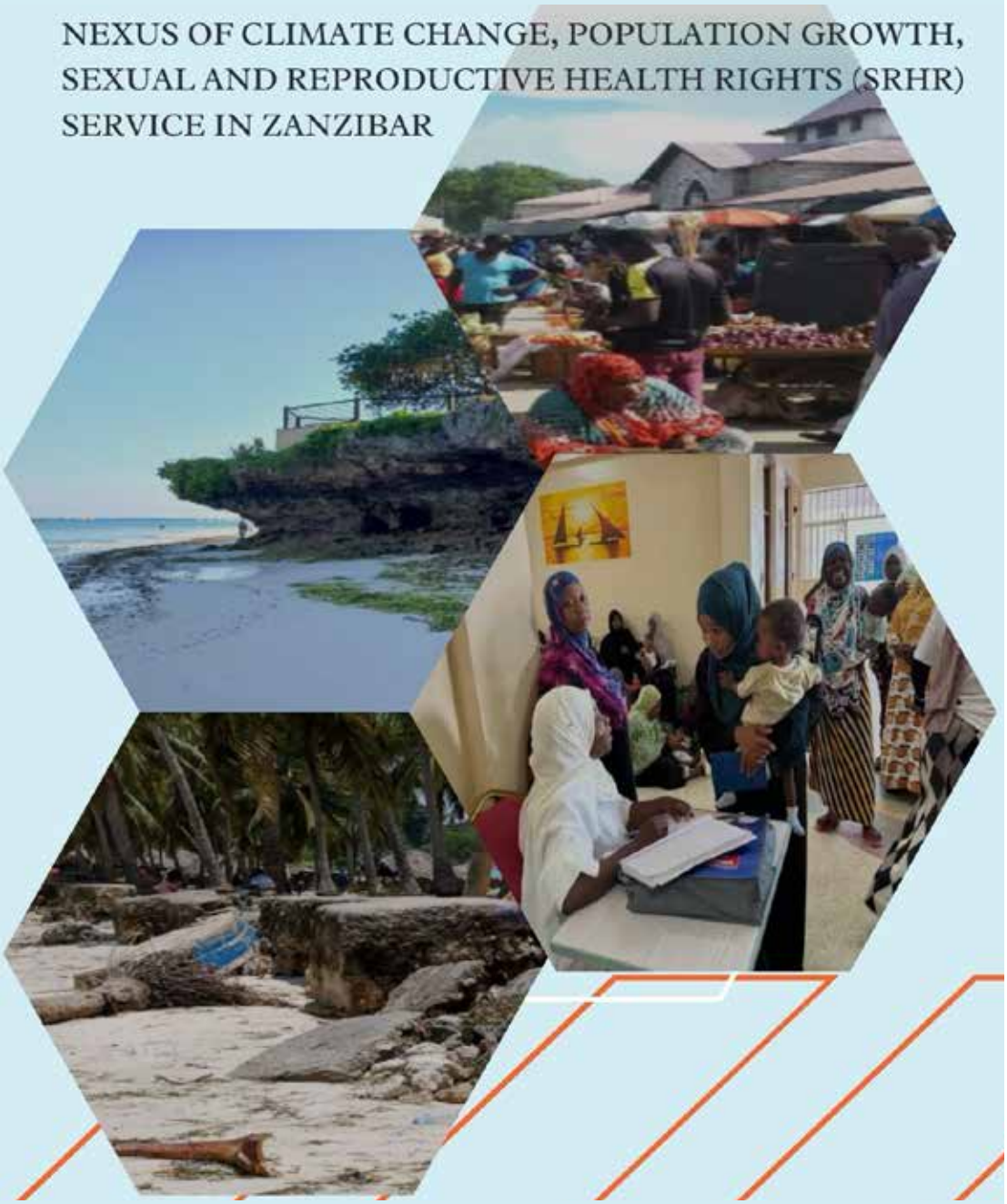
ZANZIBAR PLANNING COMMISSION

NEXUS OF CLIMATE CHANGE, POPULATION GROWTH, SEXUAL AND REPRODUCTIVE HEALTH RIGHTS (SRHR) SERVICE IN ZANZIBAR



2025

REPORT ON NEXUS OF CLIMATE CHANGE, POPULATION GROWTH, SEXUAL AND REPRODUCTIVE HEALTH RIGHTS (SRHR) SERVICE IN ZANZIBAR

Key words
Climate Change, Population growth,
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Cover photos
Coastal erosion at Mangapwani and Makangale,
Darajani Market, and Provision of sexual and reproductive health services

Photos credits
weadapt.org; cantz.or.tz; fieldwork

Department of Human Resource Planning and Deelopment

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EXECUTIVE SUMMARY

Zanzibar faces an escalating triple challenge where rapid demographic change, heightened climate vulnerability, and structural service deficits converge to threaten sustainable development. Analysis confirms high population growth (an intercensal rate of 3.7% and a Total Fertility Rate (TFR) of 4.7), concurrent with rising temperatures and fluctuating rainfall. This demographic surge exacerbates climate stress and places unsustainable pressure on finite resources and critical social infrastructure.

The crisis is intensified by a pervasive youth rural-urban migration driven by severe Educational Opportunity Gaps and poor social services in rural areas. This movement concentrates the growing population in climate-vulnerable coastal and urban zones, leading to uncontrolled urban sprawl and environmental degradation. The study established a statistically significant link between accessing SRHS and a respondent's awareness of climate change impact, indicating that SRHS platforms are essential vectors for demographic and environmental literacy and a critical leverage point for building community resilience.

However, current policy is fragmented. A review reveals a critical failure in intersectoral integration-specifically, the lack of a unified Zanzibar Population Policy and poor mainstreaming of SRHR and gender goals into climate adaptation frameworks. The high growth rate demonstrates that current planning is outpaced by demographic reality.

To effectively manage the TFR of 4.7 and build climate resilience, the Government of Zanzibar must immediately adopt a Decentralized Development Strategy and institutionalize a Climate-Population-SRHR Nexus. Key actions must include: Mitigating Migration by constructing and equipping advanced secondary schools and Vocational Training Centres (VTCs) with skilled staff in rural areas; Strengthening Rural Services by

investing in climate-resilient health facilities and implementing salary supplements (20-30%) to retain specialized technical staff; and Institutionalizing the Nexus by creating a Vulnerability Dashboard that integrates real-time climate, population, and SRHR data to guide all future policy and investment decisions.

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ANC	Antenatal Care
CPR	Contraceptive Prevalence Rate
DHIS2	District Health Information Software 2
FGD	Focus Group Discussion
GIS	Geographic Information Systems
HBS	Household Budget Survey
IMMR	Institutional Maternal Mortality Ratio
ILFS	Integrated Labour Force Survey
LUSL	land use, land cover
NBS	National Bureau of Statistics
OCGS	Office of the Chief Government Statistician
RGoZ	Revolutionary Government of Zanzibar
SDGs	Sustainable Development Goals
SPSS	Statistical Packages for Social Science
SRHR	Sexual Reproductive Health and Rights
TDHS	Tanzania Demographic and Health Survey
TFR	Total Fertility Rate
TPHC	Tanzania Population and Housing Census
TMA	Tanzania Meteorological Authority
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Emergency Fund
ZADEP	Zanzibar Development Plan
ZAHB	Zanzibar Annual Health Bulletin
ZEMA	Zanzibar Environmental Management Authority
ZHSSP	Zanzibar Health Sector Strategic Plan
ZPC	Zanzibar Planning Commission

Chapter One

INTRODUCTION

1.1. Background

Zanzibar, a semi-autonomous state of the United Republic of Tanzania, is currently facing a complex convergence of rapid demographic change, heightened climate vulnerability, and evolving health and development priorities. This nexus aligns with the dual challenges Tanzania is experiencing nationally related to SRHR and the climate crisis. Extreme weather events such as prolonged dry spells, droughts, and floods have been observed across the country, increasing the burden on the health system and being associated with increased prevalence of vector-borne and water-borne diseases.

The dynamics in Zanzibar are fundamentally shaped by a high annual population growth rate (3.7%), high fertility rates, a youthful age structure (40.8% under age 15), and increasing urbanization (49%) (OCGS, 2022). This growth places mounting pressure on essential public services and infrastructure, including health, education, housing, water, and sanitation.

Zanzibar's unique geographical setting and socio-economic structure make it highly susceptible to the impacts of a changing climate. Climate change significantly compounds these vulnerabilities, with the region experiencing rising sea levels, increased coastal erosion, fluctuating rainfall patterns, and more frequent extreme weather events (TMA, 2022; Khatib, 2019; Makame, 2013; Dubi, 2000). This includes saline intrusion contaminating vital groundwater wells (the main source of freshwater) and high-intensity rainfall events causing serious flooding. Given this current state, Zanzibar is operating with an existing adaptation deficit, meaning it is not adequately prepared to manage current climate variability, let alone future changes.

1.1.1 Climate Impact and Socio-Economic Stress

The environmental stressors have far-reaching consequences for food security, water availability, public health, and livelihoods, particularly for marginalized communities reliant on climate-sensitive activities like tourism, agriculture, and fishing. Local communities are already suffering

effects such as the decline of seaweed farming, which is a vital source of income, primarily due to increasing Sea Surface Temperature (SST) and the proliferation of invasive marine plants (Msuya, 2011; BBC, 2014). Concurrently, the fisheries sector faces threats from ocean warming and critical habitat loss, leading to shifts in fish stock distribution and reduced catch potential. The critical freshwater supply is threatened as saltwater intrusion contaminates vital groundwater wells and renders low-lying agricultural land, such as paddy farming areas, unsuitable for production, thereby exacerbating existing food insecurity. Furthermore, the aesthetic degradation of the marine environment, including widespread coral bleaching and accelerating coastal erosion, directly threatens the crucial tourism sector ((Westmacott et al., 2000).

The threat extends directly to public health. Changes in rainfall patterns alter mosquito breeding habitats, influencing the transmission of vector-borne diseases like malaria and dengue fever (Gubler, 2011). Moreover, the heightened frequency of extreme weather events disrupts essential health services and increases the incidence of waterborne diseases (URT, 2018; URT, 2021). This health burden is compounded by existing hurdles in the provision of Sexual and Reproductive Health and Rights (SRHR) services across Zanzibar, which is currently characterized by high rates of teenage pregnancies, unintended pregnancies, and maternal mortality (Choonaara et al., 2024; Moshi & Tilisho, 2023). The full SRHR package-which comprises essential services like maternal and newborn health, contraceptives, and support for gender-based violence-remains unevenly accessible (Starrs et al., 2018). Women, youth, and persons with disabilities, particularly those in remote or climate-impacted areas, face significant barriers to access. Evidence suggests that climate change puts the SRHR of women and girls under serious threat, increasing their vulnerability, yet climate change policies have often overlooked or poorly incorporated SRHR dimensions (NAP Global Network & Women Deliver, 2020). This exclusion from adaptation planning exacerbates existing inequalities and results in missed opportunities to strengthen resilience, particularly for women and girls.

1.2. The Nexus of Population, Climate, and SRHR

The confluence of rapid demographic shifts, heightened climate vulnerability, and persistent barriers to health services creates a complex and dangerous negative feedback loop that threatens Zanzibar's development goals. Understanding this systemic risk requires an integrated analytical framework.

1.2.1 Integrated Modeling Approach: The PCS-DM

Given the complex, intertwined nature of these challenges, the research team developed the Integrated Population, Climate, and SRHR Dynamics Model (PCS-DM) to systematically analyze the relationships between these factors. This model explicitly studies the interlinkages between key parameters, including: the Population Growth Rate, Fertility Rate, and Urbanization Rate (as demographic drivers); Sea Surface Temperature (SST) and the Frequency of Extreme Weather Events (as climate variables); and Access to Comprehensive SRHR Services and Economic Vulnerability (as resulting socio-economic and health outcomes).

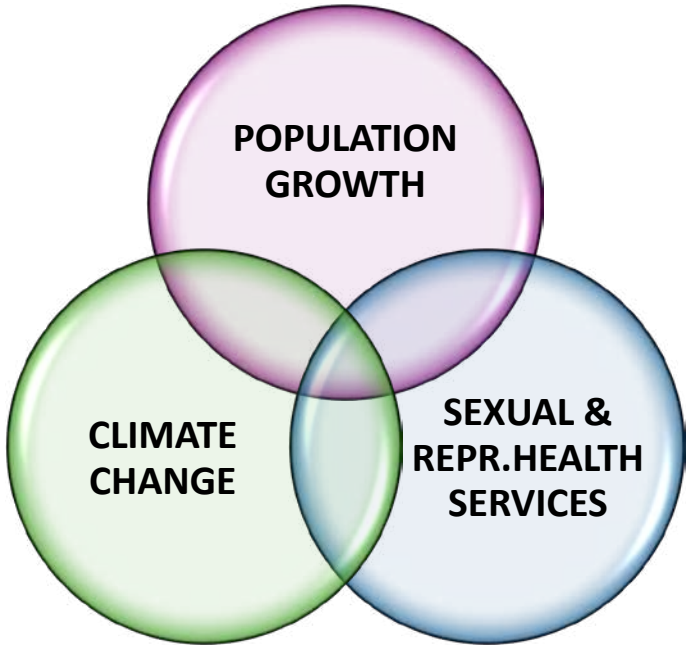

Figure 1.1. The Population, Climate Change, and SRHR Nexus. Source: custom-designed, proprietary analytical framework

Source: Created by the research team specifically for this study

The diagram visually represents the central concept of the study, which is the Interconnected Nexus driving Zanzibar's vulnerability. The overlapping areas represent the complex feedback loops and compounding stresses that result from the interactions between these three essential drivers.

1.2.2 The Dynamics of Compounding Stress

The mechanism of this negative feedback loop begins with rapid population growth, often concentrated in coastal urban areas due to migration and high fertility, which places vulnerable populations in zones exposed to climate shocks like sea-level rise and coastal erosion. This concentrated demographic pressure on limited land and infrastructure leads to inadequate housing and sanitation, which subsequently heightens the risk of waterborne diseases following climate-induced floods.

Simultaneously, the displacement and economic hardship caused by climate change - such as the collapse of the seaweed farming industry or damage to tourism - directly limit families' ability to access essential SRHR services, including contraceptives and maternal care (UNFPA, 2024). Crucially, inadequate SRHR services sustain high fertility rates, fueling the rapid population growth that intensifies pressure on the natural resources and public service systems necessary for climate resilience. Evidence indicates that climate change places the SRHR of women and girls under serious threat, significantly increasing their vulnerability (NAP Global Network & Women Deliver, 2020).

Therefore, addressing these issues in isolation is demonstrably insufficient. Despite the clear link, the SRHR dimensions have often been overlooked or poorly incorporated into climate adaptation policy frameworks (NAP Global Network & Women Deliver, 2020). This exclusion, as evidence suggests, can exacerbate existing vulnerabilities and inequalities for women and girls (Angie & Dazé, 2021). An urgent, holistic, and integrated approach that embeds SRHR considerations within climate and development policies is essential to break this negative cycle and build a more resilient and equitable Zanzibar (IPCC, 2022; UNFPA, 2024).

1.3. Justification

Against this background, Zanzibar faces the triple challenge of high vulnerability to population growth, climate change, and inadequate Sexual and Reproductive Health and Rights (SRHR) services. Rapid population growth increases pressure on finite resources and public services, while climate change exacerbates vulnerabilities, particularly for marginalized groups. Given the critical interconnectedness of these issues, their intersection remains significantly under-researched in the Zanzibar context.

This study, therefore, aims to analyze and broaden an understanding of how this nexus causes overlapping challenges and creates compounded risks, which require cross-sectional solutions. Additionally, it provides actionable recommendations for integrated policy responses that promote resilience, gender equity, and inclusive development. UNFPA and the Zanzibar Planning Commission (ZPC) are jointly undertaking this study to analyze this intersection and provide evidence-based recommendations to inform policy, planning, and programs, ensuring alignment with the Zanzibar Development Vision 2050, the Zanzibar Climate Change Strategy, and the Zanzibar Population Policy.

1.4. Objectives

The purpose of this study is to assess the interconnectedness between climate change, rapid population growth, and access to SRHR services in Zanzibar and generate strategic, evidence-based recommendations for integrating SRHR into national and local resilience planning. Specifically, the assignment aims to:

a) Analyze spatial and temporal changes in relation to population growth, climate change vulnerability, and sexual and reproductive health and rights (SRHR) services in Zanzibar.

b) Examine the causality between climate change and demographic transformation.

c) Evaluate the current state of climate change, health, SRHR services, gender equality, and population dynamics to determine their inclusion in or omission from the Zanzibar development policies.

d) Produce findings that inform and support the implementation of national strategies such as the Zanzibar Development Vision 2050, the National Population Policy, the Health Sector Strategic Plan, and the Zanzibar Climate Change Strategy.

1.5. Methodology

The study utilized an Exploratory Research Design and adopted a mixed-methods research approach, integrating both quantitative modeling and qualitative analysis to holistically explore the complex interconnections between climate change, rapid population growth, and access to Sexual and Reproductive Health and Rights (SRHR) services in Zanzibar.

The quantitative component was centred on the development and application of the Integrated Population, Climate, and SRHR Dynamics Model (PCS-DM). This involved applying advanced econometric techniques to analyse historical and projected data, thereby establishing causal links and simulating the compounding effects of the nexus. This quantitative analysis was complemented by a comprehensive desk review of national census reports, demographic and health surveys, climate projections, and relevant policy documents.

For guidance and quality assurance throughout the process, a Technical Working Group was established. This group was composed of experts from relevant areas of expertise, including climate change, demography, health, and economics, to guide the entire assignment—from the initial design and data collection to analysis and report preparation.

The qualitative component involved gathering context-specific insights through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) with stakeholders across both Unguja and Pemba. The entire methodology was executed with strict adherence to national development priorities, ensuring high and granular disaggregation of findings to allow for more informative results, inclusiveness, and alignment with the Zanzibar Development Vision 2050, the Blue Economy agenda, and the Sustainable Development Goals (SDGs). This triangulation of advanced modeling, policy analysis, and ground-level qualitative data ensured the resulting policy recommendations are robust and evidence-based.

1.5.1 Reservation made to the Terms of Reference

The team found that some of the mentioned indicators, such as Annual CO2 emission per capita, Climate risk index score, Vulnerability score, and Readiness score, which are required in the ToR, are not feasible to obtain data specific to Zanzibar due to budget and time constraints. The computation of these indicators requires extensive data collection, which is beyond the scope of this assignment. As such, a few reservations have been made by using the proxies of these indicators, such as temperature and rainfall, which are more relevant to Zanzibar, and the data are readily available.

Moreover, spatial analysis requires extensive data and in-depth geo-spatial analysis with additional cost of procuring the relevant tools, which is also beyond the scope of this assignment; therefore, the consultant set a scope of using shape files to represent the findings geospatially.

1.5.2 Data Sources and Collection

The data utilized in this study were collected from both secondary and primary sources. Secondary data, which forms the core of the quantitative modeling, was sourced from official national and international reports, including Census Reports, Annual Statistical Abstracts, Bulletins, and relevant documents from the ministries of health, the Zanzibar Environmental Management Authority (ZEMA), the Tanzania Meteorological Authority (TMA), the Second Vice President's Office, and other authoritative entities.

The secondary data collection focused on three main interconnected thematic areas, with time series data collected over varying periods based on availability:

- This thematic area concentrated on analyzing both the primary climate change drivers and the resulting impacts between 1990 and 2022. Key focus variables included Temperature, Rainfall, and the Frequency and intensity of extreme weather events (such as floods, droughts, and storms). The resulting climate change impacts were quantified using variables like Fatalities, injuries, and people displaced, Socio-economic losses, and Environmental damage.

- The demographic context and its relationship to environmental and resource pressure. Data spanning from 1988 to 2022 were collected and computed, covering variables such as Population growth rate, Population density and distribution, and Urbanization trends; and
- Access to and availability of comprehensive SRHR services were analyzed using data available between 2019 and 2024. Key indicators included those related to family planning, fertility rate, mortality rate, and sexually transmitted infections (STIs). Detailed Antenatal Care (ANC) indicators were also collected, such as the number of ANC clients aged below 20 years; the number of clients with 1st contact before 12 weeks; the number of clients with 1st, 4th, and 8th contacts; expected pregnancy; and the resulting coverage rates for 1st contact before 12 weeks, 4+, contact at least 4 contacts), and 8th contact coverage.

To complement the secondary data analysis, fresh qualitative data (primary data) were collected from selected government officials and other population and economic development players through closed-ended questionnaires distributed across both Pemba and Unguja. Other primary data were collected from various groups within the community, including indigenous people, academia, employers, and other relevant groups. To complement the secondary data analysis, fresh qualitative data (primary data) were collected from selected government officials and community groups across both Pemba and Unguja. The initial target for primary data collection, based on the statistical calculation (see Section 2.2), was to reach approximately 385 respondents; however, the study received only 270 clean responses. This limited response rate was primarily attributed to the unfortunate timing of the study, which coincided with the high-tension election period, significantly reducing participation rates. Nevertheless, the integrity and robustness of the overall analysis were maintained as the quantitative modeling and overall findings were heavily furnished and cross-validated using the extensive secondary data sources. The data analysis approach is summarized as follows:

- Quantitative Analysis was performed using statistical data from census data, the Tanzania Demographic and Housing Survey (TDHS),

Housing Budget Survey (HBS), climate models, health indicators, service availability records, and trend projections.

- Qualitative Research was collected primarily through closed-ended questionnaires, with an equity-focused lens concentrating on disparities affecting women, adolescents, persons with disabilities, and rural communities.
- Geospatial Mapping was utilized Geographic Information Systems (GIS) to visually express and analyze the overlap between population density, climate risks, and SRHR service locations.

1.6. Data Analysis Method

Primary quantitative data, collected via Kobo Toolbox and analyzed using SPSS and Stata statistical software, were utilized for both descriptive and inferential analysis. The study used these tools to profile respondent demographics, quantify public perception, and determine the factors significantly predicting a respondent's likelihood of reporting climate change impacts (using Logit and Probit models). For the analysis of secondary data, specifically historical trends in population growth, rainfall, and temperature (1994-2024), the Toda-Yamamoto Granger Causality Test was applied via Stata. This advanced econometric technique was selected because of its proven ability to accurately determine the causal effect between variables, even when dealing with mixed stationary variables (I (0) and I (1)), which is a unique property of the present dataset. This test is critical for determining whether, for instance, high population growth is influenced by climate variability, or vice-versa, thereby assisting policymakers in identifying which variable should be primarily targeted or controlled in an integrated policy approach.

To precisely quantify the environmental consequences of rapid, uneven population growth and the resulting urban sprawl over time, a Post-Classification Change Detection Analysis was performed on historical satellite imagery and aerial photographs spanning four key periods, from 1994 to 2024. This analysis determined how specific land cover types-such as high coral rag forest and high mixed forest-were converted into

other classes, including low coral rag, cultivation, and settlements. The methodology quantified the scale of LULC transformation, including the area of natural forest lost to urbanization and agriculture, the conversion of coastal vegetation to less resilient species, and the magnitude of shoreline erosion. This provided critical evidence on the specific environmental pressures caused by human activity. The accuracy of the LULC change detection classification was rigorously validated using the Kappa Index Analysis (KIA), ensuring the reliability of the derived estimates for use in urban planning and conservation policy development.

Chapter Two
PROFILE OF ZANZIBAR

2.1 Geographical Location and Administrative Profile

Zanzibar is a semi-autonomous state that is part of the United Republic of Tanzania. The island is composed of two sister islands: Unguja and Pemba, with more than 50 other small islets. Unguja Island is a hilly island, about 85 kilometers (53 miles) long (north-south) and 30 kilometers (19 miles) wide (east-west) at its widest, with an overall area of about 1,666 square kilometers (643 square miles).

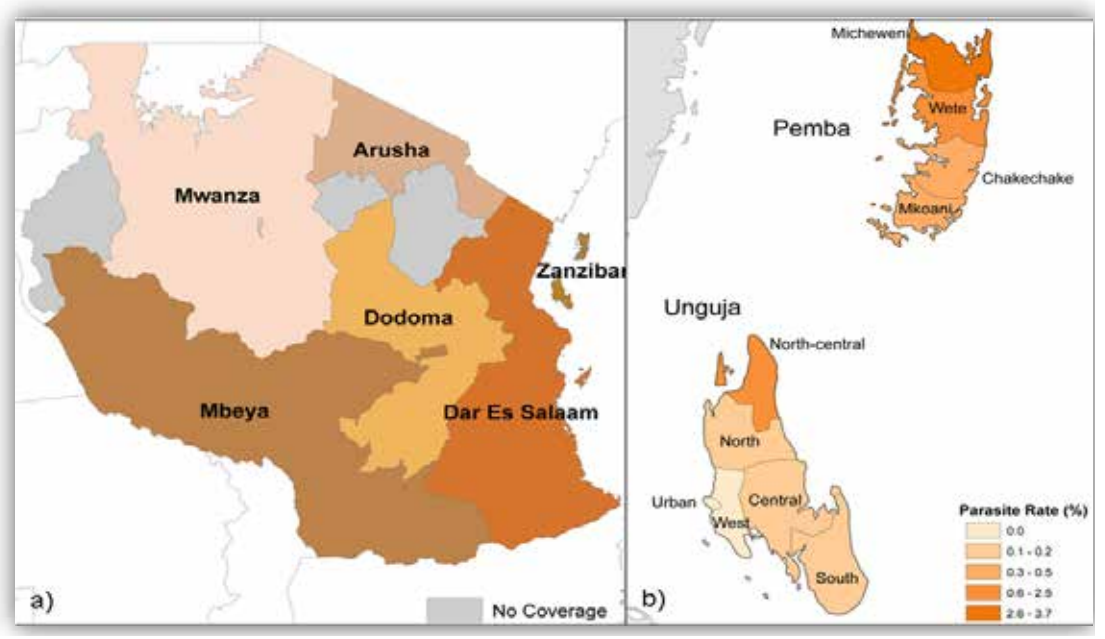

Figure 2.1: Map of Zanzibar showing its location

Source of Data: OCGS.

The archipelago has a self-governing system with its own House of Representatives (Parliament), judiciary system, and government. The court system is independent from the courts of the United Republic of Tanzania, and the Zanzibar Constitution declares Zanzibar to be a state with its own defined boundaries; even the Court of Appeal, which is the Supreme Court in Tanzania, has no mandate in matters related to the interpretation of the Zanzibar Constitution. The government is led by the president of Zanzibar, who is also the chairman of the Revolutionary Council, elected every five years.

2.2 Climatic Profile

Climate change is part of a global phenomenon outlined in Sustainable Development Goal 13, which aims to address the climate crisis by building resilience and creating opportunities for carbon-friendly development (Mashavu, n.d.). Zanzibar, as an island archipelago, is already suffering from climate-related disasters, and there is a danger of suffering from a lack of fresh water because of high temperatures and the increase of coastal salinization (UNDP, UN-Habitat, n.d; Khatib, 2019; Makame, 2013).

Contextual evidence suggests that over the past several decades, Zanzibar Island has suffered from three major extreme events, including a rise in extreme temperatures, heavy rainfall, and high wind speeds, which have caused intensifying impacts on people's lives, mostly women and children (RoGZ, 2012). For the past 30 years, there has been a persistent increase in minimum and maximum temperatures, especially from December to May, with the highest ever reaching 39°C (RGoZ, 2014). The rise in sea surface temperature, particularly for shallow water, led to a decline in the production of seaweeds, which in turn has affected the livelihood of most of the population, especially women who depend on seaweed production.

Also, rainfall variability has resulted in recurring flood incidents with tremendous repercussions on people's lives. For instance, between 2005 and 2024, it is estimated that a total of 31,489 families reported to have been affected, with 28 deaths. These incidents have had an extended impact on health infrastructures, hence disrupting the services, including those related to sexual and reproductive health (SRH). It is further documented that on 5 May 2015, the Island recorded a total of 172.00 millimeters of rainfall in three consecutive hours that caused serious flooding, which left several families homeless. Another similar incident occurred on 17 April 2016, which recorded a total of 212.4 millimeters of rainfall over the course of seven hours (Mashavu, n.d).

Furthermore, there is extreme wind speed variability; it is narrated that the strongest winds are experienced mostly in three months of the year: January, February, and August, with the monthly mean wind speeds exceeding 10 knots (Mashavu, n.d.). This, in turn, has claimed almost 1030 people's lives

between 2018 and 2024 (Zanzibar Disaster Management Commission, 2024). Additionally, Vulnerability remains high in agriculture, fisheries, water, and coastal settlements, affecting over 87 percent of the livelihoods (Climate Action Network Tanzania, n.d.).

Technical analysis reveals that temperatures in Unguja and Pemba have been increasing over the past decades, while trends of maximum and minimum temperature anomaly confirm further warming of temperatures in the future (Hamad and Sawe, 2023). This warming drives more days with heat stress, longer dry spells, and shifts in evaporation that influence both agriculture and freshwater resources.

The pattern and frequency of rainfall have become more erratic with large peaks in the scourge of heavy rainfall events resulting in flash floods alternating with significant dry periods. Yet down the track, rainfall is also expected to decline in some places around Unguja but increase in intensity on Pemba making water access less predictable across the regions (El Kasri et al., 2021).

Figure 2.2: The state of Coastal erosion on Zanzibar's beach.

Source: *cantz.or.tz; fieldwork*

One of the most significant threats Zanzibar faces is sea level rise from its position as a low-lying area. Roughly 20% of Unguja and 30% of Pemba are situated in high-risk low-elevation coastal zones prone to inundation, storm surges, and beach erosion. These changes have already started to impact coastlines, freshwater aquifers, and cultural heritage sites along the

shore. Across the wider coastal strip of Tanzania, which includes Zanzibar, estimates indicate that by 2030, almost 8,000 km² of coastal land could be lost to erosion and submergence, affecting about 1.6 million people per year through inundation due to coastal flooding (Fouad et al., 2025).

Climate change is also changing key marine and coastal ecosystems. Warmer sea temperatures and altered wave action have been pushing fish populations toward new areas, upsetting the fishing livelihoods of fishermen supporting thousands of Zanzibari families (Wilson et al., 2021). Coral reefs and mangrove ecosystems, which offer naturally protective coastal buffers and support biodiversity, are suffering bleaching, degradation, and lessened productivity from warming seas as well as human pressures.

The socio-economic consequences are now becoming apparent in coastal towns, with changing fish availability and struggling agro-pastoral regimes prompting shifts in livelihoods. Local research reveals that over half of the households in North "A" District have already shifted from subsistence fishing to other sources of income like small retailing and farming as a means of coping with loss due to climate-driven diminishing marine resources (Hamad and Sawe, 2023).

Heritage and tourism, both crucial for the identity and economy of Zanzibar, are under direct threat. At high tide, sites of cultural value such as beaches and marine heritage are particularly vulnerable to erosion and inundation, accelerating the loss of both built and natural heritage assets.

In realizing the pressing need to conserve the environment and maintain climate resilience, the Revolutionary Government of Zanzibar considers climate change as one of the cross-cutting issues that need immediate action to achieve sustainable development for the Zanzibaris. As such, the climate issues have been embedded in the Zanzibar Development Plan (ZADEP 2020-2026), which operationalizes the Zanzibar Vision 2050 through the Blue Economy.

While other adaptation policies, such as the Zanzibar Climate Change Strategy and national adaptation programs exist, nevertheless, climate preparedness is low (Howland & Thompson, 2024; Sarkar et al., 2022), and urgent action is needed to enhance resilience planning; protect ecosystems and infrastructure.

2.3 Population Distribution and Demographic Characteristics

Based on the Population and Housing Census (2022) between 2012 and 2022, the population increased from 1,303,569 to 1,889,773 persons in 2022. This represents an intercensal increase from 2.8 percent in 2012 to 3.7 percent in 2022, compared to Tanzania, where the growth rate increased from 2.7 percent recorded in 2012 to 3.2 percent in 2022. The population growth rate in Zanzibar is above of the Tanzania growth rate.

Zanzibar experiences unequal population distribution. Unguja's population is 1,346,332, twice that of Pemba, which had 543,441 people during the 2022 census; this represents growth rates of approximately 4.2% and 2.9% for Unguja and Pemba, respectively. Despite its relatively small size (2,654 km²), Zanzibar is one of the most densely populated areas in East Africa, with a population density of 782 persons per square kilometer for Unguja and 737 persons per square kilometer for Pemba. Unguja Island carries about 69% of the total population, with a density slightly higher than Pemba. Both islands are well above Tanzania's mainland average density of 67/km² in 2022, underscoring Zanzibar's unique demographic pressures.

Figure 2.3: Part of Kangagani Village, Pemba, showing bare land left because of increasing human activity, which puts pressure on resources.

Source; *Fieldwork*

The Urban West (Mjini Magharibi) Region of Unguja, which comprises Zanzibar City, has the highest population density in Zanzibar at over 2,500 persons per km². This area accounts for almost one-third of the entire population, because it is the economic, political, and administrative center of Zanzibar Island. On the contrary, the southern portion of Unguja, including Kusini Unguja (Makunduchi, Kizimkazi and Jambiani), is less densely populated with more than 1 km² per person. This trend is consistent with the very low fertility of the coral rag terrain and the scarcity of fresh water.

In Pembe, a densely settled area is central Pemba (Chake Chake District), where fertile soils with adequate roads and markets support a growing population. In contrast, the coast and the forested interior of Pemba are only sparsely settled on account of swampy conditions, mangrove vegetation, and inaccessibility.

This growth increases environmental vulnerability and mounting pressure on SRHR services. Therefore, Zanzibar, as part of a small island states with an urbanized coastal zone, land scarcity, and pressure on settlement and sanitation, requires proactive planning to monitor the population trend.

2.4 Demographic Indicators: Fertility, Birth Rate, and Life Expectancy (2019 – 2024)

Fertility and mortality are the demographic processes that drive population phenomena. As in many sub-Saharan African countries, the fertility level in Zanzibar is relatively high, and there has been a gradual decline in mortality in the past few decades. The total fertility rate in Zanzibar has decreased gradually from above five births per woman in the past to 4.7 children/woman as of 2022 (NBS & OCGS, 2022). This downward trend is due to the cumulative impact of the increase in accessibility to family planning services, improvements in girls' education, delayed age at first marriage, and increased knowledge about reproductive health. However, fertility rates are still above world averages, which indicates unmet need for contraception and reproductive health information, even among adolescents/young women.

On the other hand, in Zanzibar, infant mortality reductions have been substantial over previous decades, with estimates of around 34 deaths per 1,000 live births in 2022 and under-five mortality at around 46 deaths per 1,000 live births during the same period (UNICEF, 2023; NBS & OCGS, 2022).

Assessment of the fertility and mortality trends among women in Zanzibar for 2019-2024 has relevance to a large demographic shift with an impact on maternal and child health outcomes. Table 2.1 reveals total fertility rate (TFR) trends downward throughout the six years from 2019 to 2024, reducing from 4.87 births per woman in 2019 to 4.57 births in 2024.

Table 2.1: Fertility and Mortality Rate Trend in Zanzibar

Year	Total Fertility Rate (TFR)[1] (births per woman)	Infant Mortality Rate[2] (per 1,000 live births)	Under-Five Mortality Rate[2] (per 1,000 live births)	Maternal Mortality Ratio[3] (per 100,000 live births)
2019	4.87	34.7	54.0	320
2020	4.80	33.5	52.0	300
2021	4.73	32.0	49.0	280
2022	4.70	34.0	46.0	278
2023	4.61	29.9	45.0	260
2024*	4.57	33.0	44.0	255

Source: *Compiled from TDHS (2022), UNICEF (2023), UN World Population Prospects (2024), World Bank (2024), and Zanzibar Health Bulletin (2023).*

The interaction between fertility and mortality patterns in Zanzibar reflects the continued process of demographic transition. Characterization of these trends is important for policymakers and planners, as they have a direct impact on population growth, health system requirements, and socio-economic development.

2.5 Migration

Zanzibar is complex and shaped by social, economic, and ecological factors. People travel across Zanzibar, from Pemba to Unguja, back and forth between the islands of Zanzibar and the Tanzanian mainland, or in and out of the country altogether. According to the 2022 Population and Housing Census, the number of people living in Zanzibar increased by more than 40% between 2012 and 2022, rising from 1,303,569 in 2012 to around

1,889,773. This rapid expansion is a product of both natural growth and internal migration. It is, for the most part, due to urbanization, employment, and educational opportunities. Increasingly, people are migrating within and from the rural areas to urban centers, mainly Stone town, Nungwi, and Kiwengwa for better job opportunities in tourism, trade, and services.

Much of Zanzibar's migration relates to tourism, which accounts for about 27-29% of Zanzibar's GDP and directly or indirectly employs about 60,000 people. This has become a lodestone for Pemba and mainland Tanzania migrants, working in hotels, restaurants, construction, and transport.

Moreover, migration patterns are also affected by environmental and climatic conditions. Higher seawaters, saltwater intrusion, and coastal erosion have already begun forcing residents in low-lying fishing and farming communities from their homes. Figure 2.4 shows that until 2024, Mjini District remains a highly migrated district with a population of some 2,700 people per square kilometer and as a demographic and economic pole in Zanzibar.

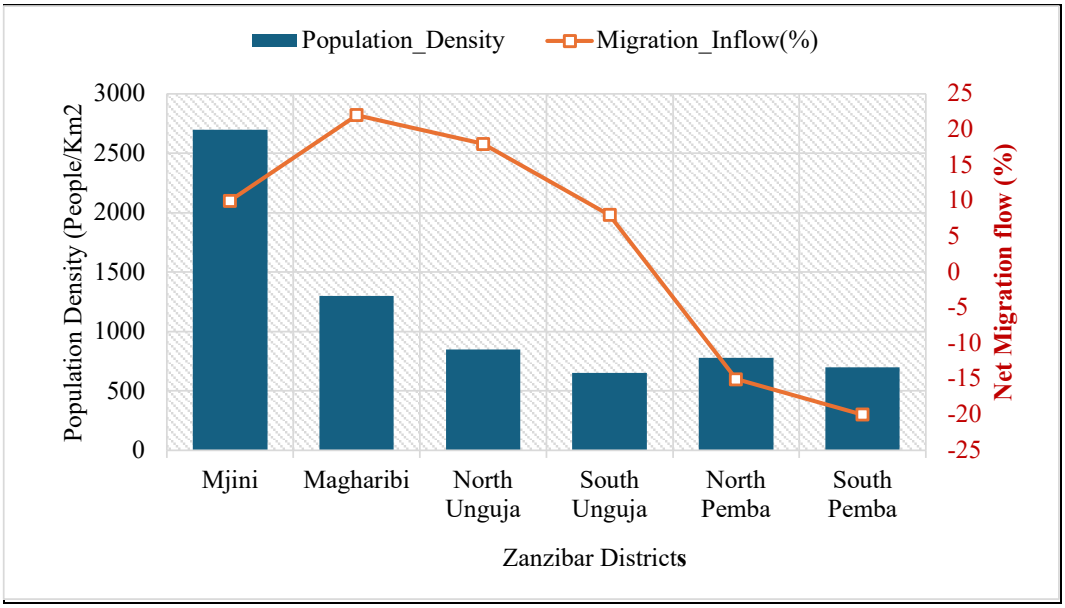

Figure 2.4: Population Density and Migration Flow in Zanzibar (2024)

Source: *OCGS/NBS (2022 census).*

2.6 Sexual Reproductive Health and Rights Services

In the Zanzibar context, the sexual and reproductive health service is a composite issue, which includes maternal and child health care, family planning, HIV/STI screening and treatments, screening for cervical cancer, and prevention of gender-based violence (TDHS, 2015/16).

Hence, improving the availability and access to SRHR and the well-being of women and girls has become one of the key priority areas of the Revolutionary Government of Zanzibar (RGoZ). This has been explicitly outlined in the Zanzibar Health Sector Strategic Plan III (ZHSSPIII) (2013/14-2018/19), which provides a road to accelerate the reduction of maternal and newborn child mortality in Zanzibar between 2019 and 2023.

Additionally, Zanzibar Vision 2020, which was then translated into the Five-Year Plans for Zanzibar Strategies for the Growth and Reduction of Poverty (i.e., MKUZA I, II, III), and now the Zanzibar Vision 2050, calls for investment in family planning to achieve Zanzibar's development aspirations. These development plans aim to reduce the maternal mortality ratio through improving the availability of voluntary family planning information and services for men and women, as well as for young people (UNFPA, 2019).

Notwithstanding the government's commitment, the progress towards improving access to and uptake of voluntary family planning information in Zanzibar has been slow. For instance, based on the report by UNFPA (nd, 1), the current contraceptive prevalence rate (CPR) in Zanzibar among married women (15-49 years) is very low at only 14%, with huge regional variation between Pemba and Unguja: Pemba South records a CPR of 7%. Fertility remains high at 5.1, and according to the Tanzania Demographic and Health Survey (2015/16), the unmet need for family planning is 28%. Moreover, the Reproductive, Maternal, Newborn, and Child Health workforce in Zanzibar is only 6.3 per 10,000 population, which is significantly lower than the recommended threshold of 23 core health workers per 10,000 population (UNFPA, 2020).

Even though the total fertility rate (TFR) trends downward from 4.87 women in 2019 to 4.57 in 2024. This slow decline can be attributable to increased

access to reproductive health services, demand for family planning as well as underlying social and economic drivers. Nevertheless, the fertility level is still above replacement, pointing to a youthful population structure that will continue stressing maternal and child health services.

The trajectory of Total Fertility Rate (TFR), Infant Mortality Rate (IMR), Under-Five Mortality Rate (U5MR), and Maternal Mortality Ratio (MMR) over 6-year period, 2019–2024, is shown in Figure 4. It indicates a gradual and steady drop in the under-5 mortality rate (U5MR) from 54.0 per 1,000 in 2019 to an estimated 44.0 in 2024. This trend reflects gains in child survival interventions such as immunization and nutrition support above global benchmarks.

The rate of reduction, however, has been slowing over the past few years, and the ratio is still considerably high, given that the SDG target is to reach a skilled birth attendance of 70 or more, pointing to enduring structural and systemic maternal health obstacles.

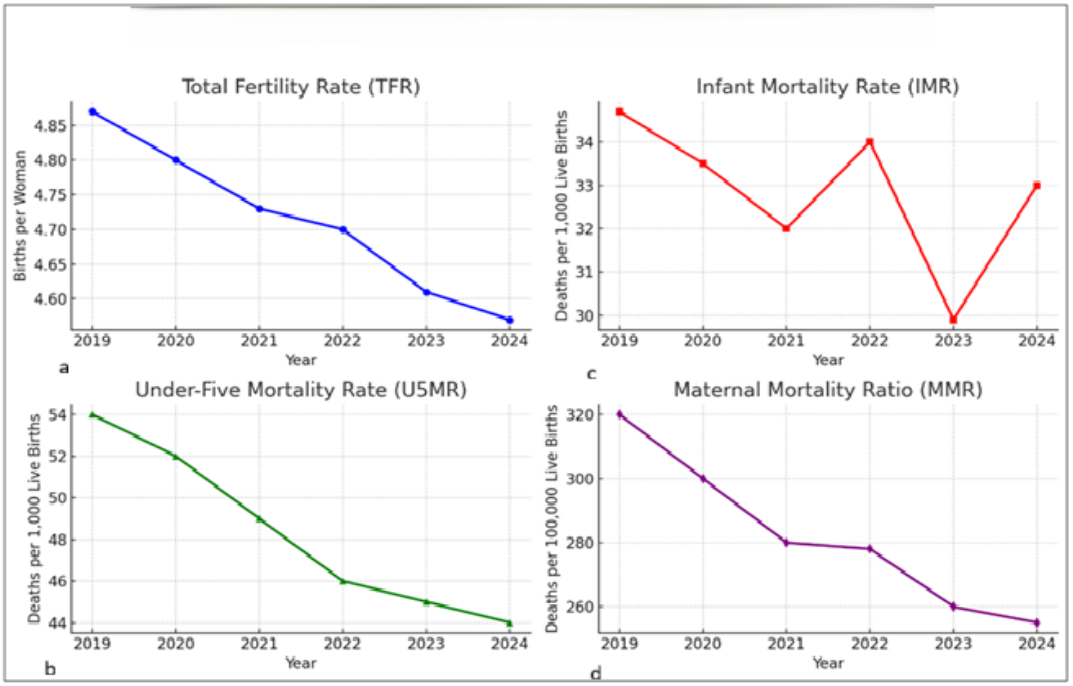

Figure 2.5: Fertility and Mortality Trends in Zanzibar (2019–2024)

Sources: *TDHS (2022), UNICEF (2023), UN World Population Prospects (2024), World Bank (2024), and Zanzibar Health Bulletin (2023).*

The unmet needs in the SRHR services, high fertility rate, and decline in mortality rates are consistent with rapid population growth and varying temperatures. This requires a profound understanding of how the interconnectedness of SRHR, population dynamics, and climate change affects each other.

Moreover, climate change interferes with SRHR services, especially maternal and child health services. As cyclones and flooding may inevitably cause damage to road infrastructure and health facilities, making travel to antenatal care (ANC), skilled birth attendance, and emergency obstetric care difficult. These perturbations result in delays in the "three delays model". These are delays in decision to seek care, delay in reaching care, and delay in receiving a good quality of care, which are associated with heightened maternal mortality and morbidity Figure 2.6. Findings from global analysis indicate that service disruption is most pronounced in islands and coastlines, making Zanzibar a typical example of vulnerable island states with the combination of perils shaped by its geophysical location and connectivity to tenuous economic supply lines.

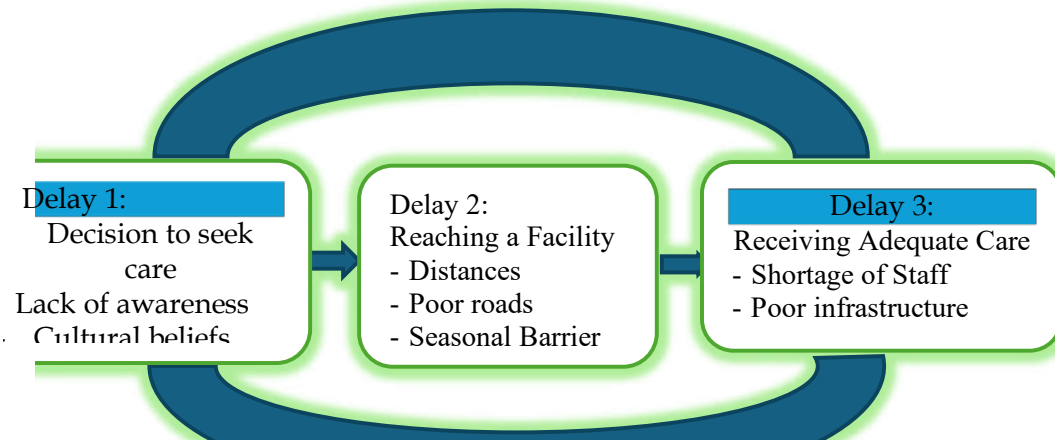

Figure 2.6: Three delay Models; ***Adapted from Thaddeus & Maine (1994) framework***

2.1.1. Climate Change and SRHR Service Disruptions

The effects of climate change in Zanzibar are being observed as temperatures increase, rainfall becomes more variable and more intense, coastal flooding and storm surges become more frequent, and a gradual sea-level rise with

localized saltwater intrusion into low-lying agricultural systems and other freshwater systems (Abdalla et al.,2023).

The climate drivers result in weakening the direct and indirect pathways to SRHR services. Direct pathways comprise episodic physical damage to health infrastructure, like directly flooded or inaccessible clinics, disruption of transport and referral mechanisms under high rainfall/ storm surges, and destruction or contamination of water supply and sanitation systems, leading to increased infection risk related to childbirth.

The indirect pathways affect livelihoods as saltwater intrusion and crop losses erode household income and food security, exacerbating risks of adolescent and early marriage, transactional sex, as well as reducing access to facility-based antenatal, delivery, and postnatal care. Programmatic reviews and adaptation project reports for Zanzibar explicitly point to saltwater inundation of farmland and coastal livelihoods, causing socioeconomic stress that affects health access, household decision-making, with related effects on water infrastructure investment.

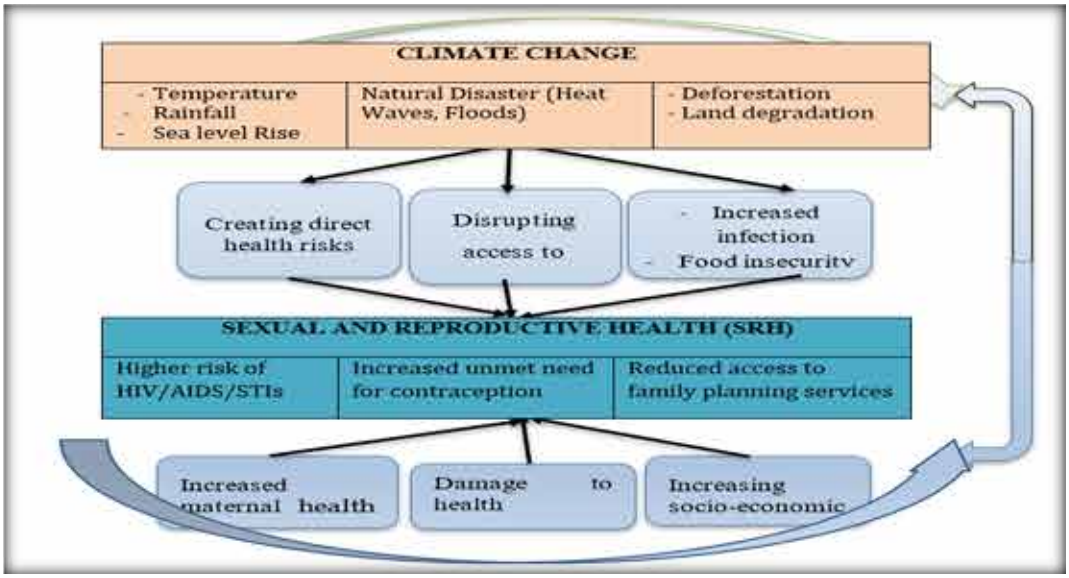

Figure 2.7: Interrelated Framework between SHRH and Climate Change.

Source: Adapted from Burns & Mutunga (2024).

Chapter Three

PRESENTATION AND DISCUSSION OF KEY FINDINGS

3.1 Spatial and Temporal Changes in Population Growth, Urban Expansion, and Climate Vulnerability in Zanzibar

Spatial and temporal changes are analyzed in terms of key variables: population growth, climate variability, and sexual and reproductive health services and rights (SRHR) in Zanzibar. The aim is to understand how these variables interact with each other on a short-term basis, to inform appropriate policy responses. To clarify the analysis, this section has been divided into three main subsections. The first examines the temporal trend in demographics, climate, and SRHR services, and the second explores spatial analysis using GIS overlays that show urban growth in relation to temperature and rainfall gradients.

3.1.1. Population Dynamics: Acceleration and Divergence (1990–2024)

The trend in Zanzibar's population growth is analyzed in terms of demographic acceleration and demographic divergence phases a disaggregated analysis that underscores its importance for policy targeting.

Figure 3.1 shows Unguja experiences a clear acceleration phase between 2000 and 2010, with growth quickly rising from around 3% in 2000 to nearly 4.2% in 2010. This rapid growth likely reflects urban expansion due to increased fertility and significant migration inflows. Unguja consistently shows higher and steadier growth rates, growing at a higher rate than that of Zanzibar in general. Unguja's sharper fluctuations contrast with Zanzibar's smoother aggregate curve, indicating that Unguja drives much of the volatility in the aggregate trend.

Figure 3.1 Pemba, on the other hand, exhibits more volatile growth. After a sharp decline around 2010 (a pronounced dip around 2011), the island entered a recovery and acceleration phase, climbing from below 2% in 2010 to over 2.5% in 2022. This rebound may signal improved retention, better health access, or policy interventions reversing earlier demographic stagnation. The demographic divergence between the regions may reflect urban–rural contrasts, differential access to services, or migration patterns

favoring Unguja. Overall, Zanzibar's Aggregate growth pattern shows a mild acceleration between 2015 and 2022, which smooths out regional volatility, suggesting a return to demographic momentum post-2010 dip.

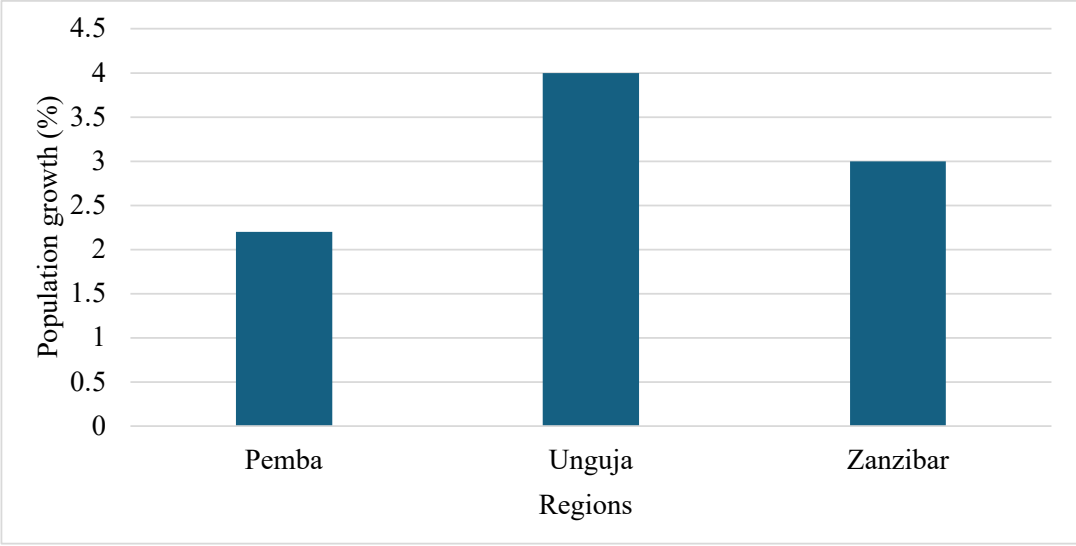

Figure 3. 1: Annual Population Growth Rate by Region (1998 - 2022).

Sources: *OCGS/NBS Census (1988 - 2022).*

a) Land Use/Land Cover Change and Environmental Pressure(1994 - 2024)

The high population growth rates and concentrated urbanization are the primary drivers of Land Use/Land Cover (LULC) change across the islands, intensifying environmental stress and vulnerability to climate shocks (Wang et al., 2008; Ali et al., 2011; IUCN, 2005).

(i) Rapid Urban Expansion and Sprawl (1994 - 2024)

The results clearly indicate that urban growth in Zanzibar (Unguja and Pemba) over the past 30 years (1994 - 2024) has been rapid and spatially uneven. This expansion is linked to an increasing population fueling demand for housing, services, and infrastructure, as well as infrastructure development, such as road expansion, which has accelerated urban sprawl into peripheral areas. Zanzibar Town, Chake Chake, and Wete have emerged as primary urban hotspots. The direction of sprawl is distinct: in Zanzibar Town (Unguja), expansion is directed eastwards and towards coastal agricultural zones; in Pemba, growth in Chake Chake has encroached into farmlands and secondary forests, while expansion in Wete is aligned with

major road corridors and coastal stretches. The environmental impacts of this sprawl include the conversion of agricultural lands and lowland forests into built-up areas.

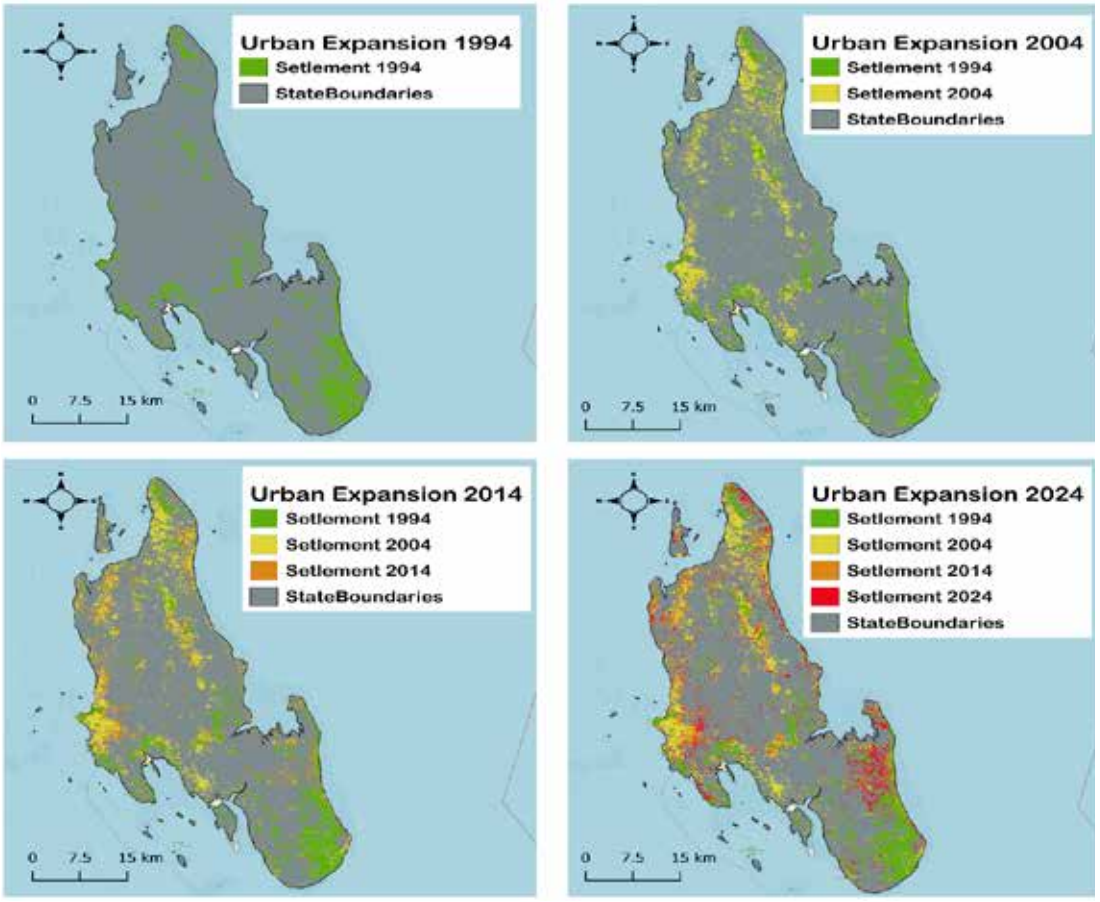

Figure 3.2: LULC change of Unguja from 1994-2024.

***Source**, researcher analysis*

(ii) Deforestation and Agricultural Expansion (1994 - 2024)

The most pronounced LULC changes since the 1990s involve the continuous conversion of natural habitats into cultivated land and settlements. The general high expansion in cultivated areas is primarily attributed to the declination of high mixed forest and high coral rag forest areas, implying that cultivation activities are dominant in fertile areas (Ingrams, 2007; Middleton, 1961). The pressure on forest cover is evident across the inter-decadal variations, demonstrating a sustained transformation of land use. For instance, between 1994 and 2004, the LULC was largely transformed

into cultivated land, evidenced by significant conversions from both Low Coral Rag Forest and Low Mixed Forest.

This pressure continued into the 2004 - 2014 decade, with substantial areas of High Coral Rag Forest converting to cultivated land. However, during this same period, a large area of cultivated land was converted back into Low Coral Rag Forest, suggesting the persistence of shifting cultivation driven by land demand (Middleton, 1961). In the final period analyzed, 2014–2024, the Low Coral Rag Forest continued to be converted into cultivated land significantly, alongside Low Mixed Forest areas. This sustained and spatially concentrated conversion into agricultural land implies an intensified demand for land resources

Low Mixed Forest areas. This sustained and spatially concentrated conversion into agricultural land implies an intensified demand for land resources

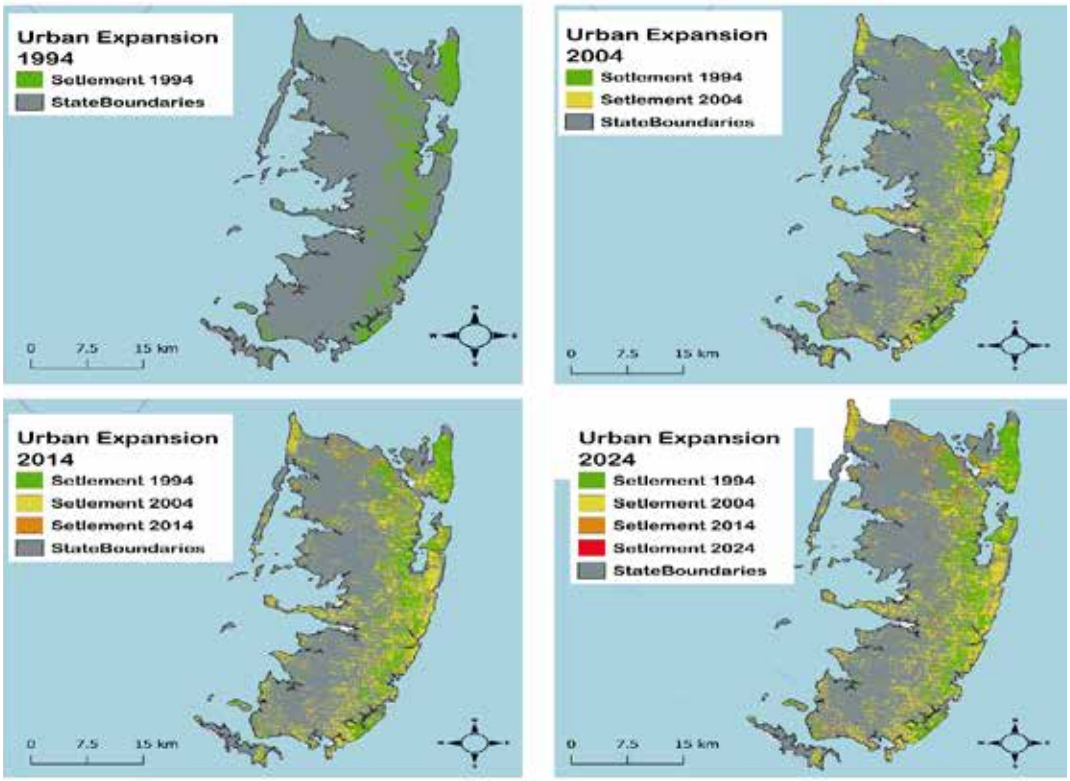

Figure 3.3: LULC for Pemba Island.

Source: *Researcher analysis*

(iii) Coastal Vulnerability and Mangrove Decline

The concentration of settlements near the seashore, a result of population and economic growth, leads to the clearance of crucial coastal forests for development, thus aggravating shoreline erosion (Bailly-Comte et al., 2009). The expansion of settlements and tourist recreational sites along the coastal area has directly affected the distribution of coconut plantations. For instance, large areas were converted between 1994 and 2004, and significant conversion continued between 2004 and 2014, supporting evidence that new land uses, such as tourism investment, increase land use pressure (Kayhko et al., 2011).

The period between 2014 and 2024 shows a marked acceleration of this coastal development, with urban expansion maps illustrating intensified encroachment on remaining coastal strips and a sustained, elevated pressure on resources such as coconut plantations and coastal forest buffers.

The decline in mangrove forest cover, a vital buffer against coastal erosion, is also associated with the combined pressure from population growth, the tourism industry, and the emergence of seaweed farming since the 1960s (Quinn et al., 2017). The intensified pressure on coastal ecosystems, including mangroves, due to the spread of settlements is a critical environmental impact of this growth. Across the wider coastal strip of Tanzania, which includes Zanzibar, estimates indicate that by 2030, almost 8,000 km² of coastal land could be lost to erosion and submergence, affecting about 1.6 million people per year through inundation due to coastal flooding (Fouad et al., 2025). This is noticeable evidence in many low-lying areas as shown in Figure 3.4.

Figure 3.4: Images of seawater intrusion affecting farmland at Tumbe village, Pemba.

Source: *Fieldwork, 2025*

Zanzibar's Aggregate growth pattern shows a mild acceleration, which smooths out regional volatility between 2015 and 2022. This phase suggests a return to demographic momentum post-2010 dip, possibly due to harmonized development efforts.

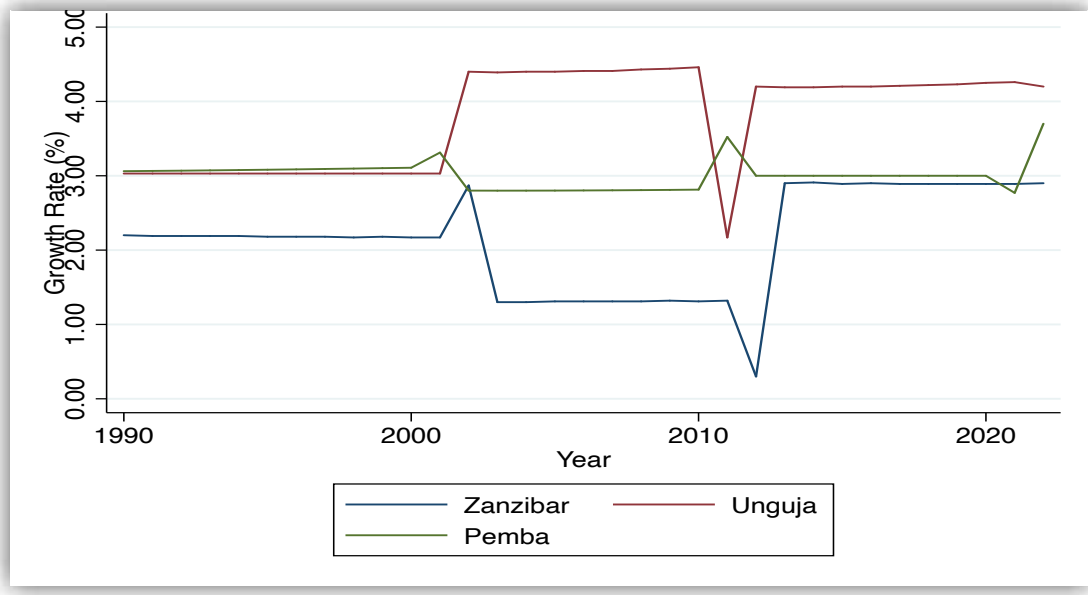

Figure 3.5: Population Acceleration and Divergence (1990 - 2022)

Sources*: OCGS/NBS Census (1988–2022), with the author's calculation.*

Demographic divergence Pemba Vs. Unguja: Unguja shows consistently higher growth rates, which are steadier, especially during the 2000s. Pemba's growth is more volatile, with a pronounced dip around 2011 and a slower recovery. This divergence may reflect urban–rural contrasts, differential access to services, or migration patterns favoring UNGUJA.

Unguja Vs. Zanzibar Aggregate: Unguja's sharper fluctuations contrast with Zanzibar's smoother curve, indicating that Unguja drives much of the volatility in the aggregate trend.

b) Temperature Pattern

As seen in Figure 3.6, Minimum Temperatures show a gradual rise from 1990 across all regions, i.e., Pemba and Unguja. Similar to the population growth pattern, the average temperature is more volatile in Pemba, indicating unpredictable warming nights. In contrast, Unguja, the Maximum Temperatures also trend upward, but are less volatile compared to Pemba, suggesting an intensification of heat stress. The maximum temperature shows a gradual increase, which is consistent with global warming patterns.

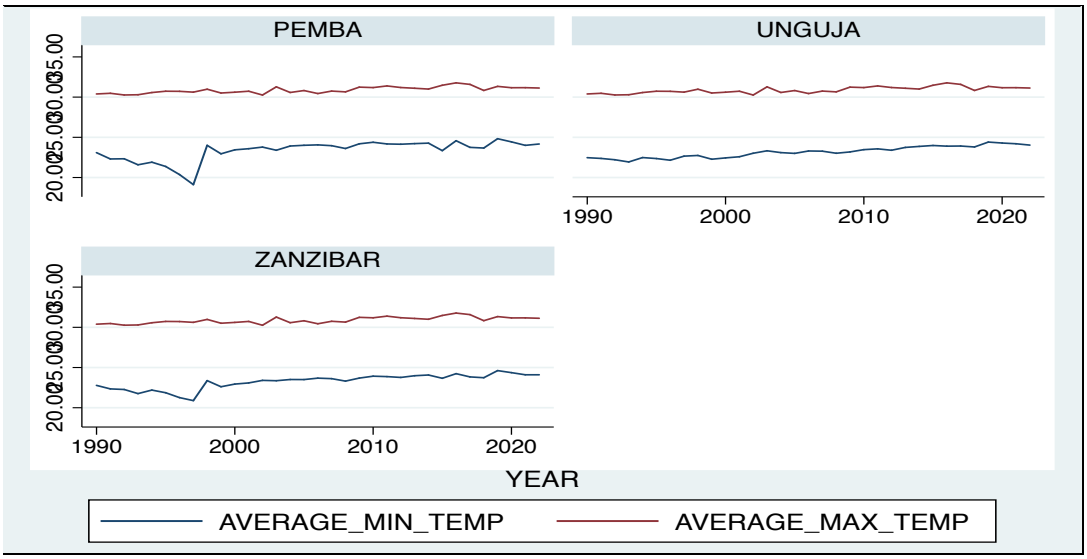

Figure 3.6: Minimum and maximum temperature trends (1990–2022).

***Source**: TMA; ZEMA (1990–2022)*

c) Rainfall Pattern

All regions, Unguja and Pemba, exhibit significant interannual extreme variability in rainfall, with no consistent upward or downward trends as seen in Figure 3.7. Pemba, on the one hand, shows relatively higher peaks in rainfall patterns, but also sharper troughs, indicating greater exposure to extreme precipitation events. On the other hand, Unguja experiences more stable but gradually declining rainfall in recent years, which may signal emerging drought risk that endangers agricultural productivity.

The erratic rainfall patterns are consistent with rising temperatures, suggesting an increase in climate unpredictability, which becomes a threat to agricultural land, water security, and civilian infrastructure. As rainfall variability increases, the vulnerability to drought, flooding, and limited access to SRHR services also intensifies.

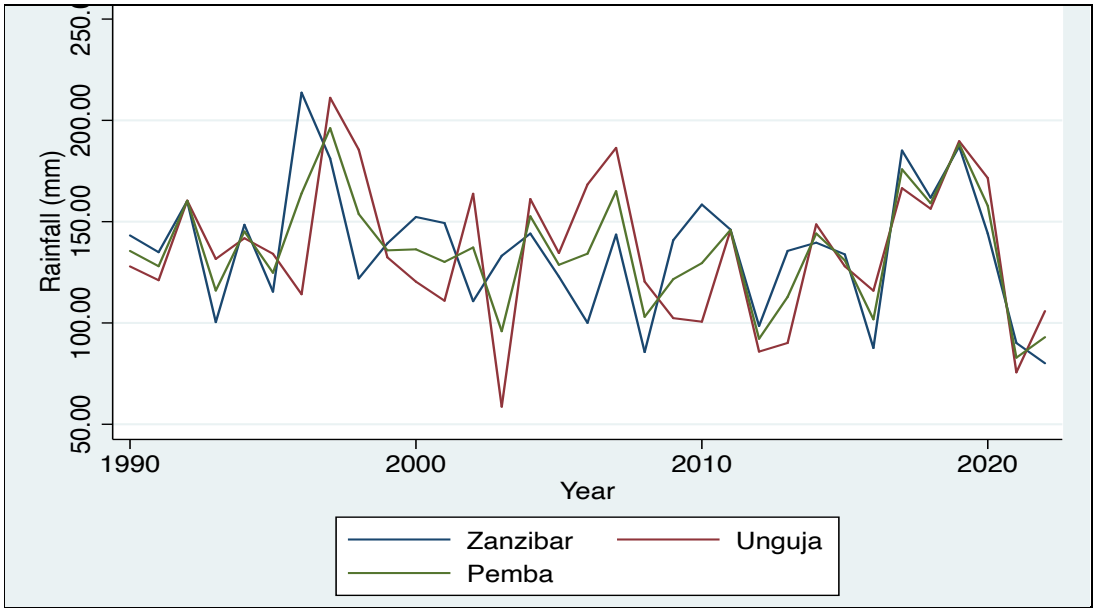

Figure 3.7: Annual rainfall pattern and interannual variability (1990–2022) by region.

Source: *TMA; ZEMA (1990-2022)*

As seen in Figure 3.7, rainfall has been consistently below 200mm since around 1998. This trend keeps worsening over time, with a notable decline in rainfall below 100 mm observed across all regions (Pemba and Unguja), starting from around 2021. The intriguing issue here is that the declining rainfall pattern coincides with rising temperatures and increasing population growth, which intensifies environmental vulnerability.

d) Climate and Demographic Trends Combined (1990–2024)

Figure 3.8 indicates that in the Pemba region, there is a dip in population growth around 2010, which coincides with reduced rainfall and rising temperatures, suggesting climate stress may have influenced fertility, migration, or health outcomes. The post-2015 rebound aligns with rainfall recovery, indicating possible climate-demographic sensitivity.

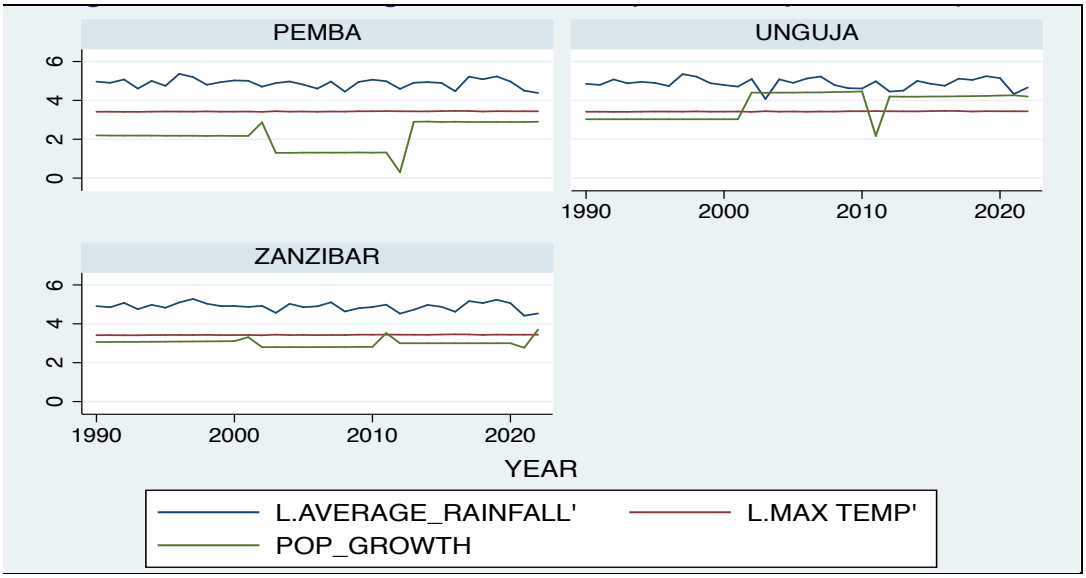

Figure 3.8: Combined climate and demographic trend index (1990–2022).
Source: *Authors' calculations (TMA, OCGS, ZEMA).*

Unguja's demographic surge in the 2000s may reflect urbanization and economic pull factors, while the post-2000 slowdown aligns with rising temperatures and declining rainfall—potentially signaling environmental constraints on growth. The aggregate trend smooths out regional volatility but still reflects the 2010 inflection point. This suggests a systemic demographic response to climate variability, reinforcing the need for climate-population integrated planning.

3.2 Trends of Sexual and Reproductive Health and Rights Services (SRHR)

The common ANC indicators include client attendance aged 20 years old and below, contact frequencies (i.e., 1st, 4th, and 8th contacts), and the expected pregnancies. The former reflects youth engagement in SRHS services, the contact frequencies indicate attendance rate, and the latter describes the expected birth rate. As seen in Figure 3.9, from 2019 to 2024,

total ANC clients in the first contacts rose steadily from 64,007 in 2019 to 70,998 in 2024. The 4th Contact Clients increased from 22,819 in 2019 to 32,886 in 2024, representing a 44% rise, suggesting an improved follow-up. Whereas in the 8th Contact, clients grew from 1,219 in 2020 to 2,814 between 2022 and 2024, though coverage remains low (3.2%). In those three contacts, the number of ANC clients is increasing but at a decreasing rate, which calls for awareness, improvement in SRHR service quality, and simplifying accessibility to the SRHR services.

Moreover, the number of ANC Clients aged below 20 years declined from 5,420 in 2019 to approximately 4,425 in 2024, possibly indicating demographic shifts or barriers to SRHS access for the youthful population. This also calls for simplifying accessibility and increasing service quality, and awareness among the youthful population.

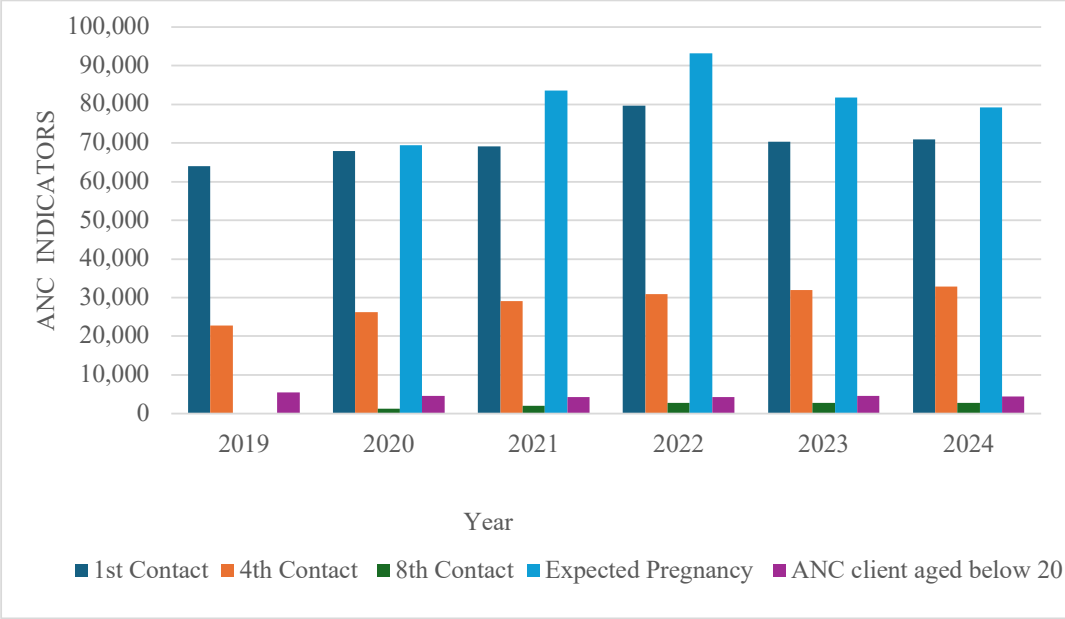

Figure 3.9: Trend of ANC indicators (1st, 4th, 8th contacts; 2019–2024).

Source: *ZAHB & DHIS2 (2019–2024).*

Moreover, the number of ANC Clients aged below 20 years declined from 5,420 in 2019 to approximately 4,425 in 2024, possibly indicating demographic shifts or barriers to SRHS access for the youthful population. This also calls for simplifying accessibility and increasing service quality, and awareness among the youthful population. Like varying climate

patterns, the expected pregnancies also fluctuated from around 69,000 (2020) to about 90,000 in 2022 and then to 79,000 in 2024. This indicates that to some extent, SRHR services react to climate dynamics.

The indicators of health delivery services are key monitoring for maternal and child health, which show the extent of utilization of skilled birth services as well as the quality of care during delivery.

In the context of Zanzibar, the trends indicate that the number of health facility deliveries is generally on an upward trajectory (Figure 3.10), with an increase from 48,160 in 2019 to a peak of 56,985 in 2023 and then slightly scaling down to a minimum of 52,919 in 2024. This increase with time indicates increased access to skilled birth services, an indicator of the success of the Reproductive and Child Health program targeting a facility-based delivery.

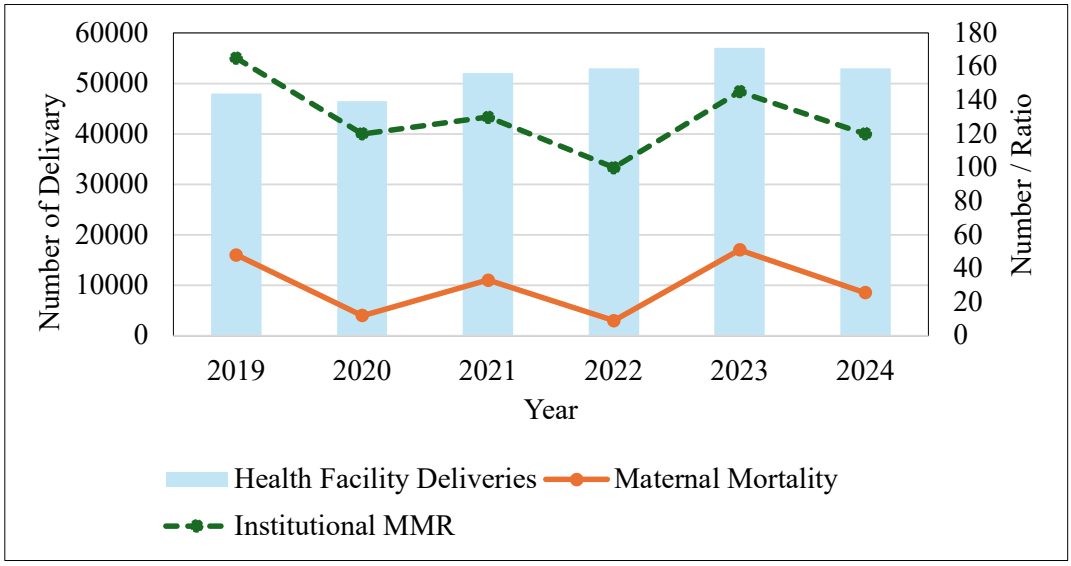

Figure 3.10: Trends in Health Facility Deliveries, Maternal Mortality, and Institutional MMR in Zanzibar (2019–2024).

The slight decline in 2024 can reflect developing problems like service interruptions, socio-cultural difficulties, or temporary resource constraints. Maternal mortality rates had remarkable variation in the same period. Maternal deaths decreased from 80 in 2019 to 52 in 2022, revealing maternal health outcomes and a potential positive effect of enhanced emergency obstetric care. Yet the subsequent increase to 83 deaths in 2023, then a decline to 64 in 2024, demonstrates ongoing variation, indicating

potentially delayed interventions, variations in care quality, or differing access to emergency services.

The institutional Maternal Mortality Rate shows a fluctuating trend, where maternal mortality per 100,000 live births occurs within health facilities. The Institutional Maternal Mortality Ratio (IMMR) rose from 99 deaths per 100,000 live births in 2022 to 145 in 2023, with a 46% increase (MoH, 2024). The denominator of the number of reported health facility deliveries as a proportion of the estimated number of pregnancies ranged between 64.5% and 69.8%. Nonetheless, there remains a sizable proportion of those who delivered outside formal health facilities. The highest was observed in 2021 (69.8%) while the lowest was in 2024 (64.5%, Art12g). The marginal decrease from one year to another suggests that facing difficulty completing universal access to SBA at birth will be an ongoing challenge.

3.2.2 Distribution of Family Planning Services in Zanzibar

Family planning is one of the key components of reproductive health and demographic transition that contributes to maternal and child health indicators, fertility patterns, and social development. In Zanzibar, family planning represents a two-sided issue at hand, allowing for substantial strides in reproductive health service delivery on the one hand, while leaving apparent disparities in utilization and access.

As seen in Table 2.1, the pattern of visits by new family planning clients varied across the 6 years. There were 31,791 new patients in 2019, which increased marginally to 32,132 in 2020. However, there was a sharp drop in 2021 to 27,982, presumably due to service interruption, social-cultural barriers, or the impact of climate change on health care utilization.

The numbers from 2022 on are steadily rising, and to round it off, also 38,212 in the year 2024. This uptick indicates another effort to push for family planning outreach, more awareness, and possibly better access to contraceptives.

Table 3.1: Family Planning Indicators in Zanzibar (2019–2024)

FP Indicators	2019	2020	2021	2022	2023	2024
Number of new FP clients' attendance	31,791	32,132	27,982	30,625	34,215	38,212
Number of continuing FP clients' attendance	61,847	62,433	58,060	58,665	61,427	70,472
Family planning acceptance rate (%) among new users	6.8	7.5	6.9	6.3	6.9	7.4

Source: DHIS2/ZAHB (2019–2024).

The increase is reflective of increasing demand and acceptance for reproductive health services in Zanzibar, as more women and couples are starting to use family planning.

Further results show that after a high of 61,847 in 2019, the number of continuing family planning clients has had little fluctuation when compared to the last few years, until 2021, which saw just 58,060 people attend. This fall coincides with a reduction in new clients, supporting the hypothesis that service provision during this year faced external challenges.

Trends of the family planning acceptance rate for new clients show no clear trend, varying from 7.5% to 6.3% by year. The acceptance rate in 2019 was a moderate 6.8%; however, this increased to 7.5% in 2020, suggesting some positive reception of program efforts at that time. Yet with a drop to 6.3% in 2022, the numbers paint a picture of difficulty enrolling new clients on modern methods, even with consistent attendance levels.

Analysis of Sexual and Reproductive Health and Rights (SRHR) service metrics, specifically Antenatal Care (ANC) utilization, reveals a critical paradox: a visible improvement in institutional capacity running concurrent with acute vulnerabilities exposed by climate change and demographic shifts (Adapted from Burns & Mutunga, 2024).

The positive trends, the rise in overall ANC contacts (1st, 4th, and 8th) and the increase in 4+ contact coverage to 50% - are strong evidence of institutional strengthening and sustained programmatic efforts (Adapted from Burns & Mutunga, 2024).

Table 3.2: Integrated Insights: SRHR vs Climate & Demography

Dimension	Observed Trend (ANC)	Related Climate Demographic Factor	Policy Implication
Service Uptake	Rising ANC contacts (1st, 4th, 8th).	Population growth also increases, driving higher demand for SRHS services.	Scale up more climate resilient SRHR service infrastructure.
Early Engagement	It is more volatile especially below 12 weeks coverage.	Possibly linked to climate shocks or outreach variability.	Strengthen awareness and service access.
Youth Attendance	Declining especially below 20 years clients.	Indicating demographic transition or social barriers.	Targeted awareness programs to youth
Coverage improvement	4+ contact coverage rising to 50%.	Institutional strengthening likely to be the driving factor.	Sustain funding & monitoring.
Climate Sensitivity	Low 8th contact coverage, stagnant.	Rainfall/temperature variability may hinder follow-up.	Climate-resilient service delivery.

Source: Adapted from Burns & Mutunga (2024).

However, this success is essentially a passive response to demographic pressure, merely accommodating the higher demand driven by rapid population growth (Adapted from Burns & Mutunga, 2024). The critical discussion here lies in the necessity to transition from passive accommodation to proactive resilience. The current policy implication to sustain funding must therefore be reframed to prioritize scaling up service infrastructure to be explicitly climate resilient, ensuring that growing demand can be met even during environmental shocks (Adapted from Burns & Mutunga, 2024).

Conversely, two key vulnerabilities underscore the system's fragility. First, the considerable volatility in early engagement (coverage below 12 weeks) suggests a systemic weakness in proactive outreach and reliability (Adapted from Burns & Mutunga, 2024). This volatility is plausibly linked to transport disruptions or service interruptions caused by climate shocks (e.g., heavy rainfall or excessive heat), indicating that the existing service model is highly climate-sensitive and unreliable when needed most (Adapted from Burns & Mutunga, 2024). Second, the declining youth attendance (clients below 20 years) represents a major policy failure to engage the key demographic responsible for future population

growth (Adapted from Burns & Mutunga, 2024). Attributing this solely to demographic transition overlooks the likelihood of persistent social barriers, stigma, or restrictive policies that prevent young women from accessing services. If this demographic is not effectively reached, the system undermines its own efforts to manage fertility rates and reduce overall population pressure, thus perpetuating the cycle of demographic and environmental vulnerability (Adapted from Burns & Mutunga, 2024). This failure demands a targeted policy shift towards removing these social barriers and strengthening targeted awareness programs for youth (Adapted from Burns & Mutunga, 2024). The low and stagnant 8th contact coverage further confirms this climate sensitivity, highlighting that rainfall and temperature variability actively hinder necessary follow-up visits, demanding an immediate commitment to climate-resilient service delivery models (Adapted from Burns & Mutunga, 2024).

3.2.3 Spatial Analysis

The series of satellite images, as seen in Figures 3.2 and 3.3, captures the extent of urban growth in Zanzibar between 1994 and 2024. The maps illustrate the way in which built-up land has expanded over thirty years, driven by a surge of urbanization powered by population growth, migration, and economic shifts.

Changes in spatial images for Unguja Islands are illustrated in the left panels, and Pemba in the right-hand panel. The pattern of settlement for each period is highlighted in a separate color: grey 1994; yellow 2004; orange 2014; red 2024. These images offer a strong testimony of the extent to which urban expansion has transformed Zanzibar's environment, particularly around its principal cities.

In Unguja, urbanization has been particularly rapid and is mainly located around Zanzibar City (Mjini and Magharibi districts). The urban district in 1994 was small, essentially the historic centre plus its immediate neighborhood. By 2004, urban development had spread out from the historical town along main roads, while new settlements such as Fuoni, Bububu, and Tunguu were sparsely populated in the more central parts of Zanzibar.

3.3 The Causality Between Population Growth, SRHR and Climate Dynamics

An econometrics method, such as the Granger causality test, is applied to population data, such as annual population growth, and climate change indicators: rainfall and temperature. This approach is useful to determine which of the two variables can Granger-cause the other. That is, whether high population growth leads to climate variability or climate variability leads to rapid or stagnant population growth and vice versa. The result is essential to influence policy dynamics in Zanzibar, as it can assist in deciding which variable should be targeted in addressing the problem that may arise due to the interaction between the two variables.

In analyzing Granger causality, two conditions must be met: the variables must be either stationary or cointegrated. As such, we have tested the stationarity or the presence of a unit root among the variables using the Augmented Dickey-Fuller (ADF).

Thus, the variables of interest are expressed in the following model:

$$POP\_GROWTH_t = a + B1Climate_{t-k} + B_2\ POP\_GROWTHt\text{-}k + é$$

Where:

- *k is a natural number 1, 2……..*
- *Pop GROWTH is the proxy of population growth, such as annual population growth.*
- *Climate represents proxies for climate indicators: temperature and rainfall.*
- *a is the constant term,*
- *b is the coefficient*
- *é s the error term*

Table 3.3: Augmented Dickey-Fuller unit root test result (level and difference)

	Pop Growth (P - Value for Z(t))	Average Temperature (P - Value for Z(t))	Average Rainfall (P - Value for Z(t))
Level 1 (0)	.9959	.6124	0.2161
Diff I(1)	.9746	.0215*	0.3365

As shown in Table 3.3, all variables are non-stationary I (0) in their level. However, in the first difference 1(1), two variables: population growth and average rainfall, remain non-stationary. In contrast, the variable: average temperature, is stationary after the first difference. Hence, we have mixed stationarity results. Please note, if one variable is I (1) and another is I (2), their levels are neither stationary nor cointegrated. This renders traditional Granger causality not feasible, unless by transforming the variables: population growth, and average temperatures into the second difference I (2), to make them stationary. Also, transform the average rainfall variable into the first difference I (1) and then run Granger causality with I (1) and (2).

However, the weakness of this approach is that the interpretation becomes a bit tricky, as we are now testing whether changes in population growth acceleration Granger-cause the change in climate variables, which implies that a second-order change in population growth predicts the first-order changes in climate variables, which is statistically valid, but economically, it is abstract. While this approach ensures **statistical validity**, its interpretation reflects dynamic changes rather **than level-based causality**.

Therefore, to align the analysis with an economic interpretation, we have tested the presence of a structural break in the data, which might be caused by regime shifts or policy-induced demographic transition, or temperature shocks leading to the non-stationarity of the variables.

Thus, to account for potential regime shifts or temperature shocks, the Zivot-Andrew test has been applied to the proxy of population growth and the proxies of climate change.

The result of the test rejected the null hypothesis of a unit root with a structural break, which implies that the variables: temperature and population growth rate are likely to be stationary in the first difference, but the regime shifts caused the data to appear nonstationary, especially in 2009 and 2017. This observation suggests that population growth and temperatures are non-stationary at I(0) after accounting for the 2009 and 2017 structural breaks, respectively. This allows us to test Granger causality with mixed stationarity; however, we will have to create and incorporate dummy variables that account for the two structural breaks.

In this case, the Tado and Yamamoto Granger causality test is more suitable. The application of the Tado and Yamamoto Granger causality test is preferable for a few reasons; it can handle both causality and mixed stationary variables, i.e., I (0) and I (1), which is a unique property of the present dataset. It is also preferable because all variables are non-stationary in their level

The results in Table 3.4 indicate that the proxies of climate change, such as rainfall and temperature, individually cannot significantly Granger-cause population growth, which implies that these variables individually cannot significantly predict population growth and vice versa.

Table 3.4: VAR Granger Causality (Tado – Yamamoto) Results with Population Growth as Dependent Variable

Variables	Chi_sq	Probability	Interpretation
Rainfall	1.511	.47	No Granger causality:
Temperature	0.11	.95	No Granger causality
Dummy of Structural Break2009	1.28	.53	No significant structural break effect from 2009 on population growth
Dummy of Structural Break2017	2.46	.29	No significant structural break effect from 2017 on population growth
All	18.09	.021	Collectively the variables Granger cause population growth

However, in their joint combination, can Granger cause population growth, as seen in the joint test last row, i.e., all variables collectively can Granger-cause population growth. This implies that climate variables lack individual predictive power; in contrast, their combined dynamics may influence population growth.

This can further be translated to mean that the past variation of the climate patterns can significantly predict future changes in population size; in other

words, the proxies of climate change variables in aggregate can be used to predict future population change. Also, the dummies of structural breaks do not have any significant effect on demographic dynamics; that is, the regime shifts in 2009 and 2017 did not have any significant influence on population growth.

3.3.1 How Environmental and Population Factors Correlate with Sexual and Reproductive Health and Rights

Table 3.5 illustrates the variation of SRHR indicators, particularly sexually transmitted diseases (STIs), in relation to population growth, temperatures, and rainfall for three years between 2020 and 2022.

STI vs Population Growth: portrays a weak negative correlation, indicating a slight tendency for STI cases to decrease as population growth increases. This may reflect effective SRHR interventions in high-growth areas. In recent years, there has been an improvement in health service delivery throughout the Unguja and Pemba Islands, which could trigger a reduction in the transmission rate.

Table 3.5: Correlation Matrix between Population Growth, Climate Dynamics, and Sexually Transmitted Diseases (STIs)

Variables	STI	Pop Growth Rate	Rainfall	Temperature
STI	1.000			
POP_GROWTH	-0.310	1.000		
RAINFALL	-0.889	-0.158	1.000	
TEMP	0.238	-0.997*	0.233	1.000

Sources: *compiled by author from DHIS2 (2020-2024).*

STI vs Rainfall: There is a strong negative correlation; as rainfall increases, STI cases tend to decrease. This is because rainy seasons may reduce mobility, social interaction, or increase clinic disruptions—leading to lower transmission or reporting of STIs cases. This observation implies that SRHR services should anticipate higher STI burdens in drier months and, as such, plan outreach accordingly.

STI vs Maximum Temperature: indicates a weak positive correlation; a slight increase in STI cases associated with higher daytime temperatures. It could possibly be linked to the increase in mobility or higher social interactions during warmer days. Though warmer days, as indicated by high temperature, are not a significantly strong driver for STIs prevalence, it is nevertheless important not to ignore.

3.4 The current state of climate change, health, SRHR service, gender equality, and population dynamics, and their inclusion in, or omissions from, Zanzibar development policies

To analyze the current state of climate change, SRHR service, and Gender equality, the study used primary data to collect the most recent data from 270 respondents in various parts of Zanzibar (Unguja and Pemba). The demographic characteristics of the respondents and their responses are shown below.

3.4.1 Demographic Information

In the context of the present study, the profile of the respondents includes regional distribution, educational status, gender, marital status, and age. More details are shown in Table 3.6.

Unguja regions: Mjini Magharibi (33%), and Kusini Unguja (28%) dominate the sample, suggesting urban and peri-urban perspectives are well represented in the study.

Pemba regions: Kusini and Kaskazini (30%), which is almost half of the Unguja's respondents; this is consistent with population distribution in Zanzibar, where half of the population resides in Pemba Island. As such, this distribution provides island-specific insights, crucial for understanding geographic disparities in SRHR access and climate vulnerability.

Gender: Male (60%) vs Female (40%) shows a moderate gender imbalance. While male perspectives are important for understanding household decision-making and migration. The women's (40%) representation is sufficient to provide insights into SRHR access, maternal health, and reproductive autonomy.

Age Group: Youth (18–35 years) = 62% of respondents, Middle-aged (36–55 years) = 38%. Youth-heavy sample aligns with Zanzibar's demographic profile and is highly relevant for SRHR and population growth dynamics.

Younger respondents are more likely to engage with climate activism, digital SRHR platforms, and migration decisions. Middle-aged respondents may reflect on family planning, economic pressures, and intergenerational climate impacts.

Marital Status: Married (48%), Single (43%), Divorced (10%). A high proportion of married individuals suggests relevance for family planning, fertility choices, and household-level climate adaptation. Single respondents may reflect youth perspectives on SRHR education, employment migration, and delayed marriage trends. Divorced individuals may highlight social vulnerabilities and gendered economic stress under climate pressure.

Education Level: Bachelor's and above (65%), Diploma/Secondary/Primary (35%). High education levels suggest respondents are more likely to understand and articulate complex links between climate, population, and SRHR. Moreover, educated respondents may favor policy-oriented solutions and institutional reforms. Additionally, lower-education groups, though smaller, are vital for understanding barriers to SRHR access, climate literacy, and service uptake in marginalized communities.

3.4.2 Descriptive and Comparative Overview of the Current status of the Nexus of Population Dynamics, Climate Change, and Sexual and Reproductive Health Services (SRHS) in Zanzibar

The descriptive findings underscore a high degree of public awareness across Zanzibar regarding the demographic and environmental challenges, which provides a critical foundation for policy intervention. A majority of respondents, 72%, reported having noticed substantial environmental change in their immediate surroundings. These changes are overwhelmingly perceived as negative by 62% of respondents. When asked to identify the most common factors contributing to this negative change, human activities were cited as the highest contributor by 38% of respondents, followed closely by concerns over overpopulation. Images such as those presented in Figure 3.8 portray the extent to which unregulated human

activities - including land degradation and unsustainable resource use - exacerbate these environmental concerns.

This recognition is further validated by the primary survey data, which indicates that the perceived contribution of overpopulation to environmental change is the highest affirmative response among the core indicators, exceeding 70%. This finding points to a widely accepted public recognition of the strain that the current Total Fertility Rate of 4.7 places on the islands' finite resources and environmental health (Zanzibar Government, 2022). In contrast to this high awareness of systemic pressure, the percentage of respondents reporting that their life was personally affected by climate change and the percentage who have accessed SRHS are significantly lower and closely aligned, suggesting a potential cognitive or reporting gap between general awareness of systemic pressure and the reporting of personal impact or service uptake. This comparative distribution of the core indicators is visually represented in **Figure 3.11**.

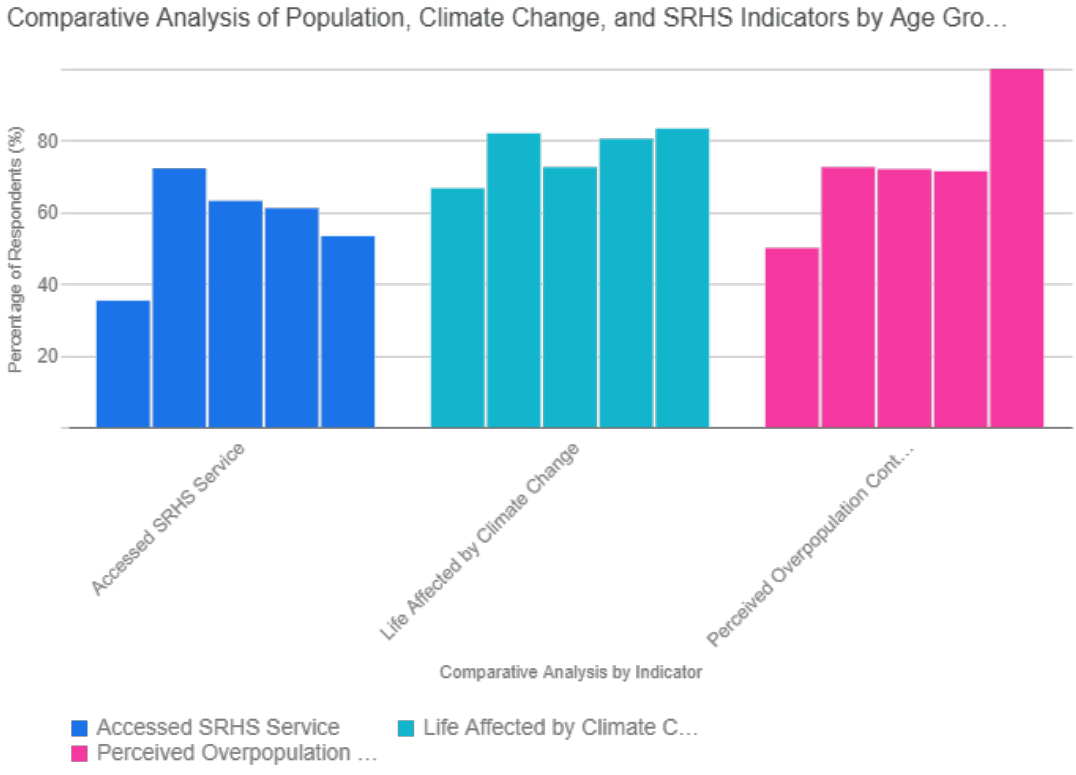

Figure 3.11: Comparative Bar Graph of Affirmative Responses for Key Indicators

Description: This figure compares the overall percentage of respondents who gave an affirmat ("Yes") answer to the key indicator in each theme: Perceived Overpopulation Contribution, Life Affec by Climate Change, and Accessed SRHS Service (Source: Primary Survey Data)

The Interlocking Crises of Migration and Service Deficits

The combined quantitative and qualitative evidence demands an integrated policy framework that addresses not only the persistent challenge of high fertility rates but also the evolving spatial dynamics of the population across Zanzibar (Unguja and Pemba), specifically the intense pressures driving internal migration. This analysis generalizes the qualitative insights from specific locations to represent systemic challenges affecting rural areas island-wide. The statistically significant link established between SRHS access and climate change impact reporting provides a robust empirical argument for intersectoral policy, critically establishing SRHS as a leverage point for building resilience. However, this essential progress is structurally undermined by population shifts.

The high intercensal population growth rate of 3.7% already presents an acute resource crisis across the islands (Zanzibar Government, 2022). This crisis is critically intensified by an accompanying phenomenon-youth rural-urban migration. This dynamic, driven by systemic service deficits (like education distribution and services) in rural areas, concentrates the growing population in urban coastal zones, often leading to unplanned settlements and urban sprawl, which directly encroaches upon fragile coastal ecosystems. The environmental damage resulting from unsustainable resource extraction and land degradation-pressures directly linked to this rapid growth-is clearly visible across the islands. For instance, Figure 3.12 illustrates the localized severity of human-induced degradation, highlighting the barren terrain at Kojifa and Kangagani, Pemba, and the sand extraction activities in Donge Mchangani.

Figure 3.12: Localized Human-Induced Environmental Degradation in Zanzibar

Description: Photographic evidence showing the barren terrain at Kojifa, and Kangagani, Pemba (top and bottom panel), and the environmental impact of sand extraction at Donge Mchangani, Unguja (middle panel). These images serve as physical examples of the pressure that population growth and unregulated resource use place on the islands' fragile ecosystems.

The sheer scale and concentration of this demographic challenge are visually reinforced by the population Distribution, which clearly shows the high-density stress points. Furthermore, the high youth dependency inherent in a rapidly growing population is illustrated by the Percentage of Children Under 18 Chart (Figure 3.13), underscoring the massive future demand for services. This increasing concentration of people and assets in low-lying urban areas (particularly around Zanzibar City) significantly escalates overall climate vulnerability, making these areas more susceptible

to sea-level rise, coastal erosion, and infrastructure failure (Oppenheimer et al., 2019).

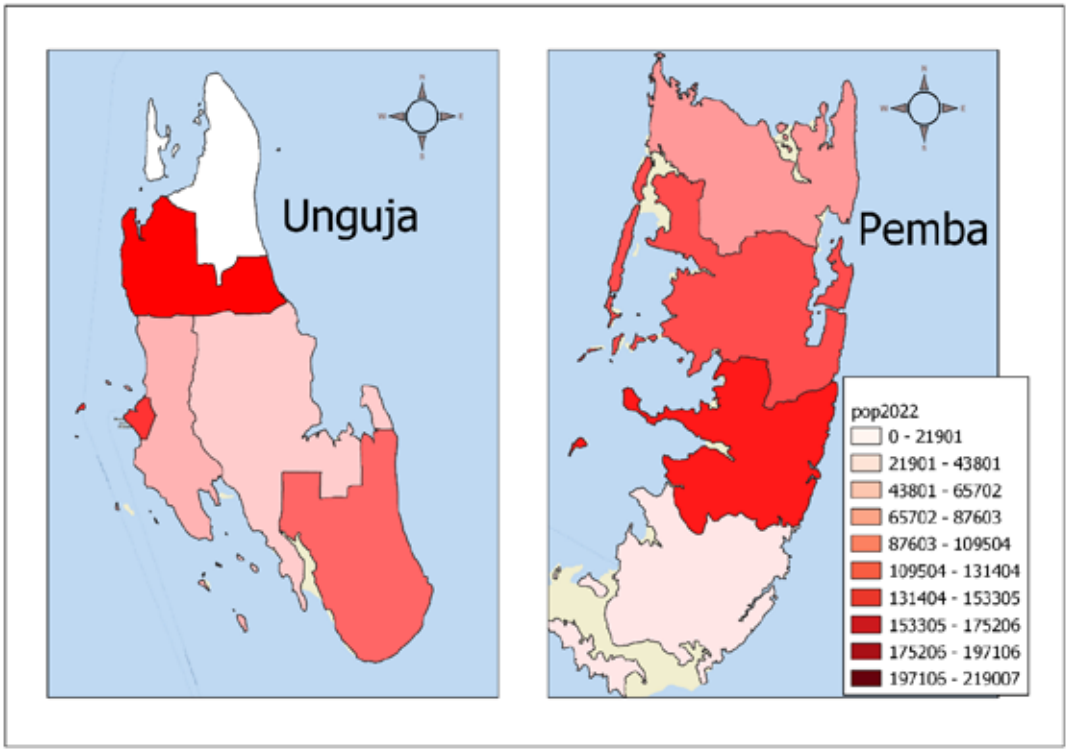

Figure 3.13: Map of Population Distribution and Density in Zanzibar (Unguja and Pemba)

Description: A choropleth map illustrating population density, highlighting the high concentration of the population in urban and coastal zones, which exacerbates climate vulnerability

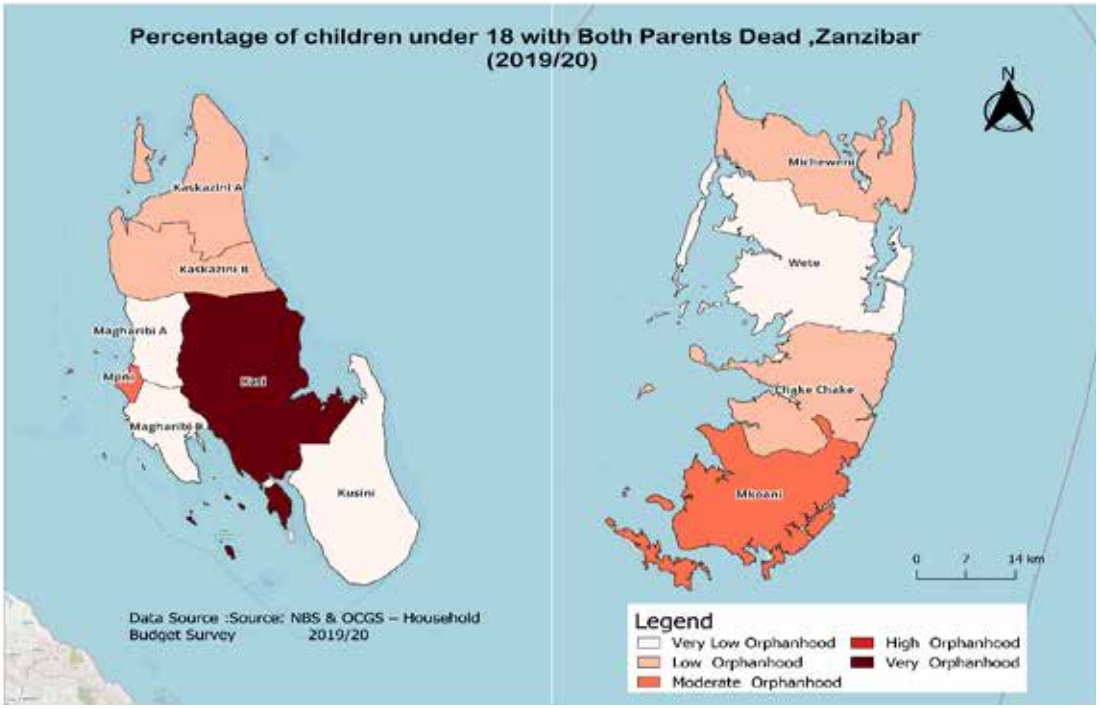

Figure 3.14: Percentage of Children Under 18 Years in Zanzibar (Map/Chart)

Description: A map demonstrating the high proportion of the population under 18 years, indicating a high youth dependency ratio and future growth momentum

The structural causes of this migration across Zanzibar are multifaceted, stemming from pronounced regional disparities in service provision. Poverty and the Deficit in Social Services are identified as powerful push factors. Qualitative data from rural communities highlights that extreme poverty and the severe lack of essential services compel youth to migrate to urban centers. The inadequacy of basic amenities, such as fully equipped healthcare facilities, clean water, and reliable transportation, forces youth and families to seek better living conditions (Adesiji et al., 2009; Njella, 2013). For example, the lack of fully equipped rural hospitals means that critical health emergencies, such as complications during childbirth, often cannot be safely managed locally, compromising maternal health outcomes and directly hindering the effectiveness of rural SRHS systems.

Furthermore, the educational opportunity gap acts as a primary structural push factor throughout rural Zanzibar. The spatial disparity in access to quality education, which is a key driver of migration, is clearly demonstrated by the Spatial Distribution of Net Primary Education Association Map

(Figure 3.15). The absence of advanced secondary schools, universities, or vocational training centers means that youth who wish to pursue higher education or gain specialized, employable skills are compelled to migrate to the areas where these facilities are equipped (Mkwananzi, 2018; Rosvall, Rönnlund, & Johansson, 2018). This compulsory migration of the most educated and energetic segment of the population results in a significant slowdown of rural development and a severe loss of agricultural productivity, as the essential labor force is depleted, leaving the elderly to manage farms (Chikire et al., 2012). This out-migration is compounded by Socio-Cultural Factors, as youth often seek to escape restrictive traditional culture and family barriers, searching for broader social interaction and freedom in more dynamic urban settings (Miheretu, 2011).

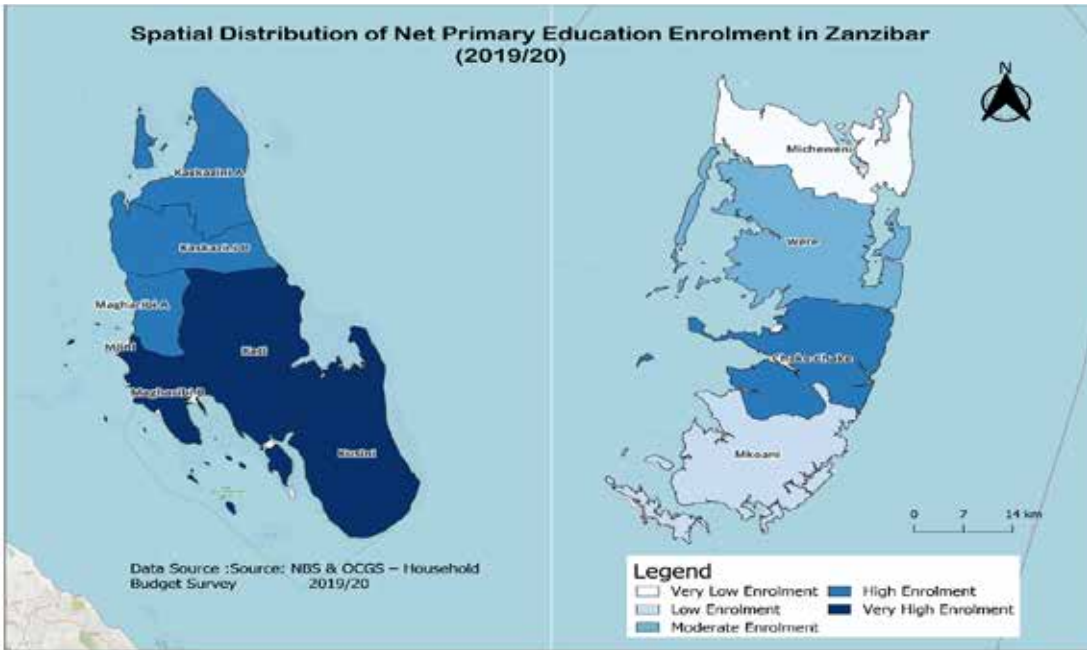

Figure 3.15: Spatial Distribution of Net Primary Education/Education Gaps Map

Description: A map visually representing the regional disparities in net primary education enrollment or access to secondary education facilities, linking educational deficit to potential out-migration zones.

This synthesis highlights the local needs that must be addressed by any policy attempting to stabilize rural populations and enhance their climate resilience. The analysis of current policy frameworks confirms the need for a new strategy. Reviewing existing documents reveals that while key sectors possess foundational policies, the intersectoral integration necessary to

address the complex nexus of population, climate, and health is critically absent. This systematic failure to link these domains is summarized in Table 3.7, highlighting specific policy omissions that must be urgently addressed.

Sector	Included Policy	Key Omissions
Climate	Adaption brief, local actor engagement	Lack of climate policy, Weak SRHR/population linkage, funding gap
Health	Health Sector Strategic Plan IV. Vision 2025	Weak climate health integration
SRHR	Zanzibar health sector strategic plan, NGOs-led programs such as Engender Health, Mary Stop etc.	Lack of unified SRHR policy and youth exclusion
Gender equality	Zanzibar Gender Indicator for SDG, political participation	Weak cross-sector gender mainstreaming
Population dynamics	Census data, Growth tracking	Lack of a well-defined Zanzibar-specific population policy

Source: Policy Review/primary data.

Description: A table summarizing key socio-economic, infrastructural, and environmental factors identified in qualitative data that limit the ability of rural residents to cope with change and incentivize migration

Chapter Four
POLICY IMPLICATION AND RECOMMENDATION

4.1 Policy Implication

Generally, this finding informs policymakers that regime shifts in climate patterns serve as leading indicators of population growth. For instance, increased and consistent rainfall patterns can stimulate agricultural production, thereby facilitating migration and high birth rates. This enables policymakers to proactively plan for infrastructure, healthcare services, education, and other resource allocations according to demographic expansion. Also, there is a need for all current infrastructural facilities that are underway to be prepared for alignment with Zanzibar's Vision 2050 and to be positively responsive to a growing population and to prepare for climate stress.

4.2 Recommendation

i. Establish a high-level Intersectoral Task Force mandated to design and implement a specific Zanzibar Population Policy that systemically links climate, SRHR, and gender goals under the overarching Vision 2050 framework. This policy must explicitly address environmental sustainability alongside reproductive health service delivery.

ii. Create a Vulnerability Dashboard to enhance evidence-based decision-making. The Zanzibar Planning Commission (ZPC) must lead this by integrating real-time data feeds from key agencies: TMA (rainfall/temperature), OCGS (population density/growth), ZEMA (environmental data), and DHIS2/Ministry of Health (SRHR service coverage/health outcomes)

iii Investigate local and cultural barriers to adolescent Antenatal Care (ANC) uptake among the under-20 population. Based on these bottom-up findings, develop targeted, age-appropriate services and institutionalize youth voices in both SRHR and climate policy design to drive higher engagement and reduce early pregnancy.

iv Integrate fertility trends with population projections (using data from OCGS and Ministry of Health) to generate refined SRHR demand forecasts and inform long-term investment in health facility and staff capacity

V. Dedicate funds to construct and fully equip specialized Form Five and Six science and arts streams in strategically selected regional centers within rural districts and on outer islands. This directly eliminates the structural necessity for high-achieving youth to migrate for advanced education, retaining valuable human capital.

vi. Establish and fully operationalize Vocational Training Centres (VTCs) in all major rural and island sub-districts, focusing on market-relevant skills (e.g., sustainable tourism, modern agriculture) to enable graduates to secure local employment or start enterprises.

vii. Invest dedicated funds to upgrade existing, or construct new, climate-resilient health facilities in rural areas and peri-urban zones that currently face poor drainage or water access. These facilities must be fully equipped to provide comprehensive, reliable access to reproductive health services (including complication management) to support the rapidly growing population

viii Allocate budget for the construction of dedicated, high-quality government housing and prioritize the provision of reliable high-speed internet connectivity, safe water supply, and consistent electricity at these remote service hubs to ensure that essential staff are motivated to remain in rural areas.

ix. Invest in technologies and training for climate-resilient agricultural productivity that does not rely on unpredictable rainfall (e.g., small-scale irrigation schemes, distribution of drought-resistant seeds). This ensures a stable food supply, reduces rural economic precarity, and stabilizes the rural workforce against climate shocks.

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