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Sand Encroachment and Coastal Degradation in Puntland, Somalia: Environmental, Socioeconomic, and Policy Implications



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Authors

Habon Hussein Mohamed, Abdi Aziz Bashi Harbi

Abstract

Somalia is widely recognized as among the countries most profoundly vulnerable to the compounding effects of climate change, widespread land degradation, and accelerated desertification (UNDP, 2020; UNFCCC, 2025). Coastal regions in Puntland, specifically within Mudug and Ra'as Caseyr, are experiencing a critical increase in sand encroachment, a dynamic process that severely threatens fragile human settlements, vital infrastructure, traditional livelihoods, and irreplaceable cultural heritage (WardheerNews, 2025). This article meticulously examines the root causes, devastating impacts, and local community responses to this environmental hazard, placing a specific analytical focus on the critically impacted coastal settlements of Kulub and Afkahalaya. Drawing on robust secondary literature, authoritative institutional reports, and detailed local observations, the study emphatically highlights how interacting factors—namely accelerating climate change, extensive coastal deforestation (driven by unsustainable charcoal production), recurrent severe droughts, and consistently weak land management practices—have collectively deepened the environmental degradation crisis (FAO SWALIM, 2012; World Bank, 2021). The paper further explores the urgent humanitarian implications, including displacement and resource insecurity, and proposes detailed, policy-oriented solutions, placing strong emphasis on Ecosystem-Based Adaptation (EBA), inclusive community participation, and the crucial role of youth engagement (UNDP & Ministry of Environment, 2024). The findings ultimately underscore the urgent need for integrated, evidence-based environmental governance to safeguard Puntland's invaluable coastal communities and ensure genuinely sustainable and resilient development.

Keywords: Sand encroachment, land degradation, climate change, Puntland, coastal communities, Somalia, Ecosystem-Based Adaptation, displacement, coastal geomorphology.

1. Introduction

Somalia faces acute and cascading environmental challenges, primarily resulting from the destructive interaction of intense climatic stressors and deeply unsustainable human activities (ACAPS, 2025). Recurrent severe droughts, exceptionally strong coastal winds, pervasive vegetation loss (a key accelerator), and unsustainable land use practices have been identified as the core contributors to widespread land degradation and desertification (IGAD, 2025). According to the foundational FAO SWALIM (2012) baseline study, over 70% of Somalia's landmass is demonstrably affected by degradation, with particularly pronounced impacts recorded in the central and northeastern regions. Coastal areas, including significant, low-lying portions of

Puntland, are hyper-vulnerable to dynamic aeolian sand movement, which increasingly threatens settled communities, critical infrastructure, and traditional livelihood systems (World Bank, 2021).

Sand encroachment has therefore emerged as a paramount and often overlooked environmental hazard along Puntland's extensive coastline, mirroring similar crises in other parts of the world's arid coastlines (Nordstrom & Arens, 1998, as cited in CTC-N). Settlements like Kulub in Mudug Region and Afkahalaya in Ra's Caseyr Region have experienced progressive, often irreversible, burial by aggressive mobile sand dunes, leading directly to mass displacement, catastrophic loss of infrastructure, and fundamental socioeconomic disruption (Mohamed, 2025). Communities traditionally dependent on fishing, semi-nomadic pastoralism, and small-scale coastal trade are disproportionately affected, as escalating environmental degradation undermines both the terrestrial resource base (grazing lands) and the marine ecosystem (coastal fisheries), thereby creating a compounding effect on poverty and food insecurity (UNDP, 2020).

2. Environmental and Climatic Context: Land Degradation and Sand Dynamics

Somalia's pervasive environmental vulnerability is intrinsically shaped by its arid and semi-arid climate, inherently limited and fragile natural vegetation cover, and extreme exposure to global climate variability. Land degradation is physically observed through accelerated soil erosion, severe loss of protective vegetation, marked decline in soil moisture holding capacity, and the relentless advance of mobile sand dunes (FAO, 2024). Crucially, recent analyses confirm that anthropogenic climate change has functioned as a significant risk multiplier, intensifying these destructive geomorphological processes by increasing the frequency and severity of droughts and unpredictably altering established wind and rainfall patterns (UNFCCC, 2025; UNDP & Ministry of Environment, 2024).

In coastal Puntland, strong seasonal monsoon winds (the *Hagaa* and *Gu* seasons) act as powerful geological agents, transporting vast quantities of loose sediment inland, particularly in areas characterized by flat coastal topography and where sparse native vegetation has been recently removed or destroyed by overgrazing (Jackson et al., 220, as cited in ResearchGate). The critical absence of effective regional land-use planning and proactive, large-scale dune stabilization measures (both mechanical and biological) has permitted the sand to advance unchecked into vital infrastructure and residential areas (SONNA, 2023). The cumulative effects threaten not only the immediate survival of present livelihoods but also the region's long-term development prospects, turning a localized problem into a regional constraint on economic growth (IGAD, 2025).

3. Case Study I: Kulub Settlement, Mudug Region – A Crisis of Displaced Services

3.1 Background and Historical Significance

Kulub is a strategically important coastal settlement located approximately 15 km north of Garacad, within the Jariiban District of Mudug Region, Puntland. Established originally around 1995–1996, Kulub developed as a critical dual-economy community focused on pastoralism and fishing, capitalizing on access to both marine resources and the historical importance of its natural harbor. The port served as an essential trade node for fishermen and merchants from major coastal

cities across Somalia, including Mogadishu, Bosaso, Marka, and Kismayo, thereby playing a pivotal, yet fragile, role in the regional economy (Mohamed, 2025).

3.2 Compounding Environmental Shocks and Sand Acceleration

The settlement first faced a profound catastrophe in 2004, when Kulub was severely impacted by the Indian Ocean tsunami (locally remembered as *Sulaamadii*), which resulted in loss of life, extensive initial infrastructure damage, and immediate displacement. While humanitarian agencies supported initial, temporary reconstruction, a subsequent, chronic environmental crisis emerged and accelerated. From 2013 onward, sand encroachment became visibly aggressive, initially blocking critical infrastructure like main roads and access routes, especially those leading to essential community water wells. The severity intensified dramatically during the devastating regional drought of 2016 (known locally as *Sima*), after which the rate of sand expansion accelerated continuously and alarmingly between 2016 and 2025, suggesting a non-linear relationship between drought-induced vegetation mortality and sand mobilization capacity (Mohamed, 2025; ACAPS, 2025).

3.3 Catastrophic Socioeconomic and Humanitarian Impacts

The rate and volume of sand encroachment in Kulub have reached unequivocally critical levels, resulting in the complete burial of homes, the primary community school, the central mosque, and the local health post (Mohamed, 2025). The structural collapse of basic services has been functionally total, mandating a large-scale, forced displacement of the population. Critically, the most vulnerable demographics—including the elderly, the chronically ill, and economically marginalized households—have often been left trapped in the initial settlement site under exceptionally harsh conditions defined by acute water scarcity and the complete absence of health and education services. Both the livestock-based and the fishing livelihood systems were severely disrupted by the environmental shift, leading to a demonstrable increase in poverty levels and dependency on external humanitarian aid (UNDP, 2020).

4. Case Study II: Afkahalaya and Ra'as Caseyr Region – The Burial of History

Afkahalaya is an exceptionally ancient coastal town situated approximately 20 km east of Caluula in the remote Ra'as Caseyr Region. With a rich history potentially spanning more than three centuries, Afkahalaya once thrived as a vibrant commercial *entrepot*, exporting valuable commodities such as frankincense, processed livestock products, and diverse marine resources (Mohamed, 2025). However, the relentless persistence of sand encroachment, compounded by pervasive land degradation, have gradually, but inevitably, rendered the historic settlement uninhabitable.

Detailed technical assessments and corroborated local accounts robustly indicate that the mobile sand dunes advanced at a highly destructive average rate, estimated between 20 and 30 meters per year, ultimately engulfing the entirety of the historic town site (Mohamed, 2025). This rapid, uncontrolled progression led directly to widespread displacement, the total loss of property (including ancient structures), and terminal economic decline. The relocated population now struggles in a newly established, unplanned settlement nearby, facing severely limited access to

basic services and relying heavily on fragile pastoralism and minimal small-scale agriculture, increasing their susceptibility to future climatic shocks.

The Ra'as Caseyr economy traditionally hinges on artisanal coastal fishing, livestock rearing, smallholder farming, and trade. However, recent research conducted by development initiatives, such as those supporting the *Regreening Africa* framework and the *Puntland: Restoring Land and Livelihoods* project, consistently highlights severe, systemic land degradation, rapid vegetation loss, and extensive overgrazing as the primary, interlocking constraints on sustainable livelihoods in this ecologically fragile dryland region (FAO, 2024; IGAD, 2025).

5. Interacting Drivers of Sand Encroachment and Coastal Destabilization

The severe and accelerating expansion of sand dunes threatening Puntland's coastal settlements is a direct, multivariate outcome of several self-reinforcing factors, a dynamic observed across other vulnerable dryland coastlines (Hidalgo García, 2022, as cited in Frontiers Partnerships):

- Geophysical Vulnerability: The naturally flat terrain and inherently limited natural vegetation cover of the coast provide minimal frictional resistance, enabling massive aeolian sediment transport inland (FAO SWALIM, 2012).
- Climatic Stress: Recurrent and prolonged droughts (e.g., the *Sima* drought of 2016) cause widespread mortality of deep-rooted vegetation, exposing bare, loose soil to aggressive wind erosion (ACAPS, 2025; WardheerNews, 2025).
- Aeolian Dynamics: Strong seasonal coastal monsoon winds provide the sustained, high kinetic energy required for the massive and continuous saltation and transport of sand inland, often creating large transverse dunes (Nordstrom & Arens, 1998, as cited in CTC-N).
- Anthropogenic Pressures: Deforestation and overgrazing weaken the biological crust and remove stabilizing plant roots, particularly in the foredune and backdune areas, directly addressing the major anthropogenic driver of vegetation loss (Yusifova and Togola, 2022, as cited in Frontiers Partnerships).
- Institutional Weakness: The critical lack of long-term sand control and integrated land management strategies means there is no effective policy enforcement or technical intervention to implement measures like sand fencing or protective revegetation (SONNA, 2023).
- Global Change Multiplier: Climate change is documented to be intensifying aridity, potentially altering local wind speed variability, and heightening overall environmental stress, making natural recovery progressively harder (UNFCCC, 2025).

6. Community Resilience, Humanitarian Consequences, and the Role of Youth

Communities directly affected by the relentless sand encroachment have been forced to adopt diverse, but often ineffective, coping strategies, including reactive, short-distance migration to marginally less affected areas (typically establishing new hamlets 4-7 km away), opportunistic informal settlement expansion, and limited, often poorly coordinated, collective action (Mohamed, 2025). However, the efficacy of these local responses is severely constrained by widespread poverty, chronically weak local institutional support, and a profound lack of technical capacity for

the requisite large-scale environmental engineering or restoration (Olukoye and Kinyamario, 2009, as cited in ResearchGate).

The humanitarian fallout from this chronic environmental crisis is profound and multi-layered, encompassing mass homelessness, acute food insecurity (due to destruction of both grazing and fishing grounds), widespread disruption of education, chronic water scarcity, and heightened public health risks from forced relocation (ACAPS, 2025). Displacement has particularly eroded the intangible social cohesion and irreplaceable cultural heritage, a loss keenly felt in historically significant settlements like Afkahalaya.

Youth engagement is increasingly recognized as a potentially transformative pathway for building long-term resilience in fragile dryland regions (Frontiers Partnerships, 2024). Through dedicated environmental awareness campaigns, the implementation of large-scale tree planting and grass stabilization initiatives, and meaningful participation in local decision-making bodies, young people can be mobilized as proactive contributors to sustainable land management and localized climate adaptation efforts. Empowering youth as environmental stewards is essential for developing durable, community-owned resilience strategies (World Bank, 2025; ResearchGate, 2009).

7. Policy Recommendations: Integrated Environmental Governance and EBA

To effectively mitigate sand encroachment and provide durable, sustainable protection for coastal settlements in Puntland, the following multi-scalar policy measures, aligned with Ecosystem-Based Adaptation (EBA) principles, are urgently recommended:

1. **Ecosystem-Based Dune Stabilization:** Implement large-scale, phased afforestation and ecosystem restoration programs focused on establishing vegetative barriers using indigenous, salt-tolerant, drought-resistant species (e.g., *Commiphora* cuttings, mangroves where appropriate) for both foredune and backdune stabilization (UNDP & Ministry of Environment, 2024; ReliefWeb, 2014; ResearchGate, 2009). Complement this with mechanical measures like sand fencing (wood or plastic barriers 1-1.5 m high) to initially trap sand and build up an artificial dune ridge (FAO, 1993, as cited in FAO).
2. **Community-Driven Capacity Building:** Establish community-based environmental awareness and training initiatives that equip local populations, particularly women and youth, with the technical skills for tree nursery management, application of mulching techniques (e.g., straw or biodegradable netting for moisture retention), and long-term site monitoring, ensuring local ownership and sustainability (ResearchGate, 2009; Frontiers Partnerships, 2024).
3. **Resilient Infrastructure and Planning:** Prioritize investment in climate-resilient basic services and integrated urban planning, ensuring new developments avoid high-risk dune migration zones and are supported by robust environmental safeguards against burial and flooding (UNFCCC, 2025; ResearchGate, 2025).
4. **Monitoring and Technical Research:** Institutionalize continuous research, monitoring, and high-resolution spatial mapping (GIS/Remote Sensing) of sand movement dynamics to provide the essential baseline data for timely, targeted physical interventions and resource allocation, moving away from reactive responses (ResearchGate, 2025).

5. Governance and Enforcement: Establish inclusive, multi-stakeholder governance frameworks that integrate traditional ecological knowledge with modern planning principles, while strictly enforcing anti-deforestation laws, particularly against illegal coastal charcoal production (IGAD, 2025; Frontiers Partnerships, 2024).

8. Conclusion

The compelling, tragic experiences of Kulub and Afkahalaya serve as potent, localized illustrations of the deep, destructive interconnections between accelerating environmental degradation and fundamental human wellbeing (World Bank, 2021). Once vibrant, thriving coastal settlements in Puntland have been transformed into desolate landscapes of mobile sand and humanitarian displacement, offering a stark and sobering warning about the catastrophic long-term costs of environmental neglect and policy inertia (Mohamed, 2025). Protecting Somalia's vital coastal environments is therefore not merely a technical ecological imperative; it is an overriding social, critical economic, and non-negotiable cultural necessity for national stability (UNDP, 2020). Without immediate, concerted, and technically informed action guided by integrated, community-led environmental governance and EBA strategies, the further, profound loss of invaluable land, history, and human livelihoods in coastal Puntland is tragically inevitable.

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Authors



Habon Hussein Mohamed is a public health professional focused on strengthening community resilience against climate-related health risks, improving environmental health systems (sanitation, hygiene, and pollution control), and supporting climate advocacy campaigns for youth and communities in the Somali context.



Abdiaziiz Baashi Harbi is a Somali leader, the IYCM Global Ambassador for Somalia, and Founder of the Daryeel Climate and Peace Center (DCPC), who advocates globally for youth inclusion, adaptation finance, and climate justice while championing sustainable development, climate resilience, and transparent financial governance within Somalia.



Info@climategenerationmovement.org
www.climategenerationmovement.org/



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