# Water, land and power: Environmental conflict drivers in Abyan, Yemen

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RESEARCH REPORT

Berghof Foundation

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# EXECUTIVE SUMMARY

This report explores the environmental drivers of conflict in the governorate of Abyan, Yemen, and identifies resilience factors.

The governorate of Abyan lies in southern Yemen on the coast of the Gulf of Aden. It is mostly agricultural and is bordered by Aden and Lahj to the west, Shabwah to the east and Al-Bayda to the north.

The report analyses the interplay between environmental degradation and conflict in Abyan, emphasising how water scarcity, land degradation and extreme weather events intensify social tensions in a region already destabilised by war and weak governance. Drawing on qualitative interviews and secondary data, the research illustrates how environmental stressors – exacerbated by climate change – are increasingly drivers of conflict, with critical implications for stability and resilience in Abyan. It concludes with recommendations for local stakeholders and international organisations and donors.

Abyan faces severe environmental challenges, including recurring droughts, desertification, soil salinity and flooding. Water scarcity is central to these issues, with agriculture consuming over 90 per cent of the region's limited water resources. Traditional irrigation infrastructure has decayed, over-extraction of groundwater has accelerated, and regulatory enforcement has collapsed. Flood protection systems have deteriorated from years of neglect, and uncoordinated private attempts to manage floodwaters often worsen downstream impacts, triggering disputes between farmers. Inadequate sewage and waste management, exacerbated by water scarcity and flooding, also pose environmental and health risks, with wastewater contaminating drinking water and public areas, contributing to disease and worsening water scarcity and competition over resources. Abyan's reliance on agriculture and fishing further exposes communities to livelihood shocks. Desertification, invasive species like the Saysaban tree, and declining soil fertility threaten food security. Meanwhile, the region's informal governance systems are stretched thin and cannot sustainably address the scale of environmental disputes.

In these ways, environmental stressors are deeply entangled with local power structures, weak governance and historical patterns of tribal land control, with the result that they have become significant drivers of displacement, livelihood loss and deadly land and resource disputes. Displacement and livelihood loss are intermediary causes linking environmental issues to conflict via their negative impact on social cohesion and coping strategies. Disputes over irrigation canals, monopolised access to wells, and unmanaged floodwater redirection are directly driving conflict, resulting in fatalities and compounding the identified intermediary

causes by breaking community ties and contributing to land loss and thus to resource scarcity and livelihood challenges.

In the face of these significant environmental conflict drivers, the report highlights existing conflict management systems as factors of resilience. Tribal customs, religious authorities, local governance systems and grass-roots initiatives intersect – sometimes cooperatively, sometimes in tension – to mediate disputes and maintain social cohesion. Despite resource constraints, local authorities in particular have played a key role in coordinating responses to environmental and resource-related conflicts. Drawing on case studies and local examples, the report describes the adaptive but fragile systems that underpin conflict resolution in Abyan today, highlighting their ability to mediate some conflicts and partially fill the governance vacuum. However, these responses are overwhelmed and under-resourced. They require reinforcement by sustained investment in environmental infrastructure, data systems, and formal regulatory authority that is sensitive to local context.

Local stakeholders, including community organisations, associations, tribal leaders and local authorities, can play a vital role in mitigating environmental conflicts. Some key opportunities include building community awareness of ongoing current dynamics and potential responses, including supporting farmers to revive traditional irrigation and water conservation techniques, and training in new techniques for water conservation and more resilient agriculture, as well as mediation of water disputes and the negotiation of water-sharing agreements within and between communities to prevent potential conflicts. There is also the potential for effective partnerships between local authorities and the private sector to address some of the identified challenges. Although coordinated national leadership on climate and environmental issues is ultimately needed, much mitigation can be done at the local level, leveraging a range of potential partnerships.

International organisations and donor agencies can support such efforts to strengthen Abyan's climate resilience and conflict mediation systems. Supporting irrigation and water management systems, including mitigating risks from flooding, may be the top priorities, alongside support aimed at building local authority capacities and capabilities to mitigate the impact of environmental and climate stressors before they lead to conflict.

# LIST OF ABBREVIATIONS

| | |
|---|---|
| AQAP | Al-Qaeda in the Arabian Peninsula |
| AWSLC | Abyan Water & Sanitation Local Corporation |
| FAO | Food and Agriculture Organization (of the United Nations) |
| FGD | Focus Group Discussion |
| GDP | Gross Domestic Product |
| IDP / IDPs | Internally Displaced Person / Internally Displaced Persons |
| IRG | Internationally Recognised Government (of Yemen) |
| KfW | Kreditanstalt für Wiederaufbau (German Development Bank) |
| ND-GAIN | Notre Dame Global Adaptation Initiative (Index) |
| NGO / NGOs | Non-Governmental Organization / Organizations |
| UN | United Nations |
| UNDP | United Nations Development Programme |
| USD | United States Dollar |
| YER | Yemeni Rial (Yemeni Riyals) |

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# 1. Introduction

This research paper explores the intersection of environmental challenges and conflict in Abyan, Yemen. It begins with an overview of how water scarcity, environmental degradation and flooding, exacerbated by climate change, have intensified socio-political tensions and contributed to conflict, particularly in the context of weak state institutions. The paper then examines key drivers of environmental instability, including unsustainable agricultural practices, unregulated groundwater extraction and deteriorating infrastructure.

The paper then turns to assess the capabilities of state institutions in managing environmental crises. It finds that these capabilities are very limited due to prolonged conflict and a lack of technical capacity and financial resources. There are elements of a vicious cycle: weak governance is exacerbating environmental conflict drivers through unregulated land use, mismanagement of water resources and deteriorating sanitation conditions, while such drivers in turn place additional pressure on authorities' ability to provide services, respond to and prevent disasters, and contain environmental conflicts, further exacerbating environmental conflict drivers. Tribal conflict resolution mechanisms and informal governance structures serve to manage disputes, but these efforts are sometimes insufficient in the absence of formal state intervention.

The paper concludes with recommendations for local authorities, local organisations and international actors, advocating for improved climate resilience measures, regulatory reforms and increased investment in environmental infrastructure.

# 2. Methodological approach

The study adopts a qualitative research approach, integrating both primary and secondary data sources. Primary data collection involved semi-structured interviews with 25 individuals, including community members, women, journalists, community leaders and local authority officials, to gather firsthand insights into environmental challenges and their impact. Additionally, the research included one focus group discussion (FGD) with female community members, as they were underrepresented in the key informant interviews conducted. The interviewees come from a geographically diverse range of locations, from major urban centres like Zinjibar to remote eastern and western areas of Abyan, such as Mahfad and Mudiyah, capturing a broad spectrum of experiences and challenges. These interviews provide contextualised narratives on how resource scarcity and climate change contribute to social and economic instability in Abyan.

Secondary data sources were reviewed alongside the primary data collection. They include reports from international organisations such as the United Nations, the World Bank and environmental research institutions. Where available, these were supplemented by statistics provided by local authorities.

A major limitation encountered during the research process was the lack of updated, accurate and accessible data from local authorities' statistics. This data gap reflects broader institutional weaknesses, including limited technical capacity, underfunding, and poor data management at the governorate level. As a result,

much of the analysis relies on triangulation with primary interview data and extrapolation from national or international datasets.

The study follows an interdisciplinary approach, drawing from environmental science, political ecology, and conflict studies to provide an understanding of the issue. By combining qualitative fieldwork with an analysis of secondary data, the research presents a holistic view of the environmental challenges facing Abyan and offers practical recommendations for mitigating resource-based conflicts in the governorate.

# 3. Environmental crisis in Yemen

Yemen faces some of the most severe climate challenges in the world, with extreme water shortages, rising temperatures and increasing desertification threatening both livelihoods and stability.[1] Rainfall has become more unpredictable, bringing destructive floods in some areas while leaving others in prolonged drought. These environmental pressures have worsened in the wake of ongoing conflict, which has damaged infrastructure, displaced communities and made it even harder for people to adapt to changing conditions. According to the 2022 ND-GAIN Index, Yemen ranks 171st out of 181 countries in terms of climate preparedness relative to its level of vulnerability, highlighting the nation’s high exposure and limited capacity to adapt.[2]

Water scarcity stands out as one of Yemen's most pressing challenges. The average Yemeni has access to only about 78–85 cubic metres of water per year, a stark contrast to the global water stress threshold of 1,700 cubic metres per person annually.[3] This alarming shortage is exacerbated by the fact that approximately 90 per cent of Yemen's water resources are consumed by agriculture – a sector that contributes only 6 per cent to the country’s Gross Domestic Product (GDP).[4] Yet, despite its limited economic output, agriculture remains Yemen’s largest source of employment and a critical lifeline for rural communities. For generations, communities relied on traditional water management techniques like terraced farming and rainwater harvesting to make the most of limited resources.

Historically, access to groundwater, particularly after the introduction of diesel pumps, was deeply unequal. Wealthier farmers and landowners were often able to drill deeper wells and invest in pumps, while poorer and marginalised groups were left with little to no access to water for irrigation or household use. These divides also fuelled local grievances and competition over water, intensifying conflict dynamics in already fragile areas. As solar pumps became more available, they democratised access to some extent but also accelerated the rate of aquifer depletion in the absence of regulation and sustainable groundwater governance. Combined with population growth, poor policies and lack of oversight, as well as climate change, which has reduced the volume and consistency of rainfall, the amount of water pumped directly from aquifers has increased significantly and traditional water management systems have fallen into disrepair. Even before the current conflict began, it was estimated that over-exploitation of limited renewable water resources alone – excluding the effects of climate change – could lead to a 40 per cent reduction in agricultural production in Yemen by 2030, according to a 2011 World Bank study.[5]

Even before the current conflict, over-exploitation alone was projected to cut Yemen's agricultural production by 40% by 2030.

Over the past six decades, temperatures have steadily risen, and this trend is expected to continue until 2050. By 2060, average annual temperatures in Yemen could increase by 1.2°C to 3.3°C, depending on global climate patterns.[6] Coastal areas, like Abyan, are expected to experience less pronounced warming than areas in the interior. Simultaneously, Yemen is rapidly losing its fertile land to desertification, making it harder for people to farm and survive. A study prepared by the Ministry of Planning and International Cooperation, alongside the United Nations, showed that 15.9 per cent of land in Yemen – or roughly half of non-desert land currently – is at risk of desertification within the next few decades.[7] Desertification leads to a yearly loss of 3–5 per cent of arable land in Yemen, severely impacting agricultural productivity.[8] In addition, encroachment of saltwater into coastal aquifers is degrading agricultural land in coastal areas, particularly as sea levels rise and aquifers are depleted. Loss of arable land is exacerbating food insecurity, displacing communities and straining natural resources.

Rising sea levels are also washing away shorelines and putting the fishing industry at risk. Yemen ranks among the top five low-income nations most susceptible to sea-level rise, with an increase of 0.3 to 0.54 metres expected by 2100.[9] Some cities, including Aden, are particularly vulnerable. Aden is ranked as the sixth most at-risk location in the world for sea-level rise and storm surges, putting coastal communities at an elevated risk of displacement and economic loss.[10] Although limited data is available, it is likely that the nearby Abyan Delta would be similarly affected.

Yemen has adopted a series of environmental protection laws aimed at preserving its natural resources and mitigating pollution. Notably, Law No. 6 of 1995 on Environment Protection focuses on safeguarding the environment, maintaining the balance of natural ecosystems, and combating various forms of pollution arising from economic, agricultural, industrial and construction activities. It also emphasises the protection of local species and the implementation of international environmental obligations.[11]

This legislative framework, which may be in need of updating, is not consistently applied, as the ongoing conflict in Yemen has severely weakened state institutions, draining resources and shifting priorities away from environmental concerns. This has led to challenges not only in implementing and monitoring environmental regulations, but also in formulating new policies that adequately address the evolving and intensifying environmental challenges. As a result, there has been a rise in pollution, unchecked resource depletion, and environmental degradation, with few mechanisms in place to adapt to the current crisis.

Recently, the Ministry of Water and Environment in Aden has established a Climate Change Unit dedicated to advancing climate change projects, providing technical support, and developing national frameworks at the ministerial level.[12] However, at

local and district levels, there is little in the way of climate policy or implementation capacity, complicating any steps towards effective delivery of climate initiatives and the dissemination of environmental policies across Yemen.

A YEMENI VILLAGER SHOVES A CANAL FOR FOAMING WATER CREATED BY A WELL DRILLING RIG DIGGING WATER WELL ON THE OUTSKIRTS OF SANA'A, YEMEN. © PICTURE ALLIANCE / DPA | YAHYA ARHAB. 2013.

## 4. The current conflict

The civil war in Yemen, which began in 2014 following a coup by the Houthi rebels against the internationally recognised government (IRG), has led to a fractured state with competing factions controlling different regions, making governance increasingly difficult. This fragmentation has not only weakened national institutions but has also hindered the implementation of policies and the delivery of essential services, further deepening the crisis.

Beyond the conflict between the internationally recognised government and the Houthi movement, conflict between Al-Qaeda in the Arabian Peninsula and the government is of particular relevance to Abyan, where much of the open violence associated with the group has played out. Since the mid-1990s, AQAP has exploited tribal and community networks by offering material benefits in exchange for protection, recruitment or passive support. Such alignments are typically transactional and short-lived, shaped by local interests rather than ideology. Nevertheless, AQAP took control of Zinjibar, Abyan's capital, in 2011–2012 and again in 2015–2016. Although no longer holding territory, its continued presence has contributed to weak governance, distrust, and heightened insecurity for civilians.[13] Currently, most of Abyan remains stable, with security risks primarily concentrated in remote northern districts bordering Al-Bayda – areas under Houthi

control and where AQAP activity has intensified following its displacement from central Abyan. Despite ad hoc incidents, AQAP does not hold territorial control in the province.

Yemen's and Abyan's overlapping conflicts have manifested in a deepening humanitarian catastrophe that touches every aspect of civilian life. The conflict has devastated Yemen's infrastructure; roads, schools and hospitals have been damaged or destroyed, leaving millions without access to basic services. Over 4.5 million Yemenis have been internally displaced, with more than 19.5 million people, including 10 million children, in need of humanitarian aid.[14] Meanwhile, the conflict has intensified food and water shortages, pushing millions towards severe hunger and malnutrition. The humanitarian situation is dire – over 17 million people face acute food insecurity, with many relying entirely on humanitarian aid.[15]

Years of instability have exacerbated environmental challenges, worsening the immediate humanitarian toll. Unregulated drilling of wells and soil degradation have accelerated desertification and water scarcity, making it even harder for communities to sustain themselves.[16]

The war has had a profound social impact, fractured families and uprooted entire communities. With more than 4.5 million displaced, social ties that once formed the backbone of Yemeni society have been weakened.[17] Many children have lost access to education, either because schools have been destroyed or repurposed for military use, or because they are forced into labour or early marriage as families struggle to survive.[18]

Women have been particularly affected, bearing the brunt of displacement and economic hardship. Many have lost male relatives who served as the primary breadwinners in their families and women have been forced to assume new roles as sole providers for their families. The war has also heightened gender-based violence, child marriage and human trafficking. At the same time, the conflict has reshaped gender roles, with women increasingly taking on leadership roles in households and communities.

Women are assuming new roles as sole providers yet bearing greater risks of violence and exploitation.

Yemen's economy, already fragile before the conflict, has been pushed to the brink. The collapse of state institutions and disruption of trade have led to skyrocketing food prices, putting necessities out of reach for millions. The healthcare system has also crumbled, with over half of the country's medical facilities either non-functional or operating at reduced capacity due to funding shortages, supply chain breakdowns, and damage from airstrikes and ground fighting.[19] The spread of diseases such as cholera, malnutrition and lack of medical care have created a deadly public health crisis, adding to the suffering. The lack of proper waste management and pollution control has exacerbated the situation.

# 5. Introducing Abyan

The southern province of Abyan occupies a strategically significant location, bordered by Aden – the temporary capital of the country – and Lahj to the west, and Shabwah, where there are significant hydrocarbon reserves, to the far east. To the north, it shares a boundary with Al-Bayda province, while its southern coastline lies along the Arabian Sea, an important maritime and economic hub. The province consists of 11 districts and has a population of just over 630,000 residents.[20] Additionally, Abyan has become a refuge for more than 52,000 internally displaced persons (IDPs) who have fled conflict in other parts of Yemen.[21]

**GOVERNORATES IN YEMEN**

SOURCE: BERGHOF FOUNDATION, NOVEMBER 2025

## 5.1. Geography and tribal landscape

Abyan is notable for its diverse terrain, ranging from mountainous highlands in the north to fertile coastal plains and arid deserts in the east. This varied landscape has shaped the region's tribal communities, influencing settlement patterns based on geography, history and economic activity.

## 5.2. Northern and eastern regions

The northern and eastern areas of Abyan are predominantly mountainous, interspersed with valleys and extensive agricultural land. These mountainous and agricultural regions support sheep grazing, beekeeping and farming. Nomadic Bedouins frequently migrate across these lands, moving between districts such as Al-Mahfad, Mudiyah, Lawdar and Yaramis in search of pasture and water for their livestock, primarily sheep and camels.

The northern highlands, known as Yafa'a, are home to several Abyan tribes, including the well-known Al-Saadi and Al-Yazeedi tribes, who are part of the Yafa' tribal confederation.

Further east, the Al-Kazmi tribe is the most prominent, particularly in Ahwar and Al-Mahfad. Historically involved in trade and fishing, the Kazmi tribe has played a key role in regional commerce, managing overland trade routes connecting Abyan to Shabwa and Hadhramawt. Their strategic position along the Arabian Sea coast has also given them significant influence in local politics and economic activities.

## 5.3. Coastal and southwestern plains

The Abyan Delta, a key coastal plain, serves as a major water resource and agricultural hub. The fertile lands of Zinjibar and Khanfar have historically been associated with the Al-Fadhli tribe, who ruled the region under the Fadhli Sultanate. As major landowners, many Fadhli families continue to control vast agricultural areas, although some lands have been sold or leased over time.

The coastal and southwestern areas remain critical to Abyan's economy, supporting farming, fishing and trade, with access to key maritime routes along the Arabian Sea.

## 5.4. Tribal governance and customary law

In Yemen, Islamic Sharia law forms the foundation of the legal system, as the country is rooted in Islamic traditions. The official legal framework is heavily influenced by Islamic jurisprudence, and some of the laws passed by the state are interpreted in accordance with Sharia. Alongside state law, tribal traditions play a major role in daily life, especially in dispute resolution and maintaining social order. Many communities rely on tribal sheikhs and councils to settle conflicts and enforce customary law (urf). Some of the most well-known districts where tribal authority remains strong include Lawdar, Mudiyah, Al-Wade'a, Al-Mahfad, Ahwar, Rasd, Sabah and Khanfar. When disputes cannot be resolved through tribal mediation, they are often referred to the formal judicial system, which itself recognises the importance and legitimacy of tribal rulings in many cases. If neither tribal customs nor formal court rulings provide a resolution, the matter is sometimes escalated to religious law (Sharia), underscoring its authoritative role in Yemen's legal and moral landscape.

## 5.5. Climate

Abyan lies within Yemen's hot tropical climate region.[22] The governorate experiences two distinct climate zones due to its varied topography. In the mountainous and plateau regions, summers are moderate and warm, with an average temperature of 20.9°C, while winters are relatively cold to moderate, averaging 13°C.[23] In contrast, the plains and lowland regions experience a hot and humid summer, with an average temperature of 31.3°C, while winters remain warm, averaging 23.1°C.[24]

The governorate is classified as an arid region, receiving low and highly variable rainfall. The average annual rainfall is approximately 180.7 mm, but its distribution is uneven across the governorate.[25] Several factors, including topography, elevation and wind direction, influence rainfall levels and patterns. Summer rainfall is

concentrated in the mountainous highlands, while precipitation decreases towards the southern plains. Spring rains (March to May) provide limited precipitation, covering most of the governorate. However, for the rest of the year, Abyan experiences prolonged drought conditions, severely impacting agriculture and water availability. Additionally, rainfall during peak summer temperatures leads to high evaporation rates, causing significant water loss before it can be stored or utilised.

## 5.6. Agriculture and the Abyan Delta

Abyan accounts for about 5 per cent of Yemen's total farmland, and a high rate of over 70 per cent of its residents depend on income from the agricultural sector.[26] Abyan's agricultural success is largely attributed to the Abyan Delta, one of Yemen's most important agricultural regions. The delta is nourished by several major valleys, including Hassan Valley and Bana Valley, which run through the districts of Zinjibar and Khanfar, providing fertile land for thousands of farmers.

Abyan's agriculture is a mix of subsistence and small-scale commercial farming. Farmers grow crops such as maize, millet, sorghum, wheat, sesame, and some fruits and vegetables like mangoes, tomatoes and okra.[27] These crops are sold in local markets in Zinjibar and Ja'ar and in regional hubs like Aden. However, the lack of structured value chains, cooperatives and post-harvest infrastructure results in major losses and limited profit margins. Some crops, like sesame and honey, have export potential, but limited market integration and conflict-related trade disruptions have stifled growth.

Many farmers rely on spate-fed agriculture, which depends on seasonal rainfall for crops such as maize and millet. The increasing variability of rainfall due to climate change has made this method unreliable, leading to lower yields and food insecurity. Agriculture remains highly labour-intensive, with agricultural machinery remaining out of reach for farmers, who use simple hand tools such as axes and shovels to cultivate the land.[28] While this method fosters a deep connection to traditional farming, productivity is limited, making it difficult for farmers to meet growing food demands.

The Abyan Delta's irrigation system in its current form dates largely from 1954 and supports over 40 per cent of the region's farmers, or approximately 13,000 families.[29] Other farmers use dirt channels from wadis to their fields or rely on historic waterwheels and other traditional methods to lift and distribute water.[30] However, increasing water scarcity, over-extraction of groundwater and climate change are placing severe pressure on these systems.

Water for the Abyan Delta originates from rainfall collected in the mountainous regions of Yafa', Al-Dhalae, Ibb and Al-Bayda, just north of Abyan. Wadi Bana, the delta's main water source, receives 150–200 mm of annual rainfall, but its flow is highly unpredictable, fluctuating between drought conditions and flash floods. The wadi experiences up to 19 flood events per year, primarily between March and October, contributing an estimated 162 million cubic metres of surface inflow.[31] However, due to high runoff, limited recharge capacity and evaporation, only a fraction of this water replenishes the underlying aquifer. The approximately 86.4 million cubic metres withdrawn annually through groundwater extraction results in a net depletion of 15 million cubic metres per year.[32] This unsustainable water use has raised concerns about long-term agricultural viability and water shortages for farmers.

Another major challenge affecting Abyan's agriculture is soil salinity, which is particularly severe in the Abyan Delta. As freshwater levels drop, saltwater from coastal areas infiltrates inland aquifers, and farmers are increasingly forced to irrigate their crops with saline water. As a result, approximately 25 per cent of farmland in the delta is now affected by moderate to high soil salinity, making it increasingly difficult to maintain agricultural productivity and threatening long-term land viability.[33] This degradation is primarily driven by both direct saltwater intrusion and the use of already brackish water for irrigation.

A YEMENI COUPLE RIDES A DONKEY-DRAWN CARRIAGE DOWN A STREET AFTER YEMENI MILITARY ROUTED AL-QAEDA MILITANTS FROM THE SOUTHERN PROVINCE OF ABYAN, YEMEN. © PICTURE ALLIANCE / DPA | YAHYA ARHAB. 2013.

## 5.7. Fishing industry

The fishing sector is a crucial part of Abyan's economy, particularly in southern coastal towns like Shuqrah and Ahwar, where thousands of families depend on fishing for their livelihoods. There are approximately 13,000 fishermen operating over 4,000 boats in roughly 18 fishing associations.34 The Arabian Sea provides a rich source of tuna, mackerel, sardines and other marine species, which are either consumed locally, traded in inland markets or exported internationally. However, there are challenges, such as export regulation changes, lack of tools for fishermen, and inadequate infrastructure to support fish processing, storage, transportation and market access. Without cold storage facilities, modern fishing equipment and efficient transportation networks, fishermen struggle to preserve their catch, leading to spoilage and financial losses. Additionally, the lack of proper harbours and dock facilities makes it difficult for fishing vessels to operate efficiently.

# 6. Environmental drivers of conflict

This chapter examines how environmental challenges are contributing to rising tensions and conflict in Abyan, Yemen. Environmental drivers of conflict refer to the ways in which issues like water scarcity, flooding, drought and pollution can intensify competition over limited resources and strain social relationships – particularly in areas where governance is weak and infrastructure is failing. In Abyan, these environmental pressures are not just development concerns; they are actively shaping how communities interact, fuelling disputes over land and water and, in some cases, leading to violence. By looking closely at local experiences, this chapter highlights how environmental stress is deeply connected to social instability in the region.

## 6.1. Water scarcity

Water scarcity has long been a challenge in Yemen, and Abyan is no exception. The province faces groundwater depletion, overuse of water resources, particularly in agriculture, and a lack of local authority oversight to regulate water management. Additionally, there are no effective tools to measure groundwater replenishment rates, further complicating efforts to address the issue.

In Abyan governorate, spate irrigation, which depends on seasonal floods, is the primary method of watering crops, followed by groundwater extraction.[35] However, these two sources alone are not enough to meet the region's growing water demands. Even in the Abyan Delta, home to one of Yemen's largest irrigation networks, water shortages remain a persistent issue, making it increasingly difficult to sustain both agriculture and household water needs.

The scarcity of water has not only impacted agricultural productivity but has also fuelled violent disputes. In the Abyan Delta, conflicts over water access for farming have led to more than 100 fatalities over the past decade, driven by a mismatch between formal and informal water rights, outdated legal frameworks, and weak enforcement of previously accepted agreements.[36] In many areas, tribal laws are more widely recognised and, in some cases, more effective than state legislation in managing natural resources. However, the coexistence of these systems without clear alignment often creates legal ambiguity and fuels disputes over water allocation.

> "In the Abyan Delta, conflicts over water access for farming have led to more than 100 fatalities over the past decade."
>
> FAO AND THE MINISTRY OF AGRICULTURE AND IRRIGATION (2022)

In the agricultural sector, which uses 90 per cent of the available water, over-extraction has become a growing concern. Farmers rely on groundwater wells and seasonal floods for irrigation, but with continuous pumping, aquifers are being depleted faster than they can refill. According to the last well census conducted by local authorities in 2016, the total number of wells had reached 2,099. Since then, no official count has been conducted, and unregulated well drilling has become increasingly widespread. The actual number of wells is expected to have increased dramatically, due in part to the

growing number of interventions by humanitarian and development organisations since 2016. In some cases, these projects are implemented without prior approval or coordination with local authorities, who often lack the financial and logistical capacity to document or monitor new wells.

While existing laws require wells to be spaced at least 500 metres apart to reduce groundwater depletion, drilling is now routinely occurring as close as 100 metres apart, and in some cases, even less. Local authorities highlighted that the water table is rapidly falling. Prior to the conflict in 2014, wells were drilled to a depth of 8 metres. Today, drilling reaches depths of over 80 metres to access water.[37]

Irrigation issues go beyond well drilling, as the destruction of traditional water management infrastructure exacerbates water scarcity. The widespread sale of fertile farmland for residential development has led to the blocking and destruction of irrigation canals, depriving farmers of essential water access. Many farmers, driven by poverty and local conflict, have sold their lands to buyers who construct buildings over irrigation channels, disrupting the flow of water and causing tensions between farmers downstream and new landowners.

One example occurred in 2018 in the Quriyat area of Khanfar district when a farmer sold his land for the construction of an education centre. The new building blocked a critical irrigation canal, cutting off floodwater access to surrounding farms and igniting a long-standing conflict. Despite intervention from local authorities, the Agriculture and Irrigation Office and tribal leaders, the dispute remains unresolved in court. Similar cases across Abyan have intensified land and water conflicts and strained agricultural productivity.

The introduction of solar-powered pumps has been a mixed blessing in terms of water management. As there are no marginal costs, interviewees highlighted that some farmers leave solar-powered water pumps running throughout the day simply because they forget about them or fall asleep.[38]

The over-extraction and depletion have impacted farmers' agricultural produce, especially fruits and vegetables that may need large amounts of water, like bananas. In the Batis area of the delta, famed for high-quality bananas, production collapsed by 70 per cent in recent years.[39]

The unequal access to water is not limited to rural farming communities; in urban areas, ageing water networks have also added to tensions. A local staff member shared a story about a farmer from Zinjibar who, due to the fragile state of old water networks, cannot reliably access water. The local water network cannot pump water at high capacity for fear of breaking the system. As a result, water pressure in the pipes must be kept low, which means that water use closer to the pump has effectively cut off downstream users from water access. This has generated tensions and disputes between neighbourhoods and even between neighbours, with one reported case of two close friends in the locality severing ties due to tensions over water access.[40]

In the rural village of Kalsam in Sirar district, where more than 3,000 families reside, a recent tragedy underscored the deadly consequences of unchecked resource conflict. A local resident recounted how a long-standing dispute between two families over access to water from a well affected by drought and water scarcity

escalated into violence, resulting in the deaths of two young men. She mournfully added that water has turned "from a source of life to a cause of death."[41]

In addition to conflicts among farmers, the crisis has been intensified by local power structures. Some tribal sheikhs in Abyan control access to water, prioritising their own relatives while leaving others struggling. Instead of de-escalating tensions, these power dynamics often fuel resentment, deepening divisions within communities. Several respondents have shared that, at times, tribespeople exploit their influence by seizing control of community wells that were once public, restricting access and turning them into private sources of profit by selling the water. This practice has further marginalised vulnerable populations, forcing them to either pay high prices for water or endure severe shortages.

> "Water has gone from a source of life to a cause of death."
>
> RESIDENT OF KALASAM, SIRAR DISTRICT

Most districts lack government-supported water infrastructure, with only a few neighbourhoods in Zinjibar receiving limited public water services. As a result, many families living on an average income of less than $50 (USD) are forced to rely on private water tankers, which cost around 15,000 Yemeni Riyals (approx. $7) per 5,000 litres; in hard-to-reach and mountainous areas such as Mahfed district, the cost can go up to 60,000 Yemeni Riyals ($26) – a heavy financial burden for struggling households. Others resort to harvesting rainwater by collecting it in open-ceiling tanks on rooftops or open land, although this method is unreliable and dependent on seasonal rainfall.

## 6.2. Flash floods

In August 2024, severe flooding struck the Khanfar district of Kadmah Bin Laour in Abyan. According to the Executive Unit for Internally Displaced Persons (IDPs), over 300 households – comprising both displaced persons from other Yemeni provinces and local Abyan residents who had previously relocated due to conflict – were impacted.[42] Homes constructed from clay, wood or hay proved especially vulnerable. Once exposed to flooding, the clay and dirt foundations softened, ultimately leading to structural collapse. Additionally, the flooding affected more than 980 acres of Abyan's Delta region, a vital agricultural hub. While flooding is not new to the region, it has become noticeably more frequent and destructive in recent years, due to a combination of deteriorating flood protection infrastructure, changing rainfall patterns and the impacts of climate change.

The infrastructure designed to prevent flooding in the Abyan Delta region and surrounding areas – including dams, canals and earthen barriers – has deteriorated significantly due to years of neglect. As dams and barriers are, in many cases, made from sand, stones and gravel, they are maintenance-intensive and degrade rapidly if material washed away by floods is not replaced on a regular basis. This has left the region increasingly vulnerable to seasonal floods. Over time, repeated flooding further degrades the already fragile infrastructure, increasing the likelihood of catastrophic breaches. Local authorities have been unable to rehabilitate and maintain these dams due to high costs, ultimately halting maintenance efforts since 2012.[43]

Lack of maintenance also affects the largest, reinforced dams in Abyan, with adverse downstream effects. According to the Deputy Director of the Agriculture and Irrigation Office in Abyan, due to the need to protect weakened barriers such as Al-Eish Dam and Al-Sadah Dam from catastrophic failure, local authorities are forced to divert more floodwater into irrigation canals, which were not designed to handle such large volumes, causing them to overflow. The excess water then follows the natural downward slope of the land, eventually draining into the sea – eroding fertile land, destroying irrigation infrastructure, and wasting valuable freshwater that could otherwise have filled the dams' reservoirs to support agriculture and local water supplies.[44]

> "Private, uncoordinated flood-barriers often worsen downstream impacts, turning neighbours into rivals and spark conflict."
>
> ABYAN DELTA FARMER — 03 FEB 2025, ADEN

Because of the poor public flood protection infrastructure, private flood and water management efforts are undertaken by farmers, who have built earthen barriers to redirect water to their fields or to protect them from flooding. However, these barriers are built in uncoordinated ways and therefore often have unintended consequences by redirecting water away from downstream fields, leaving some farmers without enough water for their crops or diverting excess water onto neighbouring lands, causing flooding and damaging crops. Unsurprisingly, these adverse impacts become flashpoints for triggering disputes between farmers.[45]

Moreover, flooding generates land conflicts when the water washes away land markings or fences and alters accepted informal markers, like canals, a point raised repeatedly by both male and female interviewees.[46] One female farmer from Lawdar district recounted a particularly intense dispute that affected eight families within the same lineage in a single village. To end the conflict, the families decided to sell the entirety of the disputed land to a single buyer. However, the deal was widely seen as unfair, with the land sold for less than its actual value. Such conflicts create social tensions and strained relationships and in the worst case escalate to violence and killings that can initiate extended cycles of revenge. In tribal contexts where land is deeply tied to identity and belonging – not only as a source of livelihood but as a marker of lineage and history – such disputes carry high emotional and social stakes.

## 6.3. Desertification and drought

The southwestern provinces of Abyan, part of the delta regions discussed earlier and situated east of Aden along the Gulf of Aden, are experiencing rapid desertification, driven by climate change, prolonged droughts, water scarcity and human activities, with a significant impact on the region's agriculture and local livelihoods. Farmers, shepherds and beekeepers have all struggled with worsening conditions, which have fuelled competition for resources and, in some cases, deadly conflicts. According to a 2024 survey by the local Agriculture Office, 10 per cent of the non-flooded lands in the Abyan Delta have been destroyed by floods, while fully

40 per cent suffer from climate-related issues, including desertification, sandstorms and the uncontrolled spread of the Saysaban tree.[47]

In particular, the Sakin, Aaeth and Al-Daraj areas have been significantly affected by desertification. Extreme weather events, poor irrigation practices and, most notably, the rapid spread of the Saysaban tree have contributed to the region's declining agricultural productivity.[49] Originally introduced in North Yemen in 1974, the tree was intended to support soil stabilisation and enhance drought resilience. However, it has since spread uncontrollably, encroaching on farmland, depleting water sources, and disrupting natural ecosystems.[50] It grows in difficult and arid conditions and can withstand drought, poor soil and salinity. It aggressively invades agricultural lands and is very difficult to clear due to its deep and extensive root systems, which can reach to depths of 35 metres and generate new shoots unless fully removed. The tree also releases allelochemicals from its roots, inhibiting the growth of surrounding vegetation in a process known as allelopathy, adversely affecting any crops or feedstock in the vicinity.[51] It also outcompetes crops, other trees and grazing grasses, and forms dense clumps that create shaded habitats for wildlife, including reptiles and insects that are harmful to crop yields. Beyond degrading farmland and pastures, its seeds can be toxic to livestock if consumed in large quantities and its leaves are unsuitable as fodder. The Saysaban seeds retain their ability to germinate for up to 10 years, awaiting suitable conditions. The Saysaban is spreading rapidly, is resistant to efforts to remove it, and significantly degrades the agricultural usefulness of the land it grows on. Farmers perceive it as one of the greatest threats to agricultural sustainability in Abyan, and the latest statistics from the Agriculture and Irrigation Office indicate that in the Abyan Delta, more than 8,000 acres of farmland have become desertified due to the spread of the Saysaban tree.[52]

**SAYSABAN TREE**

An invasive, drought- and salt-tolerant tree introduced in 1974 that now spreads rapidly across Abyan. Its roots reach up to 35 m and release allelochemicals that suppress crops and grazing grasses, deplete water, and create dense thorny thickets that injure livestock. Seeds remain viable for up to 10 years. In the Abyan Delta, over 8,000 acres of farmland have been degraded by Saysaban.

Similarly, shepherds have consistently complained about the impact of this tree on their livestock. When sheep graze, they often wander into the dense thickets of Saysaban, getting trapped among its thorny branches. The thorns injure the sheep, tearing their bodies and udders, leading to infections and loss of milk production. Additionally, sheep that ingest and excrete the seeds are among the main vectors of its spread into new areas, furthering its invasive growth and heightening tensions between farmers and shepherds.

Drought, too, has become an unavoidable reality in Abyan, affecting everything from agriculture to daily life. The region now experiences longer dry seasons, rising temperatures and unpredictable rainfall. Rivers and wells that once supported farming communities are drying up, leaving people struggling to grow crops, raise livestock and find enough water for their daily needs.[53]

The effects of drought and environmental degradation have been particularly severe in Yaramis and surrounding areas,[54] where desertification is driving people to give up their farms and relocate to other parts of Abyan like Al-Husn, Batis, Jaar, Al-Makhzan, Uthman and Zinjibar. Another area that has been particularly hard-hit is

Lawdar district, historically one of Abyan's largest centres of livestock-rearing. The public pastures, valleys and mountain ranges where shepherds graze their flocks now support significantly fewer animals due to drought. With grazing areas rapidly disappearing, shepherds are forced to travel further and have encroached into private farmland, leading to rising tensions with farmers. In 2023, a grazing dispute escalated to the killing of one of the conflict parties in Lawdar.[55]

Beekeepers are also feeling the impact of drought and extreme temperatures. Honey production, according to the Office of Agriculture and Irrigation, has declined by at least 40 per cent as floral resources have withered, leaving bees with fewer nectar sources.

Many districts of Abyan are historically arid and drought-prone. Limited and irregular rainfall has long been a challenge, and while unpredictability appears to be increasing, a key part of the story is the degradation of water harvesting infrastructure and its inability to keep pace with increased needs and demands. Local communities struggle to store water during rains and to collectively manage water during dry seasons. Without adequate storage systems and effective governance of water stores, entire villages risk running out of water during extended dry spells, particularly for agriculture.

The inability to secure a reliable water supply has also contributed to displacement. By 2008, families in Abyan were already leaving their homes after losing access to farmland, livestock and clean water. Today, these pressures have only intensified. The ongoing cycle of water scarcity, conflict and migration continues to destabilise Abyan's rural communities.[56] In some cases, entire households have migrated to Aden and neighbouring governorates in search of more sustainable living conditions and economic opportunities.

## 6.4. Sewage

For decades, Abyan governorate, particularly its rural areas, had no formal sewage networks. Villages relied on traditional waste disposal methods, with sewage often dumped into wadis (seasonal riverbeds) or left in open areas, leading to environmental and health risks.

The Abyan Water & Sanitation Local Corporation (AWSLC) was established in 2006 to manage urban water and sewer services in Zinjibar, the governorate's capital.[57] Shortly afterwards, the German development bank KfW designed and built a piped sewage network and wastewater treatment facility for the city, which became operational in 2008. By 2014, right before the civil war escalated, more than half of Zinjibar's urban population was connected to the sewer network.[58] There is also a sewage system in place in Khanfar district, where the network serves approximately 5,500 families in Al-Hisn (Batis), 30,000 families in Jaar City and 4,200 families in Al-Koud.[59] However, sewage pipes are not necessarily accompanied by treatment facilities. In these smaller networks, the only existing treatment site is a small, natural plant in Al-Koud, covering 15 acres and using biological treatment methods. In Al-Hisn and Jaar City, sewage is directly discharged into irrigation canals that run through residential areas for 1,200 metres before reaching privately rented land, contributing to the spread of waterborne diseases, mosquitoes and foul odours.[60]

Following the outbreak of conflict in 2014, sewage systems in the governorate rapidly deteriorated due to instability, lack of management and prolonged power

outages. Maintenance and treatment operations collapsed, sewage pumps stopped working due to fuel shortages, and wastewater treatment plants became inoperable. As a result, many residents returned to using pit latrines and cesspools.[61]
The existing sewage network in Abyan is in severe disrepair, with numerous challenges obstructing maintenance. Many manholes lack covers, leaving them vulnerable to dirt, blockages and accidents. Community misuse of the system, including dumping plastic bags, clothing and sanitary products, frequently results in clogged pipes, which are already too narrow, at 6 to 8 inches in diameter, to handle increasing waste volumes. Overgrown Saysaban trees have also damaged key infrastructure and sewage pipes, while obstructing maintenance work.

With limited sewage network coverage, cesspools are widely used. Many are either left uncovered or covered with deteriorating wooden or iron panels, increasing risks, particularly to children and animals, of falling into the pits. As cesspools are generally not sealed or lined, sewage seeps into the surrounding soil and can contaminate groundwater. Once a cesspool reaches capacity, homeowners must hire a pump to remove the wastewater, a costly service many people cannot afford.[62] When families are unable to pay for sewage removal, waste overflows into neighbouring homes, streets and farmland, worsening the sanitation crisis. One woman from Khanfar district described how she often wakes up to find wastewater pooling outside her home. Concerned for her children's health, she turned to her local community committee, a volunteer-based group under the local authorities, which, however, lacked the resources to take meaningful action.

Local authorities have warned that seepage from cesspools contaminates groundwater, particularly in areas where drinking water wells are located nearby and groundwater is drawn from shallow aquifers. In these locations, untreated sewage infiltrates groundwater sources, mixing with the clean water supply and leading to outbreaks of waterborne diseases like cholera.[63] Cesspools also provide breeding grounds for other disease vectors, such as the mosquitoes that carry dengue fever. Some residents have reported foul odours and discoloration of their drinking water, clear signs of contamination.

In the Jabal neighbourhood of Sha'ar City in Khanfar, where 80 families live near drinking water wells, cesspools have leaked, mixing sewage with drinking water and increasing the likelihood of waterborne diseases. Sewage overflows have also impacted public spaces and residential neighbourhoods. In Batis, Lawdar, in 2020, wastewater entered homes, affecting both residents' health and the environment.[64] More recently, in September 2024, in Al-Husn, Khanfar district, sewage overflowed into three elementary schools, flooding playgrounds and nearby homes.[65] While these kinds of sanitation failures have not always led to direct conflict, they contribute to growing frustration and public mistrust in local authorities. Over time, this erosion of institutional credibility can weaken social cohesion and heighten the risk of community unrest, especially when local grievances remain unaddressed. Local authorities have noted that frequent sewage overflows have led to violent disputes, some escalating to gunfire or instances where residents buried manholes to prevent further overflow.

## 6.5. Solid waste management

Under the Ministry of Local Administration, legislation was introduced in the late 1990s to address Yemen's growing waste management crisis. Law No. 20 of 1999 established the City Cleaning and Development (Improvement) Funds to finance local waste services, and the Public Cleanliness Law (No. 39 of 1999) defined

municipal roles and responsibilities for waste collection and disposal.66 In Abyan, as in other governorates, local authorities used these laws to develop basic waste collection infrastructure through municipal crews and local cleaning funds. However, service coverage remained limited outside city centres, leaving rural areas without proper waste management.

Today, Abyan generates an estimated 40 to 50 tonnes of waste per day, with Zinjibar and Khanfar producing the largest share – approximately 25 tonnes daily. The districts of Lawdar and Mudiyah contribute around 3.6 tonnes per day. Public sanitation services in Abyan are nearly non-existent, with local authorities collecting waste only once every few weeks. As a result, most residents resort to burning garbage in densely populated neighbourhoods or dumping waste in random locations, including sensitive areas near canals that lead to the ocean. This practice has serious environmental and health consequences, contributing to air and water pollution.67

In response to Abyan's growing waste management crisis, the first landfill in Zinjibar was established in 2001 through a rental agreement. However, over two decades later, the site remains unused due to ongoing disputes among stakeholders. The Sanitation Office has long objected to transporting waste to the site, citing prohibitive costs, while residents have resisted its use over health concerns and its proximity to residential areas. The Environmental Protection Office has also raised alarms about the landfill's location near the coastline, warning of serious environmental risks.

Attempts to identify alternative disposal sites have similarly faced obstacles. The Cleanliness and Improvement Fund Office initially signed contracts with landowners in Wadi Hassan and the 7 October – Al-Hisn area to set up new landfill locations. However, the Wadi Hassan site was eventually discontinued. A subsequent landfill was established on rented land in Wadi Dofas, along the Abyan coast, but this too proved problematic: situated too close to the sea, it allows waste to seep into the ocean via flood channels.

In 2018, the Fund sought a more sustainable solution by purchasing 30 acres in the Sheikh Salem area of Zinjibar district to develop a waste recycling project. Yet this initiative also stalled, hindered by limited funding, high operational costs, the site's remoteness, and ongoing security concerns.

As a result of this unresolved conflict, residents and municipal garbage trucks continue to dump waste into canals, originally designed for flood drainage into the ocean. This illegal dumping has led to widespread contamination of water sources and obstructed the canals, reducing their capacity to manage stormwater. As a result, flooding has worsened in many areas, especially during heavy rains, as the blocked canals are unable to drain excess water effectively. Farmers have also contributed to uncontrolled waste disposal, discarding agricultural waste along roadsides, in public spaces and on open land. The accumulated waste provides shelter for rats, snakes and scorpions, and by blocking runoff from the canals, creates stagnant pools where mosquitos breed, posing serious health risks to farmers and nearby communities. Farmers have also reported increased loss of livestock and reduced crop production due to pests.

Plastic waste has emerged as a concern for coastal communities and the fishery sector. Fishers and environmental officials report increasing volumes of plastic debris in the water, which entangles fishing nets, disrupts marine habitats and

reduces fish populations. Some fishers themselves add to the problem by using green plastic bottles as improvised lures. According to the Office Manager of the Fishery Authority, shipping companies also exacerbate the issue by dumping garbage and waste directly into the sea. This waste eventually washes up along Abyan's shores, polluting beaches and clogging fishing equipment.

## 6.6. Air pollution

Air pollution in Abyan is a growing concern, with serious consequences for public health and the environment. While there is limited region-specific data, national and regional studies highlight worsening air quality across Yemen. One of the main contributors is the burning of waste, particularly plastic and other non-biodegradable materials, which is a common practice due to the lack of solid waste management infrastructure. Factories in the governorate have also used coal to fuel operations, affecting air quality.

In Khanfar's Batis area and surrounding villages, including Halmah, Al-Jabaleen, Miklan and Al-Ramliyyah, farmers are dealing with environmental pollution caused by a coal-burning factory in the district. This pollution has caused acid rain, which was first noted by residents in 2024 and has inflicted significant damage on agricultural lands.[68] While data is limited, information shared by a local civil society youth organisation suggests that some sesame farmers in nearby areas have experienced a decline in production and a noticeable drop in product quality over the past two agricultural seasons, which is also believed to be linked to air pollution from coal-fired factories. A recent study of Caesium-137 contamination in the Abyan Delta also highlights elevated levels of the radioactive isotope, which may be linked to coal burning or cement production involving contaminated inputs.[69]

# 7. Conflict management systems

This section explores how tribal customs, religious authority, local governance and grass-roots initiatives intersect – sometimes cooperatively, sometimes in tension – to mediate disputes and maintain social cohesion in the face of environmental drivers of conflict. It also examines the destabilising influence of armed groups, particularly Al-Qaeda in the Arabian Peninsula (AQAP), and how local authorities, despite resource constraints, have played a key role in coordinating responses to environmental and resource-related conflicts. Through case studies and local examples, the section illustrates the adaptive but fragile systems that underpin conflict resolution in Abyan today.

Conflict management in Yemen is generally shaped by multiple layers of actors and mechanisms, including formal institutions, customary tribal law, grass-roots initiatives and the influence of armed groups. Historically, tribal law has been the most relied-upon form of dispute resolution, particularly in rural areas where state institutions have limited reach. Approximately 80 per cent of conflicts are resolved through customary mediation, reflecting its accessibility, cultural legitimacy, and swiftness in addressing local disputes.[70]

Tribal mediation typically involves multiple actors, including sheikhs, community elders and, at times, religious figures whose participation lends legitimacy to decisions. However, this system is not without its limitations. It often marginalises vulnerable groups, such as the Muhamasheen and individuals in socially

stigmatised professions. Women also face significant barriers due to prevailing gender norms that may restrict their involvement in conflict resolution.

In contrast, local administration becomes more relevant in urban settings or when disputes involve administrative issues such as public service delivery, infrastructure or formal legal matters. While coordination between tribal and formal authorities is not always consistent, both systems can be complementary when clearly defined. Despite these constraints, there are documented cases where women have effectively drawn on tribal customs to mediate disputes, suggesting potential for more inclusive practices if existing norms are challenged and reformed.[71]

Religious leaders also play a significant role in mediating local conflicts, leveraging their moral authority to encourage reconciliation and strengthen social cohesion.[72] While there is limited documentation on environmental mediation disputes, their involvement often complements both tribal and formal mechanisms, particularly in rural areas.

In this complex environment, formal institutions such as local authority offices have made strides in addressing conflict, particularly when working collaboratively with tribal leaders, religious figures and community committees. Local authorities often act as conveners, bringing together diverse stakeholders to negotiate solutions, document agreements, and ensure implementation through both formal and customary channels.

For example, in the aftermath of environmental disputes – such as those stemming from unauthorised well-drilling or the contested use of shared water resources – local authorities have collaborated with tribal mediators to negotiate ceasefires, establish shared access agreements, and halt further resource extraction to prevent escalation. A recent case in Al-Mahfad district illustrates how this approach can help defuse even the most volatile situations.

The conflict began amid rising concerns over groundwater scarcity, when two tribes clashed over control of a dam and the surrounding valley. Both claimed ownership and sought to block the other from accessing or developing water resources. Tensions escalated when one tribe dug a new well and deliberately buried an existing well belonging to their rivals, sparking an armed confrontation that left 11 people dead, including two civilians with no affiliation to either tribe.

The crisis was eventually resolved through tribal mediation led by community leaders from Yafa'a – a region that spans both Lahj and Abyan governorates, traditionally divided into Upper Yafa (in Lahj) and Lower Yafa (in Abyan). The mediators brokered an agreement declaring the valley public property, ensuring that no single tribe could claim exclusive rights or restrict access. As part of the settlement, new well-drilling was suspended and the buried well was reopened. While the victims' families accepted a compensation bond as part of the tribal settlement, effectively resolving the personal grievance, the accused remains in custody, as the state continues legal proceedings to address his obligations under formal law.

In addition to their mediation efforts, local authorities have also led volunteer-driven initiatives aimed at improving daily living conditions and strengthening community engagement. Notably, volunteer initiatives and sports teams have actively collaborated with the Cleanliness and Improvement Fund in Abyan governorate, playing a key role in raising community awareness and addressing

waste accumulation. These initiatives have contributed directly to waste removal, neighbourhood cleanups and tree planting efforts, improving environmental conditions in several areas.

Community committees, often composed of elders, educators, women and other respected local figures, serve as a crucial bridge between citizens and local authorities. These committees, formed through collaboration, help monitor potential conflict flashpoints, relay community grievances and assist in mobilising timely interventions. In areas where police forces are overstretched, these committees, which are grass-roots bodies, play a critical role in maintaining social stability at the neighbourhood level and resolving everyday disputes. They have also demonstrated initiative in leading local development efforts. For example, committees in Shaqra'a and Zinjibar have organised coastal cleaning campaigns, mobilising the youth and residents to address environmental degradation and strengthen community ownership over shared spaces.[73] Community campaigns have been successfully complemented by efforts by local NGOs, which have done much to promote climate adaptation through awareness campaigns on rainwater harvesting, kitchen gardening and disaster preparedness. These initiatives teach rural families, for example, how to build rooftop rainwater tanks, store animal fodder ahead of dry seasons and use home gardens to enhance food security.

Existing local authority structures are also important in building resilience. Local authorities are key players in managing natural resources, resolving disputes and overseeing development activities across various sectors. Depending on their area of expertise, agencies such as water, agriculture and sanitation offices focus on specific responsibilities within their respective fields. For instance, the Agriculture and Irrigation Office, with support from international organisations, has taken a lead in promoting sustainable agricultural methods. Although the larger infrastructure programmes needed to mitigate vulnerabilities at scale are out of reach for the local authorities, there have been a number of small-scale local initiatives, particularly in the sewage sector, leveraging (limited) donor support, social ties, existing local authority capacities and expertise, and possibilities for public-private partnerships to create small-scale sewage projects that help alleviate pollution impacts from human waste at a local level, without needing larger investments or progress on thorny issues like land ownership, public revenues and national-level support. For example, in Khanfar district, a significant intervention involved the removal of an obsolete sewage network running beneath residential areas and its rerouting through new pathways in the Qadr Allah and Bedouin neighbourhoods, replacing 220 metres of the old system.[74] Similarly, in the Laham area, where some homes sit below the level of the old sewage network, a new system was installed, including concrete ground tanks and a fuel-powered pump, benefiting 54 homes. A similar intervention was carried out in the Qadr Allah neighbourhood, but with a solar-powered pump, serving 48 homes.[75]

# 8. Conclusion

The research shows that water scarcity, flooding, desertification, waste mismanagement and degraded infrastructure are deeply entangled with local power structures, weak governance and historical patterns of tribal land control. Conflict over irrigation canals, monopolised access to wells and unmanaged floodwater redirection have already resulted in fatalities, broken community ties and land loss, making it clear that unresolved environmental issues now form a central driver of local conflict in Abyan. As climate extremes worsen, these drivers are likely to continue growing in significance and can be expected to interact, compounding their impact. At the same time, the study reveals the persistence of informal systems of resilience: tribal mediation, grass-roots committees and community-driven workarounds are attempting to fill the governance vacuum. But these responses are overwhelmed and under-resourced. They require reinforcement by sustained investment in environmental infrastructure, monitoring systems and better data, as well as attempts to update and apply existing environmental regulations in ways that are sensitive to local context.

> In Abyan, environmental pressures are no longer slow-onset problems; they are accelerating drivers of displacement, livelihood loss and deadly disputes.

In addressing these challenges, local authorities, national authorities, donors and international partners have an important role to play. Their efforts need to align with what is happening on the ground. For external actors, that means working closely with tribal leaders, local authorities and community groups and not just bringing in outside solutions. Rather, interventions and advocacy should support localisation and take into consideration local concerns for long-term impact.

# 9. Recommendations

Local stakeholders, including community organisations, associations, tribal leaders and local authorities, can play a vital role in mitigating environmental conflicts. Key opportunities include:

- To mitigate environmental conflicts:
  - Support local mediation initiatives and capacities and provide support to conflict resolution mechanisms to take environmental concerns and sustainability more systematically into account, particularly around fair water-sharing agreements.

- Support community dialogue on resource management and water issues, for example through bringing up- and downstream communities into dialogue with one another and enhancing awareness of the needs and concerns of affected communities.

- Consider establishing climate change focal points, units or other suitable structures at the local authority level to assist with planning, coordination and community outreach around climate change and environmental pressures, including through joint sensitisation, dialogue and conflict resolution initiatives by local authorities, civil society organisations and tribal/community leaders.

- To address environmental conflict drivers:

  - Launch climate advocacy and awareness campaigns and support community initiatives to help communities better understand the impacts of climate change and what they can do to respond. These awareness campaigns can be women- and youth-led and include radio broadcasts, school-based events and social media outreach; they could also draw on religious authorities to help influence community attitudes and behaviours.

  - Explore waste recycling programmes, including programmes that turn agricultural and household waste into compost or biofuel, creating economic opportunities while addressing environmental concerns around waste and waste-related pollution. Consider opportunities to cooperate with the local private sector here.

  - Initiate plans to remove the Saysaban trees in areas where they are encroaching on agricultural land and explore opportunities to recycle or repurpose the removed biomass for sustainable use.

- To support adaptation measures at the local level:

  - Foster collaboration with local businesses to fund small-scale infrastructure projects, such as improved drainage systems and decentralised water treatment facilities that benefit businesses and surrounding communities while ensuring environmental sustainability.

  - Provide support to farmers in climate-resilient techniques such as crop rotation, water-efficient irrigation and organic fertiliser use. Community-led initiatives can also support local seed banks and improve food security.

  - Build capacity on conflict-sensitive adaptation measures with key personnel in local authorities – consider involving relevant partners from civil society, the community and/or private sector in capacity-building and/or outreach activities.

International organisations and donor agencies can provide critical support in strengthening Abyan's climate resilience and conflict mitigation efforts. Priority areas for intervention include:

- To mitigate environmental conflicts:
  - Support community-based initiatives that promote dialogue, inclusivity and community agency and encourage residents from different backgrounds, including IDPs, to collaborate on projects that help mitigate environmental stressors and conflict drivers.
  - Support inclusive local consultation processes and mechanisms as well as capacity-building programmes on mediation of environmental conflicts and negotiation of resource-sharing agreements. Consider complementing emerging resource- and water-sharing agreements with small-scale measures, infrastructure initiatives and collective monitoring mechanisms to support their implementation in the mid- and longer term.
  - Build on the work of local conflict resolution structures by providing support, raising awareness and developing capacities to build an understanding of and effectively address environmental drivers of conflict.
  - Encourage the establishment of partnerships and sustainable cooperation structures/initiatives between environmental experts, peacebuilders and local governance institutions to create holistic solutions that are realistic, acceptable and sensitive to the context and conflict dynamics.
- To address environmental conflict drivers:
  - Mainstream conflict and environmental sensitivity in existing approaches and initiatives, for example by ensuring that the longer-term environmental impact of interventions is considered in (participatory) planning of interventions and by building the capacities of local climate and environment actors on conflict sensitivity (including by collecting and sharing good- and bad-practice examples that illustrate the specific impacts of various measures).
  - Invest in decentralised wastewater treatment plants in underserved areas, incentivise upcycling agricultural waste and involve local committees in revenue-generating activities for sustainability.
- To promote adaptation measures at the local level:
  - Support local adaptation planning, for example through training in climate adaptation, and equip local authority staff and other stakeholders with skills in environmental governance, climate-smart agriculture and natural resource management.

- Support the implementation of local adaptation plans, prioritise infrastructure development and encourage investment in irrigation and flood protection, such as flood-resistant roads, improved sewage systems and sustainable irrigation projects, to enhance climate adaptation and reduce vulnerability of particularly exposed areas and communities.

- Conduct vulnerability assessments and climate impact studies to inform policy decisions and disaster response strategies and make them available to national and local stakeholders

- Create sustainable livelihood opportunities, in cooperation with local private sector stakeholders where possible, in green sectors that can offer income sources while promoting environmentally responsible practices.

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