more divided and divisive. As these problems are often local and caused in part by people themselves, victims and perpetrators are often found within the same community. For example, in the case of dumping or burning solid waste in the streets or overflowing cesspits, everyone suffers, including those responsible, from the air pollution caused by burning garbage, the pests attracted by garbage, or the malaria, dengue and other diseases spread by mosquitos breeding in stagnant water. Such issues can deepen divisions and conflicts within communities, especially between those who have the means to ensure cesspits are maintained and garbage collected, and those who do not.

Water pollution and falling water tables are among the issues where those responsible for the problems may, or may not, also be victims, and the relationship is neither visible nor direct. This makes community responses largely ineffective at present. Most people do not understand the movements and structures of aquifers, whether shallow or deep, and the time lag between rainfall and replenishment of shallow aquifers, let alone deep ones, further complicates the issue.

Issues such as the use of agro-chemicals cause clear divisions between crop producers who use them on their crops and the beekeepers whose bees are killed by them. In this case, ignorance of the risks involved is likely to play a part, as both sellers and buyers of the agro-chemicals may be unaware of the dangers they pose, particularly as they are far more likely to have come across commercial advertising for the products than frank assessments of the risks.

Recommendations

What this report has shown clearly is that any programming in Yemen, and in particular in the areas in Yemen's southeast most affected by climate and environmental change, needs to take the stress factors resulting from environmental issues into account and consider how they impact on infrastructures, governance and the social fabric of the local communities. Project design and implementation in any sector, be it humanitarian, development or peacebuilding, must be climate-sensitive to ensure comprehensive and sustainable solutions to Yemen's multi-dimensional challenges.

The recommendations arising from this fieldwork can be addressed by a variety of actors, ranging from the local authorities themselves to local and international NGOs and larger development agencies. Training, awareness-raising and education are extremely important and the foundation stones for development and improved living standards and can be covered by smaller organisations, while hardware and material support are also necessary, particularly at a time when national authorities are unable to fulfil their roles, and can be provided by larger development agencies. The following recommendations are drawn from the interviews and focus on the most urgent issues:

A cross-cutting recommendation is the inclusion of women in any proposed actions.

On development projects, the following recommendations were made:

- Conduct proper assessments and involve the community in designing projects: this will avoid duplication and ensure the relevance and long-term sustainability of interventions
- For international organisations implementing projects: address the relevant authorities and ensure coordination with local authorities instead of investing solely in community-based initiatives. Many of these authorities have conducted baseline studies and have project plans but lack sufficient funding to implement them.

For local authorities

- Coordinate international organisations' development projects within the governorate, particularly on water and sanitation networks
- Engage in peer learning with counterparts in other governorates and countries to exchange on solutions to their challenges
- Establish an emergency management centre, ideally with coordination links between Al Mahra and Hadhramawt
- Work towards establishing and enforcing a requirement to conduct environmental impact assessments for all projects and implement regulations and laws in force
- Improve the infrastructure within nature reserves to facilitate visitors' appropriate behaviour (signage, designated paths, waste bins and public toilets)
- Initiate community-level prizes for 'cleanest neighbourhood', 'best managed sub-district for beekeeping', anti-pollution actions, etc.

For community organisations

- Provide training and awareness-raising on fundamental environmental issues affecting the communities concerned for community members and leaders, including women, young people and schoolchildren
- Map the flora, fauna and wildlife within the two governorates
- Launch community initiatives to remove *prosopis juliflora*, *parthenium* and other invasive species from pastures and neighbourhoods [their dried leaves can be used as animal fodder, but if seeds are eaten, then the droppings spread the bushes more widely].

For international organisations and INGOs

- Provide training[24] for community members and leaders, including women, young people and schoolchildren, local authority staff, and community organisations working on environmental issues and conflict
- Support local authority efforts to implement existing regulations, conduct peer learning and initiate community-level prizes
- Support reforestation, using beneficial tree species that are particularly appreciated by the people and their livestock and bees, e.g. the *ziziphus spina-christi* and acacia varieties, and encourage community initiatives to remove *prosopis juliflora*, *parthenium* and other invasive species from pastures and neighbourhoods; provide incentives for such actions
- Support existing active community organisations and the formation of others focused on environmental issues, particularly by involving young people to ensure that the next generation will be more environmentally aware and sensitive
- Consider reward or incentive schemes for local authority departments for improvements in environmental performance
- Assess the cost of developing more environmentally friendly solid waste disposal, sewerage infrastructure and management at the municipal level in towns and cities, establish appropriate mechanisms in rural areas and invest in any equipment and infrastructure required
- Support governorate early warning for climate-related disasters through training, equipment and communications.

24 Please refer to Annex 1 for a detailed list of training recommendations for community members and leaders, local authority staff and environmental community organisations.

Annex – detailed recommendations

(Environmental) I(NG)Os to provide training for community members and leaders, including women, young people and schoolchildren on:

- climate change and its implications for their governorate: current situation, prospects and major expectations; essential mitigation actions; what individuals can do; what government should do;
- management of water resources, explaining the process of replenishment of shallow and deep aquifers, the sources of pollution, principles of sustainability, importance of prioritising domestic over agricultural use; how to control pollution;
- rainfall, watercourse flows and the importance of keeping them free of obstruction; this is important for all communities, to help them avoid building in unsuitable places and worsening the environmental problems;
- implications of the rising sea levels and other oceanic changes for the eastern Yemeni coast;
- solid waste management: its importance; the role of waste in causing diseases; recycling and its benefits;
- mitigation measures which can be implemented by citizens and authorities;
- preparation for future cyclones or other disasters: this includes both advance warning methods and basic first aid and emergency planning training.

(Environmental) I(NG)Os to provide training for local authority staff on:

- methods to separate different kinds of waste, to avoid contamination of household waste with medical waste;
- mechanisms to reduce water and air pollution from the oil wells in the Sah area (near the Hadhramawt oil fields;
- educational approaches to environmental issues, to help officials use more effective methods to raise awareness of environmental issues. In particular, how to reach polluters [e.g. garage operators, artisans, agrochemical suppliers]; in addition to the technical information, using clear and accessible language and finding ways of persuading people and working with them in a positive and mutually respectful manner is very important and such training would have a major impact on the effectiveness of technical information provided;
- conflict identification and resolution, using actual local examples and focusing on specific issues;
- existing environmental protection legislation in all fields and methods of enforcing it;
- ways to enforce regulations on the protection of wadi beds and prevent encroachment on their areas;
- preparation for future cyclones or other disasters: this includes both advance warning methods and basic first aid and emergency planning training.

Environmental) I(NG)Os to provide training for community organisations addressing environmental issues and conflict on:

- communication skills (particularly social media messaging) and basic environmental issues, including how best to reach those who do not respect the environment;
- preparation for future cyclones or other disasters: this includes both advance warning methods and basic first aid and emergency planning training;
- subjects they consider important, e.g. the Sons of Hawf Association members may want specific training on dealing with *parthenium*, while people in coastal areas or Wadi Hadhramawt would have different requirements.

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