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The Role of the Environment in Peacebuilding in Yemen

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Executive Summary

This CARPO Report addresses the relationship between violent conflict and environmental governance in Yemen. It translates the concept of environmental peacebuilding to the case of Yemen, where it has not yet received broader attention in terms of mediation and post-conflict reconstruction efforts. The study compares six different governorates, namely Sana'a, Dhamar, Ibb, Ta'iz, Aden and Hadhramawt. It finds that all governorates face specific threats. In addition to well-known problems resulting from water scarcity, the study further shows that waste management and pollution are one of the most pressing issues across Yemen. If these challenges are not addressed adequately and in a sustainable manner, they can accelerate social conflict and ultimately threaten long-term solutions for peace and stability in the country. In light of the myriad of Yemen's environmental and social challenges, the Report provides some empirical snapshots of environmental initiatives that can offer inspirations for concrete action on environmental peacebuilding strategies.

Introduction

Beyond the enduring disastrous humanitarian crisis resulting from the ongoing war, Yemen is also experiencing an ecological crisis and a looming climate collapse.[1] The crises confluence of a civil war, resource scarcity, increasing environmental degradation and severe effects of climate change depict a complex threat in which several aspects reinforce each other. The lack of a centralized and cohesive government results in the fact that ecological challenges are only addressed inadequately, if at all. At the same time, a lack of provision of services and economic downturn, all due to the current violent conflict, increase ecological problems. The large numbers of internally displaced people (IDPs) constitute another source of growing environmental vulnerability.

These multi-dimensional linkages, all of which can be subsumed under the frames of environmental conflict and peacebuilding, require greater attention. Over the last two decades, scholarship has emphasized that various aspects such as environmental consequences of war, sustainable and inclusive natural resource management, dynamics of conflict and natural disasters or environmental degradation play an important role in peace negotiations and

1 Special thanks are dedicated to Howida al-Qubaty and Manal al-Mahdali, master students at the Gender-Development Research and Studies Center (GDRSC) at Sana'a University, for data collection and processing.

post-conflict reconstruction and reconciliation. Current peacebuilding efforts, however, are mostly embedded in a liberal agenda or paradigm "that favors situational short-term economic growth solutions over long-term environmental resource availability concerns" (Swain & Öjendahl 2020: 9). Environmental resources – be it general resource types such as arable land or fresh water or more specific ones such as wood, oil and gas, animals and plants (Lee 2020) – are needed for present economic prosperity and welfare: But it is even more important and necessary to ensure that these resources are sustainable in the longer term. As some longitudinal studies have shown, violent conflicts that have emerged over access to and/or distribution of natural resources "are twice as likely to revert to conflict in the first five years [after a conflict settlement]. Nevertheless, less than a quarter of peace negotiations aiming to settle conflicts linked to natural resources have addressed resource management mechanisms" (Swain and Öjendahl 2020: 9). As the authors conclude: "This is highly surprising and a state of affairs that is not satisfactory" (ibid.). Broader efforts and long-term strategies are consequently needed to achieve durable and sustainable peace.

The nexus between violent conflict and environmental stress is particularly apparent in war-torn Yemen: It is apparent that environmental destruction is a direct repercussion of violent conflicts or conflict-induced refugee movements in the country. Yet, questions of a broader and long-term sustainable and environmentally peaceful development have generally been ignored amid the effects of the ongoing war. To the best knowledge of this Report's authors, the young but nascent field of environmental peacebuilding – while acknowledging the importance of the Yemen case – has not provided much systematic and in-depth analysis on the country so far.[2]

Relying on recent work by Tobias Ide and colleagues, we define environmental peacebuilding as "multiple approaches and pathways by which the management of environmental issues is integrated in and can support conflict prevention, mitigation, resolution and recovery" (Ide et al. 2021: 2–3). If environmental aspects have been considered in peacebuilding strategies, they mostly remain on a rather superficial stage of what some scholars have labelled *technical* environmental peacebuilding, which fights symptoms over the short-term. While this resembles the above-mentioned critique of a dominating liberal agenda, more long-term environmental peacebuilding, which also includes questions of environmental justice and intensified preventative measures, must be addressed. These more comprehensive efforts are also called *restorative* and *sustainable* environmental peacebuilding (Dresse et al. 2019; see also Carius 2007; Fröhlich 2021).

2 Only very recently, the topic has gained greater attention. Recent publications thus include Sowers & Weinthal 2021; Lackner 2021; and al-Mowafak 2022.

As regards Yemen, there are numerous studies about water scarcity and its role in peacebuilding efforts.[3] Water is a crucial resource for meeting daily family needs and is a key input for agriculture, livestock production and varied sorts of microbusinesses. Violent conflicts will have adverse impacts on water quality and availability if accessibility is proscribed by active fighting or the presence of landmines. These impacts are particularly acute in areas of displacement. Migration flows and growing water needs of IDPs in already water-stressed areas lead to more violence between host communities and internally displaced persons. Providing a social long-term perspective such as raising awareness on sustainable water management blended with training on maintenance of water infrastructure for both communities, in addition to technical assistance, might ensure sustainable co-existence.

We suggest, however, that this narrow focus on one specific environment-related threat obscures many other key concurrent environmental challenges. In this way, this study contributes to the recently increased interest in systematically analyzing the "links between the environment and peace (both positive and negative)" that has been subsumed in the interdisciplinary approach of environmental peacebuilding (Ide et al. 2021: 2). It transfers the concept of environmental peacebuilding to the case of Yemen. We designed our research as a within-country study comparing six different governorates, namely Sana'a, Dhamar, Ibb, Ta'iz, Aden and Hadhramawt. Among other factors, the selection of cases reflects a high variance of diverse climatic features and topography, as well as actors in terms of external involvement (e.g. involvement of external state actors but also presence of international donors and organizations) and local authorities affiliated with different political factions (particularly the Huthis, also referred to as Ansar Allah, the internationally recognized government and the Southern Transitional Council). While all governorates face a variety of environmental challenges, the study emphasizes the core challenges that are most prevalent in each analyzed unit. From a methodological perspective, the analysis is based on desk research and combines different qualitative approaches such as a document analysis of scholarly literature and formal situation reports by in-charge authorities, as well as local and international organizations. Additionally, 19 semi-structured expert interviews with representatives of international organizations and local stakeholders were conducted between September and November 2021.[4]

The study found, in addition to the well-known problem of water scarcity, waste management – particularly solid waste/garbage but also liquid waste – as one of the most pressing issues.[5] Additionally, illegal and excessive wood-

3 Particularly, the 'endemic' water scarcity of Yemen has received much attention, see, for instance: Lackner 2020; Ward 2015; Weiss 2015; Lichtenthaeler 2010.

4 Because of the politically sensitive nature of this research, almost all interview partners have been anonymized.

5 Research interview with a representative of an international organization, September 2021.

cutting caused by a shortage of fuel derivatives emerged as a new problem of resource management and a potential conflict driver. As well, some governorates face other specific threats, such as deterioration of land resources, destruction of coastal and marine environment, and natural disaster risks. Alongside pointing out the varying key environmental challenges across the individual governorates, this CARPO Report further provides some empirical snapshots of environmental initiatives that can offer inspirations for concrete action in the framework of environmental peacebuilding strategies. In the following, each governorate will be described individually. Key findings that include the broad spectrum of environmental challenges, affected actors and the response and management of these threats will be discussed in a subsequent section, which provides the basis for concluding remarks and recommendations that are explicitly addressed to international organizations.

This CARPO Report results out of a research project implemented on behalf of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH by commission of the German Federal Ministry for Economic Cooperation and Development (BMZ) and with co-financing from the European Union. In its approach to Yemeni-international research cooperation, it builds on a previous project at CARPO. Implemented on behalf of GIZ by commission of the German Federal Ministry for Economic Cooperation and Development (BMZ), this project resulted in CARPO Report 06 and CARPO Briefs 14 and 16–19. Both projects are now subsumed under the initiative 'Research Cooperation on Peacebuilding in Yemen'.

Environmental Stress and Concerns in Six Governorates

Sana'a: Waste and Resource Management Problems

One of the most frequently cited environmental problems in the capital of Yemen relates to waste mismanagement, which includes solid waste, sewage and garbage accumulation. Even before the war, Yemeni cities such as Sana'a lacked appropriate numbers of waste management stations, with the few present not qualified to recycle solid, medical and radioactive waste. Several interview partners referred to al-Azraqayn dumpsite in Sana'a as a salient example of the existing waste management stations: a primitive waste facility that is highly overloaded and meets neither basic waste-management standards nor the city's need of waste processing.[6] The war has only increased the

6 Research interview with a representative of the Environment Protection Authority, Sana'a branch, September 2021; research interview with a representative of a local organization, September 2021.

problem of waste management, as seen in the bombing of the newly constructed medical incinerator in Sana'a in 2015 (Browning 13.12.2021). Further difficulties of waste incinerators include frequent electricity outages due to a shortage of diesel, interruptions of salaries, and the lack of back-up maintenance and financial support.[7] Human-caused pollution because of waste is particularly true for sewage stations. A general lack of sanitary facilities, hygiene measures, as well as solid waste, pollution and garbage accumulation have resulted in bacterial contamination of drinking water, leading to many cases of cholera (Camacho et al. 2018; Lyons 12.10.2017) and other diseases causing diarrhea.[8]

The role and effects of waste management and pollution as trajectories for continuing social grievances and tensions in Yemen has not yet been adequately studied. However, studies on garbage dumps and other forms of waste assemblage in other parts of the world have shown them to be an important dimension in the complex relationship between humans and nature, with potential to deepen socio-political conflicts (e.g. Robbins 2020: 190–191; Bennett 2010; Lindner & Meissner 2015). The waste crisis in Sana'a (and other areas, especially Ta'iz) engenders a "slow (…) but powerful form of violence" by gradually poisoning the Yemeni population and inflicting attritional violence (Fenton 2021). It further deepens grievances over the lack of effective governance since waste management is an essential and core aspect of public service and public health, and thus of a functioning state system. Especially in armed conflicts, deterioration of public health is a particular area of concern, due to the breakdown of health and social services and its increased risk of disease transmission, as well as battle injuries and deaths. In turn, delivery of health care (i.e. restoring mental and physical health) is an important part of post-conflict reconstruction and reconciliation (Gutlove 1998).

CASE 1: Garbage Collection Initiative

"I want to give you an example of an environmental problem that happened in my neighborhood. We used to dispose our household garbage on the sidewalks which caused problems for one of our neighbors because the water tank of his house was placed nearby. The neighbor became angry and started to remove the garbage from the sidewalk to the street to protect his water source from contamination and his family from illness. People from the neighborhood

7 Research interview with a representative of the Water and Environment Center (WEC), Sana'a University, September 2021. See also Foppen 2002.

8 Research interview with a representative of a local organization, September 2021; research interview with an anonymous environmental expert, September 2021.

became annoyed as their children could not play any longer on the streets, they had to walk on this garbage and their cars were affected too by broken glass when driving over it. This created many tensions between him and others and ended up in physical confrontations between their sons. I and other women from the same quarter asked the children to inform their families to stop throwing the garbage in our quarter and throw it in the garbage can on the main street where it is emptied more than once every day. The children were like ambassadors. They started to stop throwing their garbage on the street. I also went to about ten houses in the neighborhood and asked the adults to throw their waste into the waste can on the main street. By the time, and after about three weeks of fruitful efforts, all people in the neighborhood threw their garbage in that waste can on the main street. Within a month, our quarter was the cleanest place in Old Sana'a. The good thing is that by the beginning of the war, when the cleaners stopped working and all places were dirty, our quarter was still clean. People from other quarters used to ask why our streets were clean all day. People in my neighborhood were so proud and started telling others about their achievement as their quarter was still clean in the absence of cleaners. Many people from other quarters started adopting our initiative, and other quarters turned also clean. The whole square with its 200 houses became clean. Also, the street sweepers have stopped coming to every quarter, as people throw their garbage in the waste can on the main street until now." (Research interview with one of the women of this local initiative, November 2021.)

Besides the scarcity and pollution of water resources, another growing environmental threat and possible entry point for environmental peacebuilding relates to unsustainable woodcutting. The rate of woodcutting has expanded due to the lack of diesel, the increase in cooking gas prices and a flourishing black market for fuel derivatives (diesel, petrol, cooking gas). Particularly in the winter seasons, when it is cold and agricultural activities are at their lowest level, people (have more time to) collect firewood and thus further severe damage of ecosystems.[9] Besides the destruction of vegetation and biodiversity, firewood collection causes frictions and conflicts between people because trees are illegally cut; for example, from public yards. According to interview partners, there are misperceptions and unawareness among the population because "many people cut trees that belong to other people, thinking that they are not owned by anyone."[10] But the problem extends beyond individual practices: According to the dean of the Faculty of Arts at Sana'a University,

9 Research interview with a representative of an international organization, September 2021.

10 Research interview with an anonymous environmental expert, September 2021.

37 trees were "cut from the yard of the faculty and sold in an official tender for more than 2 million Yemeni Rial (US$ 8,000)" (cited in Aldahbashy 09.05.2019). Moreover, according to a government survey, "[m]ore than 860,000 trees a year are being cut down to supply Sanaa's 722 bakeries alone, which burn around 17,500 tonnes of firewood each year" (ibid.).[11] This linkage of illegal and excessive logging with social instability has not yet received much attention in the study of environmental conflict, but constitutes a subject of growing importance as it creates tensions within local communities and between the population and governmental institutions.

Conflicts over access and distribution of natural resources in Yemen's capital, caused by pollution or unsustainable resource exploitation, birth other problems. The most affected and vulnerable people include farmers who own agricultural land in Bani Hushaysh, a district in Sana'a governorate, and in Bani al-Harith, a district in Sana'a city. These farmers are no longer able to till their fields due to a lack of water and thus are threatened by a loss of income and livelihoods. Similarly, (young) women and girls, with their responsibility to obtain water for household use, are another vulnerable group. Due to increased poverty, lack of income and inability to pay already reduced public water bills, they are often forced to fetch water from the steadily decreasing free sources in Sana'a city (provided by philanthropists or international aid, as the cost of water rises or traditional water reserves deplete).[12] Households often include extended family members, increasing the demand for water (Zabara 2018), but frequently the allowance is only one canister of 10 to 20 liters, an insufficient amount. At the water collection points, the more powerful women often suppress the weaker ones. Women and children often fight over who gets water first and how much and women often become physically aggressive towards other water collectors when these try to fill more canisters.

CASE 2: Fatima's Dream: Fighting Against Plastic Bags Initiative

Fatima is a very engaged woman heading the General Directorate for Women at the Environmental Protection Authority (EPA) in Sana'a. Among her many initiatives, where she has played a leading role, is the fight against plastic bags. Millions of thin, unrecyclable plastic bags are thrown by people onto streets and into the landscape without caring about the damage they cause to the environment. They are scattered everywhere, but in particular in the qat markets in cities and in rural settlements; the plastic bags are then carried away

11 Further evidence of deforestation in Yemen since the beginning of the conflict is provided by Weir 2019.

12 Ibid.

by the wind and get snagged on trees, clog irrigation canals and rainwater runoff discharge systems, cover fields and end up in the sea. The unshakeable belief of Fatima in a Yemen without plastic bags takes all her efforts as she attempts to take action and ask for local and international support. Her tireless advocating at the highest level in the country to place a ban on plastic bags keeps her very busy. Yet, "a total ban cannot be enforced," decision-makers at the EPA argue. Fatima wants decision-makers to at least force plastic bag producers to produce biodegradable bags and eventually enforce higher taxes on plastic bag producers and distributers. Fatima has organized many workshops to teach women to sew bags from organic material, for example flour and sugar sacks. This encourages society to use the bags in multiple ways while at the same time empowering women economically. But these sewn bags are not sufficiently attractive to win over use. There is an obvious need for an innovative marketing idea to get the attention of people to use paper and fabric bags. Fatima keeps saying: "One day I will have huge problems because I am stubborn in approaching decision-makers, but I don't care. I want this mess to end." (Research interview with Fatima al-Ghuli, November 2021.)

Dhamar: Deterioration of Land Resources

The governorate of Dhamar, bordering on Sana'a, faces similar challenges. The urban areas suffer from an overflow of solid waste as well as medical and other hazardous garbage, while the rural areas suffer from excessive woodcutting. Untreated wastewater discharged by thermal spa facilities to agricultural land poses another challenging environmental threat. While there is a basic incinerator for garbage in Wusab district, garbage incinerators connected to health facilities are missing. Additionally, hazardous waste is often thrown away with health and medical facilities' waste, without any prior treatment. Consequently, infection by different viruses, such as hepatitis, are spread widely across Dhamar.[13] People often think the government is solely responsible for improper waste management. However, small-scale and bottom-up initiatives, such as described above in Case 1, can incentivize people to dispose their garbage to nearby waste bins rather than throw it on the streets. Such an initiative could be expanded to other governorates, such as Dhamar.

Having said that, Dhamar differs from Sana'a and its waste problems in terms of Dhamar's greater amount of arable land and larger agricultural activities, which elicit other forms of environmental stress. While social frictions due to

13 Research interviews with representatives of the Environment Protection Authority, Dhamar and Aden branches, September 2021.

illegal logging have not been reported, the governorate faces environmental problems such as the decrease of other crops (e.g., coffee) in favor of qat cultivation, which aggravates problems with water sustainability and household-level food production (Ajl 2018). After the interruption of salary payments in 2016, many people started planting qat. As a cash crop throughout the entire year, the growing of qat offers people more financial revenue; but its widespread cultivation has led to depletion of water sources as the plant needs much irrigation (Lichtenthaeler 2010; Heffez 23.07.2013). Traditional irrigation methods, such as the flooding of fields, were often very simple, and lead to the overexploitation of precious groundwater. The spread of solar pumps has soared over the past few years, in light of the breakdown of the national electricity grid, but their use has only exacerbated the situation with overextraction of groundwater (Aklan & Lackner 2021). One interview partner emphasized that the mountainous woodland of 'Utma district, with its rich terrestrial flora, has been particularly affected. Some farmers there have replaced coffee with qat trees even though it is well known among the farmers that coffee requires less water. The cultivation of qat has caused many wells to dry out in the area, leading to conflicts between neighboring farmers over dwindling water resources.[14]

CASE 3: Finding Incentive-Based Alternatives to Qat Cultivation

"I think it is difficult for the organizations to force people to stop planting qat. However, the farmers could be encouraged to plant fruits and vegetables instead of qat. Because the farmers know very well the consequences of qat planting as it needs a lot of water and the dangers of the pesticides used to grow qat. Therefore, there could be activities like providing farmers with agricultural seedlings and greenhouses to grow fruits such as strawberries and watermelons. There is a success story of planting mango in 'Utma district. It was an idea of a person, not an organization nor local authorities. If the farmers are supported with agricultural seedlings, the situation will be better, because it is difficult for the farmers to plant vegetables or fruits due to the high prices of agricultural seeding. To encourage farmers to stop planting qat, there should be alternatives. Also, there is a need for awareness-raising sessions and brochures." (Research interview with a representative of a local environmental organization, September 2021.)

14 Research interview with a representative of the Environment Protection Authority, Dhamar branch, September 2021.

Ibb: Food and Water Insecurity

The governorate of Ibb also experiences various environmental problems from solid waste, extensive tree-cutting and water scarcity. The war has led to many internally displaced people migrating to Ibb, which has exacerbated the environmental pressure. For instance, the sewage network of Ibb was designed for 5,000 people more than 20 years ago; today the total population exceeds one million.[15] While water scarcity is found in all regions in Yemen, its conflict-driven consequences are especially apparent in the governorate of Ibb, which is characterized by large-scale agriculture. This region, especially the Suhul area, was once known as the breadbasket of Yemen. Soil degradation and desertification have now turned the fertile arable land into wasteland and urban sprawl.[16] The decline of farmlands, depletion of groundwater reserves and tree-cutting has caused conflict among people. Ibb has one of the highest numbers of land-grabbing incidents in Yemen, resulting in numerous violent conflicts every year. As described in the case of Dhamar, initiatives to restore and rebuild agricultural land (e.g. incentive-based alternatives to cultivating qat) are needed and could provide entry points for lowering the conflict potential between farmers.

Even before the war started in 2015, deadly consequences from fights over water resources have been reported in different Ibb districts, such as al-Radhma or al-Makhadir.[17] Qat is a major environmental problem that accelerates social conflict. Similar to Dhamar governorate, the cultivation of this profitable crop has significantly increased in Ibb, due to personal economic losses from the war. Qat's accompanying problems, however, have a long history and date back prior to the war. Although there is a lack of data on the number of casualties caused by frictions over arable land and water, there are some records. A newspaper article from the year 2013 (Al-Sakkaf 02.10.2013) reports on a violent conflict between qat farmers and governmental security forces in the governorate after the state-run electricity company started digging a well in the Wadi al-Ghayl area. Anger and fear over dwindling water resources due to the new well led to attacks by local farmers. The newspaper reported that around 14 people died and more than 50 were injured as a result this one conflict.

15 Research interview with a representative of the Environment Protection Authority, Aden branch, September 2021.

16 Research interview with an anonymous environmental expert, September 2021; research interview with a representative of the Environment Protection Authority, Aden branch, September 2021.

17 Research interview with a representative of the Public Authority for Environmental Protection, Ibb branch, September 2021.

CASE 4: Wadi Flow Regulation Initiative

The riverbed of Wadi Bana, the site of the most rainfall in Yemen, flows from the mountainous Ibb governorate and passes Lahij governorate into the Abyan Delta. Several years ago, this water stream caused serious troubles to farmers who irrigate their crops along the riverbed. In times of drought or low rainfall, farmers upstream would divert water into their fields, which had severe negative impacts on irrigation mid and downstream, and caused fights among the various farmers. The Food and Agriculture Organization (FAO) assisted in rehabilitating agricultural land; for example, installing solar panels for water pumping and repairing water canals in several Yemeni regions. But this aid was not offered in upstream Wadi Bana. Throughout several meetings, farmers from the different regions gathered and decided to solve the problem. In 2019, they convinced the FAO to do a reassessment of the needs of the areas from the source to the estuary, along with solving the problems related to the water distribution rights in the valley. (Research interview with a representative of a local environmental organization, November 2021.)

Ta'iz: Environmental Stress and Conflict-Induced Refugee Movements

Ta'iz in the southwest of Yemen faces environmental problems in terms of solid waste, sewage and water scarcity. As several interview partners have reported independently of each other, the lack of sewage services for around 80 percent of the people in the governorate negatively affects population health. In particular, the governorate has severe problem with fluoride contamination of wells, a natural hazard causing dental and skeletal fluorosis. The concentration is so high (more than ten times the 1.5 mg/l recommended by WHO) that the closure of wells has been highly recommended, but such action would put locals under further water stress. Farmers use this water for irrigation, but drink from treated water sources when affordable (Aqeel, Al-Amry & Alharbi 2017; Al-Amry 2009). The war has greatly weakened the performance of the Water and Sanitation Local Corporation in Ta'iz city. Poor sanitation services, especially in IDP camps, accelerate the growth of bacteria in the freshwater storage, causing the spread of diseases such as cholera, as well as leading to chronic diarrhea, general weakness and loss of appetite. Malnutrition, especially among children and pregnant women, is a widespread problem. During the rainy season, the rate of diseases related to water quality increases significantly, as rainwater mixes with polluted groundwater reserves or water tanks. According to people on the ground, this is a greater problem in Ta'iz than in other governorates.[18] The war

18 Research interview with a representative of a local organization, September 2021.

has exacerbated a historically critical water situation, as the inability of many consumers to pay for water supply services ultimately leads to a "collapse of the water and sewage system."[19] The loss of fee revenue causes financial problems for the local water and sanitation corporations, which in turn are also not able to pay their employees. Additionally, the health infrastructure has broken down, and hospitals are unable to treat all those with illnesses caused by water contamination. The problem of garbage accumulation also causes additional environmental problems (Weir 2019).[20] In many cases, people in the villages simply burn their garbage, causing air pollution.[21] As described for Sana'a, the contamination and pollution of the environment, such as air and water, limits the availability of these natural resources and constitutes a major source of potential conflict between hostile parties, as well as leads to growing mistrust of and grievance against the authorities.

As all interview partners in Ta'iz emphasized, those most affected by these environmental problems are women, the elderly, children and IDPs. While many men have lost their jobs and/or are away participating in the fighting, women are forced to look for income while also caring for the family. Increasing environmental stress also means more conflict over decreasing resources.[22] The influx of IDPs has caused conflicts over natural resources with the locals, especially over fresh water. For instance, utilities deliver water only once a month in Ta'iz city. This only fuels tensions between host communities and IDPs over steadily dwindling water resources (Werner 2021; al-Mowafak 2021). Given the decrease of water availability due to demographic growth and pollution, many people search for water sources in other areas. According to one interviewee: "Sometimes they dig wells, but the water is often salty and undrinkable."[23]

CASE 5: Informal Recycling Efforts and Limiting Soil Degradation

Despite the widespread habit of burning plastic waste that is especially common in rural areas, informal small-scale businesses benefit from collection of trash in larger urban cities of the governorate. The solid waste separation and collection (recycling) by poor people has increased immensely during the past few years. They sell the waste (for example, plastic bottles) per kg to retail shops. The latter then sell them to bigger collection businesses. Plastic

19 Ibid.

20 For some visual impressions, see Borbon 05.11.2019.

21 Research interview with a representative of a local organization, September 2021.

22 Ibid. The (psychological) suffering of many Yemeni men has also resulted in an increase in gender-based violence; see further: al-Gawfi, Zabara & Philbrick Yadav 2020.

23 Research interview with a representative of a local organization, September 2021.

bottles are shredded and then exported. Metal waste used to be exported to China. Also, car oil waste and expired car and solar power batteries are now being recycled. However, standards are not controlled by state authorities. (Research interview with a consultant and former representative of the Environment Protection Authority branch in Aden, September 2021.)

Another civic initiative included citizen's participation in removing accumulated waste from a large area in Ta'iz and confining it to a specific place. The soil of the area from which the waste was removed was subsequently treated chemically. It became a large football field so that the citizens can use it and keep it clean at the same time. (Research interview with a representative of a local environmental organization, September 2021.)

Aden: Degradation of the Marine and Coastal Environment

Like many other governorates in Yemen, Aden faces problems of waste management, pollution and water scarcity; problems which have amplified through the increasing numbers of IDPs hosted by the governorate. In contrast to Sana'a and its surrounding regions, however, the Aden governorate in southern Yemen has specific environmental challenges that are often linked to its coastal borders. One of the major problems relates to sewage water that mixes with seawater, destroying the local marine environment. The sewage system in Aden city is old and dysfunctional, and major amounts of sewage are directly discharged into the sea without treatment. Moreover, during the heavy rains between April and September 2020, resultant floods caused mixture of sewage with clean water from the public network.[24] The torrential rains in 2021 that led to flash floods again aggravated the situation, flowing together with sewage (Al-Akwa & Zumbrägel 2021). Wastewater pollution has increased and seriously impacted the general health situation, particularly in the IDP camps and slums of Aden city. Although there were many complaints from citizens, governmental response and action was absent.[25] While there are currently some initiatives to solve the waste management problem, the poor infrastructure of refugee camps and informal areas in Aden makes it especially difficult to implement these measures. Lastly, the large and growing population of the governorate of Aden is further threatened by sea level rise. Conservative scenarios of between 0.33m and 0.60m of sea level rise over this century would lead to large, inundated areas, as well as coastal erosion and flooding hazards.[26]

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24 Research interview with a representative of the Environment Protection Authority, Aden branch, September 2021.

25 Research interview with a consultant and former representative of the Environment Protection Authority, Aden branch, September 2021.

26 Research interview with a representative of the Environment Protection Authority, Aden branch, September 2021; see also Al Saafani et al. 2015.

Additionally, with its many ports, the governorate is one of Yemen's major hubs of transportation. However, environmental problems, such as the ship sewage and other waste, accompany the financial benefits. Aden has experienced a number of oil tanker disasters (e.g., in 2009, 2013 and 2017); but the most salient example is the sinking of an abandoned oil tanker in summer 2021, which resulted in a large oil slick along the southern coasts. In addition to the above-mentioned pollutants, waste from the electricity plants is routinely discharged into the sea, negatively affecting the natural landscape and marine organisms. The resultant poisoned fish have a large impact on food security, population health and the country's economy, as the fish industry is an important pillar for both export and in-country sales (*Developing Yemen's Fishing Industry* 2020). A major problem is that most of this pollution remains unnoticed. Fishermen are often unaware of invisible contamination (e.g., through heavy metals) and consumers focus on the price rather than the purity of the fish. This unawareness is mainly caused by a lack of monitoring and reporting requirements. There is a quality inspection lab in Aden that can detect toxic waste such as heavy metals, but analyses are confined to fish for export, thus exposing local markets across the country to large amounts of poisoned and/or spoiled seafood. According to a former official at the Environment Protection Authority (EPA) in Aden: "There should be a weekly notification to inform the fishermen about the places allowed to fish. (…) There is a need for integrated work between all involved stakeholders; one of them is the fishery associations."[27] He also stated that the fishermen should be informed whenever there is a leak from any ship and fishing activities should stop immediately.[28] The major 2021 oil spill mentioned above, which resulted in large numbers of dead fish and attracted much attention throughout local media, also created tensions between fishermen and the authorities. Directly after the accident, Yemeni fishermen submitted complaints to the local authorities about the oil contamination of fish stocks, fearing for their income. They received no response. Only after a video footage of waste from the ship being thrown into the sea was circulated did the attorney general file a criminal charge.[29] The destruction of the marine environment and biodiversity in the Yemeni territorial waters in the Gulf of Aden is a powder keg of social grievances and turmoil: pollution through chemicals, untreated wastewater or oil leaks, and overfishing limits the fish stocks, a major economic backbone of the area; poisoned fish stocks engender a public health crisis and food insecurity; pollution of fresh water further aggravates the spread of diseases; and occasional or long-term effects of climate change such as flash floods and sea level rise destroy livelihoods,

27 Eleven fishery associations exist in Aden which are responsible for supporting small-scale fishery businesses.

28 Research interview with a consultant and former representative of the Environment Protection Authority, Aden branch, September 2021.

29 Ibid.

housing and infrastructure. Additionally, the presence of IDPs exacerbate the already tense situation over limited natural resources. Without comprehensive and sustainable interventions to solve these multiple issues, instability will continue to dominate the governorate of Aden.

Hadhramawt: Climate Change as Threat Multiplier

In Hadhramawt governorate, Yemen's largest, the effects of climate change are most apparent in terms of desertification and an increasing number of natural hazards, such as cyclones and flash floods. During the past decade, Yemen has experienced increasing numbers of cyclones and changing rainfall periods due to climate change. A gradual increase of erratic rainfall, noticed since the early 2000s, culminated in the extreme flooding in 2020.[30] Flash floods constitute one of Yemen's biggest environmental threats stemming from climate change. Urbanization and the expansion of agro-investments over decades has eliminated the trees and shrubs that act as natural barriers to flooding (Al-Eryani 2020b). Particularly, in the last two years, the number and scale of flash floods has dramatically increased (Al-Akwa & Zumbrägel 2021; see also Al-Eryani 2020a). Environmental risks include flash floods that mix with waste and byproducts from oil refining – such as large quantities of salinity produced water and other chemicals – and are transported over long distances. This is particularly true for the Wadi Hadhramawt area: Floods washed out the ground storage where the oil industry dumps its waste, thus contaminating the water flowing into wadis, polluting the soil and groundwater resources, and damaging farmland and vegetation (ibid.). In the oil industry, clean water is extracted from the Hadhramawt water basin and oil-polluted water is reinjected into the groundwater. Frequent cases of cancer are reported in the area, especially among women and children.[31] Multiple cancer cases are even reported a further distance from oil production sites (Lackner 2021). As already reported for other governorates, the effects of such pollution on public health puts significant strain on Yemen's government and will impair peaceful state-society relations long after the war has ended.

In addition to pollution and negatively impacted human health, flash floods also destroy infrastructure. Most houses in Hadhramawt valley are built in the wadis and from mud, leaving them highly exposed to heavy rainfall events and flash floods. The same is true for tents of displaced families that have migrated to the area as a result of the war. Heavy rains also destroyed the transport system (e.g., road, bridges) and wrecked water and electricity networks (Al-Akwa & Zumbrägel 2021: 8–9).

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30 See further: International Disaster Database (EM-DAT). Available at *https://www.emdat.be/* (27.04.2021).

31 Research interview with a consultant and former representative of the Environment Protection Authority, Aden branch, September 2021; research interview with a representative of Environment Authority, Hadhramawt branch, September 2021.

Between the rainy seasons, Hadhramawt faces the growing threat of desertification that leads to destruction of farmland. The destruction of fertile agricultural lands in particular constitutes a long-term problem. Hundreds of agricultural acres were either flooded or dried out. Many small farmers remain unable to restore their agricultural lands due to the lack of financial assistance for the high cost of restoration. This engenders concerns over general food insecurity and increases the human insecurity of those who depend on natural resources for their livelihoods. This loss of income can enhance climate-induced migration or increase the number of people who are forced to turn to illegal sources of income to compensate the loss or who might feel compelled to join one of the various current military factions for a salary, thus adding to the country's social and political instability.

CASE 6: (Re)Creating Water Drainage Channels

Adaptation strategies are needed that are able to cope with the absence of modest and continual amounts of rain and the now more common sudden and erratic torrential rainfalls. One solution could be the expansion of drainage channels and water reserves as well as providing incentives for citizens (e.g. basic services, infrastructure, job creation) to leave the valley and settle on the higher plateau. There are several endeavors to establish and rehabilitate water drainage systems. Oftentimes this includes restoring or reactivating traditional rainwater drainage systems (*manahil*) and retention basins (such as cisterns or *qanawat*). As irrigation systems they can help to avoid desiccation of arable land. Importantly, they can also be used for draining excessive water caused by heavy rainfall.

Unfortunately, the responsible authority, the office of the Environmental Protection Authority in Hadhramawt Valley, was shut down in 2016. This resulted in a lack of public environmental projects that are desperately needed in light of the above-described severe effects of climate change combined with growing pollution. According to our interview partners, the Danish Relief Council as well as the Food and Agriculture Organization (FAO) are implementing such restoration projects. The FAO worked in collaboration with local stakeholders in the al-Qatn and Shibam districts of Wadi Hadhramawt, areas of recent armed conflicts. Despite a security vacuum, it was possible to implement water-related projects such as flood irrigation, utilization of torrential water, and rehabilitation of the traditional flood irrigation facilities by collecting rainwater and floods in those facilities. (Research interviews with representatives of local environmental authority and international organizations, December 2020 and September 2021.)

Discussion: Key Environmental Threats and Their Current Management as Potential Conflict Catalysts

Many scholars who conduct research on environmental conflict emphasize an indirect rather than direct influence on the dialectic relationship between the management of nature and violent conflict. Particularly the Political Ecology approach emphasizes that environmental processes are co-determined by other political, economic and cultural forces. In this sense, "environmental conflicts are contextualized by and played out through cultural differences, discursive representations and material practices" (Le Billon 2015: 605; see also Verhoeven 2018). "Linking environment and conflict is not a straightforward process," as Lee (2020: 24) emphasizes, but an environment factor "can add to the likelihood of conflict, along with other factors." Focusing mainly on the example of water scarcity, other scholars have also emphasized this link between the environment and the ongoing conflict in Yemen (Smith & Krampe 2018: 205–7; Lackner 2019b). Adding to this still scarce literature thread, this Report has identified multiple environment-related challenges resulting from climate change, natural hazards, environmental degradation, pollution or mismanagement that are either exacerbated by the ongoing war or could result in new conflicts. All areas across Yemen face similar challenges, but the scale and scope of environmental threats differ depending on the governorate. For instance, the main problems in Sana'a, Dhamar and Ta'iz relate to waste management and garbage pollution. Ibb is more concerned with soil pollution and destruction of arable land, whereas the coastal areas of Aden have specific challenges related to maritime pollution. Hadhramawt, in turn, suffers from soil destruction driven by climate change as well as human-caused pollution, particularly from the oil industry.[32] Evidence shows that all these threats have a constant and high potential for violence, as the fight over resources is a crucial element in driving conflict behavior (Lee 2020: 25–6). For example, in some areas in Ibb fighting has been reported, with dozens of fatalities, that can be traced back to social problems directly caused by unequal access to and distribution of water resources.[33] While Yemen was already suffering from some of these problems prior to the war, the ongoing military conflicts have only augmented the severe effects: the destruction of infrastructure, loss of workforce, and increased pollution problems across the country. The following table – although not all-inclusive – indicates the myriad of environmental threats that differ across single governorates.

32 Research interview with a representative of a local organization, September 2021.

33 Research interview with an international consultant, November 2021.

Table 1: Overview of Key Environmental Challenges Across Governorates

Governorate	Key Environmental Challenges
Sana'a	Assemblage of garbage and toxic waste High rate of liquid waste from factories, laboratories, hospitals and pesticides Hazardous and medical waste Illegal and excessive wood cutting
Dhamar	Indiscriminate use of water for irrigation (flood irrigation) Indiscriminate use of chemicals, fertilizers, and pesticides for cultivating qat and vegetables Reduction of crop varieties grown Sewage spills into streets and farmlands
Ibb	Indiscriminate use of water for irrigation (flood irrigation) Indiscriminate use of chemicals, fertilizers, and pesticides for cultivating qat and vegetables Reduction of crop varieties grown Sewage spills into streets and farmlands
Ta'iz	Assemblage of garbage and toxic waste Contamination of surface and ground water with chemicals, industrial materials and sewage wastes High rates of migration from rural to urban areas Pollution and climatic change
Aden	Degradation of marine and coastal environment Over-fishing of fisheries during fish-breeding seasons Degradation of natural habitats of flora and fauna Poaching of birds, mammals, reptiles Overfishing and use of unlicensed fishing methods Pollution of sea and beaches with oil, ship waste, sewage waste and industrial waste Sea level rise
Hadhramawt	Tsunamis and cyclones resulting in occasional flash floods Contamination of water resources due to oil industry Sea level rise Landslides Frequent droughts and rain storms Temperature fluctuations and changes in precipitation patterns Degradation of agricultural land, terraces, soil erosion, desertification, and deterioration of soil fertility

As the case studies on single governorates further reveal, those most affected are the marginalized, including the poor, IDPs, women and children. Many people have lost their jobs and income due to the war. Women are forced to compensate the loss of income in addition to their traditional role of taking care of the home and family, particularly the elderly, the sick and children.[34] Many women, especially in the rural areas, are starting to take up their husband's work in the farming sector.[35] However, environmental problems are decreasing the size of agricultural land, limiting the country's most important source of work and income. According to some of the few existing statistics, around 70 percent of Yemenis live in rural areas, of which 55 percent work in the agricultural sector (Lackner 2019a). Across the country, rain-fed and irrigated agricultural and animal farming are key sectors that demand around 90 percent of all water reserves. The lack of water creates economic and social problems that often harshly affect women and their children.[36] Furthermore, IDPs are suffering from environmental pollution that adds to their already poor hygiene and sanitation situation. Since many refugee camps have been built on unwanted land that is highly exposed to flooding, the torrential rains in the last years have resulted in a significant loss of IDP shelters and food stocks (Al-Akwa & Zumbrägel 2021). Lastly, the youth will be the biggest loser of the severe effects of climate change and environmental degradation. According to one interviewee: "Those who are greatly affected by environmental problems are the next generations, as natural resources are being depleted. I believe that future generations will not have access to the same resources that we have."[37]

Given Yemen's significant environmental vulnerability that also affects the country's social and economic conditions, responses of climate adaptation and mitigation of environmental degradation are considerably low. Yemen has signed many laws and agreements related to the environment, but there is no enforcement of these laws. Environmental concerns have no priority in light of violent conflicts.[38] Additionally, many projects on environmental adaptation and climate change (e.g. monitoring stations for pollutants) have been stopped due to the war.[39] This is particularly the case in the northern regions. Among the political fragmentation, the branches of the EPA in most

34 Research interview with a representative of the Almusawa for Engineering Consultancy, September 2021. See also Heinze & Stevens 2018.

35 Research interview with a representative of the Environment Protection Authority, Aden branch, September 2021; research interview with a representative of the Almusawa for Engineering Consultancy, September 2021.

36 Research interviews with representatives of the Public Authority for Environmental Protection, Ibb and Dhamar branches, September 2021; research interview with a representative of a local organization, September 2021.

37 Research interview with a representative of a local organization, September 2021.

38 Research interview with a representative of a local organization, September 2021.

39 Research interview with an anonymous environmental expert, September 2021.

governorates have more or less stopped operating due to a lack of financial assistance. Moreover, also due to insufficient payment of salaries, many sector experts have either left the environmental bodies or even emigrated from the country (Lackner 2021). External support is also limited, as the majority of external organizations and donors are mainly oriented towards humanitarian efforts, thus generally neglecting environmental problems.[40] The military equipment throughout the country also leads to greater pollution. For instance, many Yemenis are concerned over a decaying supertanker, the F.S.O. Safer, carrying more than a million barrels of oil in its tanks and moored about thirty miles northeast of the port of al-Hudayda. The tanker could leak, explode or sink at any time and cause an environmental disaster of catastrophic proportions (Caesar 04.10.2021).[41] As one interview partner summarizes the overall situation:

> *"The agricultural sector, the Water and Sanitation Local Corporation, the General Authority for Rural Water and Sanitation Projects, and the EPA are currently powerless due to the war. They became unable to provide the financial and human resources as well as technical capabilities to present studies and discuss them correctly from all sides, and to implement projects, all of which has been brought on by lack of sufficient budget and the collapse of the economy (…). Experts are unable to travel to Yemen, making Yemen paralyzed. There is no budget, staff and experts as was the case in the past before the war."*[42]

Interviewees furthermore reported that the absence of governmental responses also leads to rising tensions between local communities. In some instances, individuals have established initiatives to mitigate this problem, as presented in the case studies of initiatives in Sana'a and Ta'iz. These initiatives, however, are limited and projects that tackle environmental threats are mostly bottom-up, informal, and small-scale. Due to the war, the major focus of local authorities and international organizations lies on humanitarian assistance and direct emergency aid.[43] While the international donor and development community was comparatively active during the 1990s and 2000s to set up development and climate change-related projects, these were sidelined by the war.[44]

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40 Research interview with a representative of the Environment Protection Authority, Sana'a branch, September 2021; research interview with a representative of a local organization, September 2021; research interview with a representative of the Environment Protection Authority, Hadhramawt branch, September 2021.

41 Also: research interview with a representative of a local organization, September 2021.

42 Research interview with a representative of the Almusawa for Engineering Consultancy, September 2021.

43 Research interview with a representative of an international organization, September 2021.

44 Research interview with a representative of an international organization, September 2021; see also Al-Eryani 2020b.

Perfunctory treatment of climate and environmental topics is another problem in many sectors.[45] Providing one salient example regarding project focus, an interviewee pointed to several beach clean-up projects, whereas measures to limit and reduce the degree of oil pollution on the coasts are ignored.[46] In terms of media coverage, environmental topics are not a priority: Despite its relevance, "the media hesitates to increase environmental coverage and raise awareness" (Saleh, Preston & Transfeld 2020). The lack of available data and public awareness is an additional factor for low performance on the environment by policymakers and implementers.

When reassessing environmental stress in Yemen and its implications for peace and stability, we can subsume three different sources of instability that, in line with the current scholarship on environmental conflict, indirectly rather than directly lead to violent conflicts (Lee 2020: 25–6). These include: (a) conflicts over access and distribution of resources; (b) environmental degradation and climate change as a potential conflict multiplier; and (c) the ongoing war as an environmental conflict accelerator. Having said that, not all environmental problems have the same potential to ignite violent conflicts. Based on research interviews as well as available literature, access to and control of resources are certainly the greatest catalysts for violent conflicts. Many studies have shown this is especially true of access to fresh water (Ward 2015; Al-Saidi 2020). However, this Report further shows that other resources, such as arable land and biomass (particularly wood and fish stocks), can be a component of social instability. Another aspect that has increased during the war is the poorly researched problem of waste management and pollution (Fenton 2021). As the literature on environmental peacebuilding also emphasizes, climate-induced migration flows constitute another source of social tension (Swain & Öjendahl 2020). This is also applicable in Yemen, where we can find high rates of migration from rural to urban areas, especially in Ta'iz, Aden and Hadhramawt governorates. Although a detailed assessment study on these environmental challenges and their impact on violent conflicts is still missing, this Report presents some preliminary findings in Table 2. We identify the different sources of conflict and categorize environmental challenges along their potential for violent conflicts.[47]

45 Research interview with a consultant and former representative of the Environment Protection Authority, Dhamar branch, September 2021; research interview with a consultant and former representative of the Environment Protection Authority, Aden branch, September 2021.

46 Research interview with a consultant and former representative of the Environment Protection Authority, Aden branch, September 2021.

47 Of course, the table represents ideal types. Some of the environmental challenges and their impact on violent conflicts are also cross-cutting issues and may reinforce each other.

Table 2: Types of Environmental Stress and Conflict[48]

Description	Direction of Relationship	Type of Environmental Challenges
Access and distribution of resources	Environment to conflict	Uncontrolled drilling of wells, informally and deliberately Excessive depletion of water Indiscriminate use of groundwater for irrigation Overfishing Illegal wood cutting Cultivation of qat, excessive irrigation and reduction of crop varieties Poaching of birds, mammals and reptiles
Environmental degradation and climate change	Environment to conflict	Human-caused pollution of environmental media (soil, air, water) Degradation of agricultural land (soil erosion, desertification, sand encroachment, and deterioration of soil fertility) Reduction of crop varieties and fish stocks Tsunamis and cyclones resulting in flash floods Drought
Increased destruction of environment in war	Conflict to environment	Weak environmental management and responses to climate change Growing pollution of environmental media (soil, air, water) (e.g. through military equipment) High rates of migration from rural to urban areas Little attention to environmental stress

Conclusion & Recommendations

Building on the approach of environmental peacebuilding, the following section provides several policy recommendations on how environmental issues could become an integral part of discussions and solutions on post-conflict reconstruction and reconciliation. It builds on the Report's key finding that if climate action is taking place in Yemen, it remains on a superficial level that tackles only some symptoms in the short-term. Long-term efforts on environmental peacebuilding are largely absent: But there are several areas in which international organizations can help Yemen implement more comprehensive endeavors in order to avoid potential climate collapse and its unprecedented consequences on governance, post-conflict reconstruction, reconciliation as well as human security.

48 Partially inspired by Lee 2020: 22.

This includes the second dimension of *restorative* environmental peacebuilding, which "provides shared spaces to acknowledge past injustices and recognize the other as a legitimate interlocutor," as well as the third dimension of *sustainable* environmental peacebuilding that "addresses the root causes of potential conflicts by focusing on equitable resource distribution as a pre-requisite for sustainable development and peace" (Dresse et al. 2019: 110). Until now, there is no institutional framework with a special focus on environmental peacebuilding in Yemen. In fact, the concept is barely known.[49] Against this backdrop, this CARPO Report points to the relevance of acknowledging environmental peacebuilding as a key part of Yemen's peace-building process. To promote the concept of environmental peacebuilding, we make several suggestions for concrete action by international actors in Yemen. In scope of the above-introduced theoretical framework, these measures tackle core dimensions of politics, livelihoods and economy, but also have a strong focus on social relations and human capital (Ide et al. 2021: 3–4).

Institutional empowerment and fostering coordinative environmental governance: Unsurprisingly, environmental issues experienced a setback during the war. Local and national environmental institutions must be empowered in terms of financial, human and technical resources, must coordinate better to increase trust and mutual understanding through cooperation, and must adapt a more conflict-sensitive approach towards climate change and environmental degradation. This is a long-term endeavor. In the shorter term, the international community should assist governmental entities such as the Ministry of Water and Environment (MWE) and the EPA to compile comprehensive proposals on climate action measures. Moreover, other affiliated institutions that work under the umbrella of the MWE – such as the National Water Resources Authority (NWRA), the National Water and Sanitation Authority (NWSA), the Water and Sanitation Local Corporations (WSLCs) and the General Authority for Rural Water and Sanitation Projects (GARWSP), as well as the Ministry of Agriculture and Irrigation (MAI) and the Ministry of Fish Wealth (MFW) – should be involved in the development of strategies to address environmental problems and receive the attention of donors. According to interview partners both inside and outside of Yemen, a lack of governance is at the heart of the issue. Thus, what is needed is a stronger collaboration of institutional bodies, as well as a clear central framework and a prioritization of the most important environmental-related concerns and threats that, as this CARPO Report shows, differs tremendously across Yemen.[50] This also includes updating the country's environmental legislation and monitoring its enforcement. As a first concrete step,

49 See the website of CEOBs at *https://ceobs.org/countries/yemen/* (14.12.2021).

50 Research interview with a representative of the Environment Protection Authority, Sana'a branch, September 2021; research interview with an international consultant, November 2021.

international organizations can assist in providing salaries for the employees of local environmental authorities. The international community can also help foster the dialogue between the individual governmental entities by providing neutral platforms for exchange.

Restoring livelihoods while adapting to climate change: For many people on the ground and other observers, it is imperative that environment-related programs and initiatives should create economic benefits. Environmental projects should tackle economic aspects that may improve the situation and income of people who have suffered tremendously from the war. For instance, and most importantly, the destruction of farmland and fish stock due to pollution and climate change is a major concern that will have significant impacts on the country's stability. As laid out above in this Report, the fight over agricultural land and water is a major source of conflict. Implementing programs to restore fertile farmland could therefore play a crucial role in peacebuilding and conflict resolution. This might include providing alternative crops of similar profit instead of qat, building drainage systems against flash floods, producing energy from wastewater and restoring traditional irrigation systems, such as spate-flow irrigated wadis in lower lying areas or underground aqueducts (*qanawat*) irrigation in the highlands. As Case 6 highlights, some international organizations, such as the FAO or the Danish Relief Center, are implementing water-related projects in Hadhramawt that could prevent future conflict. On the national level, the Social Fund for Development (SFD) has proven to be a reliable partner in improving agricultural activities. These interventions include crop and tree cultivation, enhancing irrigation systems (e.g., terrace rehabilitation and rainwater harvesting projects) but also climate change adaptation measures such as combating flash floods through the creation of dams and diversion channels.[51] International donors should also consider expanding ongoing programs, for instance via the Small and Micro Enterprises Promotion Services (SMEPS), that have a particular focus on rural areas and livelihood support for vulnerable communities.[52] At the same time, programs for governorates on the coast should consider measures that secure fish stock as a major source of income for many people (*Developing Yemen's Fishing Industry* 2020). Here, initiatives to rehabilitate fishing facilities in the coastal strip of Hadhramawt and al-Mahra, executed in collaboration with the GIZ, could serve as a best-practice model to adapt to other areas.[53]

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51 See the website of SFD at *https://www.sfd-yemen.org/* (15.12.2021).

52 See the website of SMEPS at *http://smeps.org.ye/* (15.12.2021).

53 Research interview with a representative of the Almusawa for Engineering Consultancy, September 2021. See, for instance, the GIZ program 'Transitional Assistance in Yemen: Strengthening Resilience and Promoting Vulnerable Households'. Available at *https://www.giz.de/en/worldwide/79977.html* (15.12.2021). In its *Country Strategy Note, July 2021 – December 2024* (available at *https://yemen.un.org/en/160004-2021-2024-country-strategy-note* (03.01.2022)), UNDP Yemen also lists "boosting food security and green, inclusive economic development," including "support to local agriculture and fisheries" as "programme priority #1" (p. 39).

Lastly, external assistance should focus more on alternative sources of energy to counter the recent problem of extensive and illegal woodcutting. For example, introducing solar cookers to rural areas can potentially help mitigate woodcutting practices.[54]

Empowering local activities and community responses on waste management to prevent potential conflict: In light of a lack of governmental support to adequately address environmental issues and a major focus on short-term humanitarian and emergency help of international organizations, local actors have emerged to fill the vacuum of mitigating pressing environmental challenges.[55] As the empirical snapshots from some governorates show, there are several informal and bottom-up initiatives on waste management. So far, however, not much attention has been shifted to these problems, as there is a common perception that "waste management is not 'sexy' in humanitarian work" (Weir 2019). Yet garbage accumulation and accompanied pollution growth (e.g., by burning plastic) is a serious problem and an obstacle for sustainable peace in Yemen. Another problem is the hazardous waste from hospitals. Here, medical facilities need to be assisted in their waste management and disposal systems. It all aggregates the pollution of environmental media (air, water and soil) and can cause new conflicts over these dwindling resources. International organizations should assist local actors in their solution-based initiatives to minimize the severe effects of waste management. One concrete endeavor could be to expand the work of the Cleaning and Improvement Fund in al-Hudayda governorate to other areas.[56] Other efforts should aim at building sewage networks in all governorates. Due to the absence and inability of national governance, civil society and local communities have started interventions to solve waste management problems. These small-scale and decentralized structures of waste management constitute a promising field in which to start locally and then elevate initiatives onto a broader scale.[57] As waste specialist and consultant Martin Bjerregard stressed with regards to Yemen:

> *"Working at the neighbourhood level with the engagement of residents and shop owners is where it all starts – parents understand the risk waste poses to their children in the streets. Weaving these*

54 Research interview with an anonymous environmental expert, September 2021.

55 Environmental engagement of civil society is not a new phenomenon. A World Bank study from 2013 found that civil society organizations working on environmental issues hat increased since the 1990s with about 15% of all CSOs working – at least partially – on environmetal protection and a further 10% focusing on the management of natural resources. While the majority of CSOs taking an interest in the environment work in the field of water resources, others also address questions of chemical and radiological pollution, desertification, biological diversity and the dangers of pesticides and agricultural fertilizers (World Bank 2013). On youth engagement in regard to environmental issues, see also al-Kholidy, al-Jeddawy and Nevens 2020: 11–12.

56 Research interview with a representative of the Environmental Protection Authority, Aden branch, September 2021; see also Jahaf 18.04.2019.

57 For a similar assessment, see Lackner 2021: 23–5.

> *smaller projects into an overall regional crisis waste management plan is a challenge but our successful experiences in Syria making fuel briquettes out of waste, or recycling debris at a neighbourhood level, show that it is possible" (cited from Weir 2019).*

Fostering environmental mediation: Increasing environmental stress, as well as conflict and competition over dwindling resources, require stronger cooperation and coordination among many different actors, including relevant governmental authorities, non-governmental entities, formal and informal community leaders, civil society and religious figures. Although much needed, environmental mediation does not play a prominent role in environmental peace-building efforts to date.[58] International organizations can help to establish dialogue platforms and convene meetings of these various actors. This could be undertaken by cultivating a sense that climate change is a collective threat and awareness-building measures on environmental interdependence.[59] The key aim should focus on the realization that environmental cooperation "outgrows the self-interested rationale of conflicts" (Dresse et al. 2019: 100). These neutral forums should help foster exchange between civil society and state institutions by identifying mutual benefits, provide scenario analysis on sustainable management options, and help monitor the implementation of resulting agreements. Efforts to strengthen these partnerships must be built upon a better understanding of the needs and conditions of local authorities as well as local communities. As this CARPO Report and other publications (e.g., Zabara 2018; al-Gawfi, Zabara and Philbrick Yadav 2020) have stressed, enhancing the role of women in the environmental sector is crucial: Women are more vulnerable but also more sensitive to environmental stresses due to gendered divisions of labor (e.g., water provision). There are several examples of women's participation in awareness campaigns on hygiene, proper waste disposal, and drinking water quality. Also, the Yemeni Women's Union and al-Islah Charitable Association support initiatives for rainwater harvesting and expanding wells, reservoirs and water networks (Qassim et al. 2020: 12). Local and international peacebuilding organizations could also be encouraged and empowered to adopt environmental mediation. For example, a conflict mediator from Abyan trained by Search for Common Ground successfully mediated "a two-year dispute over faulty waste disposal services that had previously blocked roads, preventing people from reaching schools, hospitals, and water sources" (Search for Common Ground 2021: 12).[60] Also, DeepRoot Consulting

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58 Research interview with an international consultant, November 2021.

59 See also Ide, Palmer & Barnett 2021: 104.

60 Subsequently, "[l]ocal private donations allowed the community to set up a new waste disposal system – and to build a new road to allow for the safe delivery of water" (ibid.).

has tried to contribute to trust-building between the conflict parties in Ta'iz by establishing environmental projects. While DeepRoot's initiatives to get parties to remove garbage mounds or activate water pumping stations in relevant frontline areas have not yet been put into practice, they point to the peace-building potential in environmental challenges (Scott 2020: 8).

Advance and improve data collection, analysis and human capacity: There is a lack of environmental science as a discipline and consequently also of qualified environmental scientists. There is further a dearth of tools and measuring devices (e.g., environmental laboratories) to study the impact of climate change and environmental degradation. As one interviewee highlighted, Yemen has not a single monitoring station on its 2,500 km coastline.[61] Development aid and assistance could also be used to improve the country's human and technological capacities for environmental research and work. Besides technology transfer, platforms could be created to transfer knowledge and expertise. A major task is to enhance human capacity by training staff at national and local environmental authorities and institutions. As this Report has emphasized, there is no one-size-fits-all solution given the country's diversity. Instead, risk assessment and prioritization of the most pressing threats must be undertaken according to local environmental conditions.[62] All this will help to promote qualified and specialized staff and experts in environmental issues who could eventually coordinate their efforts across governorates to combat climate change and environmental degradation on a collective base.[63] In addition to enhancing local academic expertise and capacities, raising more awareness of environmental challenges among Yemen's population is needed. Building advocacy networks could be achieved through workshops or incentivized through conditioned funding. A promising local initiative in this regard is the informational platform Holm Akhdar [Green Dream], which was established in 2012 as the first Yemeni website tackling environmental issues and providing investigative reports on environmental concerns in Yemen.[64] Empowering such local organizations could also help mitigate growing social tensions and conflict linked to environmental stress by increasing awareness and fostering environmental education.

61 Research interview with a representative of a local organization, September 2021; research interview with a representative of the Environment Protection Authority, Sana'a branch, September 2021.

62 Research interview with a representative of the Water and Environment Center, Sana'a University, September 2021.

63 Research interview with a representative of Environment Protection Authority, Hadhramawt branch, September 2021.

64 See the website of Holm Akhdar at *https://holmakhdar.org/* (13.12.2021).

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