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PEOPLE'S ACTION FOR CLIMATE RESILIENCE (PACR)

COASTAL CLIMATE CHANGE VULNERABILITY OF PAKISTAN

AGRICULTURE, FISHERIES AND LIVESTOCK

By
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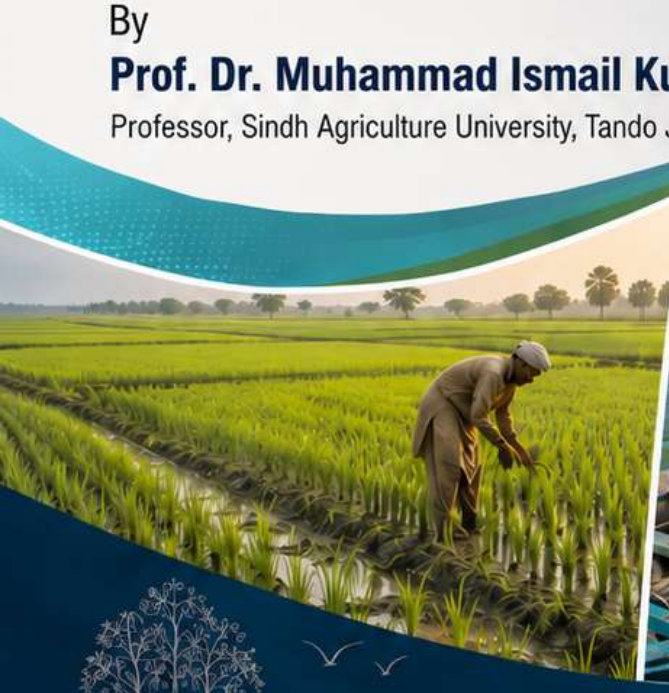

Foreword

The coastline of Pakistan is the first to be affected by the global climate crisis. The residents have little to do with the problem, yet they are taking the biggest hit. This work is born out of a simple belief that adaptation policy for the coast needs to begin with lived experience. We must learn from what the people of the coast have lost, and what they see as timely and feasible solutions. The study brings a deltaic district of the North-Western part of Punjab (Sindh) closer to the Makran district of the South-Eastern part of Balochistan, and thus, it attempts to go beyond generalizations of coastal risk and to the differentiated approach to understanding that is needed to adapt.

There's a disturbing aspect to some of what we saw. Every year, communities experience emergency response, but continue to cycle from one emergency to another without ever finKinding relief. Women and children are burdened with a load that they are not responsible for. The sea and the delta are evolving at a pace quicker than any institutions are supposed to defend. Nonetheless, the report is overall optimistic, for much of this vulnerability is created by choices choices regarding water, choices about what kind of assistance is offered, choices about who is at the table when choices are made — and other choices are still available to us. The study is made available for the use of communities, researchers, and partners in the policy-making process to make those better choices.

Acknowledgements

This study rests, first and foremost, on the participation of the coastal communities of Sujawal and Gwadar districts. Their members gave their time freely and shared their knowledge and experience with honesty and generosity. Their testimony is the foundation of this report, and the greatest debt is owed to them.

The study team also thanks the field enumerators, facilitators and note-takers who carried out the household survey, focus group discussions and key informant interviews in demanding conditions, along with the local officials, line-department representatives, community leaders and civil-society organizations who shared their perspectives. The work was carried out with the Support of South Asia Partnership Pakistan and Peoples's Action for Climate Resilience (PACR). Responsibility for the analysis, the interpretation and any errors rests with the study team alone.

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Acronyms and Abbreviations

Acronym	Definition	Acronym	Definition
ACIAR	Australian Centre for International Agricultural Research	KII	Key Informant Interview
ADB	Asian Development Bank	LIVAQUA	Sindh Livestock and Aquaculture Sectors Transformation Project
AR6	IPCC Sixth Assessment Report	NAP	National Adaptation Plan
BHU	Basic Health Unit	NDC	Nationally Determined Contribution
CNIC	Computerised National Identity Card	NGO	Non-Governmental Organisation
CPEC	China–Pakistan Economic Corridor	PPS	Probability Proportional to Size
FAO	Food and Agriculture Organization	PWD	Person(s) with Disability
FGD	Focus Group Discussion	RO	Reverse Osmosis
FMD	Foot and Mouth Disease	SCRP	Sindh Coastal Resilience Sector Project
GCF	Green Climate Fund	SST	Sea-Surface Temperature
GESI	Gender Equality and Social Inclusion	SPHF	Sindh People's Housing for Flood Affectees
GIS	Geographic Information System	SPSS	Statistical Package for the Social Sciences
GoP	Government of Pakistan	PMD	Pakistan Meteorological Department
IPCC	Intergovernmental Panel on Climate Change	PPR	Peste des Petits Ruminants

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Glossary of Key Terms

- **Adaptive capacity:** The ability of a household or community to anticipate, cope with, respond to and recover from climate hazards, shaped by access to assets, credit, information, services and institutions.
- **Deh:** A revenue village, the smallest cadastral unit of land administration in Sindh. Several named dehs in the study area have been permanently submerged.
- **Exposure:** The degree to which a system experiences climate-related hazards, measured in this study as reported hazard incidence over the past decade.
- **Harmful algal bloom (Red/blue tide):** A rapid proliferation of algae that discolours the water, depletes oxygen and releases toxins, killing fish. Reported as increasingly frequent off the Makran coast.
- **Keystone variable:** A variable on which the viability of several other systems depends. In this study, freshwater plays that role in the delta and marine-ecosystem integrity on the Makran coast.
- **Relief–dependency paradox:** The pattern, documented here, in which reactive post-disaster assistance takes the place of proactive adaptation investment, keeping people alive while leaving their vulnerability intact.
- **Salinity intrusion:** The advance of saline water into freshwater land, soil and groundwater, driven in the delta by reduced river flow and rising sea level.
- **Sensitivity:** The degree to which livelihoods and wellbeing are affected when a hazard occurs, reflecting dependence on climate-sensitive resources.
- **Triangulation:** Cross-checking findings across multiple data sources and methods to strengthen validity; in this study, the convergence of survey, interview and discussion evidence.
- **Vulnerability:** The propensity to be adversely affected by climate change, understood as a function of exposure, sensitivity and adaptive capacity.

Executive Summary

Pakistan contributes only about 0.9 per cent of global greenhouse-gas emissions, yet it ranks among the countries most exposed to the consequences of climate change (Government of Pakistan, 2021). Along its 1,050-kilometre coastline, shared between Sindh and Balochistan, live communities whose livelihoods rest almost entirely on climate-sensitive natural resources: farmland, freshwater, grazing land and the sea. This study assesses coastal climate vulnerability across the three livelihood systems that anchor the coastal economy — agriculture, fisheries and livestock — in an integrated, sector-linked way. Two districts were purposively selected to represent Pakistan's two contrasting coastal ecologies: Sujawal District in the Indus deltaic belt of Sindh, and Gwadar District on the Makran coast of Balochistan.

The assessment followed a cross-sectional, descriptive and exploratory mixed-methods design. The quantitative evidence comes from a structured household survey of 402 analysed households (203 in Sujawal, 199 in Gwadar) drawn from sampled villages through a multistage cluster design. The qualitative evidence comes from fourteen key informant interviews (KIIs) and six focus group discussions (FGDs) involving more than one hundred community participants, together with line-department and civil-society perspectives. Four lead indicators structured the analysis — exposure, sensitivity, adaptive capacity and resilience — supported by a retrospective hazard and damage profile covering the last ten years. Findings from the three instruments were triangulated with one another and read against current national and international evidence, including the Asian Development Bank's Sindh Coastal Resilience Sector Project, the World Bank's Sindh Livestock and Aquaculture Sectors Transformation Project, the Sindh Climate Change Policy 2022, and the peer-reviewed sea-level science of the Pakistan Sea-Level Working Group.

Principal findings

- Exposure is heavily concentrated in Sujawal. For nearly every hazard assessed, Sujawal households reported exposure at three to five times the Gwadar rate. In the low-lying Indus delta, coastal and riverine flooding, salinity intrusion, cyclones and erosion combine into a compound and recurring hazard pattern, while the rockier, more elevated Makran coast around Gwadar faces real but comparatively lower physical exposure.

- Two distinct hazard signatures emerged. The Sindh deltaic signature is a crisis of freshwater loss and submergence: the disappearance of downstream Indus and canal flows combined with advancing tidal and saline intrusion. The Balochistan Makran signature pairs coastal erosion with a cluster of marine-ecosystem hazards sea-surface warming, harmful algal blooms (the Red Tide), oxygen depletion, jellyfish swarms, coral and mangrove loss, and the decline or local disappearance of key fish species a cluster the original hazard taxonomy did not fully anticipate.

- Sensitivity is high in both districts, but the food- and water-security gap is stark. About two-thirds of Sujawal households reported a food shortage (65.5%) and a

drinking-water shortage (67.5%) within the last twelve months alone, compared with under one-fifth of Gwadar households.

- All three livelihood sectors show severe climate sensitivity. Among engaged households, 73.1% of farming households reported crop loss over the past decade, 59.5% of fishing households reported catch decline (70.2% experienced storm-disrupted work and 50.0% lost gear or boats), and 68.1% of livestock-keeping households lost animals.

- Adaptive capacity is, paradoxically, weakest where exposure is highest. Sujawal households reported far lower access than Gwadar households to credit (4.0% against 45.6%), insurance (0.0% against 26.4%), extension services (23.4% against 58.0%) and the internet (11.9% against 74.6%), despite facing much greater hazard exposure. This is the profile of a community cycling through repeated emergency relief rather than benefiting from durable, anticipatory adaptation investment.

- Health is a frontline vulnerability. Half of all households (50.2%) reported a climate-linked health problem in the last five years — 63.9% in Sujawal — dominated by waterborne (39.3%) and vector-borne (38.3%) disease. Children under five and school-age children bear the largest share of this burden, and most affected households reported major difficulty obtaining treatment, chiefly because facilities are too far away and treatment too costly.

- Coping is increasingly erosive. In Sujawal, 62.2% of households cut the quantity or quality of their food to cope with their most serious recent shock, and recovery took far longer than in Gwadar. Confidence in the ability to recover from a future shock is low across the sample and lowest in Sujawal.

- Gender and social exclusion compound physical risk. Women's participation in income decisions and their physical mobility are both more constrained in Sujawal, and self-perceived exclusion from formal support is dramatically higher there (57.7% against 7.3%).

- Awareness of the term 'climate change' is low (37.3%) relative to near-universal lived experience of climate hazards, and stated willingness to adopt new practices is similarly low (10.4%). Communication should therefore be hazard-specific and practical, and the cost and access barriers to concrete interventions must be visibly reduced.

The single clearest entry point: safe drinking water

Across household, community-project and health-support questions alike, safe drinking water is the most consistently prioritised need: 57.0% of households named it their most urgent household need, 66.7% the most feasible community project, and 29.1% a top health-support priority. Water security is at once the leading cause of waterborne illness, the binding constraint on livestock health, a driver of agricultural salinity stress, and the heaviest daily burden on women. It therefore works as a foundational, cross-sectoral investment that underpins agriculture, fisheries, livestock and health interventions rather

than competing with them. The qualitative record echoes this almost word for word. As one delta fisher put it, “Hunger does not kill us; diseases have killed us.”

Policy implications

The study concludes that institutional failure matters as much as physical climate change in explaining coastal vulnerability. Unfinished infrastructure (a fishing jetty under construction since 2007; incomplete flood-affectee housing), weak enforcement of fisheries regulation, elite capture of relief, and the near-total absence of veterinary, health and extension services in remote settlements together explain why communities remain trapped in reactive coping. The recommendations chapter sets out a phased Coastal Adaptation Policy Action Framework built on six pillars: water security; climate-resilient agriculture and salinity management; fisheries governance and marine-ecosystem protection; livestock and animal-health resilience; climate-health and social protection; and institutional, gender-responsive and community-anchored governance. Each pillar is aligned with the Sindh Climate Change Policy 2022, the National Adaptation Plan (2023), and the ongoing ADB and World Bank coastal investments. The overarching recommendation is a shift in coastal policy from episodic disaster relief to planned, anticipatory, community-validated adaptation, beginning with universal safe water and basic services as the platform on which sector-specific resilience can be built.

Three headline messages follow for decision-makers. First, differentiate by coast: the deltaic and Makran signatures are different problems requiring different instruments, and the Makran coast in particular still lacks a scaled, ecosystem-oriented investment vehicle comparable to the deltaic operations now under way. Second, lead with the keystones: freshwater security in the delta and marine-ecosystem protection on the Makran coast condition the returns to every other intervention and should come first in the sequence, with safe drinking water as the paradigmatic no-regret investment. Third, reform the institutions that deliver adaptation: transparent targeting, protection against elite capture, secure tenure and the genuine inclusion of women and marginalised groups are the conditions under which adaptation finance produces reduced vulnerability rather than repeated relief.

The evidence base behind these conclusions is unusually strong for a study of this scope. Findings are triangulated across a 402-household survey, fourteen key informant interviews and six focus group discussions, and checked against current national policy and the peer-reviewed literature. Where the three instruments converge — and they do converge on the primacy of water, the two hazard signatures, the relief–dependency paradox and the centrality of institutions — the conclusions can be stated with confidence. The study therefore offers not just a diagnosis of coastal vulnerability but a practical, sequenced and institutionally grounded route out of it.

Chapter 1
Background and Introduction

1.1 Introduction

Climate change is no longer a possibility but a reality for the coastal communities in Pakistan. This report offers a specific vulnerability assessment of the coastal zone, targeting agriculture, fisheries and livestock (AFL), as well as the people relying on them as their livelihood. It addresses an identified evidence gap. The physical risks of the coast (sea-level rise, salinity intrusion, cyclones, erosion and heat) are becoming more detailed and better documented at the national scale, but integrated analysis at the district level that is linked to the sectors and grounded in communities is less widely available. However, coastal-adaptation decisions remain largely based at the household level without clear evidence of the distribution of vulnerability, exposure and sensitivity of livelihoods and the extent to which adaptation responses are considered feasible and urgent at the household level.

In order to fill this gap, the study combines a structured household survey with focus group discussions and key informant interviews in two representative and contrasting coastal districts and unpacks the findings using the four commonly cited indicators of vulnerability (exposure, sensitivity, adaptive capacity and resilience). It is not to just write about difficulties. To generate meaningful and policy relevant evidence which can inform targeting and sequencing of adaptation investments in the most climate-exposed coastal communities in Pakistan.

1.2 Pakistan's climate-vulnerability context

Despite its small contribution to global GHG emissions, Pakistan is among those countries most impacted by extreme weather. The Government of Pakistan has recorded its vulnerability to climate risks such as glacier melt, floods, and changing rainfall patterns with its contribution of approximately 0.9 per cent of global emissions in its updated NDC (Government of Pakistan, 2021). The scale of the hazard was demonstrated by the catastrophic floods of 2022, which submerged about one-third of the country and impacted tens of millions of people, while the fragility of the systems upon which rural livelihoods depend was demonstrated by the magnitude of the losses.

Agriculture, coastal areas, biodiversity, water and disaster preparedness are among the top priority sectors for adaptation listed in the National Adaptation Plan (NCP) (2023) Ministry of Climate Change and Environmental Coordination). The Sindh Climate Change Policy 2022 also explicitly addresses increased sea levels in the province's coastal region causing salinity and sea intrusion, and the province's agrarian and pastoral economy's sensitivity to drought, heatwaves, water insecurity and coastal hazards at provincial level (Government of Sindh, 2022). In addition to the other pressures facing Balochistan's long Makran coastline are problems of sea-level rise, cyclone intensification and stress on marine ecosystems, along with rapid and largely unplanned urbanisation around the port of Gwadar.

1.3 Coastal zone of Pakistan

The coastline of Pakistan is approximately 1,050 km long, which includes Sindh coast in the east and Makran coast in Balochistan (west). There is an intrinsic difference between the two coasts in terms of geology, geomorphology and socio-economic structure. The coast of the Sindh and the Indus delta area is a geologically passive margin, a low-lying system of tidal creeks, mud flats, lagoons and fringing mangroves formed by the interaction of river sediment and marine processes. The Balochistan coast is a geologically active rocky coastline of uplifted terraces and pocket beaches where tectonic uplift is of the order of 1-2mm/yr on average and is over balancing the relative sea-level rise over the last 2000 years (Rabbani et al., 2008; Weeks et al., 2023).

The Asian Development Bank (2025) estimates that there are approximately 3.9 million people in the coastal districts of Pakistan, and that their livelihoods are generally based on agriculture and livestock and fisheries. Fisheries have national importance in terms of economic value and nutrition: In Pakistan, total fish production in 2022 was approximately 666,000 tonnes of which marine capture fisheries accounted for approximately 350,000 tonnes (or around 53 per cent) (Asian Development Bank, 2025). However, fish consumption in Pakistan still exists at the lowest per-capita level compared to other countries of the world which is about 2kg of fish per capita per year, highlighting the direct link between climate's impact on marine and coastal resources to the livelihood and food security challenges faced by these communities (World Bank Group, 2018).

1.4 Sindh's Coast and Indus Delta

The Indus delta area in the coastal region of Sindh is one of the world's largest arid-zone deltas, and is one of the areas in Pakistan that will be most vulnerable to sea-level rise because of its low elevation, land subsidence and fragility of its ecosystems. The present delta has an area of about 600,000 ha divided into sixteen major creeks and innumerable smaller ones, mudflats and mangrove fringes (Rabbani et al., 2008). The delta has undergone a dramatic change in the quantity of sediment and freshwater flowing downstream since the 1960s, caused by extraction from their sources and construction of the barrages, resulting in the saltwater intrusion, loss of mangrove and landward migration of the sea.

For many delta communities, the structural turning point is associated with the construction of the Kotri Barrage and the progressive loss of downstream Indus flows felt from the 1970s onward, and with the cyclone of 1999 that ruptured livelihoods across the deltaic belt. Salinity has since become a defining structural constraint. Research summarised in the sea-level literature and by the Australian Centre for International Agricultural Research indicates that 70 to 80 per cent of soils in Sindh are moderately to strongly saline, and that coastal agricultural areas such as Thatta, Sujawal and Badin are highly susceptible to waterlogging and seawater intrusion (Weeks and Harrison, 2020). It is against this backdrop that the Asian Development Bank's Sindh Coastal Resilience Sector Project targets Thatta, Sujawal and Badin — districts whose conditions have been degraded by the combined effects of land subsidence, flooding, erosion and saline intrusion (Asian Development Bank, 2025).

1.5 The Balochistan coast and the Makran belt

The Balochistan coast stretches over roughly 770 kilometres along the northern Arabian Sea. It is one of Pakistan's most ecologically valuable and economically significant coastal regions, home to more than 300 commercially important fish species and supporting the livelihoods of thousands of small-scale fishing families. Unlike the Indus delta, the Makran coast around Gwadar is arid, rocky and comparatively elevated, though it sits within a low-elevation coastal zone in which a large share of the land still lies close to sea level. Local hydrologists observe that the surrounding sea is rising faster than global averages, that new wetlands are forming, and that salt-tolerant species are displacing native vegetation.

The dominant climate narrative on the Makran coast combines physical erosion with marine-ecosystem stress: sea-surface warming, coral loss, harmful algal blooms and the decline of high-value species, aggravated by illegal deep-sea trawling, marine pollution and untreated sewage discharge. Cyclones Yemyin (2007) and Phet (2010), both of which struck the Makran coast, forced fishing communities to evacuate and caused severe damage to boats, nets and cold-storage facilities. Gwadar's rapid development as a deep-sea port under the China–Pakistan Economic Corridor has added a further layer of pressure on drainage, sanitation and water supply, while the flash flood of February 2024 — roughly double the city's typical annual rainfall in little more than a day — underscored the settlement's exposure to extreme rainfall.

1.6 Rationale and significance

A dedicated, sector-linked evaluation of coastal climate vulnerability is timely for policy and necessary for analysis, for three reasons. First, coastal Pakistan concentrates a large, resource-dependent population in landscapes where multiple hazards interact, yet integrated evidence linking those hazards to specific livelihood systems and social groups remains limited. Second, major public investment is now being committed to coastal resilience among it the Asian Development Bank's Sindh Coastal Resilience Sector Project and the World Bank's Sindh Livestock and Aquaculture Sectors Transformation Project which raises the value of granular, household-level evidence for targeting, sequencing and design. Third, the cross-provincial design, which compares a deltaic Sindh district with a Makran Balochistan district, allows the two dominant coastal hazard signatures of Pakistan to be examined side by side, strengthening the transferability of the conclusions.

The study matters because it connects coastal climate change directly to food systems, rural livelihoods and human health. Its results are intended to move the policy conversation from generalised climate risk towards sector-specific and place-specific decision-making, and can inform coastal-adaptation planning, salinity management, climate-smart agriculture, fisheries resilience, livestock protection, climate-health programming and local development. The work aligns with national and provincial climate-policy frameworks, including the National Adaptation Plan (2023) and the Sindh Climate Change Policy 2022.

Beyond its immediate policy utility, the study makes a distinct analytical contribution. Placing a subsiding, salinising deltaic district and an eroding, warming Makran district within a single comparative frame makes it possible to separate the hazard drivers common to Pakistan's coast from those specific to each ecology — a separation that single-site studies struggle to achieve, and one that is essential for designing and targeting adaptation correctly. The paired-district design also allows the study to test, rather than assume, the relationship between physical exposure and adaptive capacity. That test yields the study's central and counter-intuitive finding: the more exposed district is the one less able to adapt. In this way the study contributes not only district-level evidence but a transferable approach to comparative coastal vulnerability assessment in data-scarce settings.

1.7 Problem statement

Pakistan's coastal areas face a compound and intensifying combination of sea-level rise, coastal and riverine flooding, salinity intrusion, erosion, ecosystem degradation, heat stress and livelihood disruption. This vulnerability is not uniform. In agriculture, the binding constraints are soil and water salinity, declining crop productivity and land loss. In fisheries, they are habitat change, unstable and declining catches, species loss and damaged coastal infrastructure. In livestock, they are heat stress, water and fodder shortage, a rising disease burden and the consumption of saline drinking water. Existing evidence establishes how serious these risks are, but the integrated, sector-linked, district-level vulnerability analysis that could guide targeted adaptation remains minimal. This study addresses that gap directly.

1.8 Aim

The aim of the study is to determine the climate-change vulnerability of coastal Pakistan across the agriculture, fisheries and livestock sectors, and to identify the priority adaptation actions most likely to strengthen resilient coastal livelihoods.

1.9 Specific objectives

- To define the key climate-related risks that occur along the coastlines of Pakistan, such as a rise in sea-level, salinity encroachment, erosion, coastal flooding, and thermal stressor.
- To determine the exposure, sensitivity, and adaptive capacity of agriculture, fisheries, and livestock systems of selected coastal districts.
- To locate sectoral vulnerability hot spots in terms of spatial and socioeconomic indicators.
- To compare the comparative susceptibility of the three industries and enter the most vulnerable populations.
- To prescribe viable adaptation plans to policymakers, local governments as well as coastal communities.

1.10 Research questions

Five research questions guide the study, harmonised between the concept proposal and the revised methodology:

Table-1.1: Research questions guiding the study.

No.	Research question
Q1	What are the key climate change risks to the coastal areas of Pakistan?
Q2	What are the various impacts of such hazards on agriculture, fisheries, and livestock?
Q3	What are the most vulnerable coastal regions and livelihood communities?
Q4	Which processes diminish or enhance local adaptive capacity?
Q5	What are the most appropriate adaptation interventions in enhancing resilience in coastal Pakistan?

1.11 Scope and structure of the report

The study is cross-sectional and focuses on two purposively selected coastal districts Sujawal (Sindh) and Gwadar (Balochistan) chosen to represent Pakistan's two dominant coastal ecologies. In line with the preference for fewer districts with deeper engagement, the design favours analytical depth and comparative insight over broad geographical coverage. The remainder of the report proceeds as follows. Chapter 2 reviews the scientific and policy evidence base. Chapter 3 describes the study area and presents the study-location maps. Chapter 4 sets out the methodology and indicators in full. Chapter 5 presents the quantitative household-survey findings and Chapter 6 the qualitative findings from the KIIs and FGDs. Chapter 7 integrates the evidence in a scholarly discussion, Chapter 8 draws the conclusions, and Chapter 9 presents the recommendations together with a phased policy action framework. References and annexes follow.

1.12 Intended audience and use

The study is written for several audiences. For provincial and federal policymakers in climate change, agriculture, fisheries, livestock, irrigation, health and disaster management, it offers district-level evidence and a phased framework to guide the targeting and sequencing of coastal-adaptation investment. For development partners and financiers including those already committed to Sindh's coast it provides household-grounded evidence on where vulnerability concentrates, which groups are excluded from support, and which interventions communities regard as feasible, so that investment can rest on local realities rather than generic assumptions. For local governments, community organisations and civil-society actors, it documents lived experience and community

priorities in a form that supports advocacy and participatory planning. And for the research community, it offers a comparative analytical approach and an evidence base for further longitudinal and intervention studies. Throughout, the aim has been to produce a study that is usable rather than merely descriptive, translating evidence into actionable and properly sequenced recommendations.

Chapter-2
Literature and Policy Context

This chapter places the study within the current scientific evidence on coastal climate hazards in Pakistan and within the national and international policy and investment frameworks that shape coastal adaptation. It draws on peer-reviewed science, government policy and the most recent programme documentation of the Asian Development Bank and the World Bank, so that the field evidence in later chapters can be read against and contribute to an up-to-date knowledge base.

2.1 Sea-level rise and the Pakistan coast

Recent scientific synthesis warns that Pakistan's coast is becoming increasingly vulnerable to sea-level rise and to extreme coastal water levels. Bringing together the expertise of the newly established Pakistan Sea-Level Working Group, Weeks et al. (2023) report that under high-emissions scenarios consistent with the IPCC Sixth Assessment Report, local sea-level rise at Karachi may range between roughly 0.24 and 0.95 metres by 2100, and could reach one metre by 2110. The same review stresses that rising sea levels shorten the return period of high-water events, increasing the frequency and severity of coastal flooding and erosion, and it points to an urgent need to improve the availability of sea-level and coastal measurement data and to integrate coastal climate services into the National Adaptation Plan.

The two provincial coasts respond differently to the same global signal. The Indus deltaic coast of Sindh is geologically passive and subsiding, which amplifies relative sea-level rise, while the Balochistan (Makran) coast benefits from tectonic uplift of about one to two millimetres per year that has historically offset part of the rise (Rabbani et al., 2008; Weeks et al., 2023). This asymmetry bears directly on the present study. It predicts, a priori, that the deltaic Sindh site should experience more acute inundation and salinity exposure than the uplifted Makran site a prediction the household survey in Chapter 5 strongly corroborates.

2.2 Salinity, land loss and the Indus delta

Salinity intrusion is the defining agro-ecological process of the Sindh coast. As downstream Indus flow has fallen, seawater has advanced into the delta, degrading soils and groundwater and progressively turning once-productive farmland barren. National and provincial assessments agree. The Sindh Climate Change Policy 2022 records that a substantial share of the province's agricultural land had already been affected by saltwater intrusion, and that soil salinity reduces both crop productivity and the nutritional quality of produce (Government of Sindh, 2022). The sea-level literature adds that over the last fifty years Pakistan's mangrove ecosystems a natural buffer against storm surge and a nursery for fisheries — have declined substantially in cover and species number, under pressure from reduced freshwater flow, pollution, urbanisation, overgrazing and firewood harvesting (Weeks et al., 2023). The loss of that buffer feeds back into greater exposure for the communities behind it.

Land loss in the delta is not gradual and abstract; it is experienced as the submergence of named settlements. The qualitative record assembled for this study documents the complete submergence of several revenue villages (dehs) in the Sujawal deltaic belt evidence that matches, and gives human specificity to, the macro-scale processes in the scientific literature. This convergence between community testimony and published science is one of the analytical strengths of a mixed-methods design.

2.3 Fisheries under climate and human pressure

The World Bank's fisheries assessment identifies coastal fisheries as a potential engine of livelihoods, nutrition and local development, while cautioning that the sector suffers from overfishing and weak development, and that Pakistan's very low per-capita fish consumption signals both an under-used nutritional opportunity and an acute exposure of coastal food security to any further decline in the resource (World Bank Group, 2018). On the Balochistan coast, contemporary reporting documents a warming Arabian Sea, ocean acidification, shifting monsoon timing, more frequent cyclones and post-harvest losses estimated at 40 to 60 per cent among small-scale fishers using traditional wooden boats without modern navigation or cold-chain support.

Two features of the fisheries literature are especially pertinent here. First, climate hazards on the coast do not act alone; they interact with human-driven pressures illegal deep-sea trawling, destructive fine-mesh netting, middleman control and debt bondage — so that observed catch decline reflects a compound of climatic and governance drivers. Second, ethnographic work on the Gwadar fishing community underscores the role of indigenous climatic knowledge and the marginalisation of fishers from the economic and political forces reshaping their coastline. Both features appear clearly in the field evidence of Chapter 6.

2.4 Agriculture and livestock in a saline, warming coast

For coastal agriculture, the dominant adaptation challenge is salinity management under freshwater scarcity. The literature and provincial policy point to a combination of responses: salt-tolerant and bio-saline crop varieties, drainage and salinity control, improved irrigation-water supply, and climate-smart agronomic practices delivered through extension. For livestock a critical household safety net in the Sindh coastal belt the Sindh Climate Change Policy 2022 notes that climate change raises disease outbreaks, cuts production through fodder unavailability, and diminishes water quantity and quality (Government of Sindh, 2022). The World Bank's Sindh Livestock and Aquaculture Sectors Transformation (LIVAQUA) Project, approved in 2024, responds directly to these pressures by promoting climate-smart, resilient small and medium producers and strengthening resilience to animal-health and climate-related shocks (World Bank, 2024). This study's household evidence on fodder shortage, animal heat stress, disease and saline drinking water for animals speaks directly to the problem that programme is meant to address.

Read together, the sectoral literature makes one thing clear: agriculture, livestock and human health on the coast share a common dependence on freshwater. Salt-tolerant crops still need water to flush the root zone. Fodder production depends on freshwater

irrigation or rainfall. Animal health deteriorates when the only available drinking water is saline, and human illness rises with the same contaminated supply. Interventions aimed at a single sector in isolation — an improved seed here, a veterinary campaign there — will therefore under-perform an integrated approach that secures the freshwater base on which all three depend. In this sense, the literature anticipates from the direction of policy and agronomy the keystone role of freshwater that this study establishes empirically from the direction of household and community evidence. It also anticipates the study's insistence that the sectors be planned together, not in the administrative silos through which they are conventionally governed.

2.5 Coastal health as a climate outcome

A growing body of evidence links coastal climate hazards to human-health outcomes through several pathways: saline and unsafe drinking water driving waterborne and kidney and bladder disease; standing water after floods and rainfall increasing vector-borne disease; extreme heat causing heat illness; and food insecurity driving malnutrition, particularly among children. The provincial policy framework explicitly recognises the food-security, malnutrition and health dimensions of climate change in Sindh (Government of Sindh, 2022). This study treats health not as a downstream consequence to be noted in passing but as a frontline vulnerability in its own right, with dedicated survey and qualitative modules. The community evidence justifies that choice: the recurring statement that disease, not hunger, is the proximate threat to life places health at the centre of how coastal populations themselves experience climate change.

2.6 National and provincial policy frameworks

The study is anchored in a coherent policy architecture. At the national level, Pakistan's Updated Nationally Determined Contribution (2021) frames the country's climate exposure and commitments, while the National Adaptation Plan (2023) sets out adaptation priorities across agriculture, coastal areas, water, biodiversity and disaster preparedness. At provincial level, the Sindh Climate Change Policy 2022 — the province's first — provides a roadmap that recognises sea intrusion, salinity, food insecurity, heatwaves and water insecurity as defining challenges, and requires attention to vulnerable groups in climate planning (Government of Sindh, 2022). Balochistan's coastal governance operates through its coastal development and climate-change institutions and the Gwadar Development Authority, within the wider context of CPEC-related development. These frameworks supply the policy hooks to which the recommendations in Chapter 9 are aligned.

2.7 Current investment landscape

The coastal-adaptation investment landscape shifted materially in the period immediately before this study, which raises the policy value of granular, household-level evidence. In December 2025 the Asian Development Bank approved the Sindh Coastal Resilience Sector Project, a concessional-loan operation co-financed by the Green Climate Fund and targeting the disaster-prone districts of Badin, Sujawal and Thatta. Its stated aims include protecting hundreds of thousands of people, safeguarding around 150,000 hectares of agricultural land, restoring some 22,000 hectares of forest, and

mainstreaming women's leadership in resilience planning, with at least a quarter of funds allocated to women-led initiatives (Asian Development Bank, 2025). This project will be executed by the Sindh Irrigation Department and the Sindh Forest and Wildlife Department, incorporating resilient water infrastructure, nature-based solutions and enhanced management of coastal resources. The World Bank's LIVAQUA Project (2024) is also working with livestock and aquaculture producers to promote climate-smart agriculture in Sindh.

The present study is directly relevant to programme design and targeting, due to Sujawal being an explicit target district of the ADB operation. The household and qualitative information gathered here, around the focus of exposure, the groups that lack support and the interventions considered feasible by communities, can support these and similar investments in local realities instead of generic assumptions.

2.8 The two-coastal comparative evidence

The study is based on the fundamental concept that the Sindh and Balochistan coasts are two separate physical systems which has been supported by the scientific literature. Sea-level dynamics show that the Indus deltaic coast is subsiding and that the sediment supply of the delta-building process has been lost due to water regulation upstream. Relative sea-level rises in the Karachi–delta region have been estimated at approximately 1 mm per year over the last century, rising to nearly 1 m by 2100 depending on the climate scenarios and emissions used. The Makran coast, on the other hand, is an active tectonic environment, experiencing localised uplift of 1–2 mm/yr, and an oceanography characterised by warming of the Arabian Sea, cyclogenesis and HABs. The two contrasting geophysical settings shape the two hazard signatures observed in the empirical chapters, 5 and 6.

Soil-salinity assessments for coastal Sindh indicate that the large majority of soils in the deltaic belt are salt-affected, consistent with this study's finding that salinity is the dominant agricultural hazard in Sujawal. Fisheries-sector analyses document Pakistan's low per-capita fish consumption and the structural weaknesses of its fisheries governance, which provide context for the Gwadar findings on catch decline, weak co-management and the vulnerability of artisanal fishers. Recent reporting on extreme rainfall at Gwadar including the February 2024 event in which rainfall over a day and a half approached twice the district's typical annual total illustrates the compound exposure of the Makran coast to both slow-onset ecological change and acute hydro-meteorological extremes.

2.9 Policy architecture and investment landscape

The study sits within an active and evolving policy and investment landscape. Federally, Pakistan's updated Nationally Determined Contribution and its National Adaptation Plan establish the strategic framework for adaptation, notwithstanding the country's negligible share of global emissions and its acute exposure to climate impacts. Provincially, the Sindh Climate Change Policy provides the governing instrument for the delta, with explicit attention to coastal zones, water and the vulnerable sectors examined here.

On the investment side, two major operations frame the opportunity for translating the study's findings into action. The Asian Development Bank's coastal-resilience operation for Sindh targets the deltaic districts, including Sujawal, with substantial concessional investment in coastal protection, freshwater and mangrove restoration, and reserves a significant share of benefits for women-led activity an alignment directly relevant to the freshwater and gender findings of this study. The World Bank's livestock and aquaculture transformation operation for Sindh offers a corresponding vehicle for the livestock and fisheries pillars of the recommendations. The Makran coast, however, lacks an equivalently scaled, ecosystem-oriented instrument, and the study's findings bring that gap into sharp relief.

2.10 Gender, social inclusion and the differential burden of coastal change

A substantial body of climate and disaster scholarship establishes that vulnerability is socially differentiated. Women, the elderly, children, persons with disabilities and the poor typically bear a disproportionate share of climate harm — not because of any inherent fragility, but because of unequal access to resources, information, mobility and decision-making power. In coastal and agrarian settings, the gendered division of labour sharpens this differentiation: women are usually responsible for water collection, food provision and care, and so are the first and most heavily affected when water becomes scarce or saline, food runs short, or illness spreads. Where women are excluded from the community forums in which relief and adaptation decisions are made, their needs and knowledge are systematically under-represented in the response. The study's attention to women, female-headed households and other at-risk groups is grounded in this literature and in the gender-responsive commitments of Pakistan's climate-policy framework and of the major coastal-investment instruments now in preparation, which reserve a defined share of benefits for women-led activity.

The literature also warns against treating social inclusion as a residual, cross-cutting add-on. Because the distribution of exposure, sensitivity and adaptive capacity is itself shaped by gender, class, tenure and age, an assessment that does not disaggregate along these lines will misread both the location and the causation of vulnerability. This study accordingly places gender and social inclusion inside the core analysis rather than at the margins, disaggregating key indicators by district and, where the data permit, by household headship and social group.

2.11 Disaster risk, institutions and the limits of relief

The disaster-risk-reduction and political-ecology literatures converge on one proposition: a natural hazard becomes a human disaster only through the social and institutional conditions it meets. On this view, reducing disaster risk requires not only physical defences and early warning, but stronger institutions, entitlements and governance arrangements the things that determine how exposure and capacity are distributed. A recurring theme is the limitation of relief-led response. Humanitarian assistance delivered after each shock is necessary for survival, but it does not by itself reduce underlying vulnerability; where it substitutes for anticipatory investment, it can entrench dependency and erode local capacity. International policy has accordingly shifted towards anticipatory

action, shock-responsive social protection and the reallocation of resources from repeated response to risk reduction.

This literature provides the interpretive lens for one of the study's central findings, the relief–dependency paradox, in which the more exposed district receives more assistance yet stays more vulnerable, because the assistance is overwhelmingly reactive. It also motivates the study's emphasis on institutional repair extending credit, insurance, extension, connectivity and transparent, participatory governance as a necessary complement to physical adaptation investment. The policy frameworks reviewed above provide an architecture within which such strengthening could be pursued; the study's findings, however, point to a substantial gap between policy intent and institutional reality on the ground.

2.12 Synthesis and the conceptual framework

The study adopts the widely used framing in which vulnerability is a function of exposure (the degree to which a system experiences climate hazards), sensitivity (the degree to which it is affected when hazards occur) and adaptive capacity (its ability to anticipate, cope with and recover from them), complemented by an explicit resilience measure and a retrospective hazard-and-damage profile. Vulnerability is the result of higher exposure and sensitivity and lower adaptive capacity. This framing is reflected in the survey instrument and the analysis and enables a comparison of the two study districts to be made on the same basis. From literature reviewed here, a clear testable expectation emerges, that the Indus delta (salinising) will exhibit high exposure and sensitivity compared to the Makran coastal uplift, and adaptive capacity will vary by local exposure and configuration of assets, services, connectivity and institutions, not just physical exposure. Chapters 5–7 put that expectation to the test, and in significant ways, enhance it.

Chapter-3
Study Area and Study-Location Maps

This chapter explains the geographical context of the study and provides the maps of the study location areas. The two districts were chosen strategically to represent the two major coastal ecologies in Pakistan and to allow for a systematic cross-provincial assessment of the vulnerability of the various sectors of agriculture, fisheries and livestock.

3.1 Overview of the Coastal study zone.

The coast of Pakistan is situated in Balochistan and Sindh in the northern Arabian sea from Iranian border in the west to Indian border at Sir creek in the east. The two study districts, Gwadar in the arid, rocky Makran coast in the west and Sujawal in the low lying Indus deltaic belt in the east, separated by the city of Karachi, the main port and biggest city of the country, are located within this zone. The two districts are separated by about 600 km and are respectively on the uplifted-margin and the subsiding-delta end of the national coastal spectrum.

Map 3.1. Coastal zone of Pakistan with the study Districts of Sujawal (Sindh) and Gwadar (Balochistan). These are only indicative of coastline and locations for orientation purposes.

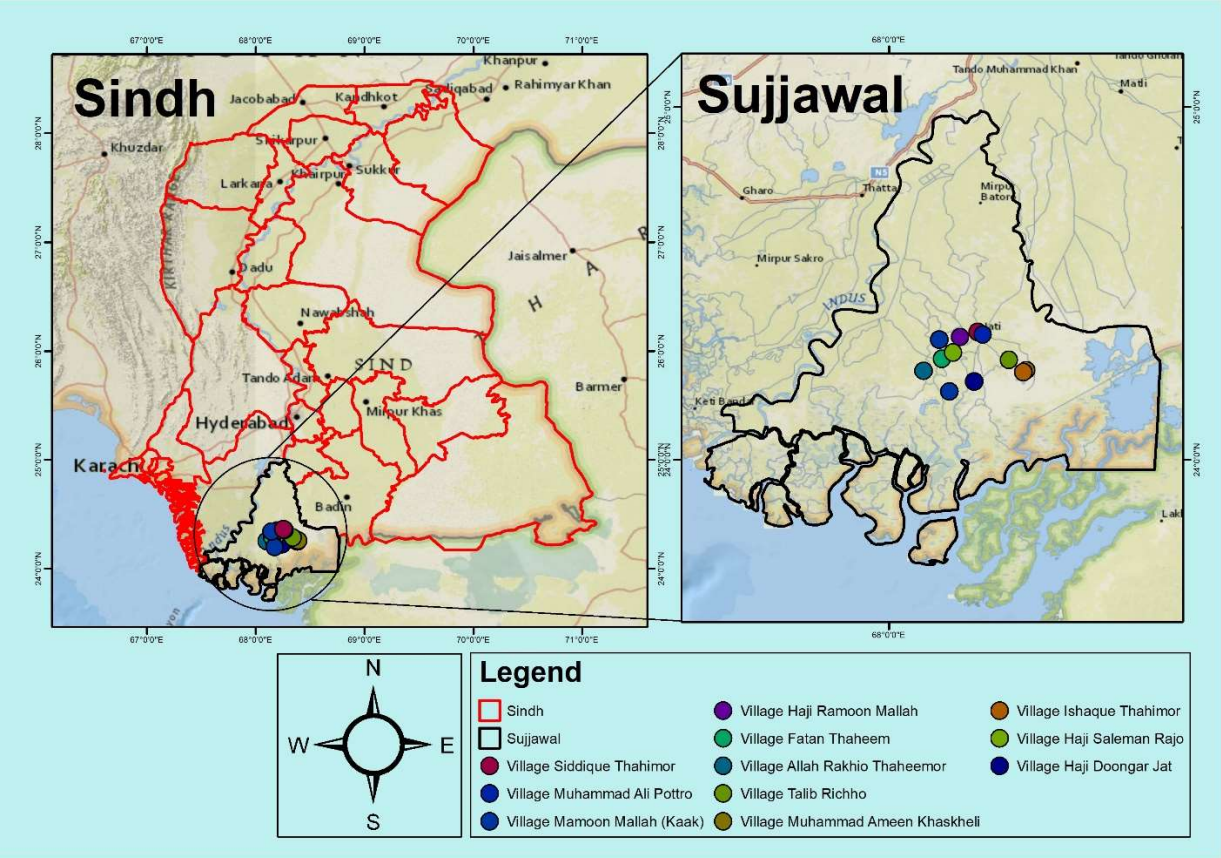
There are differences between the two coasts that are relevant to the vulnerability of the coasts for climate change impacts. Sindh coast is a passive sediment accretion coast of

tidal creeks, mudflats and mangroves, which is subsiding and extremely vulnerable to inundation and salinization. The Balochistan coast is an active tectonically uplifting margin with rocky headlands and pocket beaches with physical erosion and marine-ecosystem change the predominant hazards. These contrasts will serve as the backdrop for the interpretation of each subsequent finding.

3.2 The Indus deltaic belt (Sindh) and Sujawal District

The Sujawal District is in the south-eastern part of Sindh in the active and relict delta of the Indus River. It is part of the deltaic belt, which is a specific focus of the Asian Development Bank (ADB) project on Sindh Coastal Resilience due to land subsidence, flooding, erosion, and saline intrusion, in addition to neighboring Thatta and Badin (Asian Development Bank, 2025). The district's exposed coastal talukas of Jati, Shah Bandar and Kharo Chan are part of a seaward landscape of tidal creeks, with a predictable lunar cycle of tidal activity that brings seawater into the tidal creeks twice each month during spring tides. Map 3.2 shows the district town of Sujawal in the Sindh study area, the coastal deltaic talukas of Jati, Shah Bandar and Kharo Chan, and the creek system surrounding these settlements.

Map 3.2: Sindh study area



The Sindh study site is fixed as Sujawal District, with fieldwork concentrated in its exposed coastal and deltaic talukas of Jati, Shah Bandar and Kharo Chan. These talukas lie on

the active deltaic frontline where salinity intrusion, submergence and freshwater loss are most acute, and they provide the deltaic counterpart to the Makran study site in Gwadar.

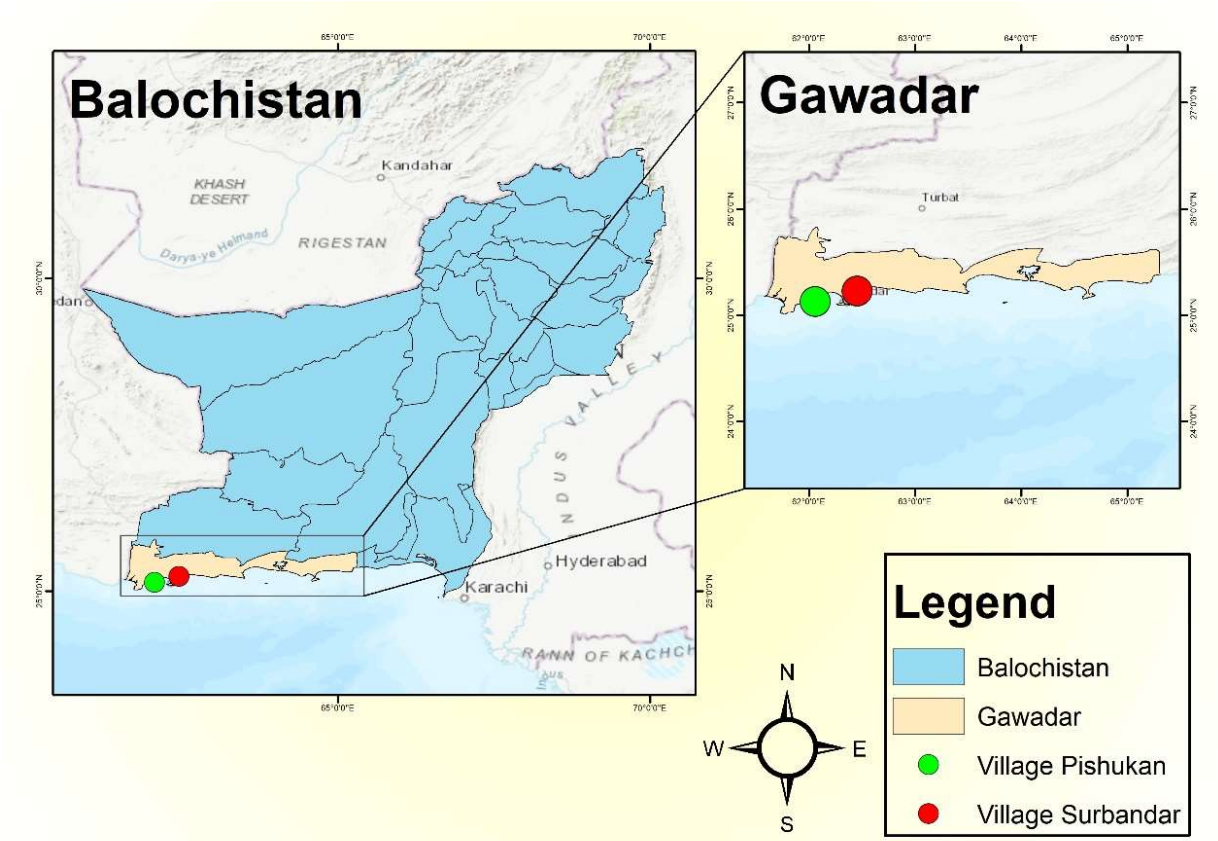
The livelihoods in the study belt of Sindh include agriculture (rice, wheat, fodder and vegetables in areas where water is available), livestock (buffaloes, cows, goats and historically camels) and fisheries in the delta areas. There is a scarcity of land ownership (in one of the villages surveyed, only around one-fifth of households owned land) and the majority rely on livestock and fishing as the primary productive assets, meaning this loss has a high impact at the household level.

The limited and distant provision of basic services in the deltaic belt adds to physical exposure. The responses in the focus groups were largely that children in Jati travel nine to ten kilometres to the nearest school and health services are similarly distant, under resourced and in more remote settlements, absent. The patchy distribution of settlements along creeks and the poor connectivity between settlements further contribute to distance being a determinant of vulnerability, which can slow response times for health care during illness or assistance during disaster. The freshwater infrastructure that the belt relies on, including canals like the Sher Khan, was reported as not functioning as before, while the flood-rehabilitation houses constructed since the floods were deemed incomplete. The survey's finding on adaptive capacity to climate change must be interpreted within this institutional context of the service and infrastructure deficits.

3.3 Gwadar District and the Makran coast (Balochistan)

Gwadar District occupies the central Makran coast of Balochistan. The district town sits on a distinctive hammerhead peninsula and has been transformed over the last two decades by the development of a deep-sea port under the China–Pakistan Economic Corridor. Map 3.3 shows the Balochistan study area: Gwadar city, the nearby fishing settlements of Surbandar and Pishukan, the seasonal Dasht River, and the neighbouring settlements of Jiwani and Pasni.

Map-3.3 Balochistan study area



Gwadar lies within a low-elevation coastal zone in an arid setting prone to drought, groundwater depletion and rising sea levels. The economy is overwhelmingly fisheries-based in some settlements the great majority of households depend directly or indirectly on the sea with livestock (goats, sheep, donkeys and some cattle) kept as secondary, subsistence assets and agriculture largely negligible. The distinctive climate stresses reported here are coastal erosion, which has consumed homes, mosques and land in some wards; marine-ecosystem degradation, in the form of warming water, harmful algal blooms and species decline; shifted storm timing; and the strain that rapid urbanisation places on drainage, sanitation and water supply. A recurring social feature of Gwadar is an educated-but-unemployed youth cohort, which adds a socio-economic and aspirational dimension of vulnerability quite different from the physical exposure that dominates the Sindh site.

The fishing settlements around Gwadar illustrate the district's service and infrastructure gaps. In Surbandar, where the great majority of households depend on the sea, participants reported the absence of round-the-clock maternity services and a basic health facility staffed by a single doctor and lacking diagnostic equipment such as X-ray. In Pishukan, a fishing jetty reported as under construction since 2007 remained incomplete after more than a decade and a half, constraining safe landing and the development of the value chain. Rising school-dropout rates, particularly among girls after the middle level, were reported in Surbandar, connecting the education–employment

mismatch to the earliest stages of schooling. Where piped supply is inadequate, freshwater is bought by tanker at very high cost. In short, although Gwadar enjoys better connectivity and market access than the Sindh deltaic belt, its coastal fishing settlements face acute and specific service deficits of their own.

3.4 Comparative rationale

The paired-district design is central to the study's analytical logic. Comparing a subsiding deltaic district with an uplifting Makran district allows the study to separate hazard drivers common to both coasts (heat, freshwater stress, storm exposure, fisheries decline, health burden) from those specific to each ecology (deltaic submergence and salinity in Sindh; marine-ecosystem collapse and erosion in Balochistan). This distinction, developed in Chapters 6 and 7, is essential for designing adaptation responses appropriate to each setting rather than uniform across a coast that is, in reality, two very different coasts.

Chapter-4
Research Methodology

This chapter sets out the study's methodology in full: the research design, sampling frame and design, sample size and its justification, the definition and measurement of the four lead indicators, respondent selection and the inclusion of vulnerable groups, data-collection instruments, analytical procedures, ethical considerations and the limitations of the approach.

4.1 Description of the proposed methodology

The study followed a mixed-methods approach, combining quantitative and qualitative techniques to assess the climate vulnerability of coastal communities across agriculture, fisheries, livestock and related livelihood systems. The design was intended to produce both measurable evidence and grounded contextual understanding of climate risks, impacts, coping practices and adaptation options. Throughout, particular attention was paid to the differentiated experiences of women, elderly persons, children and adolescents, persons with disabilities, and other people with special needs. The quantitative component measured the prevalence and distribution of exposure, sensitivity, adaptive capacity, resilience and recent losses; the qualitative component explained the mechanisms behind these patterns and identified locally feasible adaptation pathways.

4.2 Design of the study

The design was cross-sectional, descriptive and exploratory. Data were collected at a single point in time (May–June 2026), while the major climate-related hazards and damages of the preceding ten years were documented through retrospective recall. Two complementary streams were combined:

- Quantitative (household surveys), to measure exposure, sensitivity, adaptive capacity, resilience and recent climate-related losses across agriculture-, fisheries- and livestock-dependent households.
- Qualitative (focus group discussions and key informant interviews), to generate in-depth insight into local perceptions, community coping strategies, institutional constraints and feasible adaptation pathways, and to triangulate the survey findings.

4.3 Sample universe

The sample universe comprised coastal communities in two selected districts of Pakistan one each from Sindh and Balochistan that have experienced significant sea-level rise, salinity intrusion, coastal flooding, erosion and livelihood disruption over the last decade. Consistent with the preference for fewer districts and deeper engagement, the study concentrated on two districts to allow more intensive fieldwork and stronger comparative analysis:

- Sindh Province: Sujawal District, including its highly exposed coastal and deltaic talukas of Jati, Shah Bandar and Kharo Chan.
- **Balochistan Province:** Gwadar District, including highly exposed coastal settlements along the Makran belt.

4.4 Sampling design: multistage cluster sampling

A three-stage cluster design was used, pairing purposive selection of high-exposure primary units with probability-based selection at village and household level.

Stage-1: Selection of Taluka/Tehsils (PSUs).

A high hazard exposure coastal taluka/tehsil was chosen within each district in consultation with the local stakeholders based on the three criteria of hazard exposure, livelihood dependence, accessibility and security. This resulted in representation across the provinces and deeper analysis on a smaller number of high risk locations.

Stage-2: The villages (secondary sampling units) were selected.

Eight villages were selected from each taluka/tehsil, with preference being given to villages close to the coast or affected by salinity and flooding, as well as affected by erosion and livelihood stress, with a preference for a diversity of livelihoods. This resulted in sixteen villages altogether (8 villages x 2 talukas).

Stage-3: Selection of households (final sampling units)

Twenty-five households were selected in an average village within the selected villages. Allocation was proportional to village size and settlement pattern; households were taken by systematic random sampling from a prepared list of village households with samples taken every kth household.

Table-4.1: Summary of the multistage cluster sampling design.

Stage 1	Sampling unit 1	Method	Resulting sample
1	Taluka/Tehsil (PSU)	Purposive selection from 2 coastal districts	1 taluka per district × 2 districts
2	Village (SSU)	PPS, prioritising hazard-prone coastal villages	8 villages per taluka × 2 = 16 villages
3	Household (FSU)	Systematic random sampling, proportional to village size	25 households per village × 16 = 400 households

4.5 Sample size and its justification

The planned sample was 400 households (25 households × 16 villages), supplemented by roughly 8–10 FGDs and 20–24 KIIs across the two districts to strengthen triangulation. Under the standard assumptions of a 95 per cent confidence level and a 5 per cent margin of error, a minimum sample of close to 384 households is generally sufficient for household-level analysis; the sample was rounded to 400 for operational convenience and stronger subgroup analysis. In the event, 402 households were retained for analysis after data cleaning (six of the 408 surveyed households were excluded because they lacked essential district or respondent identification), closely matching the plan. The sample is adequate for descriptive and comparative analysis across the two districts and for examining key patterns in vulnerability, losses and adaptive capacity. The qualitative tools further strengthen the study's explanatory power through triangulation and permit comparison across provinces, livelihoods, gender and vulnerability categories.

4.6 Selection of respondents and inclusion of vulnerable groups

A gender-sensitive and intersectional approach guided respondent selection. In each sampled household, the preferred respondent was an adult member with strong knowledge of household livelihoods, climate hazards, losses and coping practices. Where relevant, women farmers, fisherwomen, livestock managers, female-headed households, elderly persons and persons with disabilities or special needs were purposively included. Child- and adolescent-related vulnerabilities were captured through adult caregivers, teachers, health workers and other key informants, in line with ethical safeguards. The household survey set a target of at least 40 per cent women respondents, and field teams maintained inclusion targets and documentation for elderly persons, persons with disabilities, low-income households and other at-risk groups, so that intersectional vulnerabilities were properly reflected. In the achieved sample, women made up 47.0 per cent of respondents and female-headed households 20.9 per cent.

4.7 Measurement of lead indicators

Vulnerability was assessed through four core indicators, supported by a retrospective hazard and damage profile covering approximately the last ten years.

Table-4.2: The four lead indicators and their measurement.

Indicator	Definition used in this study	Illustrative measures
Exposure	The extent to which a household or community is exposed to climate hazards.	Reported experience of flooding, salinity intrusion, sea-level rise/sea encroachment, erosion, cyclone, drought and heat over 10 years.
Sensitivity	The degree to which livelihoods and wellbeing depend on, and are affected	Income, asset, food, water and health impacts of hazards; dependence on natural resources.

	by, climate-sensitive resources.	
Adaptive capacity	The ability to anticipate, respond to and recover from climate risks.	Access to savings, credit, insurance, information, connectivity, extension, and institutional/social support.
Resilience and hazard trend	Documented coping, recovery and adaptation, and the profile of major losses and changing hazards.	Coping strategies; recovery time; confidence in future recovery; 10-year loss and hazard profile.

These indicators were measured through structured survey questions and qualitative discussion guides, and triangulated with secondary data. Higher exposure and sensitivity combined with lower adaptive capacity indicate higher vulnerability.

Table 4.3 sets out the detailed operationalization of each indicator into measurable sub-components and data sources the analytical bridge between the abstract framework and the survey and qualitative instruments.

Table-4.3: Operationalization of the vulnerability indicators into measurable components and data sources.

Component	Sub-component / variable	Data source	Measurement approach
Exposure	Hazard incidence (9 hazard types, 10 yr)	Household survey (Section 7)	Binary reported experience, aggregated to district rate
Exposure	Acute-event experience (flood/cyclone/erosion)	Household survey; FGD	Reported direct experience; place-based FGD mapping
Sensitivity	Livelihood dependence on climate-sensitive resources	Survey (Sections 4–6); KII	Sector engagement; qualitative dependence narratives
Sensitivity	Income, asset, food, water, health impacts (12 mo)	Survey (Sections 8–10)	Reported impact rates by district
Adaptive capacity	Financial access (credit, insurance, savings)	Survey (Section 11)	Reported access rates by district
Adaptive capacity	Services and connectivity (extension, internet)	Survey (Section 11); KII	Reported access; institutional-presence narratives
Adaptive capacity	Relief received (government, NGO)	Survey (Section 11); FGD	Reported receipt; qualitative relief-cycle analysis

Resilience	Coping strategies and severity	Survey (Section 12); FGD	Reported coping hierarchy; qualitative limits
Resilience	Recovery time and future confidence	Survey (Section 12)	Reported recovery within/beyond one month
Cross-cutting	Gender roles, mobility, exclusion	Survey (Section 14); FGD	Reported roles; self-perceived exclusion; women's FGD
Cross-cutting	Awareness, willingness, priorities	Survey (Section 13)	Reported awareness/willingness; ranked priority needs

The mixed-methods design ensures that each indicator is measured both extensively, through the survey, which permits district comparison and quantification, and intensively, through the interviews and discussions, which explain the mechanisms and meanings behind the numbers. This dual measurement is the methodological foundation of the triangulation presented in Chapter 6.

4.8 Data collection

4.8.1 Quantitative data collection

Structured, face-to-face household surveys collected quantitative data on demographics, livelihoods, climate hazards, losses and damages, exposure, sensitivity, adaptive capacity and resilience, together with dedicated modules on climate-related health hazards and on gender and social inclusion.

4.8.2 Qualitative data collection

Focus group discussions were held with community members from different livelihood and social groups women, men, fishers, farmers, livestock keepers, youth, elderly persons and other vulnerable categories. Each community FGD had roughly 8–12 participants, ran for about 90 minutes and was facilitated by trained moderators using participatory tools; district-level stakeholder consultations added institutional perspectives. Key informant interviews were conducted with local government officials, line departments, climate-adaptation practitioners, community leaders, service providers and representatives of civil-society and humanitarian organisations, using semi-structured guides that allowed flexibility, triangulation and context-specific probing.

In the event, fourteen KIIs and six FGDs were completed and analysed for this report. The KII set is weighted towards community and fisheries informants; the main gaps, noted transparently, are formal line-department officials (agriculture extension, fisheries, livestock/veterinary, irrigation, disaster management), health and education officers, and additional women informants. These gaps are addressed openly in the limitations (Section 4.11) and in Chapter 6.

4.9 Data analysis

Quantitative analysis was conducted in SPSS (or an equivalent statistical package), producing descriptive statistics, cross-tabulations, index construction and, where appropriate, regression-based exploration of the drivers of vulnerability, losses and adaptive capacity. Findings are presented descriptively and disaggregated by district where this reveals meaningful differences. A descriptive composite vulnerability index was constructed for comparison between the two districts only; it is unweighted and illustrative, not a validated scientific instrument, and is interpreted with appropriate caution. Qualitative analysis followed a thematic approach: FGD and KII data were coded against the four lead indicators and the three target sectors, and recurring patterns were identified relating to climate perceptions, differentiated vulnerability, coping strategies, institutional gaps and practical adaptation options.

4.10 Risk-hazard mapping

Using GIS, participatory mapping and spatial analysis, risk-hazard maps were developed to visualise the distribution and intensity of the major climate hazards across the selected districts, including the areas most vulnerable to flooding, salinity intrusion, coastal erosion and sea-level rise, as well as livelihood hotspots, service gaps, damaged assets and the settlements most affected. The maps draw on secondary spatial and hazard data and were validated, where possible, against primary survey findings, community inputs and key-informant insights. Specific, verifiable data points from the qualitative fieldwork for instance, the named submerged dehs in Sujawal and the land loss recorded in Kangani Ward were used to ground the mapping.

4.11 Ethical considerations and limitations

Informed consent was obtained from all participants; child- and adolescent-related vulnerabilities were approached only through appropriate adult key informants; and no identifying personal data are reproduced in this report. The study is subject to the following limitations, stated so that the evidence can be weighed appropriately:

- Descriptive analysis. Survey findings are descriptive (frequencies, percentages, cross-tabulations); they have not been probability-weighted or subjected to inferential testing, and the composite vulnerability index is illustrative and district-comparative only.
- Recall. The ten-year retrospective profile relies on respondent recall, which is subject to telescoping and recall bias in the timing and magnitude of past events.
- Data-quality corrections. Household-head age was corrected for 129 records in which the birth year appears to have been recorded instead of age; a small number of extreme household-size values were excluded; and a livelihood-classification inconsistency in Gwadar (roughly 59 records) led the analysis to rely on the direct sector-involvement questions rather than the single-choice main-livelihood question. These corrections are documented for transparency.

- Qualitative coverage. The KII set is community- and fisheries-weighted and falls short of the 20–24 target, with line-department, health, education and additional women informants under-represented. Some proforma cells were marked ‘not specifically discussed’, so the absence of a theme from an interview is not evidence of its absence from the village. Separate women-only FGDs were not held, which limits full gender disaggregation of the qualitative record.

None of these limitations materially undermines the central, highly consistent findings, which are corroborated across three independent instruments and against the external literature. They do, however, indicate priorities for follow-up fieldwork, set out in Chapter 9.

Chapter-5
Quantitative Findings: Household Survey

This chapter presents the findings of the household survey of 402 analysed households across the coastal talukas of Sujawal District (Sindh) and Gwadar District (Balochistan). Results are reported descriptively, disaggregated by district where the difference is meaningful, and organised around the four lead indicators and the three target sectors. All figures refer to valid (non-missing) responses for each item. The chapter closes with a summary of the key quantitative findings; the qualitative evidence that explains them follows in Chapter 6.

5.1 Profile of the household sample

The survey achieved an almost even split between the districts: 203 households (50.5%) in Sujawal and 199 (49.5%) in Gwadar, drawn from the sixteen sampled villages and closely matching the planned sample of 400.

Table-5.1: Demographic characteristics of the household sample (Sections 0–1).

Indicator	Value
Total households analysed	402
Female respondents	189 (47.0%)
Male respondents	210 (52.2%)
Female-headed households	84 (20.9%)
Households with a member with disability or chronic illness	50 (12.4%)
Mean age of household head	45.0 years
Mean household size	5.8 persons

One structurally important difference appears at once: female-headed households were far more common in Gwadar (36.3%) than in Sujawal (6.9%). This has direct implications for how adaptation support should be targeted and delivered in the two districts, and it interacts with the gender findings in Section 5.9. On socio-economic status, poverty is widespread and broadly similar across both districts 53.0 percent of households reported a monthly income below PKR 20,000 and a further 19.4 percent reported PKR 20,000–40,000. Housing is mostly semi-pucca or kacha, and safe drinking water is a cross-cutting constraint: 33.1 percent of households said their drinking water was moderately or severely affected by salinity, with hand pumps, canals or ponds and other unimproved sources supplying the majority.

5.2 Livelihood profile

Fisheries is the single largest reported primary livelihood (141 households, 35.1%), followed by agriculture (114, 28.4%), livestock (42, 10.4%) and wage labour (33, 8.2%); the remainder report small business, employment, remittances or mixed livelihoods. Sectoral engagement any involvement, not necessarily as the primary livelihood was

reported by 84 households (20.9%) for fisheries, 69 (17.2%) for livestock and poultry, and 67 (16.7%) for crop farming. Livelihood diversification is further advanced in Gwadar, where households reported higher engagement in agriculture as a secondary activity alongside fisheries, whereas Sujawal households remain more concentrated in agriculture and livestock.

One indicator of climate-driven disruption stands out because it is direct and individually attributable: nearly three in ten households (29.1%) reported having changed their main livelihood during the last ten years specifically because of climate or environmental problems, most often citing salinity, flood or cyclone damage, and crop or fish-catch decline as the trigger. This is a reported behavioural change, not a perception measure, and it establishes at the outset that climate pressure is already reshaping the coastal economy household by household.

5.3 Exposure to climate hazards

Households were asked whether they or their village had experienced each of nine climate-related hazards during the last ten years. Exposure was substantial and broad-based across the whole sample, but the district-level pattern is the single clearest and most policy-relevant result of the survey.

Table-5.2: Overall hazard exposure over the last 10 years (Section 7, n = 402).

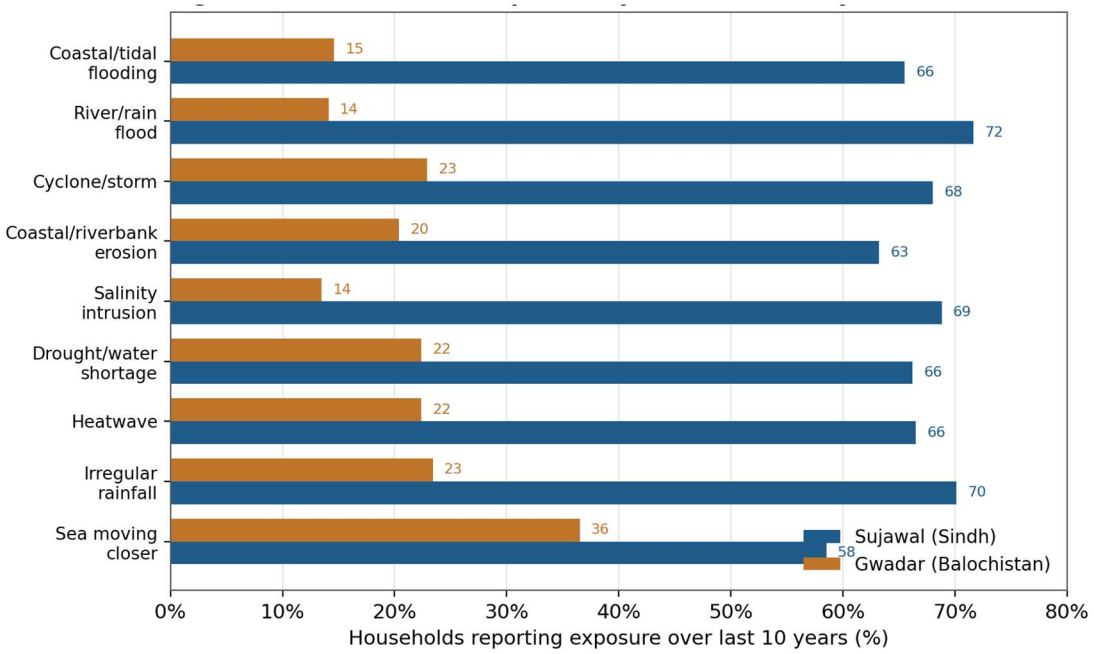
Hazard type	% of all households
Sea moving closer to village/land	46.5%
Irregular rainfall / late rains	46.3%
Cyclone, storm or strong winds	44.8%
Drought / water shortage	43.8%
Extreme heat / heatwave	43.8%
River / heavy-rain flood	42.5%
Coastal / riverbank erosion	41.3%
Salinity intrusion (land or water)	40.5%
Coastal / tidal flooding	39.6%

Disaggregation by district shows hazard exposure heavily concentrated in Sujawal. For every hazard type, Sujawal households reported exposure at roughly three to five times the Gwadar rate (Table 5.3; Figure 1).

Table-5.3: Hazard exposure by district (Section 7, Q7.1–Q7.9, n = 402).

Hazard type	Gwadar (Balochistan)	Sujawal** (Sindh)**
Coastal / tidal flooding	14.6%	65.5%
River / rain flood	14.1%	71.6%
Cyclone / storm / strong winds	22.9%	68.0%
Coastal / riverbank erosion	20.4%	63.2%
Salinity intrusion	13.5%	68.8%
Drought / water shortage	22.4%	66.2%
Heatwave	22.4%	66.5%
Irregular rainfall	23.4%	70.1%
Sea moving closer	36.5%	58.5%

Figure-1: Climate hazard exposure by district (% of households reporting exposure over the last 10 years).



This pattern is fully consistent with the geomorphology reviewed in Chapters 2 and 3. The low-lying, subsiding Indus delta around Sujawal and Jati is directly exposed to tidal action, riverine flooding and active salinity intrusion; the rockier, more elevated and tectonically uplifting Makran coast around Gwadar experiences real but markedly lower relative exposure. The finding also corroborates the scientific literature on accelerating sea-level rise and salinity encroachment in the delta. Beyond incidence, most households across the sample reported that climate shocks now recur rather than arrive as one-off events, and a majority rated overall hazard severity for their household ‘high’ or ‘very high’ — again concentrated in Sujawal. A meaningful minority reported having been temporarily

displaced at least once by flood, cyclone or erosion, a direct measure of acute exposure severity relevant to contingency and early-warning planning.

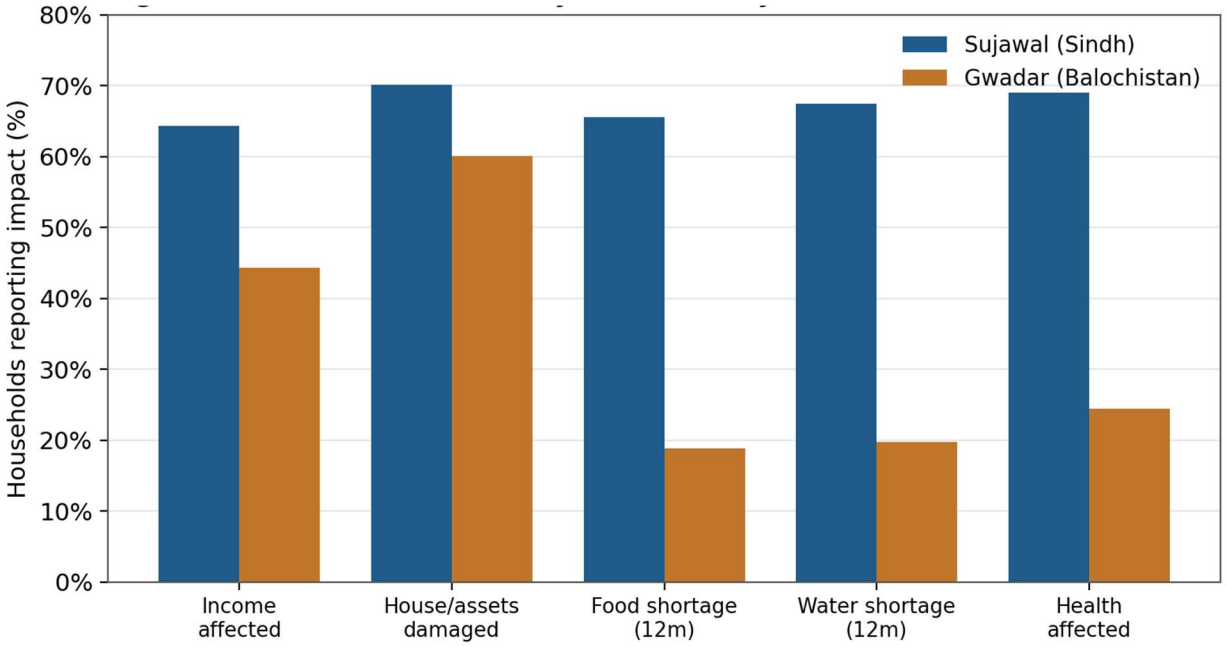
5.4 Household sensitivity to climate impacts

Sensitivity the degree to which household wellbeing and livelihoods are affected once hazards occur follows the same district pattern as exposure, though the gap is narrower, showing that even Gwadar households feel meaningful impact when a hazard strikes (Table 5.4; Figure 8).

Table-5.4: Household sensitivity indicators by district (Section 8, n = 402).

Sensitivity indicator	Gwadar	Sujawal
Household income affected by climate hazards (10y)	44.3%	64.3%
House/assets damaged by climate hazards	60.1%	70.1%
Food shortage in last 12 months	18.8%	65.5%
Drinking-water shortage in last 12 months	19.7%	67.5%
Household health affected by climate hazards	24.4%	69.0%

Figure-8: Household sensitivity indicators by district (% of households reporting impact).



Food and water insecurity form the sharpest sensitivity gap between the districts. Roughly two-thirds of Sujawal households reported a food shortage (65.5%) and a drinking-water shortage (67.5%) in just the past twelve months, against under one-fifth of Gwadar households. Taken with the high reported dependence of households on natural resources land, water, sea, fish, grazing and livestock this means Sujawal households face not only more frequent hazards but a thinner margin for absorbing their

consequences. Asset damage, by contrast, is high in both districts (60.1% in Gwadar; 70.1% in Sujawal), reflecting the shared exposure of housing and productive assets to storms and flooding.

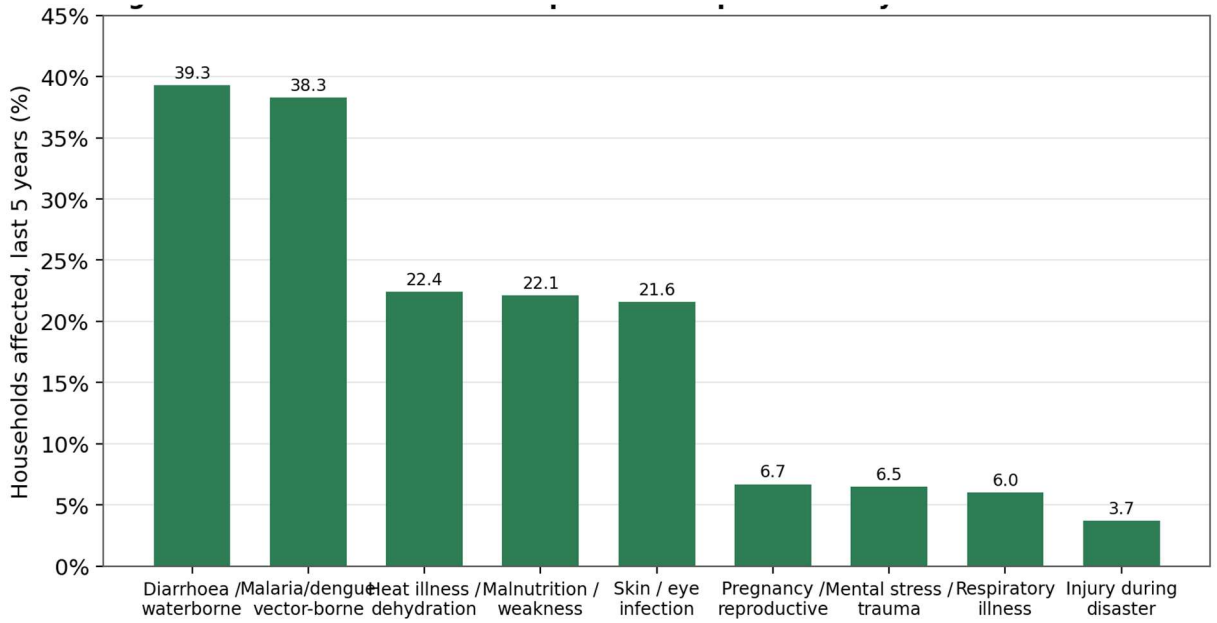
5.5 Climate-related health hazards

A dedicated module covered health problems linked to climate or environmental hazards over the last five years. Half of all households (50.2%) reported that at least one member had faced such a problem, with 21.6 per cent unsure and 26.4 per cent reporting none. As with exposure and sensitivity, the burden concentrates in Sujawal (63.9% of households) relative to Gwadar (37.8%). Waterborne and vector-borne illness dominate (Table 5.5; Figure 2).

Table-5.5: Climate-related health problems experienced by households (Q8.15, multiple responses, n = 402).

Health hazard type	% of all households (last 5 years)
Diarrhoea or waterborne disease	39.3%
Malaria, dengue or other vector-borne disease	38.3%
Heat illness / heatstroke / dehydration	22.4%
Malnutrition or weakness due to food shortage	22.1%
Skin infection or eye irritation	21.6%
Pregnancy or reproductive-health problems worsened during disaster	6.7%
Mental stress, anxiety or trauma after a climate shock	6.5%
Respiratory illness	6.0%
Injury during flood, cyclone, storm, erosion or displacement	3.7%

Figure-2: Climate-related health problems experienced by households, last 5 years (% of households).



Waterborne and vector-borne disease together affect close to two in five households, tying water insecurity and post-flood standing water directly to health outcomes; malnutrition (22.1%) mirrors the food-insecurity findings, confirming that food and health vulnerability move together. Children carry a disproportionate share of the burden. Children under five (33.6% of households) and school-age children (30.6%) were the two most frequently cited affected groups, ahead of women in general (31.8%), pregnant or lactating women (17.7%), the elderly (16.4%) and persons with disabilities (12.7%).

Access to treatment is a major constraint. Among households reporting a climate-related health problem, only 3.9 per cent reported ‘no difficulty’ obtaining treatment; 36.1 per cent reported ‘some’ difficulty, 54.9 per cent ‘major’ difficulty, and a further 2.5 per cent could not obtain treatment at all. The barriers are structural — and addressable (Table 5.6).

Table-5.6: Barriers to treatment among affected households (Q8.19).

Main barrier to treatment	Households citing this barrier
Health facility too far	148
Treatment too costly	74
Medicines not available	52
No transport available	39
Female members could not travel easily	14
Lack of CNIC / documentation	7

Asked what health support is most urgently needed, households most often cited a mobile health camp (37.6%), followed by safe drinking water (29.1%) and mosquito control

(11.9%). This reinforces the survey's dominant priority (safe drinking water, Section 5.10) and indicates that basic, accessible primary healthcare — rather than specialised, facility-based services — is the most immediately actionable health intervention.

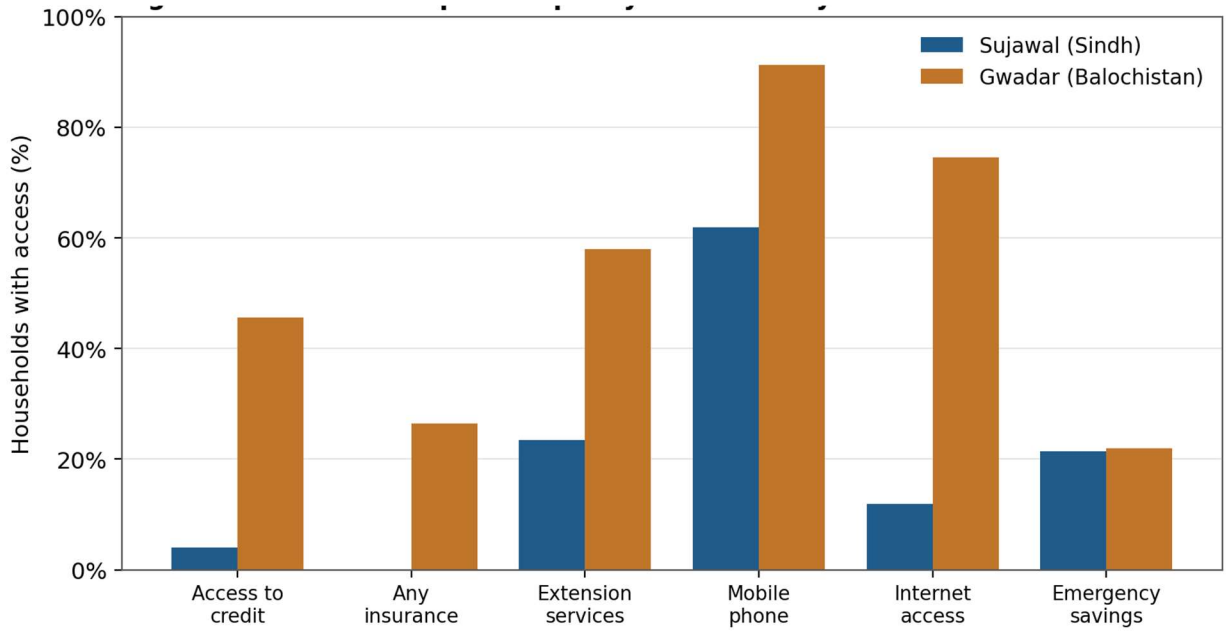
5.6 Adaptive capacity

The adaptive-capacity indicators reveal a striking and in some respects counter-intuitive pattern: Gwadar households generally report better access to information, connectivity, credit and institutional support than Sujawal households, despite facing substantially lower hazard exposure (Table 5.7; Figure 6).

Table-5.7: Adaptive-capacity indicators by district (Section 9, n = 402).

Adaptive-capacity indicator	Gwadar	Sujawal
Has emergency savings (any)	21.9%	21.4%
Can access credit/loan when needed	45.6%	4.0%
Has any type of insurance	26.4%	0.0%
Received government support after a climate shock (10y)	7.3%	21.6%
Received NGO/civil-society support after a shock (10y)	9.3%	21.4%
Has access to agriculture/fisheries/livestock extension	58.0%	23.4%
Has a mobile phone (any type)	91.2%	61.9%
Has internet access (any)	74.6%	11.9%

Figure-6: Selected adaptive-capacity indicators by district (% of households with access).



Sujawal households are markedly more excluded from credit and insurance, less connected and further from extension services yet they report receiving post-shock

government and NGO support at roughly two to three times the Gwadar rate, consistent with their higher hazard frequency triggering more relief responses. It is a pattern that might be recognized as a community that is repeatedly visiting emergency response, but seldom experiencing long-term wins from anticipatory investment in adaptation. It is one of the most policy relevant findings of the study, as it suggests that relief alone does not increase resilience, only the strengthening of the adaptive capacity of an asset base.

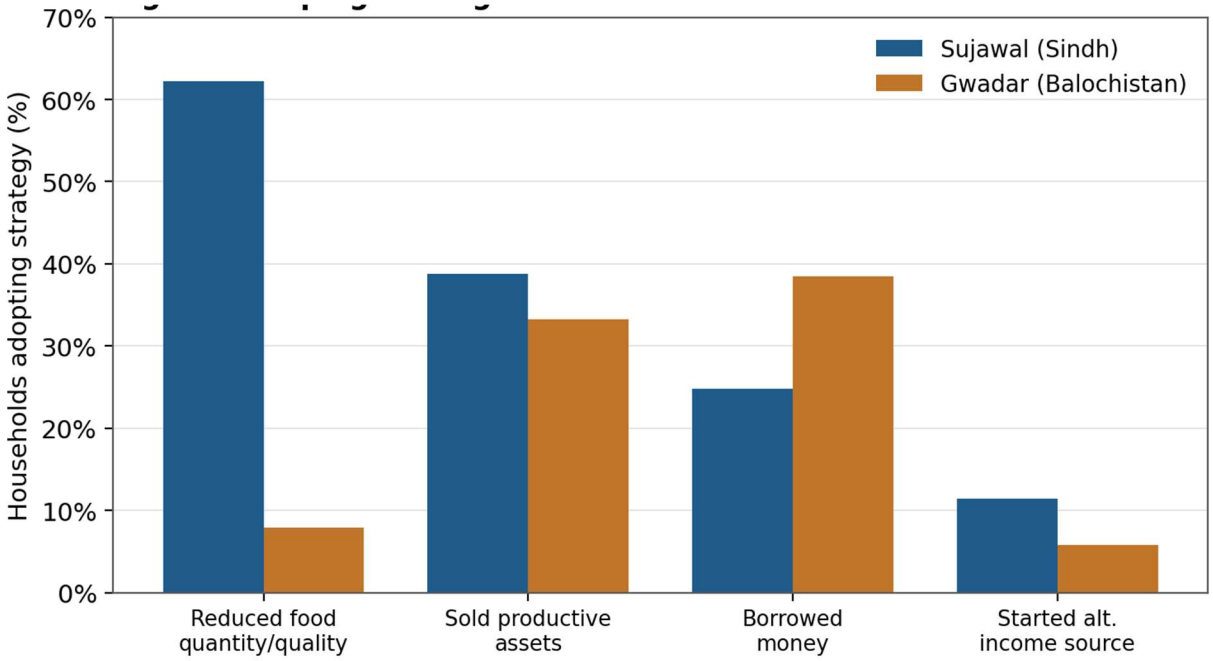
5.7 Resilience and coping strategies

Two in five households overall (40.5%) reported a major climate or livelihood shock in the last five years, rising to 60.9 per cent in Sujawal against 20.9 per cent in Gwadar. How households coped with their most serious recent shock shows a heavier reliance on negative, asset-depleting strategies in Sujawal (Table 5.8; Figure 7).

Table-5.8: Coping strategies after the most serious recent shock, by district (Section 10).

Coping indicator	Gwadar	Sujawal
Reduced food quantity/quality to cope	7.9%	62.2%
Sold productive assets (livestock, jewellery, gear)	33.3%	38.8%
Borrowed money after the shock	38.5%	24.8%
Started/expanded an alternative income source	5.8%	11.4%

Figure-7: Coping strategies after the most serious recent shock, by district.



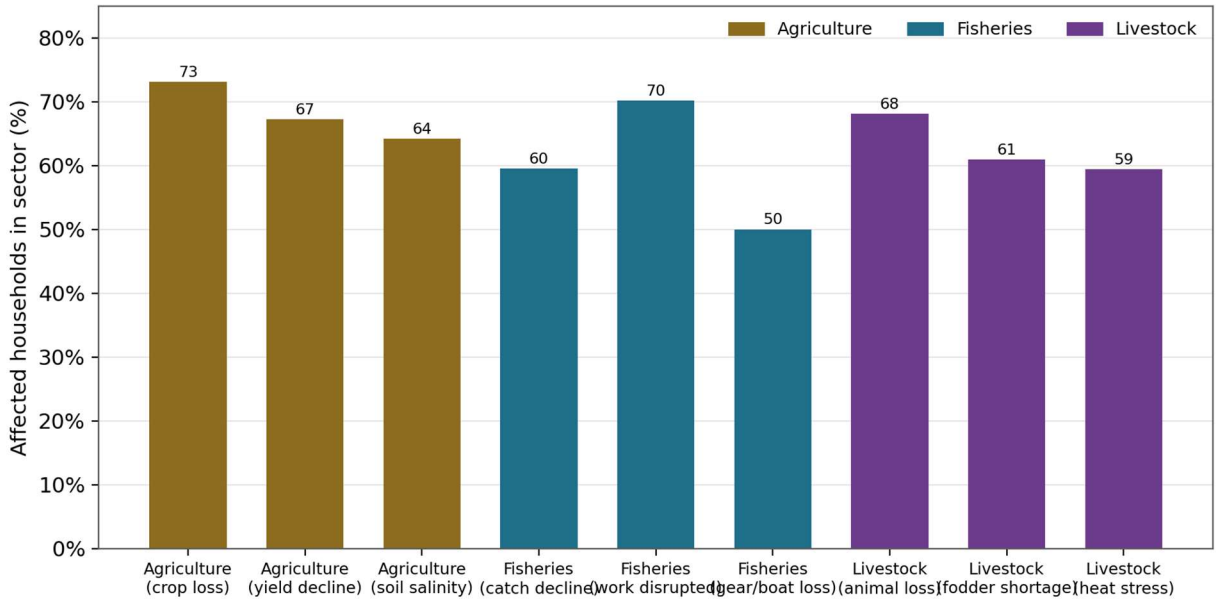
The reliance on reduced food intake as a coping strategy in Sujawal (62.2%, against 7.9% in Gwadar) is especially concerning, because it links coping behaviour directly to the malnutrition and child-health burden documented in Section 5.5. Recovery time also

differs sharply: 41.0% of Gwadar households recovered from their worst recent shock in under a month, against only 8.3% of Sujawal households, while 16.5% of Sujawal households took more than six months (against 5.1% in Gwadar). Reflecting this, confidence in the ability to recover from a future shock is low across the sample and lower still in Sujawal, where no household rated its confidence 'high' and 43.3% rated it 'low'.

5.8 Sector-specific vulnerability

All three livelihood sectors show high climate sensitivity, with roughly two-thirds to three-quarters of engaged households reporting direct, climate-related losses over the last decade (Figure 5).

Figure-5: Sector-specific climate-related losses over the last 10 years (% of engaged households).



5.8.1 Agriculture (n = 67 farming households)

Table-5.9: Agriculture-sector vulnerability indicators.

Indicator	% of farming households
Farmland affected by moderate or severe soil salinity	64.2%
Experienced crop loss due to climate hazards (10y)	73.1%
Crop yield slightly or greatly decreased vs 10 years ago	67.2%

Soil and irrigation-water salinity is the dominant constraint reported by farming households, consistent with the secondary literature on Sindh's coastal soils. Fresh irrigation water was overwhelmingly the most frequently cited urgent support need, followed by drainage and salt-tolerant seed.

5.8.1.1 Crop-specific damage and soil-salinity analysis

From generic loss to crop-specific damage. The aggregate survey figures for the farming sub-sample (crop loss 73.1%, yield decline 67.2%, soil salinity 64.2%) capture the scale of the problem but not its texture. The qualitative fieldwork in the Sujawal deltaic focus groups shows that different crops are damaged through different pathways, and that salinity operates alongside freshwater-irrigation shortage, flooding and shifting pest cycles.

Table 5.9a. Crop-specific climate stresses in the Sujawal deltaic zone (source: Sujawal focus group discussions).

Crop	Principal stress pathway	Reported effect in the Sujawal deltaic zone
Rice (paddy)	Soil salinity; unreliable/costly freshwater irrigation; flood and cyclone; new pest cycles	The most exposed field crop; productivity directly cut by salinity and standing crops destroyed by flooding
Wheat	Soil salinity; saline and costly irrigation water	Yields decline as the salt front advances and canal water becomes saline and unreliable
Cotton	Soil salinity	Productivity reduced on increasingly salt-affected land
Vegetables	Salinity; freshwater shortage; flooding; pest and disease	Kitchen-garden and market vegetables hit on several fronts at once
Fodder / clover (berseem)	Fodder-crop failure from salinity and water stress	A dual agriculture-livestock stressor: feed insecurity that transmits directly into livestock loss

Crop-level adaptation is under way but under-resourced. Farmers report a small, consistent set of local adaptations: shifting sowing dates to track changing rainfall and temperature; adopting salt-tolerant rice varieties where available (Guard Lp18, Guard Lp 11, Guard Lp 28); community promotion of bio-saline species (locally named Khabar, Khumbat, Lanoo and Jar) for degraded coastal land; kitchen gardening on small plots; and storing fodder in good seasons. Participants were emphatic that these measures are incremental and insufficient against the scale of salinity and water stress, and that distribution of salt-tolerant seed at scale, bio-saline agriculture and improved freshwater supply are their priority needs.

Towards salinity mapping. A formal, georeferenced soil-salinity map would require systematic soil electrical-conductivity sampling across the coastal talukas; this was

beyond the scope of the household survey and is identified as a priority for follow-up research (Section 9.10). In the interim, the reviewed literature indicates that 70-80% of Sindh's coastal soils are salt-affected, and the deltaic fieldwork identifies salinity as the dominant, worsening constraint, driven by twice-monthly spring-tide intrusion and reduced canal flow. Table 5.9b sets out the salinity-sensitivity of the main crops as an agronomic planning guide to prioritise varietal and drainage interventions.

Table 5.9b. Crop salinity-sensitivity guide (agronomic reference for interpreting the deltaic salinity data; not site-specific soil measurement).

Crop	Salinity sensitivity (agronomic guide)	Adaptation direction
Rice (paddy)	Sensitive	Salt-tolerant varieties; assured freshwater flushing; drainage
Wheat	Moderately tolerant	Improved varieties; timing; managed irrigation
Cotton	Moderately tolerant	Viable transitional crop on moderately saline land
Vegetables	Sensitive (most)	Raised beds; protected kitchen gardens; freshwater
Fodder / berseem	Moderately sensitive	Salt-tolerant fodder; bio-saline species

5.8.2 Fisheries (n = 84 fishing households)

Table-5.10: Fisheries-sector vulnerability indicators.

Indicator	% of fishing households
Fish catch slightly or greatly decreased vs 10 years ago	59.5%
Fishing work stopped/disrupted by storms in last 12 months	70.2%
Lost fishing gear or boat to climate hazards (10y)	50.0%

Boat and gear support was the most frequently cited urgent fisheries need, followed by market access and weather and early-warning information a pattern that reflects both the physical asset losses fishing households suffer and the chronic market disadvantages (middleman control, absent cold storage) documented qualitatively in Chapter 6.

5.8.2.1 Species-level decline, seasonal contraction and the value chain

Named species, not just a catch percentage. The survey figures for the fishing sub-sample (catch decline 59.5%, fishing work disrupted 70.2%, gear or boat loss 50.0%) are given depth by the qualitative record, which names the species in decline and identifies the mechanisms behind the numbers.

Table 5.10a. Fish species reported in decline, by coast (source: focus group discussions and key informant interviews).

Coast	Fish species named in decline (local / English)	Reported status and attributed cause
Indus delta (Sujawal)	Dhagri, Danth, Pharr, Mungro, Paplet (pomfret)	Named by delta focus group participants as severely declined or locally lost; linked to habitat and freshwater-flow change and gear pressure
Makran (Gwadar)	Gwanz (Indian threadfin), Palwar (Indian shad), Sarmai	Named in collapse; attributed to sea warming, coral and mangrove loss, and trawling

A shortening, more dangerous season. Gwadar fishers report the productive fishing window shortening from four to six months down to three to four months (roughly October to January or March), with June to August now largely unsafe because of high tides and storms - a change that is raising boat losses and crew deaths. In the delta, seasonal patterns are disrupted by irregular floods and delta change. The contraction of safe fishing days compounds the decline in catch per trip.

Structural pressures magnify the climate signal. Beyond climate, fishers consistently identify human-driven pressures: illegal deep-sea trawling operating in near-shore artisanal zones and oil pollution (“deep sea trolling also significantly decreasing the fish catch”; “oil trollers are also poisoning the sea environment” - Pishukan), and noise pollution from motorised boats. The income structure compounds the loss: under the Nakhuda-middleman-labour (khalasi) system, with widespread debt bondage through advance payments, crews retain a small and shrinking share of catch value. A large share of delta fishers are landless crew - more than half the households in some villages - with no asset cushion, the classic high-sensitivity, low-adaptive-capacity profile.

5.8.3 Livestock (n = 69 livestock-keeping households)

Table-5.11: Livestock-sector vulnerability indicators.

Indicator	% of livestock-keeping households
Faced fodder shortage in last 12 months	60.9%
Animals suffered heat stress in last 12 months	59.4%
Lost animals to flood/drought/disease/heat/water shortage (10y)	68.1%

Fodder and fresh water for animals were the two most frequently cited urgent livestock needs, followed by veterinary services and vaccination. Basic husbandry inputs, rather than breed improvement or insurance, remain the binding constraint for most livestock-keeping households.

5.8.3.1 Animal-health, fodder and water stresses

Behind the livestock headline numbers. The aggregate livestock figures (animal loss 68.1%, fodder shortage 60.9%, heat stress 59.4%) reflect a convergence of pressures documented in the fieldwork, in which climate hazards and the loss of freshwater act together on a livelihood that is the household's principal safety net.

Table 5.11a. Livestock stresses and their drivers (source: household survey, focus group discussions and key informant interviews).

Stress	Driver	Reported effect
Rising animal disease	Heat and tidal/saline intrusion; disease incidence up markedly over the last 5-8 years	Higher morbidity; small calves dying
Fodder shortage	Fodder-crop failure from salinity and water stress	Feed insecurity; distress sales; shrinking herds
Heat stress	Rising temperatures; little or no shade infrastructure	Reduced animal condition and productivity
Saline drinking water	Animals consume the same contaminated, saline borewater as people	Health decline in stock
Catastrophic events	1999 cyclone	About 300 camels lost (KII-01); a camel-dependent economy collapsed

Basic husbandry inputs are the binding constraint. The scale of unmet animal-health need is concrete: in Pishukan (Gwadar), an estimated 1,000-1,500 goats and sheep require disease control and fodder support (KII-B02). Across both districts, livestock keepers prioritise veterinary services, vaccination, fodder and fresh water for animals rather than breed improvement or insurance - indicating that basic husbandry inputs remain the binding constraint. Because livestock buffers households against crop and fishery failure, its erosion removes the last line of defence for many of the poorest families.

5.9 Gender, vulnerable groups and social inclusion

Women's participation in household income decisions is limited across the sample and more restricted in Sujawal, where 65.0 per cent of households reported that women take no part in income decisions at all (against 47.4% in Gwadar). Women's physical mobility is also more constrained in Sujawal, where 83.0 per cent of households reported that women either cannot travel or can travel only with restrictions (against 57.1% in Gwadar). Children and women were the two groups most frequently identified as 'most affected' by climate shocks (137 and 121 households respectively), consistent with the health-burden findings. Asked which group should be prioritised for adaptation support, respondents most frequently named women-headed households (115 households) and poor or landless households (100 households).

Self-perceived exclusion from government, NGO or community support is dramatically higher in Sujawal (57.7%) than in Gwadar (7.3%). Combined with the adaptive-capacity results, this suggests that Sujawal households experience both objectively weaker access to formal support and a strong subjective sense of being left out — something adaptation programming must confront directly through transparent, community-validated targeting.

The gender findings carry a subtle complication that guards against a simplistic reading. On the conventional measures of decision-making and mobility, Sujawal women are more constrained than Gwadar women. Yet Gwadar records a far higher share of women-headed households (36.3% against 6.9%), a structural feature the qualitative evidence attributes to male out-migration and to the loss of men to distant fishing and cross-border detention. Gendered vulnerability, in other words, takes different forms in the two districts. In Sujawal it appears chiefly as exclusion and constrained agency within male-headed households; in Gwadar, a large cohort of women carry sole responsibility for household survival, often without the assets, credit or services that responsibility demands. Adaptation programming must therefore be gender-responsive in district-specific ways — addressing exclusion and voice in Sujawal, and the asset, credit and service needs of women-headed households in Gwadar — rather than applying one template to both coasts. In both districts, the concentration of the health and food-security burden on women and children means that the freshwater and health investments of the recommended framework are, in effect, also the most direct gender interventions available.

5.9.1 Disaggregated impacts on women, children, older persons and persons with disabilities

Who bears the burden. The survey allows the climate burden to be disaggregated by group. When households named the members "most affected" by climate shocks, the burden fell disproportionately on children and women, followed by pregnant and lactating women, older persons and persons with disabilities (Figure D1; Table 5.15).

Figure D1. Climate-related burden by vulnerable group (% of households identifying the group as most affected).

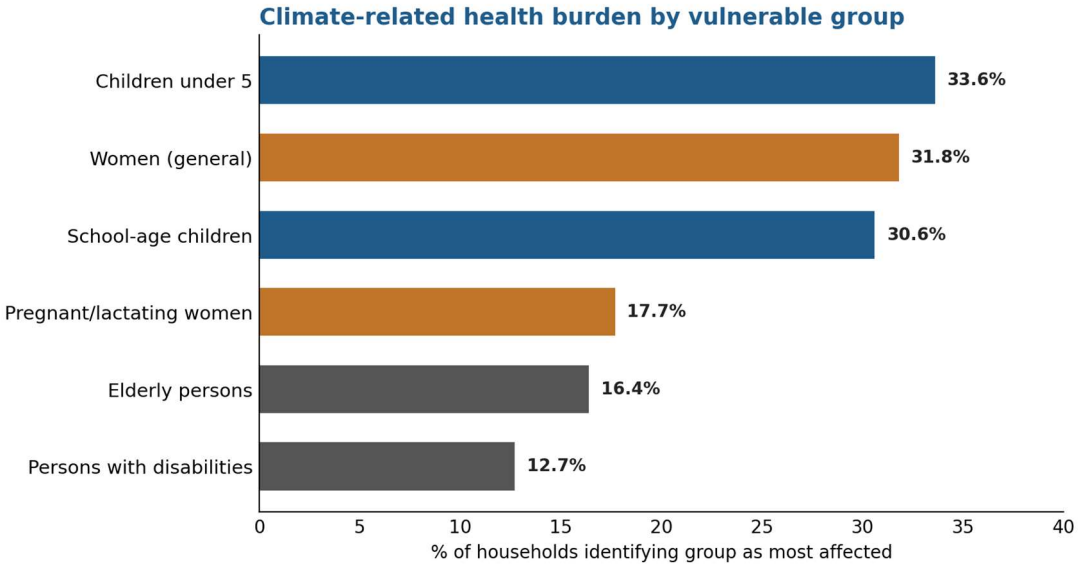


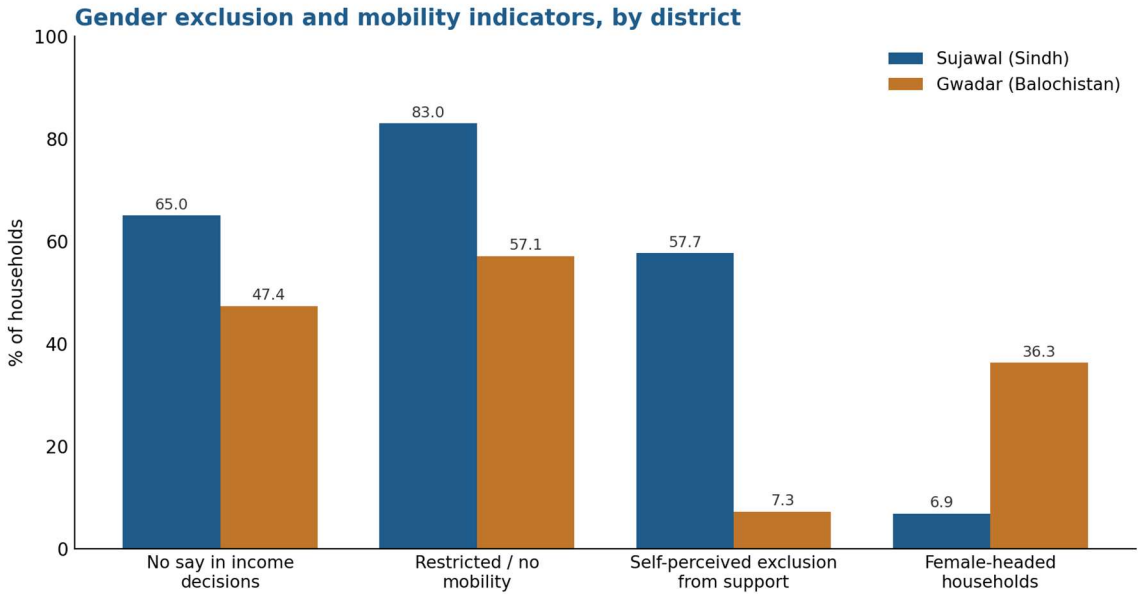
Table 5.15. Climate-related burden by vulnerable group (source: household survey; 12.4% of all households include a member with a disability or chronic illness).

Vulnerable group	Households identifying group as most affected	Note
Children under five	33.6%	Highest burden; concentrated in waterborne disease
Women (general)	31.8%	Carry the water-, food- and care-provision burden
School-age children	30.6%	Schooling disrupted; health effects

Pregnant or lactating women	17.7%	Maternal and new-born health risk
Older persons	16.4%	Heat and disease sensitivity; mobility limits
Persons with disabilities	12.7%	Access, mobility and evacuation barriers

Two forms of gendered vulnerability. Gendered vulnerability takes two different forms across the study area. In Sujawal it is expressed as constrained agency: 65.0% of households report women have no say in income decisions (against 47.4% in Gwadar), 83.0% report women cannot travel freely or only with restrictions (against 57.1%), and self-perceived exclusion from support is far higher (57.7% against 7.3%). In Gwadar it takes the form of unsupported responsibility: 36.3% of households are women-headed (against roughly 6.9% in Sujawal), a consequence of male out-migration and detention (Figure D2).

Figure D2. Gender exclusion and mobility indicators, by district (source: household survey).



Implications for targeting. When asked which groups to prioritise for adaptation support, households most frequently named women-headed households (115 households) and poor or landless households (100 households). Together with the group-level burden data, this makes the design implication explicit: women, children, women-headed and poor/landless households, older persons and persons with disabilities should be named targets in adaptation, health and social-protection programming - and the freshwater and

health investments recommended in Chapter 9 are, in practice, the most direct gender interventions available, because women and children absorb the largest share of the water-and-disease burden.

5.10 Perceptions and priority needs

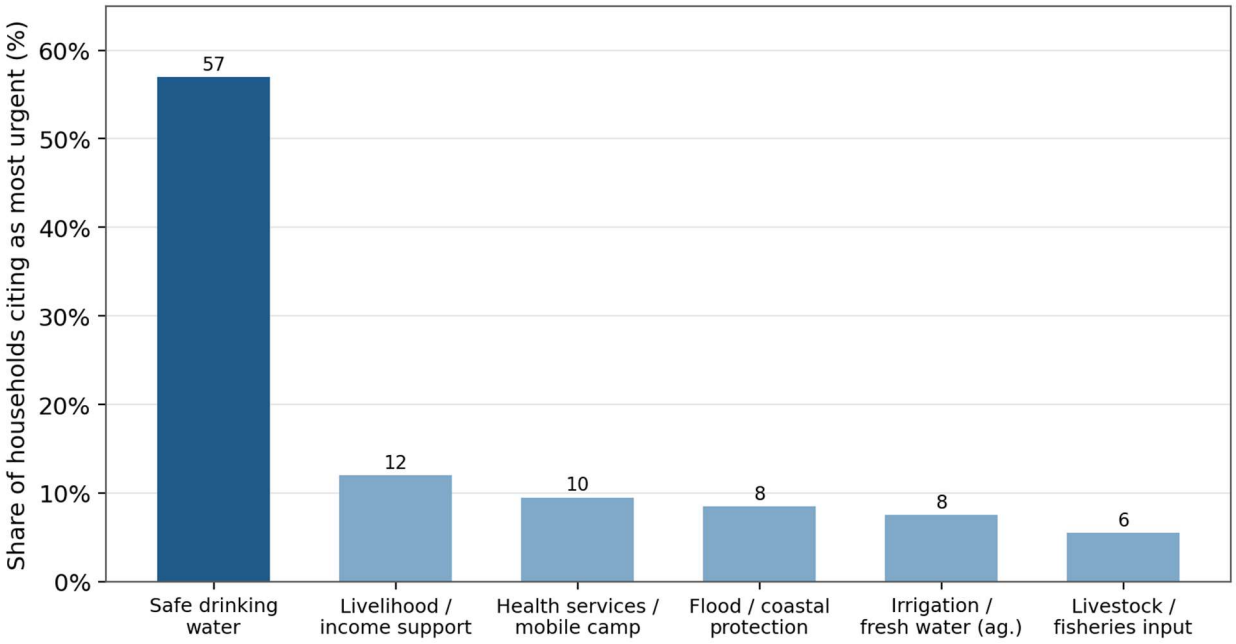
Only 37.3 per cent of respondents said they had heard of ‘climate change’ as a term, even though the same population reports direct, lived experience of multiple hazards at rates of 40–47 per cent per hazard type. This gap between formal awareness and lived experience implies that communication, training and early-warning messaging should be framed around concrete, locally recognisable hazards rather than the abstract term. Stated willingness to adopt new practices, even with support on offer, is strikingly low: only 10.4 per cent said ‘yes’ outright, and 64.2 per cent said ‘no’. High exposure combined with low named awareness and low stated willingness implies that adaptation uptake will depend less on persuasion than on demonstrably reducing the practical cost, risk and access barriers to specific, concrete interventions.

Across household, community-project and health-support questions alike, the priority need is remarkably consistent (Table 5.12; Figure 4).

Table-5.12: Priority needs and locally feasible adaptation options (Section 13).

Priority indicator	Result
Most urgent household need: safe drinking water	57.0% of households
Most feasible community project: drinking water / RO plant	66.7% of households
Most urgent health support: mobile health camp	37.6% of households
Agriculture households: fresh irrigation water as top need	majority of farming households
Fisheries households: boat/gear support as top need	majority of fishing households
Livestock households: fodder, then fresh water, as top needs	majority of livestock households

Figure-4: Most urgent household need to reduce climate vulnerability (% of households).



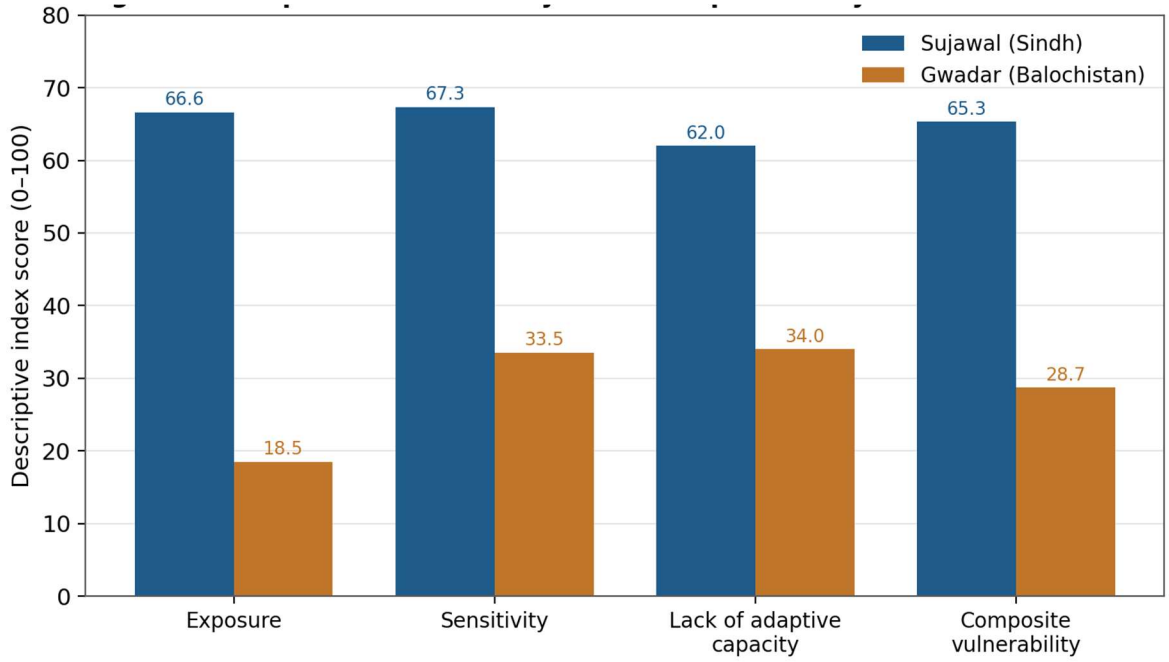
Safe drinking water at household level and as the most feasible community project — is the clearest and most actionable entry point identified by the survey. It is corroborated by the sensitivity findings (drinking-water shortage and salinity-affected supply), the health findings (water as both a leading cause of illness and a top health-support priority) and the socio-economic profile. It should be treated as a foundational, cross-sectoral investment that underpins sector-specific and health adaptation rather than competing with it.

The awareness–willingness gap deserves careful interpretation, because it is easily misread. Low reported awareness of the term ‘climate change’ does not indicate ignorance of the phenomenon: the same respondents describe, in precise terms, the advancing sea, the salinization of their land, the warming water and the vanishing fish. What they lack is not experience but the abstract vocabulary in which policy and programmes are usually framed. Communication that leads with the lived hazard — salinity, flood, catch decline, disease — will therefore connect far better than generic climate-awareness messaging. Similarly, low stated willingness to adopt new practices should be read not as fatalism but as a rational response to repeated experience of interventions that imposed cost and risk without delivering benefit. Households that have sold assets to survive and cycled through relief without escaping vulnerability are understandably cautious about further unproven demands on scarce resources. The design implication is decisive: uptake will follow demonstrated, low-cost, low-risk benefit beginning with the water and basic services communities themselves prioritize far more reliably than it will follow persuasion. Adaptation programming should earn willingness through early, visible, no-regret wins rather than assume it.

5.11 The descriptive composite vulnerability index

To summarize the district contrast, an unweighted descriptive composite index was constructed from the exposure, sensitivity and adaptive-capacity components (Figure 3). The index is illustrative and district-comparative only; it is not a validated instrument and should not be read as an absolute measure. It nonetheless captures the chapter's central message: Sujawal scores substantially higher on exposure and sensitivity and higher on lack of adaptive capacity, producing a markedly higher composite vulnerability score than Gwadar.

Figure-3: Composite vulnerability index components by district (descriptive, unweighted; for district comparison only).



5.12 Summary of key quantitative findings

- Exposure is heavily concentrated in Sujawal, at three to five times the Gwadar rate for nearly every hazard.
- Sensitivity follows the same pattern with a narrower gap; food and drinking-water shortages in the last 12 months affected roughly two-thirds of Sujawal households against under one-fifth in Gwadar.
- Health problems affected half of all households over five years (63.9% in Sujawal), led by waterborne and vector-borne disease, with children most affected and major difficulty accessing treatment.
- Adaptive capacity is paradoxically weaker in the more exposed district, with far lower credit, insurance, connectivity and extension access in Sujawal.

- Coping in Sujawal relies more heavily on reduced food intake and asset sales, and recovery takes substantially longer.
- All three sectors show high sensitivity: two-thirds to three-quarters of engaged households report climate-related losses over the decade.
- Gender and exclusion: women's decision-making and mobility are more constrained in Sujawal, where self-perceived exclusion from support is far higher (57.7% against 7.3%).
- Awareness and willingness are both low relative to lived experience, pointing to hazard-specific messaging and barrier reduction.
- Safe drinking water is the single most consistently prioritised need across household, community-project and health questions, and the clearest cross-sectoral entry point.

5.13 District-gap analysis and severity ranking

To sharpen the district contrast, the exposure data were re-examined as a set of district gaps the difference between the Sujawal and Gwadar exposure rate for each hazard. The analysis confirms that the deltaic–Makran divergence is not uniform across hazards; it is greatest precisely for the hazards belonging to the deltaic freshwater-loss signature. Salinity intrusion shows one of the widest gaps (Sujawal 68.8% against Gwadar 13.5%, a gap of some 55 percentage points), as do river and rain flooding (71.6% against 14.1%) and coastal and tidal flooding (65.5% against 14.6%). The narrowest gap appears for 'sea moving closer to village or land' (58.5% against 36.5%) the one hazard that a subsiding delta and an eroding, uplifting Makran coast experience in common, though through different physical processes. This pattern of gaps is itself evidence for the two-signatures thesis: where the hazard is deltaic in character the gap is widest, and where it is shared coastal encroachment the gap narrows.

Table-5.13. District-gap analysis of hazard exposure (percentage-point difference, Sujawal minus Gwadar).

Hazard	Sujawal** %**	Gwadar %	District gap (pp)
River / rain flood	71.6	14.1	57.5
Salinity intrusion	68.8	13.5	55.3
Cyclone / storm / strong winds	68.0	22.9	45.1
Coastal / tidal flooding	65.5	14.6	50.9
Heatwave	66.5	22.4	44.1
Drought / water shortage	66.2	22.4	43.8
Coastal / riverbank erosion	63.2	20.4	42.8
Irregular rainfall	70.1	23.4	46.7
Sea moving closer to land	58.5	36.5	22.0

The severity of exposure is underscored by the acute-exposure measure: a large share of households reported directly experiencing a flood, cyclone or erosion event, with the burden concentrated in Sujawal. Taken with the sensitivity data in which food shortage, drinking-water shortage and climate-related health effects each affected roughly two-thirds of Sujawal households against under a quarter of Gwadar households the analysis establishes that Sujawal occupies the more severe position on both limbs of the vulnerability equation, exposure and sensitivity, while at the same time holding the weaker position on adaptive capacity. This triple disadvantage is the quantitative foundation of the study's central argument.

5.14 Integrated district comparison

Bringing the indicators together produces a consolidated picture of two districts that are both vulnerable, but to different degrees and, crucially, for different reasons. Table 5.14 summarises the comparison across the four lead indicators and the principal cross-cutting dimensions. Read as a whole, it shows Sujawal as the district of higher exposure, higher sensitivity, lower adaptive capacity and more erosive coping — the profile of acute, freshwater-driven deltaic vulnerability compounded by institutional remoteness. Gwadar emerges as less physically exposed but far from secure: its vulnerability concentrates in the fisheries-dependent economy, the collapse of the marine resource base, and a distinctive social profile of male out-migration, women-headed households and educated-but-unemployed youth.

Table-5.14. Consolidated comparison of the two districts across the vulnerability indicators.

Dimension	Sujawal** (Sindh, deltaic)**	Gwadar (Balochistan, Makran)
Exposure	Very high; 3–5× Gwadar across hazards	Moderate; concentrated in erosion and marine change
Sensitivity	Very high; two-thirds report food/water shortage	Lower but real; asset damage high in both
Health burden	63.9% report climate-health problem	37.8% report climate-health problem
Adaptive capacity	Weak; credit 4.0%, insurance 0.0%, internet 11.9%	Stronger; credit 45.6%, insurance 26.4%, internet 74.6%
Coping	Erosive; 62.2% reduce food; slow recovery	Less erosive; faster recovery (41% under a month)
Dominant hazard	Salinity, submergence, freshwater loss, flood	Erosion, sea warming, ecosystem collapse
Lead sector at risk	Agriculture and livestock	Artisanal fisheries
Social profile	Women largely excluded; low female headship	High female headship; educated-unemployed youth
Assistance pattern	More post-shock relief, less adaptation	Less relief, thicker institutional environment

Vulnerability type	Acute, freshwater-driven, institution-poor	Ecological-economic, fisheries-concentrated

This integrated comparison is the empirical foundation for the two-signatures argument developed qualitatively in Chapter 6 and analytically in Chapter 7. It demonstrates that a single, undifferentiated coastal-adaptation response would misallocate effort in both districts, over-investing in the wrong instruments on each coast, and that the correct response must be differentiated according to the distinct vulnerability profile the survey data reveal.

Chapter-6
Qualitative Findings: Lived Experience, Local Knowledge and Institutional Reality

This chapter presents the qualitative evidence from fourteen key informant interviews and six focus group discussions conducted across Sujawal District in the Indus deltaic zone of Sindh and Gwadar District on the Makran coast of Balochistan. Where Chapter 5 measured the distribution and magnitude of vulnerability, this chapter explains its texture, causation and meaning in the words of the people who live it. The qualitative data serve three analytical purposes. They corroborate and interpret the survey findings; they surface hazard processes and social mechanisms that a closed-ended questionnaire cannot capture; and they foreground the institutional and governance dimensions of vulnerability that emerged, repeatedly and unprompted, as central to the coastal predicament. The analysis follows the thematic coding framework (codes A1–A21) applied to the interview and discussion transcripts, organised here as an interpretive narrative rather than a code-by-code listing.

6.1 Analytical approach and coverage

Transcripts were analysed thematically, following the six-phase sequence of familiarisation, initial coding, theme development, review, definition and reporting. Twenty-one first-level codes were generated inductively from the transcripts and grouped into higher-order themes: hazard experience and environmental change; sectoral impacts on agriculture, fisheries and livestock; the freshwater–health nexus; gender and social inclusion; adaptive capacity and coping; and institutional performance and governance. Four themes emerged that the original proposal had not anticipated; these are treated separately in Section 6.9. Saturation — the point at which further interviews stopped generating new codes — was reached within each district, indicating that the fourteen KIIs and six FGDs captured the range of salient experience, although the qualitative sample is not statistically representative and is not intended to be.

Informants spanned both districts and several knowledge positions. In Sujawal they included small and tenant farmers, livestock keepers, a schoolteacher, a lady health worker, a local NGO worker and community elders from deltaic union councils including Kharo Chan and Jati. In Gwadar they included artisanal fishers, a boat owner, a marine scientist, a women's community organiser, a university student and ward-level community representatives from Surbandar, Pishukan and Gwadar city. The six FGDs comprised separate men's and women's groups in each district plus mixed livelihood groups, with more than one hundred participants in total. The study team facilitated the discussions, with note-taking and transcription alongside audio recording where consent was given.

Table-6.1: Coverage of key informant interviews and focus group discussions by district.

District	KIIs	Informant positions represented	FGDs
Sujawal (Sindh, deltaic)	7	Small/tenant farmers, livestock keepers, schoolteacher, lady health worker, NGO worker, community elders	3 (men, women, mixed livelihood)
Gwadar (Balochistan, Makran)	7	Artisanal fishers, boat owner, marine scientist, women's organiser, university student, ward representatives	3 (men, women, mixed livelihood)
Total	14	Cross-sectoral, cross-gender, cross-generational	6 (>100 participants)

6.2 Two coastlines, two hazard signatures

The most important qualitative finding is that Pakistan's southern coast does not present one climate problem but two distinct hazard signatures, each demanding a different adaptation response. The survey established that Sujawal is more exposed than Gwadar on almost every measured hazard; the qualitative data show that the two districts are, in effect, living through different environmental crises, with different physical drivers, different ecological consequences and different implications for livelihoods.

6.2.1 Loss of freshwater, submergence and salinity in the deltaic signature.

In the case of Sujawal, informants talk of the slow onset of a catastrophe of lack of fresh water and loss of land due to the interplay of upstream water regulation, reduced flows from the Indus and rising sea level. The constant theme is the decline in the flow of fresh water since the construction of the Kotri Barrage and the corresponding encroaches of the sea onto once-farmable land as recalled in community memory. Elders remember that the saline watered villages and farmland are once again productive fields and grazing grounds, right within their living memory. The Karo Chhan (Kharo Chan) area is reported to have lost significant number of dehs (revenue villages) to inundation and named villages are recalled as having been swept under the waves.

"*Over the years, the sea has slowly and gradually taken our land from us, where our fathers used to grow rice and graze cattle, now there is only salt water. The government has built the barrage and the river has ceased to come to us*." — Community elder, Kharo Chan FGD, Sujawal

The transliterated statements of informants emphasize the tidal pattern, twice a month, related to the moon, and the way that the saline water of the tides is carried up creeks and abandoned tidal channels, polluting the shallow groundwater that is the only water supply for many households. The local canals, particularly the Sher Khan canal, have been dried up, thereby eliminating the freshet which used to keep salinity under control. The 1999 cyclone was described as a watershed event: one informant said some three hundred camels from one extended community had been lost and grazing areas were abandoned thereafter. The deltaic signature is, therefore, one of 'creeping salinisation',

'episodic catastrophic flooding' and the 'gradual transformation of freshwater agrarian landscapes into brackish unusable land'.

6.2.2 The Makran signature: erosion, warming seas and marine-ecosystem collapse

In Gwadar, the hazard signature is oceanographic and ecological rather than deltaic. Fishers and a local marine scientist describe a warming sea — put informally at around two degrees Celsius over a generation — accompanied by increasingly frequent harmful algal blooms, locally called the Red Tide and blue tide, now reported three to four times a year where they were once rare. The blooms bring fish mortality, jellyfish swarms and toxic or unsellable fish. Informants report the disappearance or drastic decline of species that once sustained the fishery, naming the Gwanz (Indian threadfin), the Palwar (Indian shad) and the Sarmai among fish now rarely caught. Coral and mangrove loss along the Makran coast is described as removing the nursery habitat on which the fishery depends.

"The fish that were our livelihood are now only memories. My father knew where to find them by the season. Now the sea is warm and strange, and the fish do not come." — Artisanal fisher, KII-B05, Gwadar

Fishers also report a shift in the storm and monsoon calendar: the season of dangerous weather that once fell in June and July now arrives in August and September, disrupting both the fishing calendar and the timing of the customary closed season. The drying of the Dasht River and reduced land-based freshwater inflow are linked to changes in the coastal ecosystem. Coastal erosion runs through the accounts: informants in Surbandar describe the loss of roughly three kilometres of shoreline and the submergence of households in the Kangani ward, while the wider community reports the coast's steady retreat into inhabited and productive land.

"Will the next generation see the sea as we see it? The coral is dying, the mangroves are gone in many places, and the tides take more of our land each year." — Chacho Khuda Bakhsh, KII-B01, Gwadar

Table-6.2: The two hazard signatures of Pakistan's southern coast.

Dimension	Sujawal** (Indus delta, Sindh)**	Gwadar (Makran** coast, ****Balochistan****)**
Primary driver	Reduced Indus flow, sea-level rise, tidal intrusion	Sea-surface warming, ecosystem change, erosion
Dominant hazard	Salinity, submergence, freshwater loss, river/coastal flood	Coastal erosion, marine-ecosystem collapse, altered storms
Signature process	Creeping salinisation of land and groundwater	Warming sea, algal blooms, habitat and species loss
Livelihood most hit	Agriculture and livestock (freshwater-dependent)	Artisanal fisheries (marine-ecosystem-dependent)

Ecological markers	Lost dehs, dry canals, saline groundwater, vanished grazing	Red/blue tide, coral/mangrove loss, jellyfish, species extinction
Adaptation implication	Freshwater security, salinity management, land protection	Fisheries governance, marine protection, erosion defence

6.3 Sectoral impacts in the words of practitioners

6.3.1 Agriculture: salinity as slow death of the land

Farmers in Sujawal describe salinity not as an event but as a condition that has redefined what can be grown and where. They report the abandonment of rice and other freshwater crops in areas grown too saline, falling yields on land still under cultivation, and a shrinking cultivable area as the salt front advances. The loss of freshwater irrigation — through canal drying, reduced barrage releases or tidal contamination is identified as the proximate cause. This is directly linked to the survey finding that the impact of soil salinity and yield decline are the predominant impacts on agriculture. The qualitative accounts provide a key element: that the loss is felt to be permanent. Any effort to irrigate and reclaim salt-affected land without freshwater flushing is futile for the farmers.

This loss is exacerbated by its social distribution. In the deltaic belt, land ownership is limited, with only a minority of households owning the land they cultivate: this means that those who do not are the most vulnerable and lack security and assets to prepare for the collapse of cultivable land. Farmers describe a sequence whereby the yield declines due to the salinization, farmers have to take out loans or sell their assets since their harvest declined, and the household's ability to invest in the drainage or salinization-tolerant inputs to stop the decline is exhausted. This vicious circle of environmental degradation and economic depletion becomes evident in the delta, with informants saying it is impossible for agriculture to break free from without outside investment in the freshwater resources.

6.3.2 Fisheries: a resource under threat and illegal employment

In Gwadar, fishers identify a fishery in ‘structural crisis’; they cite global warming as one of the causes for declining yields, while degradation of ecosystem and pressure from large mechanised trawlers in their ‘territory' are other factors in their own estimation. The qualitative data reveal a governance aspect which was unobserved in the survey, that is, evidence of fishers being pushed further out to sea to catch fish, to areas where they feel the sea is contested, and being arrested because of these experiences. The human-security aspect of coastal vulnerability was exemplified in one informant's recollection of the arrest of fishers by the Indian Navy and imprisonment for about three years – a human-security dimension of coastal vulnerability, which transforms an environmental problem into one of livelihood criminalisation and trans-border risk. Other fishers also report having boats and gear blown over, as well as the lack of access to credit or insurance to replace capital equipment. *“We do not seek charity; we seek our rights. The sea is ours, but the big boats take the fish, and when we go far to find them, we are caught and jailed.”* — Artisanal fisher, KII-01/KII-07, Gwadar

6.3.3 Livestock: disease, fodder scarcity and heat

Livestock keepers in both districts, and especially in Sujawal, describe converging animal-health crises and feed scarcity. Informants name specific diseases whose incidence they see rising: foot-and-mouth disease, lumpy skin disease, peste des petits ruminants, contagious caprine pleuropneumonia and enterotoxaemia. Fodder shortage driven by the loss of grazing land to salinity and submergence and by the drying of pasture is described as forcing distress sales and shrinking herds. Heat stress increasingly affects animal condition and productivity. The catastrophic livestock losses of the 1999 cyclone remain a reference point for the vulnerability of the livestock economy to extreme events, and informants describe the slow erosion of a livelihood that once buffered crop failure.

The significance of these losses lies in the buffering role of livestock in the coastal household economy. Historically animals have been the last resort for households of salinized crops or fishing grounds, a store of wealth to be drawn upon in times of trouble and restored when times are good. The buffer that is the herd decreases as its members die out to disease, starvation, heat and saline drinking water, increasing the vulnerability of households to the next shock and the reliance on coping strategies that were described in the survey and are eroding the herd. The selling of animals as a short-term source of food during distress, at low prices, is singled out by informants as particularly harmful, because it turns an asset that can be productive and valuable over time into something that can only be consumed in the short term, and eliminates the ability to recover in the future. The protection of livestock is not a sectoral issue but a challenge to the sustainability of the central mechanism of household resilience – and like agriculture, it shares the same water source that is the source of the broader crisis: the loss of freshwater.

6.4 The freshwater–health nexus

Water, its scarcity, its saltiness, its pollution, is the overarching variable that links change in the environment to suffering in both districts and in a manner that is highly consistent. This finding on safe drinking water as the primary need is attributed to the qualitative responses of the survey which explained that it is a need of everyday life. The saline groundwater and dwindling freshwater sources in Sujawal lead people to consuming saline water or to paying exorbitant prices for purchasing freshwater. In Gwadar, the informants state that the price of tanker water ranges from thirty five to forty thousand rupees per fill which is a substantial part of their household budgets and makes them fall into debt.

The health consequences are described in terms of the viscera. Water borne disease and diarrhea in particular is claimed to be endemic and informants make a direct link to the water they are compelled to consume. A lady health worker explained the constant burden of childhood diarrheal illness and lack of possibility of prevention when clean water is not available. The lack of service in remote deltaic and coastal settlements, distance to health facilities and treatment costs exacerbate the situation. The following is the most often cited sentence in the entire study:

“Hunger did not kill us, the sickness from bad water killed our children, we can survive on little food but bad water killed us or our children.” — Khameso Jat, KII-01, Sujawal

There is a single sentence that encapsulates the main point of the health findings: in these communities, water and disease rather than food are the links between climate change and death. It brings a new perspective to the traditional focus on food security, which is usually the focus of a climate vulnerability assessment, by making it just one part of a broader crisis whose most dangerous manifestation is waterborne and vector-borne diseases. Finally, the focus on safe drinking water in the survey is not a matter of preference, but rather a conscious decision in keeping with the rational answer communities have for the top cause of avoidable deaths and suffering: safe drinking water.

The nexus is achieved via a variety of reinforcing communication pathways that are made clear in the qualitative data. Diarrhoeal and other waterborne diseases result directly from exposure to contaminated water and saline water, and are experienced most severely by young children. The same water insecurity drives the purchase of costly tanker water, diverting scarce income from food, health care and productive investment and pushing households into debt. And the labour of securing water — borne overwhelmingly by women and girls, sometimes over long distances — consumes time and energy that might otherwise go to livelihood, care or education. Water insecurity is simultaneously a health crisis, an economic drain and a gendered time burden, and the three compound one another. Precisely because water sits at the intersection of so many pathways, restoring it offers disproportionate returns: one intervention addresses illness, cost, women’s labour and the viability of agriculture and livestock at once. This is the empirical basis for treating freshwater as the keystone of deltaic adaptation.

6.5 Gender and social inclusion

The qualitative data both corroborate and complicate the survey’s gender findings. In Sujawal, women’s exclusion from income roles and decision-making is described as near-total in many households, consistent with the survey finding that a large majority of women have no independent income role and that self-perceived exclusion from support is high. Women in the Sujawal FGDs described bearing the physical burden of water collection over long distances, managing household food scarcity by reducing their own consumption, and being absent from the community forums where relief and project decisions are made. Gender intersects directly with the freshwater crisis: women’s labour and health absorb the cost of water insecurity.

In Gwadar the picture is different, and in some ways paradoxical. The survey recorded a far higher proportion of women-headed households there, which informants attribute to male out-migration for work and to the loss of men to the hazards of distant fishing and detention. Women in Gwadar described greater visibility in community organisation, and a women’s organiser described efforts to build collective voice. Yet informants also described a distinctive Gwadar predicament: a generation of educated young women and men — informants estimated that around half of young women and forty per cent of young men attend Gwadar University — who find no employment matching their education, producing a mismatch that feeds frustration and out-migration.

"Is development only for cities? Our daughters study at the university, but there are no jobs for them here. The port was to bring prosperity, but our young people leave." — Community representative, Surbandar, KII-B06, Gwadar

The two districts together show that gendered vulnerability is not one condition but takes district-specific forms rooted in different social structures. In the delta, the dominant form is constrained agency: women are present in the household but largely absent from its economic decisions and from the forums where relief and adaptation are negotiated, so their needs and their considerable knowledge are systematically under-counted. On the Makran coast, the dominant form is unsupported responsibility: a large cohort of women head households in the absence of migrant or detained men, carrying the full burden of survival without the assets, credit and services that burden requires. Neither form is captured by simply stating that women are 'more vulnerable', and each demands a different response. What the two share is that women and children absorb the health and food-security consequences of the wider crisis — which is why the freshwater and health investments at the centre of the recommended framework function, in effect, as the most direct and immediate gender interventions available. The discussion and recommendations return to this point.

6.6 Adaptive capacity and the institutional deficit

In the qualitative data the most counter intuitive finding of the survey – that the adaptive capacity of the more exposed district is weaker than its less exposed counterpart district is explained as a story of institutional presence and absence. Better connectivity, higher credit access and the presence of NGOs and university makes the institutional environment thicker in Gwadar, though not as good as it could be. Informants in Sujawal speak of a vacuum of institutions with the state present only in the guise of post disaster relief and not in the role of long-term development or pre disaster protection.

This gives birth to what the study calls the "main paradox of deltaic vulnerability" – communities living in the delta are caught in the cycle of emergency response and not adaptation. Informants speak of food aid and cash relief being provided following each flood or cyclone, but that before the next event they were once again found in the same undefended situation. Relief can help maintain survival, but it cannot diminish the vulnerability of someone who relies on it as an alternative to structural investment, it can lead to dependency. This is why the survey result that Sujawal is getting more relief after the shock, but is more vulnerable is explained here: it is now getting relief instead of freshwater security, salinity management and coastal protection that would reduce vulnerability.

"After every flood they bring us bags of flour and then they forget us until the next flood. We do not want to live from one disaster to the next. We want the water to come back and the sea to be held back." — Community elder, Sujawal men's FGD

Informants also described elite capture, in which relief and project benefits are channelled through locally powerful intermediaries and never reach the poorest and most exposed households a governance failure that compounds the vulnerability of tenant farmers, landless labourers and women-headed households. Land-tenure insecurity emerged as

a further institutional barrier: informants in Gwadar described uncertainty over the ownership and future of coastal land in the context of port development, while informants in Sujawal described the loss of tenure as land is submerged or rendered saline.

6.7 Coping strategies and their limits

Coping in both districts is described as a descent through a hierarchy of increasingly damaging strategies. The first response to shock is dietary: households cut the number and size of meals, a strategy the survey found far more prevalent in Sujawal. Informants describe adults, especially women, eating less so that children can eat. The second response is asset depletion: the sale of livestock, gold, household goods and, ultimately, productive assets such as boats and land. The third, where possible, is migration — seasonal or permanent in search of work, described in Gwadar as a routine feature of young people's lives and in Sujawal as a last resort that fractures families and communities.

Informants are clear that these are not adaptation strategies but survival strategies, and that they erode the very capacity future adaptation would require. Selling a boat to survive a bad season removes the means of the next season's livelihood; taking children out of school to work forecloses the education that might offer an exit. The survey finding that recovery from shocks takes far longer in Sujawal is explained by the depth of asset depletion and by the absence of credit, insurance or institutional support with which to rebuild. Coping, in short, is being mistaken for resilience when it is in fact resilience's slow exhaustion.

6.8 Local ecological knowledge as evidence

A distinctive contribution of the qualitative data is the wealth of local ecological knowledge informants deploy to document environmental change. In the absence of local instrumental records, this knowledge is a valuable evidentiary base in its own right. Informants in both districts used the presence and absence of wildlife as indicators of change: parrots and vultures are described as having vanished from areas where they were once common, and rabbit populations are estimated to have halved. Fishers read marine change from the disappearance of named fish species and the appearance of jellyfish and toxic blooms. Farmers read salinity from the vegetation that will and will not grow. These observations, consistent across independent informants, triangulate with the instrumental and documentary evidence reviewed in Chapter 2 and lend the qualitative findings considerable credibility.

6.9 Emergent themes beyond the original framework

Four themes emerged from the qualitative analysis that the study proposal had not anticipated, and each materially extends the vulnerability framework.

1. Degradation of marine-ecosystems as a hazard class. The degradation of the marine ecosystem warming, algal blooms, loss of habitat and extinctions of species is a hazard in and of itself, not necessarily an outcome of the storm and flood hazards of traditional coastal hazards assessments that are used for coastal

planning in Gwadar. It calls for an ecological and fisheries-governance response rather than an infrastructure-and-relief response.

2. Human security and the criminalization of livelihood. But when fishers are arrested and jailed for fishing in areas where their rights have been violated, the scarcity of environmental resources becomes a human-security issue, a point not included in the regular economic and environmental frameworks.

3. Land-tenure insecurity. Uncertainty around land ownership and future use jeopardizes land security, which is the foundation for any long-term adaptation investment in both districts but with different motivation: submergence and salinity in the Sujawal district, and port-related development pressure in the Gwadar district.

4. The education–employment mismatch. In Gwadar, rising education levels without accompanying livelihood opportunities create disillusionment, out-migration and feeling excluded from the development process that the port was supposed to bring, undermining the notion that education will equip people to adapt to climate change.

6.10 Triangulation of qualitative and quantitative evidence

The qualitative and quantitative strands are well intertwined, with one strand explaining and supporting the other. The survey sets the distribution and magnitude of vulnerability; the interviews and discussions provide the meaning, causation and institutional context of vulnerability. Table 6.3 shows how the main survey results are correlated with their explanation in a qualitative format, which helps to show the consistency of the mixed-methods evidence base.

Survey finding (quantitative)	Qualitative explanation (KII/FGD)
Sujawal exposure 3–5× Gwadar; salinity and flood dominant	Reduced Indus flow since Kotri Barrage; tidal intrusion; lost dehs; dry canals
Gwadar fisheries catch decline; work disruption	Sea warming ~2°C; red/blue tide 3–4×/yr; coral/mangrove loss; species extinction
Safe drinking water the top priority need	Saline groundwater; tanker water at PKR 35,000–40,000; ‘hunger does not kill us, diseases have’
Waterborne and vector-borne disease lead health burden	Endemic childhood diarrhoea tied directly to contaminated/saline water
Sujawal weaker adaptive capacity despite higher exposure	Institutional vacuum; relief without protection; elite capture; low credit/insurance/connectivity
Sujawal receives more relief yet stays more vulnerable	‘Cycle of relief not adaptation’; aid substitutes for structural investment
Higher women-headed households in Gwadar	Male out-migration and detention; distinctive Gwadar demographic

Longer recovery times in Sujawal	Deep asset depletion; no credit/insurance to rebuild; migration as last resort

6.11 Focus group evidence, detailed, from the deltaic zone.

The three Sujawal focus group discussions (FGD) which consisted of three different livelihood groups (men, women and mixed) of residents of the Jat settlement of Doongar and neighbouring deltaic settlements, are able to document the deltaic hazard signature in fine detail worthy of full reporting. Permanently lost revenue villages (dehs) were identified by the participants. At least nine named dehs were reported to be completely flooded with saline water, population displacement and agricultural/agriculture land conversion in these dehs, Chalko, Dohar, Hetma, Chobatti, Chan Bello, Ket Jageer, Jhim and Tall. This community-level cadastral memory is some of the most palpable evidence of delta shrinkage for the delta, and it ties the abstraction of delta shrinkage to named places and communities.

The 1999 cyclone was always cited as the worst natural disaster in the recent history of living memory. Doongar Jat reported the deaths of over a hundred camels from this settlement, destruction of entire villages and evacuation of several communities to Jatti, some ten kilometres further inland. The event in community narrative signifies the transition from a remembered past of viable deltaic living to a present of contracted, salinised and hazard-exposed living. The losses of 1999 were attributed to the weakened state of the deltaic system due to influx of very little fresh water in the delta in the past, and the Delta would be devoid of any respite from the storm surge if there was no fresh water coming into it from the Indus.

Participants also documented ecological change through wildlife indicators with notable specificity. Parrots have entirely disappeared from areas where they were once common; vultures are no longer seen in the villages; rabbit populations have fallen by about half; snake populations, by contrast, were reported to have increased. Observed independently across groups, these shifts in the local fauna form a community-generated ecological record consistent with habitat degradation and salinisation, and illustrate the evidentiary value of local ecological knowledge discussed in Section 6.8.

On institutional performance, deltaic participants described the incomplete flood-rehabilitation housing built after recent flooding, and identified the drying of the Sher Khan canal as a specific instance of the freshwater-delivery failure underlying deltaic decline. The men's group articulated the relief–dependency paradox with particular clarity, describing a sequence in which each flood brings temporary assistance followed by neglect until the next disaster, with no intervening investment in the freshwater restoration and coastal protection that would reduce the underlying risk.

6.12 Detailed focus-group evidence from the Makran coast

The three Gwadar focus group discussions held at Gwadar city (Sadaf Hotel), Surbandar and Pishukan documented the Makran hazard signature with comparable specificity. In Surbandar, where participants reported that around ninety per cent of the population

depends directly on fishing, the FGD recorded the loss of roughly three kilometres of shoreline and the submergence of one hundred and sixty-one households in the Kangani ward. These statistics provide a sense of the coastal-erosion phenomenon that, in Gwadar, is analogous to that of salinity and submergence in the delta; that is, the physical disappearance of inhabited and productive area of the coast.

The marine-ecosystem dimension was extensively recorded by the Pishukan participants, who blame oil trollers and mechanised vessels for the drop in catches and marine pollution. One of the more frequent complaints was that the fishing jetty at Pishukan had been reported to be under construction since 2007 and it still had not been completed after over 15 years, a symbol to participants of infrastructural neglect and the disconnect between promises of development and reality on the coast. In all groups, the participants attributed this warming of the Arabian Sea, which is estimated to be two degrees Celsius, as a reason for disturbances in fish behaviour and collapse in the base of the species.

A specific and actionable governance recommendation emerged from the discussions: participants proposed shifting the seasonal fishing ban, currently imposed in June and July, to August, to match the observed change in the spawning and storm calendar. This community-generated recommendation, grounded in direct observation of ecological change, is incorporated into the policy framework in Chapter 9 and illustrates the value of embedding local knowledge in fisheries governance.

Livestock discussions in both districts named a consistent set of animal diseases perceived to be rising — foot-and-mouth disease, lumpy skin disease, liver fluke in cattle, and peste des petits ruminants, contagious caprine pleuropneumonia and enterotoxaemia in small ruminants — alongside fodder scarcity and heat stress. Health discussions documented waterborne and heat-related illness, hepatitis and eye conditions linked to contaminated water and poor sanitation, and, in Surbandar, the absence of round-the-clock maternity services, underscoring the gendered dimension of the health-access deficit.

Table-6.4: Detailed place-based evidence from the focus group discussions.

Setting	Location	Documented specifics
Sujawal FGD (deltaic)	Doongar Jat and deltaic dehs	9+ named dehs submerged; 100+ camels lost in 1999; evacuation to Jatti (10 km); vanished parrots/vultures; dry Sher Khan canal
Gwadar FGD 2	Surbandar (Kangani ward)	~3 km shoreline lost; 161 households submerged; ~90% fishing-dependent; no 24/7 maternity service
Gwadar FGD 3	Pishukan	Jetty incomplete since 2007; oil trollers/pollution; species decline; ~2°C sea warming
Cross-district	Both	Livestock disease (FMD, LSD, PPR, CCP, ETV); ban-shift June–July → August recommendation; incomplete flood housing

6.13 Institutional and practitioner perspectives

The key informant interviews reached beyond community members to practitioners and knowledgeable persons whose vantage point is institutional a schoolteacher, a lady health worker and an NGO worker in the delta; a marine scientist and a women's organiser on the Makran coast. Their accounts add an institutional layer to the community testimony, and they are notable for the consistency with which they locate the problem not only in the climate but in the machinery meant to respond to it.

The health-worker and teacher perspectives from the delta emphasise the compounding effect of distance and absence: services that exist on paper are, in practice, too far away, too under-equipped or too intermittently staffed to reach the most exposed settlements, so the health consequences of contaminated water and the educational consequences of displacement fall on households with little institutional cushion. The NGO view focuses on the nature of relief without development, where post-disaster assistance is repeated, but not the kind of investment that would mean it wouldn't be needed as often, and also on the challenge of delivering benefits to the poorest in the presence of locally powerful intermediaries. From both a scientific and an experiential point of view, the marine scientist on the Makran coast provides a scientific vocabulary for what the fishers describe: warming water, stress on the ecosystem and a decrease in the resource base. These institutional voices are united in their belief that the coast's communities do not simply suffer from the 'will of the gods' but from exposure that is compounded by institutional failures that can be corrected in principle.

6.14 Community-proposed solutions

One unique aspect of the participative fieldwork was that the communities were not simply identifying and reporting issues, but they were also providing answers, sometimes specific and realistic. These are the recommendations that were produced by the communities and are summarised below and help to inform the policy framework in Chapter 9 and provide the policy with grounding and legitimacy.

- Safe water first. Across both districts, the most insistent demand was for safe drinking water reverse-osmosis or desalination plants, protected water points, and the restoration of freshwater supply — identified as the single intervention that would most improve daily life and health.
- Complete the unfinished infrastructure. In Gwadar, communities pressed for completion of the Pishukan fishing jetty, under construction since 2007, and for proper landing and value-chain facilities; in the delta, for completion of the flood-rehabilitation housing and restoration of functioning canals.
- Reform the fishing calendar and protect the sea. Makran fishers proposed moving the seasonal fishing ban from June–July to August to match the changed spawning and storm calendar, and called for controls on destructive trawling and marine pollution to protect the resource on which they depend.

- Bring health and veterinary services to the settlements. Communities prioritised mobile health camps and, for livestock keepers, vaccination campaigns and mobile veterinary units covering the diseases they named.
- Target the poorest fairly. Community members called for transparent, fair targeting of relief and support reaching the landless, the tenant, the women-headed household and the genuinely most exposed, rather than being captured by the locally powerful.

That these solutions came from the communities themselves is significant. It indicates both a clear-eyed understanding of their own predicament and a readiness to engage constructively with well-designed intervention. It also qualifies the survey's finding of low stated willingness to adopt new practices, which reflects wariness of unproven, costly demands rather than resistance to change as such. When the intervention proposed is one the community itself has identified as feasible and beneficial, the willingness is plainly there.

6.15 Human stories from the frontline

The case studies below, drawn from the interviews and discussions, put human faces to the statistics. Names and circumstances are reproduced as recorded during the fieldwork in the study districts.

Khameso Jat, Doongar Jat (Sujawal): "diseases, not hunger, kill us"
A fisher and community figure in Doongar Jat, in the Jati taluka of Sujawal, where more than half the village are landless crew (khalasi) working on others' boats. He describes saline drinking water as a daily health emergency ranked above the climate hazards themselves, and recalls the 1999 cyclone that washed away more than a hundred camels from his village and forced families to evacuate to Jatti town, ten kilometres away. His words capture the report's central finding that the deadliest pathway from climate change runs through water and disease. *"Hunger does not kill us; diseases have killed us." - Khameso Jat, KII-01*
Ghulam Nabi Racho, Talib Racho (Sujawal): a livelihood criminalised
Pushed further out to sea by a declining catch and unmarked maritime boundaries, this Jati-taluka fisher was arrested by the Indian Navy on 7 July 2022 and held for three years in Bhuj jail, returning through the Wagah border on 10 October 2025 to find his boat, nets and engine confiscated and his household destitute. His case shows how environmental scarcity can become a cross-border human-security crisis - a dimension of coastal vulnerability that standard frameworks miss. *Key informant interview KII-07, Jati / Sujawal.*
Chacho Khuda Bakhsh (70+), Gwadar coast: the sea taking the land

An elderly fisher on the Gwadar coast describes the sea swallowing homes and even mosques through coastal erosion, and storms now arriving at the wrong time of year. His testimony anchors the Makran erosion-and-ecosystem hazard signature and the lived reality of shoreline loss documented in Surbandar, where roughly three kilometres of shoreline and 161 households in the Kangani ward have been lost.

“Will the next generation see the sea as we see it?” - Chacho Khuda Bakhsh, KII-B01, Gwadar.

Ms Saima, Gwadar: women and children at the sharp end

A social activist in Gwadar describes how women and children bear the health and food burden of climate change while remaining largely outside the fisheries value chain and the forums where decisions are taken - even as male out-migration and detention leave a growing share of women heading households alone. Her account frames gender not as a footnote but as a structural determinant of who suffers most.

Key informant interview KII-B04, Gwadar.

Chapter - 7
Discussion

In this chapter quantitative and qualitative findings are integrated and the national and international evidence base from Chapter 2 is put to use to build the core arguments for the study. The discussion is structured around five interpretive claims that together make up the study's analytical contribution: the existence of two distinct regimes of vulnerability on the southern coast of Pakistan that require different responses, freshwater as the keystone variable of coastal vulnerability, a ‘relief-dependency paradox' whereby assistance is offered as an alternative to adaptation, and institutional failure as an equal or more important factor than climatic changes in structuring vulnerability, and the human-security and ecological dimensions of vulnerability that the study has brought to the fore extend the traditional vulnerability framework. Each claim is substantiated by combining the main evidence from the study with the broader literature and the end of the chapter, revises the conceptual framework based on the findings.

7.1 Two coasts, two vulnerability regimes

The findings prove that the plight of both Sujawal and Gwadar is serious but at the same time there is qualitative difference in terms of origin, mechanism and remedy in both. It is not a difference on one continuum, but a difference of kind. Sujawal’s vulnerability is that of a deltaic system deprived of the freshwater flows that built and sustained it. The reduction of Indus discharge to the delta, associated in community memory and in the scientific literature with upstream regulation and abstraction, has removed the freshwater that once held back the sea and flushed salinity from soil and groundwater. The consequence is the creeping salinisation and submergence documented in both the survey and the interviews and corroborated by the reviewed literature’s finding that the great majority of Sindh’s coastal soils are now salt-affected and that the delta has lost extensive area across its creek network.

Gwadar’s vulnerability, by contrast, is that of a marine socio-ecological system in rapid oceanographic and ecological transition. The warming sea surface, the increasing frequency of harmful algal blooms, the degradation of coral and mangrove habitat and the loss of key fish species amount to a collapse of the resource base on which the artisanal fishery depends, compounded by coastal erosion and by the altered timing of the monsoon and storm season that fishers report. The reviewed literature on Makran sea-level dynamics, on recent extreme rainfall at Gwadar and on the ecological pressures of the wider Arabian Sea supports the community accounts of a coast in transition.

The policy implication is fundamental and is developed in Chapter 9: a single, undifferentiated coastal adaptation programme will fail both districts. Sujawal needs freshwater security, salinity management, and land and coastal protection. Gwadar needs fisheries governance, marine-ecosystem protection and erosion defence. Interventions optimised for one coast are largely irrelevant to the other. The Asian Development Bank’s Sindh Coastal Resilience Sector Project, which targets Thatta, Sujawal and Badin with substantial concessional investment in coastal protection, freshwater and forest restoration, aligns well with the deltaic signature identified here; the Makran coast

requires a distinct instrument oriented to marine and fisheries systems, and the study's findings suggest that no such instrument is yet adequately in place.

7.2 Freshwater as the keystone variable

The two-coasts argument introduces the possibility of differentiation, the freshwater argument introduces what, in the deltaic case, is at the centre of the causal web. From the interviews and the discussions, across the survey, the freshwater — how much, its saltiness, how safe it is to drink — is the one variable that links the environmental change to agricultural failures, livestock losses, disease and social hardships. Safe drinking water is a top priority within the household, most practical community-level project and a top priority health-support project. The major agricultural hazard is salinity. Waterborne disease is the biggest health problem. Proximate factors of land abandonment are the drying of canals and intrusion of the tidal water.

This convergence justifies treating freshwater security not as one sector among several but as the keystone intervention on which the viability of all the others depends. Restoring or substituting freshwater through environmental flows to the delta, salinity management, safe drinking-water supply, and rainwater and managed-aquifer approaches would simultaneously address agricultural productivity, livestock fodder, human health and the social burden that falls disproportionately on women. The converse also holds: sector-specific interventions that leave the freshwater deficit untouched improved crop varieties on land that keeps salinising, or health services treating diarrhoea while the water that causes it stays contaminated will deliver diminishing returns. The keystone status of freshwater is the study's clearest guide to the sequencing of investment.

In Gwadar the keystone variable differs in character but is analogous in function: the health of the marine ecosystem stands in the same relation to the fishing economy as freshwater stands to the deltaic economy. Protecting and restoring the marine resource base through habitat protection, controls on destructive trawling, and management of the fishery as a common-pool resource is the keystone on which the Makran livelihood system depends.

7.3 The relief–dependency paradox

The study's most policy-consequential finding is the paradox that the more exposed district receives more assistance yet remains more vulnerable. The findings of the survey revealed that the households of Sujawal reported greater prevalence of post- shock governmental and non- governmental relief than those of Gwadar and had significantly lower adaptive capacity on virtually all measures. The qualitative data address the apparent paradox: the aid Sujawal receives is more reactive relief (food, cash and materials after a flood or cyclone) than proactive investment in freshwater resources, salinity management and coastal protection which would make the risk less.

The outcome is a vicious circle. Every shock erodes household assets; relief brings household back to bare survival, not productive capacity; households are again left in an unfenced state and shaken. As time goes on, dependence on relief can be useful in undermining local institutions and self-organisation needed for adaptation, leading to

dependence on outside sources. The study refers to this as the relief–dependency paradox – a phenomenon where humanitarian aid (which may be needed at the time) becomes a substitute for structural adaptation, and thus reinforces dependency. The finding sits comfortably within a substantial development literature on the limits of relief-led response, and it reinforces the case, made across the international adaptation-finance discourse, for shifting resources from repeated emergency response towards anticipatory, risk-reducing investment.

Breaking the paradox requires a deliberate reallocation from reactive relief to proactive resilience, coupled with the institutional reforms transparent targeting, protection against elite capture, community participation that would ensure such investment reaches the most exposed. This is the organising logic of the policy framework in Chapter 9.

There is also a compelling economic logic that strengthens the moral and humanitarian case. Repeated relief is not cheap: each cycle of flood, cyclone or drought triggers expenditure on food, cash and reconstruction that recurs indefinitely because the underlying vulnerability is never addressed. One-time investment in freshwater security, salinity management and coastal protection, by contrast, reduces the frequency and severity of the losses that make relief necessary, and its benefits accrue year after year. Over a sufficient horizon, the anticipatory option is very plausibly the cheaper one, quite apart from the human suffering it averts. The study accordingly recommends, as a research priority, formal economic valuation of this comparison — the cumulative cost of repeated relief set against the cost of the resilience investment that would forestall it — to give decision-makers the fiscal argument for reallocation. Until that reallocation occurs, even generous and well-intentioned assistance will go on sustaining survival while entrenching the conditions that make survival precarious.

7.4 Institutional failure as a driver of vulnerability

A recurring theme across the qualitative data is that vulnerability in these communities is produced as much by institutional failure as by climatic hazard. The survey finding that Sujawal combines the highest exposure with the weakest adaptive capacity cannot be explained in climatic terms alone. It reflects an institutional geography in which the deltaic communities are more remote from markets, services, credit, connectivity and effective governance than their Makran counterparts. The informants argue that the institutions are absent and that relief is ad hoc, while elite capture siphons benefits away from the poorest and insecure land tenure conditions set an obstacle to long-term investment.

This reading contextualizes the study within the existing political-ecology framework of disaster where a natural hazard turns into a human catastrophe because of the distribution of exposure and capacity at unequal rates within social and institutional structures. The same cyclone, flood or drought can have very different results in varying institutional settings. The policy corollary is that adaptation will not be achieved through infrastructure and technology; the institutional deficit (extension of credit, insurance, extension services, connectivity and transparent and participatory governance) must be repaired and brought to communities that have been effectively excluded from them. The findings of this study reveal significant policy intent and institutional reality gaps in the Sindh Climate Change Policy 2022 and National Adaptation Plan 2023.

The institutional geography which creates this gap deserves to be named exactly, since it indicates where the effort for reform should be directed. The deltaic villages of Sujawal are geographically isolated; isolated by creeks, roads and towns; and the physical isolation of the villages is reflected in their institutional isolation. In the more connected, port anchored economy of Gwadar, markets, banks, insurers, extension agents, veterinary and health services and officials from relief and development are further away, more difficult to reach, and less present; and so are the goods. Distance thus becomes a determinant of vulnerability in its own right: it delays the arrival of assistance during disaster and the delivery of services in ordinary times, and it raises the cost of every transaction on which adaptation depends. Reducing this remoteness through connectivity, mobile service delivery, and the deliberate placement of institutions where the most exposed communities actually live — is therefore not peripheral to adaptation but central to it. The lesson generalises: wherever high physical exposure coincides with institutional remoteness, vulnerability will be greatest and the returns to institutional presence highest.

7.5 Extending the framework: ecology, human security and gender

The emergent themes of Chapter 6 extend the conventional exposure–sensitivity–adaptive-capacity framework in three directions that, the study argues, are essential to an adequate account of coastal vulnerability in this context.

First, marine-ecosystem degradation must be recognized as a hazard class in its own right. Conventional coastal-hazard frameworks centred on storms, floods and sea-level rise do not capture the slow collapse of a marine ecosystem warming, blooms, habitat loss and species extinction that is the dominant hazard in Gwadar. Incorporating ecological hazard requires ecological indicators, ecological monitoring and ecological governance that standard vulnerability assessment omits.

Second, human security must be built into the framework. The criminalization of fishing livelihoods through cross-border arrest and detention converts environmental scarcity into a human-security problem that no amount of local adaptation can resolve, and that demands attention at the level of maritime governance and inter-state relations. Vulnerability here is co-produced by ecological decline and by the geopolitics of a contested sea.

Third, gender and social inclusion are not a cross-cutting afterthought but a structural determinant of who bears the cost of climate change. The study finds women absorbing the burden of water insecurity through their labour and health, excluded from the forums where relief and adaptation are decided, and in the Gwadar case heading a large share of households in the absence of migrant or detained men. An adequate framework places the gendered distribution of exposure, sensitivity and capacity at its centre, not at its margin.

7.6 The study in comparative deltaic and coastal perspective

The findings resonate with, and in some respects sharpen, the international literature on the vulnerability of major deltas and low-lying coasts. The world's great deltas — among

them the Ganges–Brahmaputra–Meghna, the Mekong and the Nile share a common syndrome in which upstream water regulation, sediment starvation, subsidence and relative sea-level rise combine to drive salinisation, land loss and the erosion of agrarian livelihoods. The Indus delta, as documented here for Sujawal, shows this syndrome in an especially acute, arid-zone form: with freshwater and sediment supply drastically reduced, the delta has lost the very process that once allowed it to keep pace with the sea. The deltaic findings are therefore not anomalous but representative of a globally recognised pathway of deltaic decline which lends them external credibility while underscoring the severity of the Indus case.

The Makran findings, by contrast, align the study with the growing literature on tropical and sub-tropical coasts where the dominant threat is not submergence but the degradation of the marine socio-ecological system: warming seas, coral and mangrove loss, harmful algal blooms and fishery collapse. In this respect Gwadar has more in common with warming-sea fishing coasts elsewhere in the Indian Ocean than with the neighbouring Indus delta reinforcing the study's central insistence that the two coasts of southern Pakistan belong to different vulnerability regimes and must not be treated as one undifferentiated coastal problem. The comparative lens thus corroborates the two-signatures thesis from the direction of the global evidence base.

7.7 Political ecology and the production of vulnerability

The finding that institutional failure is as consequential as climatic change places the study squarely within the political-ecology tradition of disaster research, in which catastrophe is understood not as a purely natural event but as the product of a hazard meeting a socially produced condition of vulnerability. On this reading, the same sea-level rise, cyclone or drought yields radically different human outcomes depending on the distribution of assets, entitlements, services and power into which it falls. The Sujawal–Gwadar contrast is a natural experiment in this proposition: the more physically exposed district suffers more not only because the hazard is greater but because the institutional environment is thinner, the entitlements weaker and the exclusion of the poorest more complete. The relief–dependency paradox is, in these terms, a governance choice the selection of reactive over anticipatory action as much as a resource constraint, and it can therefore be reversed by governance reform.

An important corollary follows for adaptation practice. If vulnerability is produced socially and institutionally, it can also be reduced by social and institutional means by extending credit, insurance, extension, connectivity and voice to communities that have been excluded from them and not only by the hard infrastructure of embankments and desalination plants. The recommendations accordingly pair physical investment with institutional repair, treating the two as complementary and inseparable rather than as alternatives.

7.8 Implications for adaptation finance and the adaptation gap

The study speaks directly to the international debate on the adaptation gap the shortfall between the adaptation that is needed and the adaptation that is financed and delivered. Pakistan's negligible contribution to global emissions, set against its acute exposure,

places it at the centre of the equity case for scaled-up concessional adaptation finance, and the recent commitment of major multilateral investment to Sindh's coast is a welcome shift in that direction. The findings offer three cautions for using such finance effectively. First, finance must be differentiated by coast: an instrument optimised for the deltaic signature will not serve the Makran signature, which currently lacks an equivalently scaled, ecosystem-oriented vehicle. Second, finance must be anticipatory rather than reactive, deliberately reallocating resources from repeated post-disaster relief to the risk-reducing investment that breaks the dependency cycle. Third, finance must be institutionally safeguarded, with transparent targeting and community oversight to prevent the elite capture that would otherwise divert it from the most exposed. Without these three conditions, even substantial adaptation finance risks reproducing, at greater scale, the relief–dependency pattern the study identifies.

7.9 Sequencing, no-regret options and trade-offs

The findings carry clear implications for the sequencing of adaptation investment, which matters as much as its content. Because freshwater in the delta and marine-ecosystem integrity on the Makran coast are keystone variables, the investments that secure them should come first: their returns condition the productivity of everything that follows. Safe drinking water in particular is a no-regret option. It is the most prioritised need, it addresses the leading cause of illness, it relieves the burden borne by women, and it is beneficial under every plausible climate future, with essentially no risk of maladaptation. Basic accessible primary health care, veterinary services and community institution-building share this no-regret character: they yield benefit regardless of the precise trajectory of climate change and should not wait on the resolution of longer-term uncertainties.

Other interventions involve genuine trade-offs that decision-makers must weigh openly. Hard coastal-protection infrastructure can defend specific assets but may accelerate erosion elsewhere and lock in settlement patterns that a retreating coast will eventually make untenable; it must therefore be planned alongside, not instead of, the option of managed relocation for the most exposed submergence-threatened communities. Restoring environmental flows to the delta is arguably the single most consequential deltaic intervention, but it involves inter-provincial water-allocation trade-offs of great political difficulty and long time horizons, and it cannot substitute in the interim for local freshwater provision. In the fishery, controls on destructive trawling protect the resource but impose short-term costs that must be managed through transition support if they are to be politically sustainable. Recognising these trade-offs openly, rather than presenting adaptation as uniformly win-win, is itself a contribution to sound coastal policy.

The overarching sequencing logic that emerges is therefore: first, the no-regret keystone investments in water, health and institutions; second, the sector-specific measures in agriculture, fisheries and livestock that those keystones make viable; and third, the longer-horizon structural interventions environmental flows, managed relocation, co-managed fisheries that require sustained political commitment. The phased framework in Chapter 9 reflects this logic.

7.10 The refined conceptual framework

Integrating these arguments, the study refines the conceptual framework introduced in Chapter 2. Coastal vulnerability in southern Pakistan is best understood as the product of four interacting systems: a climatic-hazard system that differs by coast (deltaic freshwater loss versus Makran marine change); a livelihood-sensitivity system in which agriculture, livestock and fisheries are differentially exposed; an adaptive-capacity system shaped decisively by institutional presence and absence; and a governance system that determines whether assistance takes the form of reactive relief or proactive resilience, and whether its benefits reach the most exposed. Human security and gender are trans-cutting, both as determinants of distribution and experience of hazard, within all the four systems.

In this sophisticated setting, two variables, freshwater security in the delta and marine-ecosystem integrity on the Makran coast, serve as the keystones; one government pathology, the relief–dependency paradox, is what impedes change and what is necessary for institutional repair is the key to translating adaptation finance into reduced vulnerability. This framework structures the conclusions and recommendations that follow.

7.11 Attribution of impacts: distinguishing climate hazards from structural drivers

Why attribution matters. The communities in this study have experienced decades of neglect, weak governance, limited public investment and few development opportunities; recent climatic change has intensified vulnerabilities that are, in large part, rooted in these longstanding structural conditions. Distinguishing the two - so far as the mixed-methods evidence allows - matters for action: it clarifies which impacts require climate-specific adaptation, which require governance and development remedies, and which require both.

The study's evidence supports a layered reading. Some drivers are primarily climatic, some primarily structural, and most are compound. Table 7.1 sets this out. The classification is analytical and qualitative, drawn from the convergence of survey, interview and discussion evidence and the reviewed literature; it is not a formal quantitative attribution study, which would require dedicated modelling.

Table 7.1. Indicative attribution of observed impacts to climate hazards and structural drivers (analytical classification from the study's mixed-methods evidence).

Observed impact	Dominant climate signal	Dominant structural / governance driver	Reading
Salinity and land loss	Sea-level rise; less reliable monsoon	Kotri Barrage and upstream diversion cutting Indus flow to the delta	Compound: climate + water governance
Freshwater insecurity	Drought; saline intrusion	Absent piped supply; canal neglect; no RO provision	Mainly structural, climate-amplified
Fisheries decline	Sea warming; algal blooms; habitat loss	Illegal trawling; weak enforcement; middleman and debt structure	Compound
Health burden	Hazard exposure	Contaminated water; distant, under-equipped facilities	Mainly structural (water and health systems)
Relief-dependency and slow recovery	Repeated shocks	Reactive relief, no adaptation investment, elite capture	Primarily structural / governance

Disproportionate impact on the poor and women	Uniform hazard exposure	Pre-existing poverty, landlessness and exclusion	Structural vulnerability

The implication strengthens the case for action. Because so much of the observed suffering is structural, it is also remediable. Coordinated action by government institutions, civil society, the private sector, policymakers and service providers can materially reduce vulnerability even before the climate signal is fully addressed - and the most lethal impacts, those running through water and disease, are among the most fixable. Far from weakening the case for urgent intervention, this attribution strengthens it: it identifies concrete, deliverable actions that would save lives and livelihoods now, while climate exposure continues to rise.

7.12 Government response, preparedness and policy direction

A transparent note on evidence. The study's key-informant sample was community- and fisheries-weighted; formal line-department officials - agriculture extension, fisheries, livestock and veterinary services, irrigation, disaster management, health and education - were not directly interviewed, a limitation noted in Section 4.11. The account below therefore combines the government's stated policy and investment direction with community-observed delivery on the ground, and recommends that officials be directly engaged during the validation and launch of this study.

At the federal level, Pakistan's updated Nationally Determined Contribution and the National Adaptation Plan (2023) set the adaptation architecture; at the provincial level, the Sindh Climate Change Policy (2022) governs the delta with explicit attention to coastal zones, water and the vulnerable sectors examined here. On investment, the Asian Development Bank's Sindh Coastal Resilience Sector Project (approved December 2025, co-financed by the Green Climate Fund) targets the districts of Badin, Sujawal and Thatta with coastal protection, freshwater and mangrove restoration and a defined allocation to women-led activity, while the World Bank's LIVAQUA Project (2024) supports climate-smart livestock and aquaculture in Sindh. These commitments represent the government's declared preparedness and direction of travel.

Set against this, the community evidence points to a persistent gap between policy and delivery: flood-affectee housing (implemented through SPHF) reported as incomplete; weak enforcement against illegal trawling; and the near-absence of extension, veterinary and health services in remote deltaic and Makran settlements. Assistance reaches communities mainly as post-disaster relief rather than anticipatory protection. Closing this policy-to-delivery gap - through resourced line departments, functioning early warning that reaches remote settlements via the district and provincial disaster authorities, and transparent targeting - is the central governance task, and a natural focus for the official engagement recommended above.

Chapter-8
Conclusions

This study set out to assess the climate-change vulnerability of two contrasting coastal districts of Pakistan Sujawal in the Indus delta of Sindh and Gwadar on the Makran coast of Balochistan across the agriculture, fisheries and livestock sectors, using a mixed-methods design that combined a survey of 402 households with fourteen key informant interviews and six focus group discussions, all read against the national and international evidence base. The conclusions below respond directly to the study's objectives and research questions and summarise its principal contributions to knowledge and policy.

8.1 Conclusions against the research questions

On the nature and distribution of exposure (RQ1), the study concludes that exposure to climate hazards is severe in both districts but concentrated in Sujawal, which reports exposure across nearly every hazard at three to five times the Gwadar rate. Critically, the two districts face qualitatively different hazard signatures: Sujawal faces salinity, submergence, freshwater loss and riverine and coastal flooding driven by reduced Indus flow and sea-level rise, while Gwadar faces coastal erosion, marine-ecosystem collapse and altered storm regimes driven by a warming sea.

On sensitivity and sectoral impact (RQ2), the study concludes that all three livelihood sectors are highly sensitive, with between two-thirds and three-quarters of engaged households reporting climate-related losses over the past decade. Agriculture is dominated by soil salinity and yield decline, fisheries by catch decline and work disruption, and livestock by animal loss, fodder shortage and heat stress. Sensitivity is higher in Sujawal, where food and water shortages over the previous year affected roughly two-thirds of households.

On adaptive capacity (RQ3), the study reaches its most striking conclusion: adaptive capacity is weaker in the more exposed district. Sujawal households have far lower access to credit, insurance, extension, connectivity and information than Gwadar households, rely more heavily on damaging coping strategies, and take longer to recover. This inversion of the expected relationship between exposure and capacity is explained by the institutional geography of the two districts.

On the human and health dimensions (RQ4), the study concludes that the pathway from climate change to human harm runs decisively through water and disease. Half of all households reported a climate-related health problem over five years, led by waterborne and vector-borne illness, with children most affected and treatment access severely constrained. The need for safe drinking water is the highest overall need throughout the study and the health burden is best conceptualised as a freshwater–health nexus, with contaminated and saline freshwater being the primary agents of disease.

On adaptation priorities and institutional response (RQ5), the study finds that the two districts need tailored adaptation pathways, that freshwater security is the linchpin adaptation intervention, and that the current reactive relief approach needs to move to a

proactive, risk-reduction approach to adaptation through improved, participatory institutions.

8.2 Principal contributions

There are four main contributions to the study. First, it presents one of the first primary-data based vulnerability assessments of different nature that it presents an empirically founded proof of the presence of two different vulnerability regimes in Sindh deltaic and Balochistan Makran coasts. Second, it highlights and maps the "relief–dependency paradox" (inverse correlation between the level of assistance provided and the level of vulnerability reduced) as a key disease in coastal governance in the delta. Third, it shows the importance of freshwater in the deltaic system and of marine-ecosystem integrity in the Makran system, giving a strong sense of sequencing investments. For the fourth time it takes the existing vulnerability concept and integrates marine-ecosystem degradation as an additional hazard class, human security as an additional structural component and gender as a determinant, not an afterthought.

8.3 Summary of answers to the research questions

The table below distils the study's response to each research question into a single headline conclusion, providing a compact synthesis of the findings elaborated above.

Table-8.1: Summary of the study's answers to the five research questions.

Research question	Headline conclusion
Q1 Main threats and vulnerable groups	Severe exposure in both districts, concentrated in Sujawal, via two distinct hazard signatures; women, children and the poor most affected
Q2 Sectoral impacts over the decade	All three sectors highly sensitive; agriculture (salinity), fisheries (catch/ecosystem collapse), livestock (disease, fodder, heat)
Q3 Most vulnerable groups and places	Sujawal deltaic communities; tenant, landless and women-headed households; explained by exposure plus institutional remoteness
Q4 Drivers of adaptive capacity	Institutional presence/absence decisive; Sujawal paradoxically weaker despite higher exposure; relief substitutes for adaptation
Q5 Practical adaptation options	Differentiated by coast; freshwater and marine-ecosystem keystones first; institutional reform as the enabling condition

8.4 Cross-cutting lessons

Beyond the answers to the individual research questions, four cross-cutting lessons emerge that carry beyond the two study districts. First, exposure and capacity must be assessed together, never separately. The study's central finding that the most exposed district is the least able to adapt — would have been invisible to an assessment measuring physical hazard alone, and it is precisely this combination that identifies where adaptation investment is most urgently needed. Second, water is the integrating variable of coastal

vulnerability, connecting hazard to agriculture, livestock, health and gender in a single causal web; interventions that treat these as separate sectors will under-perform interventions that recognise their common dependence on freshwater. Third, the form of assistance matters as much as its quantity: reactive relief and proactive adaptation are not points on one scale but qualitatively different responses, and the shift between them is the single most consequential governance choice available to decision-makers. Fourth, local knowledge is evidence: the communities' documentation of vanished species, warming seas, and submerged villages was consistent, specific and analytically useful, and the systematic, systematic incorporation of it enhanced the assessment and the legitimacy of the response.

8.5 Transferability of the findings

The quantitative outputs are applicable solely to the context of Sujawal and Gwadar and cannot be statistically generalized to coastal population in general, although the main analytical outputs would apply to similar settings. The two-signatures distinction — deltaic freshwater loss versus marine-ecosystem degradation should hold along Pakistan's coast more broadly, with the neighbouring deltaic districts of Thatta and Badin sharing the Sujawal signature and other Makran settlements such as Pasni, Jiwani and Ormara sharing the Gwadar signature. The relief–dependency paradox and the centrality of institutional reform are likely to recur wherever high physical exposure coincides with institutional remoteness. And the comparative, mixed-methods approach in a data-scarce setting is itself transferable, offering a template for rapid, policy-relevant vulnerability assessment elsewhere on the coast and in comparable deltaic and arid-coast environments.

8.6 Overall conclusion

The overarching conclusion is that coastal vulnerability in southern Pakistan is co-produced by climatic change and institutional failure, and that reducing it requires a shift from undifferentiated, relief-led response to differentiated, adaptation-led investment — anchored in freshwater security in the delta and marine-ecosystem protection on the Makran coast, and delivered through institutions reformed to reach the most exposed and to include those whom current arrangements systematically bypass: women, tenant farmers, artisanal fishers and the landless. The communities themselves have stated this conclusion with precision. They seek not charity but the restoration of the water and the sea on which their lives depend, and the rights and institutions that would let them adapt. The recommendations that follow translate this conclusion into an actionable policy framework.

Chapter - 9
Recommendations and Policy Action Framework

The recommendations below translate the study's conclusions into an actionable, phased policy framework. They are organized into six thematic pillars, each responding to a principal finding and each aligned with the existing policy architecture — the Sindh Climate Change Policy 2022, the National Adaptation Plan 2023, Pakistan's updated Nationally Determined Contribution, and the major investment instruments now in preparation or under implementation, including the Asian Development Bank Sindh Coastal Resilience Sector Project and the World Bank Sindh Livestock and Aquaculture Sectors Transformation (LIVAQUA) Project. The framework is deliberately differentiated between the deltaic and Makran coasts, in line with the two-coasts conclusion, and is sequenced to give first place to the keystone interventions freshwater security in the delta and marine-ecosystem protection on the Makran coast on which the returns to all other investment depend.

Each pillar is presented with its rationale, priority actions, phasing across short (0–2 years), medium (2–5 years) and long (5–10 years) horizons, lead responsibility and alignment with existing policy and finance. The framework is designed to break the relief–dependency paradox by shifting the centre of gravity from reactive response to anticipatory, risk-reducing investment delivered through reformed, participatory institutions.

Five principles govern the framework as a whole. First, differentiation: interventions are matched to each coast's hazard signature rather than applied uniformly. Second, sequencing: the keystone investments in freshwater, marine-ecosystem health and basic services come first, because the returns to everything else depend on them. Third, no-regret prioritization: interventions that yield benefit under every plausible climate future safe water, basic health and veterinary services, community institutions are advanced ahead of those requiring firmer long-term forecasts. Fourth, anticipation over reaction: a deliberate reallocation of resources from repeated relief towards risk-reducing investment. Fifth, inclusion and safeguarding: transparent targeting, protection against elite capture, secure tenure and the genuine participation of women and marginalized groups, without which investment merely reproduces existing exclusions. On costing, the framework is phased rather than priced to a false precision. The study did not undertake detailed engineering or economic costing, and the indicative resourcing implied by the phased tables should be developed into full budgets through the standard project-preparation processes of the aligned instruments, informed by the community-validated priorities documented here. What the study offers is not a costed bill of quantities but a defensible ordering of priorities and a differentiated logic for where investment will do the most good.

9.1 Pillar 1 Freshwater security (the keystone pillar)

Rationale. Freshwater its quantity, salinity and safety for drinking is the keystone variable of deltaic vulnerability and a leading determinant of health, agricultural viability and the burden borne by women. It is the single most prioritised need across the study.

- Establish safe drinking-water supply in the most affected deltaic and coastal settlements through reverse-osmosis and desalination plants, protected wells and piped supply, giving priority to the Sujawal union councils with the highest salinity and disease burden.
- Secure environmental flows to the Indus delta sufficient to arrest salinity intrusion and restore freshwater flushing, pursued through inter-provincial water governance and the Indus River System Authority.
- Invest in rainwater harvesting, managed aquifer recharge and small-scale freshwater storage adapted to deltaic and Makran conditions, reducing dependence on tanker water that costs Gwadar households PKR 35,000–40,000 per fill.
- Rehabilitate and de-silt local canals and freshwater channels, including those communities have identified as no longer functioning.

Table-9.1: Phasing of freshwater-security actions.

Phase	Priority action	Lead	Alignment
Short (0–2 yr)	Emergency RO/desalination plants and protected water points in highest-salinity settlements	PHED Sindh/Balochistan; NGOs	ADB SCRP; Sindh CC Policy 2022
Medium (2–5 yr)	Piped safe-water schemes; rainwater harvesting; aquifer recharge pilots	Provincial PHED; local government	NAP 2023; ADB SCRP
Long (5–10 yr)	Restored environmental flows to delta; salinity intrusion arrested	IRSA; Federal/provincial water authorities	Updated NDC; Sindh CC Policy 2022

9.2 Pillar 2 Climate-resilient agriculture and salinity management

Rationale. Soil salinity and freshwater loss have redefined what can be grown in the delta, with the majority of coastal Sindh soils salt-affected. Agriculture needs both freshwater restoration (Pillar 1) and salinity-adapted production systems.

- Promote salt-tolerant and short-duration crop varieties, salinity-tolerant fodder and appropriate rice and wheat cultivars through participatory demonstration on farmers' fields.
- Support salinity management through bio-saline agriculture, drainage improvement, gypsum application and land reclamation where freshwater flushing can be restored.
- Strengthen agricultural extension in the deltaic zone, where the study found extension access far below the Gwadar level, using farmer field schools and lead-farmer approaches.

- Introduce index-based crop insurance and accessible agricultural credit targeted at the tenant and smallholder farmers currently excluded from both.

9.3 Pillar 3 Fisheries governance and marine-ecosystem protection (the Makran keystone)

Rationale. The collapse of the marine ecosystem — warming, algal blooms, habitat loss and species decline — is the keystone hazard on the Makran coast, compounded by unsustainable trawling and the criminalisation of fishing livelihoods through cross-border arrest.

- Establish and enforce marine protected areas and habitat restoration for coral and mangrove nurseries along the Makran coast, rebuilding the resource base of the artisanal fishery.
- Regulate destructive and mechanised trawling in artisanal fishing zones and co-manage the fishery as a common-pool resource with fisher communities.
- Revise the closed-season calendar to reflect the observed shift of the storm and spawning season from June–July to August–September, in consultation with fisher communities.
- Provide boat and gear replacement support, cold-chain and value-addition infrastructure, and accessible marine credit and insurance to artisanal fishers.
- Address the human-security dimension through improved maritime safety, clear communication of maritime boundaries, and diplomatic mechanisms to prevent and resolve cross-border detention of fishers.

Table-9.2: Phasing of fisheries and marine-ecosystem actions.

Phase	Priority action	Lead	Alignment
Short (0–2 yr)	Trawling controls in artisanal zones; revised closed-season calendar; gear/boat support	Balochistan Fisheries Dept; fisher COs	WB Revitalizing Fisheries; NAP 2023
Medium (2–5 yr)	Marine protected areas; mangrove/coral restoration; cold-chain and value addition	Fisheries Dept; marine research bodies	WB LIVAQUA; Sindh/Balochistan policy
Long (5–10 yr)	Co-managed common-pool fishery; maritime human-security mechanisms	Provincial/federal; maritime authorities	Updated NDC; national frameworks

9.4 Pillar 4 Livestock resilience and animal health

Rationale. Livestock, a critical buffer livelihood, faces converging pressures of disease, fodder scarcity and heat stress, with catastrophic losses during extreme events. The World Bank LIVAQUA project offers a major aligned investment vehicle.

- Strengthen veterinary services and disease surveillance for the priority diseases communities themselves identified — foot-and-mouth disease, lumpy skin disease, peste des petits ruminants, contagious caprine pleuropneumonia and enterotoxaemia through vaccination campaigns and mobile veterinary units.
- Develop salinity-tolerant fodder production and community fodder banks to address the shortage driven by grazing-land loss.
- Provide heat-stress mitigation through shade, water and adapted husbandry practices, and livestock insurance against extreme-event loss.
- Integrate livestock support with the freshwater and agriculture pillars, recognising that fodder and animal health depend on the same freshwater base.

Expected outcome. Reduced animal mortality and morbidity, more stable herd sizes, and the preservation of livestock as a working buffer against crop and fishery failure particularly for the tenant, landless and women-managed households for whom animals are the primary productive asset. Success would show in lower reported animal-loss rates, fewer distress sales, and better fodder and water availability during lean and hazard periods.

9.5 Pillar 5 Climate-health and social protection

Rationale. The freshwater–health nexus makes waterborne and vector-borne disease the leading pathway from climate change to human harm, with children most affected and treatment access severely constrained. Communities prioritise mobile health services.

- Deploy mobile health camps and outreach services to remote deltaic and coastal settlements the top health-support priority identified by the survey — integrated with the safe-water provision of Pillar 1.
- Strengthen water, sanitation and hygiene programming and diarrhoeal-disease prevention, recognising that health outcomes depend on the freshwater interventions of Pillar 1.
- Expand vector-borne disease surveillance and control in response to the high reported burden.
- Improve maternal and child health services in remote settlements, including round-the-clock maternity provision where it is currently absent, in response to the specific gaps documented in the fishing communities.
- Establish adaptive, shock-responsive social protection that shifts assistance from post-disaster relief towards anticipatory support, breaking the relief–dependency

cycle, with transparent targeting that reaches women-headed households, tenant farmers and the landless.

Expected outcome. A measurable reduction in waterborne and vector-borne illness, better treatment access for the most remote households, and a decisive shift in the composition of assistance from reactive relief towards anticipatory, risk-reducing support. Because the health burden is so tightly coupled to water, this pillar's success is inseparable from Pillar 1's: safe water and basic accessible primary care together address the pathway communities themselves identify as the most lethal expression of coastal climate change.

9.6 Pillar 6 Institutional reform, gender inclusion and community governance

Rationale. The study concludes that institutional failure is as consequential as climatic change. Repairing the institutional deficit — extending credit, insurance, extension, connectivity and transparent, participatory governance — is the necessary condition for all other investment to reduce, rather than merely relieve, vulnerability.

- Establish and resource community-based organisations and disaster-management committees with genuine decision-making authority over local adaptation and relief, protecting against elite capture through transparent targeting and community oversight.
- Guarantee women's participation and leadership in community forums, adaptation planning and resource allocation, in recognition of their disproportionate exposure and current exclusion, aligned with the gender-responsive provisions of the ADB SCRP, which reserves a substantial share of benefits for women-led activity.
- Address land-tenure insecurity through recognition of customary rights, resettlement policy for submergence-displaced communities, and safeguards in the context of port and coastal development.
- Link educational attainment to local livelihood opportunity, particularly in Gwadar, through skills programmes and enterprise support that address the education–employment mismatch.
- Build a coastal climate-information and early-warning system that reaches remote communities and incorporates the local ecological knowledge documented in this study.

Expected outcome. This pillar is the connective tissue of the whole framework. Its success would show not in a single indicator but in the changed performance of all the others: adaptation investment reaching the most exposed rather than the best-connected; women and marginalised groups present in the decisions that affect them; secure tenure underpinning long-term investment; and a governance system that chooses anticipatory protection over repeated relief. Without institutional reform, the physical investments of

Pillars 1 to 5 risk reproducing existing exclusions; with it, they can deliver durable reductions in vulnerability.

9.7 Consolidated policy-alignment matrix

The six pillars are designed to plug into the existing policy and investment architecture, not to stand apart from it. The matrix below maps each pillar to the principal aligned instruments, showing where responsibility and finance already exist and where gaps remain most notably the absence of a Makran-specific, ecosystem-oriented investment instrument comparable to the ADB operation in the delta.

Table-9.3: Consolidated policy-alignment matrix for the six-pillar framework.

Pillar	Aligned national/provincial policy	Aligned investment instrument	Principal gap
1 Freshwater security	Sindh CC Policy 2022; NAP 2023; Updated NDC	ADB Sindh Coastal Resilience Sector Project	Environmental flows to delta; Makran freshwater
2 Climate-resilient agriculture	Sindh CC Policy 2022; NAP 2023	ADB SCRP; provincial agriculture programmes	Extension reach in deltaic zone; smallholder credit
3 Fisheries and marine ecosystem	NAP 2023; provincial fisheries policy	WB Revitalizing Fisheries; WB LIVAQUA	Makran-specific marine-protection instrument
4 Livestock resilience	NAP 2023; provincial livestock policy	WB LIVAQUA	Deltaic veterinary reach; fodder security
5 Climate-health and social protection	NAP 2023; provincial health/social policy	Social-protection and WASH programmes	Shock-responsive, anticipatory design
6 Institutional and gender governance	Sindh CC Policy 2022; NDC gender commitments	ADB SCRP gender window	Anti-elite-capture targeting; tenure security

9.8 Indicative results framework

To support implementation and monitoring, the framework is expressed below as an indicative results chain linking activities to outputs, outcomes and the overarching goal. Indicators are illustrative and would need baseline establishment and stakeholder validation before use in a formal monitoring system.

Table-9.4: Indicative results framework linking activities to the overarching goal.

Results level	Illustrative statement	Illustrative indicator
Goal	Reduced climate vulnerability of coastal communities in Sujawal and Gwadar	Composite vulnerability score reduced against baseline
Outcome 1	Improved freshwater security and reduced waterborne disease	% households with safe drinking water; diarrhoeal-illness incidence
Outcome 2	Sustained livelihoods in agriculture, fisheries and livestock	% households reporting climate-related losses; recovery time after shock
Outcome 3	Strengthened, inclusive institutions and reduced relief dependence	Ratio of adaptation to relief spending; women's participation in decision forums
Outputs	Water schemes, salinity management, marine protection, veterinary and health services, community institutions	Number of schemes/services delivered; area under salinity management; MPAs established
Activities	The priority actions of Pillars 1–6	Activity completion against phased plan

9.9 Monitoring, evaluation and learning

Effective implementation requires a monitoring, evaluation and learning system built on a validated baseline drawn from this study's data. Three principles should govern it. First, monitoring should be differentiated by coast, tracking deltaic indicators (salinity, groundwater quality, land loss, freshwater access) and Makran indicators (sea-surface temperature, algal-bloom frequency, fish-stock status, shoreline change) separately, since one indicator set cannot capture both signatures. Second, it should be gender-disaggregated, tracking the differential burden and benefit borne by women, women-headed households and excluded groups. Third, it should incorporate community observation, formalising the local ecological knowledge documented here into participatory monitoring that improves the data and strengthens community agency at the same time. Learning from this system should feed back into adaptive management, allowing the framework to be refined as conditions and evidence evolve.

9.10 Follow-up research priorities

The study identifies the following priorities for further research to strengthen the evidence base for coastal adaptation.

1. Longitudinal monitoring of salinity, groundwater quality and land loss in the Sujawal deltaic zone, and of sea-surface temperature, algal blooms and fish-stock status on the Makran coast, converting community observation into systematic time-series evidence.

2. Economic valuation of the relief–dependency paradox, quantifying the comparative cost of repeated relief against one-time resilience investment, to strengthen the fiscal case for reallocation.

3. A gender-disaggregated study of the health, labour and time burden of water insecurity, to inform the design of freshwater and social-protection interventions.

4. Assessment of the human-security dimension of cross-border artisanal fishing, including the scale, causes and consequences of detention, to inform maritime governance.

5. Evaluation of pilot interventions — safe-water schemes, salinity management, marine protected areas and shock-responsive social protection — to build the implementation evidence base for scale-up.

9.11 Dissemination, validation and uptake

Evidence changes practice only when it reaches, and is owned by, those who make decisions. The study therefore proposes a deliberate dissemination and uptake strategy with four elements. First, a community validation stage, returning the principal findings to the study communities in Sujawal and Gwadar for verification and comment, so that the analysis reflects lived reality and local ownership of the recommendations is built from the start. Second, district and provincial stakeholder workshops, convening the relevant line departments climate change, agriculture, fisheries, livestock, irrigation, health, disaster management and local government alongside development partners and civil-society actors, to translate the framework into departmental and programme planning. Third, targeted policy briefs, distilling the six-pillar framework and the two-signatures argument into concise, decision-ready formats for specific audiences, including the sponsors of the major coastal-investment operations now under way. Fourth, academic dissemination, publishing the methodology and findings so that the comparative approach can be scrutinised, refined and applied elsewhere.

Uptake should be pursued through the existing policy and investment architecture rather than in parallel to it. The alignment matrix in Table 9.3 identifies the specific instruments provincial climate and sectoral policies, the National Adaptation Plan, and the multilateral coastal-investment operations into which each pillar can be embedded. The study's district-level evidence is particularly suited to informing the targeting and sequencing decisions those instruments must make, helping to ensure that substantial adaptation finance goes where exposure and exclusion are greatest, and is delivered in the anticipatory, institutionally safeguarded form the findings show to be essential.

9.12 Policy recommendations for provincial and federal government

Because this study is intended to inform provincial and federal policy forums and a formal launch, the six-pillar framework above is distilled here into clear, actionable recommendations addressed to the tiers of government responsible for delivery. The recommendations are evidence-based and sequenced, leading with the no-regret water,

health and institutional actions that the findings show would save the most lives soonest, and assigning each to an indicative lead department or entity to support uptake.

Recommendations for provincial government (Sindh and Balochistan).

Table 9.5. Priority recommendations for provincial government (Sindh and Balochistan).

Priority area	Recommended action	Indicative lead
Safe drinking water	Roll out safe-water, piped-supply and RO/desalination schemes in the most saline deltaic and Makran settlements; treat as the first-order intervention	Public Health Engineering; local government
Salinity and agriculture	Scale salt-tolerant seed and bio-saline agriculture; strengthen agricultural extension in coastal talukas; invest in drainage and freshwater delivery	Agriculture research and Extension; Irrigation and revenue
Fisheries and marine	Enforce anti-trawling rules in artisanal zones; revise the closed-season calendar to the shortened window; establish marine protected areas; support boats, gear and cold chain	Fisheries; Coastal Development; climate change
Livestock	Mount vaccination campaigns and mobile veterinary units; provide fodder and water support for animals	Livestock and Veterinary Services
Health and protection	Deploy mobile health camps and WASH; strengthen maternal and child services; introduce shock-responsive social protection targeting the poorest	Health; Social Welfare
Institutions and gender	Resource district disaster authorities and community organisations; ensure transparent targeting, women's participation and tenure security	Planning and Development; local government; DDMA; PDMA

Recommendations for federal government.

Table 9.6. Priority recommendations for federal government.

Priority area	Recommended action	Indicative lead
Delta freshwater	Secure environmental flows to the Indus delta to arrest salinity advance;	IRSA; Ministry of Water Resources

	strengthen inter-provincial water governance	
Adaptation finance	Mobilise and channel concessional and Green Climate Fund adaptation finance to both coasts, including a dedicated Makran marine-and-fisheries instrument	Ministry of Climate Change; EAD
Policy coherence	Align NDC and National Adaptation Plan implementation with provincial coastal policies; establish shared monitoring	Ministry of Climate Change
Human security	Establish diplomatic and maritime mechanisms to prevent cross-border detention of fishers and to communicate boundaries clearly	Foreign Affairs; Maritime Security Agency
Disaster preparedness	Strengthen national early-warning systems so alerts reach remote coastal settlements	NDMA

Delivery should be coordinated across tiers through the existing policy architecture: provincial departments deliver front-line services, while the federal government provides the water-governance, adaptation-finance and cross-border enablers that provinces cannot secure alone. Sequenced this way, the recommendations move from immediate life-saving measures to the structural reforms that determine long-term resilience.

9.13 Concluding statement

The people of Sujawal and Gwadar stand on two of the most severe climate-change frontlines in Pakistan, but they stand on them differently: the delta is losing its freshwater and its land, and the Makran coast is losing its sea. In both places, the study finds, hazard becomes human catastrophe through institutions that deliver relief in place of protection and that bypass those most in need. The framework set out here offers a differentiated and phased pathway anchored in freshwater security in the delta and marine-ecosystem protection on the Makran coast, and delivered through reformed and inclusive institutions to break the cycle of vulnerability and to answer the communities' own demand: not for charity, but for the water, the sea and the rights on which their future depends.

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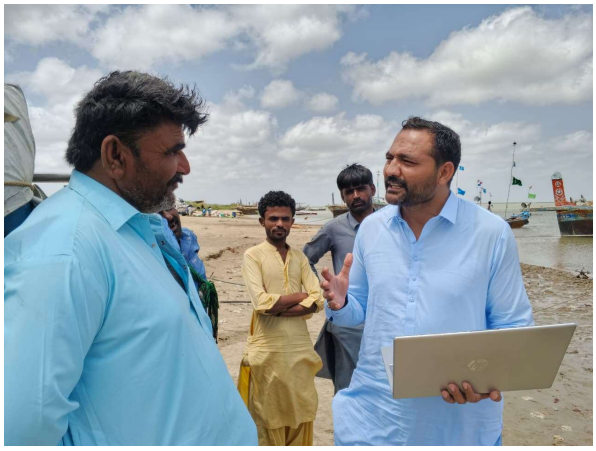
Picture Gallery

District Sujjawal, Sindh

FGD's at Jatti City, District Sujjawal

FGD's at Village Doongar Jatt, District Sujjawal

FGD's at Village Hassan Thaheem, District Sujjawal



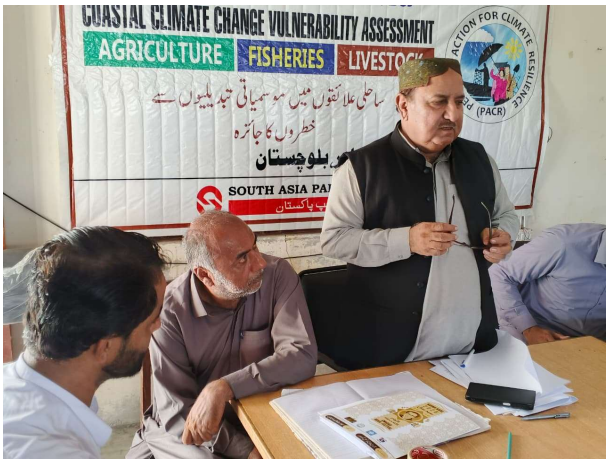

Household Field Data Collection, District Sujjawal




District Gawadar, Balochistan

Focus Group Discussion at Sadaf Hotel Gawadar City

Focus Group Discussion at UC Pishukan, District Gawadar




FOCUS GROUP DISCUSSIONS (FGDs)
COASTAL CLIMATE CHANGE VULNERABILITY ASSESSMENT
AGRICULTURE
LIVESTOCK


FOCUS GROUP DISCUSSIONS (FGDs)
COASTAL CLIMATE CHANGE VULNERABILITY ASSESSMENT
AGRICULTURE
FISHERIES
LIVESTOCK


FOCUS GROUP DISCUSSIONS (FGDs)
COASTAL CLIMATE CHANGE VULNERABILITY ASSESSMENT
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FOCUS GROUP DISCUSSIONS (FGDs)
COASTAL CLIMATE CHANGE VULNERABILITY ASSESSMENT
AGRICULTURE
FISHERIES
LIVESTOCK
SOUTH ASIA PARTNERSHIP PAKISTAN

Focus Group Discussion at UC Surbandar, District Gawadar

Household Field Data Collection at UC Pishukan and Surbandar, District Gawadar

Annexes

Field Data Collection Team at District Sujjawal, Sindh

Sr. No.	Name	Designation
1.	Raja Vinod Kumar	Field Coordinator
2.	Shanker Singh	Enumerator
3.	Pawan Kumar	Enumerator
4.	Shazia	Enumerator
5.	Pehlaj Rajput	Enumerator
6.	Sonia Kumbhar	Enumerator

Field Data Collection Team at District Gawadar, Balochistan

Sr. No.	Name	Designation
1.	Ms. Abro Baloch RCDC Gawadar	Field Coordinator
2.	Aatifa	Enumerator
3.	Hani	Enumerator
4.	Muhammad Moosa Yaar	Enumerator
5.	Junaid	Enumerator
6.	Barkat Basheer	Enumerator

Annex A Thematic coding framework

The qualitative analysis applied twenty-one first-level codes (A1–A21), grouped into the higher-order themes summarised below.

Table-A.1: Higher-order thematic structure of the qualitative coding framework.

Theme	Representative codes	Focus
Hazard experience and environmental change	A1–A5	Salinity, submergence, erosion, sea warming, altered storms
Sectoral impacts	A6–A9	Agriculture, fisheries, livestock, land loss
Freshwater–health nexus	A10–A12	Drinking water, waterborne disease, health access
Gender and social inclusion	A13–A15	Women's roles, exclusion, women-headed households
Adaptive capacity and coping	A16–A18	Credit, extension, coping strategies, migration
Institutional performance and governance	A19–A21	Relief vs adaptation, elite capture, land tenure

Annex B Key informant coverage

Table-B.1: Key informant interview coverage by code, district and focus.

Code	District	Position	Sector focus
KII-01	Sujawal	Community elder / farmer	Agriculture, water, health
KII-02–05	Sujawal	Farmers, livestock keepers, LHW	Agriculture, livestock, health
KII-06–07	Sujawal	Teacher, NGO worker	Education, institutions
KII-B01	Gwadar	Community elder (Chacho Khuda Bakhsh)	Fisheries, ecology
KII-B02	Gwadar	University student	Education–employment
KII-B05	Gwadar	Artisanal fisher	Fisheries, marine change
KII-B06	Gwadar	Ward representative (Surbandar)	Land tenure, erosion
KII-B03–B04, B07	Gwadar	Boat owner, marine scientist, women's organiser	Fisheries, ecology, gender

Annex C Selected community voices

The following statements, drawn from the interviews and discussions, are reproduced to convey the communities' own framing of their situation.

- *"Hunger does not kill us; diseases have killed us."* — Khameso Jat, KII-01, Sujawal
- *"We do not seek charity; we seek our rights."* — KII-01, Sujawal
- *"The fish that were our livelihood are now only memories."* — KII-B05, Gwadar
- *"Will the next generation see the sea as we see it?"* — Chacho Khuda Bakhsh, KII-B01, Gwadar
- *"Is development only for cities?"* — Community representative, Surbandar, KII-B06, Gwadar

Annex D Household survey instrument structure

The household survey questionnaire was organised into thematic sections mapped to the exposure–sensitivity–adaptive-capacity framework. The structure below summarises the instrument administered to 402 households.

Table-D.1: Thematic structure of the household survey instrument.

Section	Theme	Illustrative content
0–1	Identification and demographics	District, union council, respondent sex, household headship, household size, disability/chronic illness
2–3	Socio-economic profile	Income band, main livelihood, housing type, poverty indicators, drinking-water source
4–6	Livelihood and change	Sector engagement (agriculture, fisheries, livestock, labour), livelihood change due to climate
7	Exposure (10-year hazard profile)	Nine hazard types experienced over the past decade, by household
8–9	Sensitivity	Income, asset, food, water and health effects over the last 12 months
10	Health	Climate-related illness, illness types, affected age groups, treatment access and barriers
11	Adaptive capacity	Credit, insurance, extension, connectivity, information, relief received
12	Coping strategies	Dietary reduction, asset sale, migration, borrowing, recovery time
13	Priorities and adaptation	Most urgent household need, most feasible community project, health-support priority, willingness to adopt

14	Gender and inclusion	Women's income and decision roles, mobility, self-perceived exclusion from support

Annex E Key informant interview and focus group guides

The semi-structured KII and FGD guides covered the following thematic domains, with probes adapted to informant position and district context.

Key informant interview domains

- Observed environmental change over the informant's lifetime (climate, sea, land, water, ecology).
- Sector-specific impacts within the informant's area of expertise (agriculture, fisheries, livestock, health, education).
- Freshwater availability, quality and health consequences.
- Institutional performance: relief, development, extension, targeting and governance.
- Gender, social inclusion and the distribution of impact and support.
- Adaptation options, community priorities and barriers to change.

Focus group discussion domains

- Collective hazard history and the identification of demarcation events (e.g. the 1999 cyclone).
- Place-based documentation of land loss, submergence and erosion.
- Local ecological indicators of change (wildlife, vegetation, fish species, water).
- Livelihood coping strategies and their limits.
- Infrastructure and service gaps (water, health, education, jetties, housing).
- Community-generated recommendations and priorities.

Annex F Detailed sensitivity and health data

The tables below present the district-disaggregated sensitivity and health data underpinning Chapter 5.

Table-F.1: Sensitivity indicators by district (Sections 8–9).

Sensitivity indicator	Gwadar %	Sujawal** %**
Household income affected by climate	44.3	64.3
House / assets damaged by climate hazards	60.1	70.1
Food shortage in last 12 months	18.8	65.5
Drinking-water shortage in last 12 months	19.7	67.5
Household health affected by climate	24.4	69.0

Table-F.2: Health burden and access (Section 10).

Health dimension	Result
Households reporting a climate-related health problem (5 yr)	50.2% overall (Sujawal 63.9%, Gwadar 37.8%)
Leading illness — diarrhoeal / waterborne	39.3% of affected households
Vector-borne illness	38.3% of affected households
Age group most affected	Children under five (33.6%)
Major difficulty accessing treatment	54.9% of affected households
Leading treatment barrier	Facility too far (148 households), then cost (74)
Top health-support priority	Mobile health camp (37.6%)

Annex G Detailed adaptive-capacity and coping data

Table-G.1: Adaptive-capacity indicators by district (Section 11). Note the inversion: the more exposed district (Sujawal) has weaker capacity yet receives more post-shock relief.

Adaptive-capacity indicator	Gwadar %	Sujawal** %**
Access to credit	45.6	4.0
Any insurance	26.4	0.0
Access to agricultural extension	58.0	23.4
Internet / connectivity	74.6	11.9
Post-shock government relief received	— lower	21.6
Post-shock NGO relief received	— lower	21.4

Table-G.2: Coping strategies and recovery time by district (Section 12).

Coping / recovery indicator	Gwadar %	Sujawal** %**
Reduced food intake as a coping strategy	7.9	62.2
Sold assets to cope	33.3	38.8
Recovery from last major shock within one month	41.0	8.3

The two annex tables show the study's core quantitative paradox: the district with the highest exposure and sensitivity (Sujawal) has the lowest adaptive capacity, and the most destructive coping strategies, together with the slowest recovery from the shock — and yet, it receives the highest level of relief after the shock. This is the empirical signature of the relief–dependency trap that is investigated in Chapters 6 and 7.

Annex H Indicating implementation roadmap

The roadmap below cascades the six-pillar approach through the three planning horizons, and shows where each pillar is focusing its effort. It is indicative only and would require costing, institutional assignment and stakeholder validation before it can be adopted.

Table-H.1: Indicative implementation road map over the three planning horizons.

Pillar	Short (0–2 yr)	Medium (2–5 yr)	Long (5–10 yr)
1 Freshwater security	Emergency safe-water plants; protected points	Piped schemes; harvesting; recharge	Environmental flows; salinity front arrested
2 Resilient agriculture	Salt-tolerant demonstration; extension surge	Salinity management; credit and insurance	Reclaimed land; diversified systems
3 Fisheries and marine	Trawling controls; revised ban calendar	Marine protected areas; habitat restoration	Co-managed fishery; human-security mechanisms
4 Livestock resilience	Vaccination campaigns; mobile vet units	Fodder banks; livestock insurance	Integrated, freshwater-linked livestock system
5 Climate-health / protection	Mobile health camps; WASH surge	Vector control; anticipatory social protection	Resilient rural health system
6 Institutions and gender	Community organisations; transparent targeting	Tenure recognition; women’s leadership	Inclusive coastal governance; early warning

Annex I Study limitations and reflexivity

In an effort to be transparent and to foster scholarly discussion, the following are restated and discussed as the principal limitations of this study.

- *Cross-sectional design. The survey only shows one snapshot in time, while the ten-year hazard and loss profile is based on memory; this may be affected by recall and salience bias, especially for events that are demarcating, like the 1999 cyclone.*
- *Descriptive, non-inferential analysis. The composite vulnerability index is unweighted and illustrative and is not a validated instrument, it is used to compare districts and the study does not claim that the results are statistically representative of the broader coastal population.*
- Qualitative representativeness. The fourteen interviews and six discussions were not statistically representative, but were used to explain and provide context to the survey and not as a means of generalisation on their own.
- Knowledge as evidence, local knowledge. Community observations of change (wildlife, species, sea temperature) are useful, consistent and internally valid, but not instrumental measurements and are triangulated with documentary and scientific evidence where possible and reported as a community generated measurement.
- Reflexivity. The study team brought agricultural-extension and social-science and community-engagement knowledge to the study, and the questions asked reflect this, while the participatory position developed and underpinned community trust is also reflected in the presentation of findings.

The constraints imposed on the study's findings neither preclude the generalizations we have made, nor diminish the importance of the key conclusions that we have reached, which are well triangulated: 1) two distinct hazard "signatures", 2) the importance of freshwater and marine-ecosystem integrity, 3) the relief dependency paradox, and 4) the necessity of institutional reform to reduce coastal vulnerability.

Annex J Fieldwork settlement level documentation

The specific, place-based evidence documented in the focus group discussions and key informant interviews is summarized in the table below, and provides a settlement-level record of the environmental and infrastructural conditions that informed the analysis.

Table-J.1: Settlement-level environmental and infrastructural documentation.

Settlement / area	District	Documented conditions
Doongar Jat and deltaic dehs	Sujawal	1999 cyclone destroyed villages and killed 100+ camels here; evacuation to Jati (~10 km); nearest school ~9–10 km
Chalko, Dohar, Hetma, Chobatti, Chan Bello, Ket Jageer, Jhim, Tall	Sujawal	Nine-plus named revenue villages (dehs) reported permanently submerged by the advancing sea
Sher Khan canal area	Sujawal	Freshwater channel reported no longer functioning reliably; salinity flushing lost
Surbandar (Kangani ward)	Gwadar	~3 km of shoreline lost; 161 households submerged; ~90% fishing-dependent; no round-the-clock maternity service; rising girls' dropout
Pishukan	Gwadar	Fishing jetty incomplete since 2007; oil trollers and pollution reported; species decline; ~2°C sea warming
Gwadar city (Sadaf Hotel FGD)	Gwadar	Red/blue tide 3–4× per year; jellyfish; shifted storm calendar (June–July → August–September)

Ecological indicators reported consistently across the deltaic FGDs included the complete disappearance of parrots, the absence of vultures from the villages, a decline of roughly half in rabbit populations, and an increase in snakes a community-generated record of habitat change consistent with salinization and land degradation. On the Makran coast, the reported local decline or disappearance of named fish species (including the Gwanz/Indian threadfin, the Palwar/Indian shad and the Sarmai) and the loss of coral and mangrove habitat provided the corresponding markers of marine-ecosystem change.

Annex K Study team and field composition

The study was designed and led by the research team of the Department of Agricultural Education, Extension and Short Courses, Sindh Agriculture University, Tandojam, and delivered with the support of trained field enumerators, facilitators and note-takers. Members of the study team facilitated the focus group discussions, with dedicated note-taking and transcription alongside audio recording where consent was granted. The team's multidisciplinary composition spanning agricultural extension, social science, climate and rural development supported the mixed-methods design and the integrated interpretation of quantitative and qualitative evidence.

Annex L Detailed priority-needs and perceptions data

The tables below present the detailed priority-needs and perceptions data underpinning Section 5.10 and the recommendations. They document the consistency with which safe drinking water emerges as the leading priority across household, community and health questions.

Table-L.1: Priority needs across household, community and health questions (Section 13).

Question	Leading response	Share
Most urgent household need to reduce vulnerability	Safe drinking water	57.0%
Most feasible community project	Drinking water / RO plant	66.7%
Most urgent health support	Mobile health camp	37.6%
Second health-support priority	Safe drinking water	29.1%
Third health-support priority	Mosquito control	11.9%

Table-L.2: Perceptions, awareness and behavioural change (Sections 7 and 13).

Perception indicator	Result
Had heard of the term ‘climate change’	37.3% yes
Willing to adopt new practices if supported	10.4% yes; 64.2% no
Changed main livelihood due to climate in last 10 years	29.1% yes
Rated household hazard severity ‘high’ or ‘very high’	Majority, concentrated in Sujawal
Reported climate shocks now recur rather than occur once	Majority of the sample

Table-L.3: Sector-specific priority support needs (Section 13).

Sector	Top priority support need identified by engaged households
Agriculture	Fresh irrigation water, then drainage and salt-tolerant seed
Fisheries	Boat and gear support, then market access and weather/early-warning information
Livestock	Fodder and fresh water for animals, then veterinary services and vaccination

Read together, these tables show that the priority-needs data are not scattered; they converge on a small number of foundational interventions — safe drinking water above all, followed by accessible basic health and veterinary services and sector-specific productive inputs. That convergence is what allows the recommendations in Chapter 9 to

be sequenced with confidence, leading with the water and basic-service investments that communities across both districts and all three sectors identify as the most urgent and the most feasible.