Environmental Science and Policy 160 (2024) 103846

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Weaving scientific and local knowledge on climate change impacts in coastal Kenya, Western Indian Ocean

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ARTICLE INFO

Keywords:
Climate change
East Africa
Gender
Indigenous and local knowledge
Scientific knowledge
Small-scale fisheries

ABSTRACT

Climate change poses severe threats to coastal social-ecological systems (SES) worldwide. Recent calls recognize the importance of including Indigenous and local knowledge (ILK) in research on climate change impacts. Yet studies that have attempted to weave ILK and scientific knowledge have seldom considered the gendered nature of climate change impacts. Building on the literature on gender and climate change and knowledge pluralism, this study contributes to addressing this research gap by exploring local knowledge on climate change impacts and its relation to scientific knowledge through a gendered approach and focusing on the Western Indian Ocean region, and more specifically on Kenya. We adopted a mixed methodology combining qualitative and quantitative approaches. We found evidence of pronounced climate change impacts on coastal SES both in the scientific literature and in local reports. Our findings highlight that there is an extensive overlap between information derived from scientific and local knowledge systems. Importantly, our study revealed reports of change that were only provided by SSF communities, namely changes in coastal dynamics, a decrease in rainfall, and a decrease in the abundance of green algae. Although we found gendered variations in changes reported by SSF communities, gendered differences of climate change impacts on SSF were not detected in the reviewed literature. Overall, our results suggest that knowledge cross-fertilization generates a holistic, relational, and place-based view of climate change impacts, which may support sound and gender-inclusive adaptive policies. We conclude by suggesting key policy recommendations for climate adaptation and risk management

1. Introduction

As climate change escalates, its effects amplify worldwide (IPCC, 2021). In the ocean, climate change is substantially affecting coastal and marine ecosystems in complex and connected ways (Scheffers et al., 2016). Further, coastal and marine ecosystems are closely interwoven with human societies in dynamic social-ecological systems (SES), with climate change considerably altering coastal communities worldwide (Eddy et al., 2021). Given their high reliance on fish for their daily protein needs and a weak adaptive capacity to a changing climate, tropical regions in particular are severely affected by climate change impacts on marine fisheries (UNEP-Nairobi Convention & the Western Indian Ocean Marine Science Association WIOMSA, 2015). In turn, climate risks in tropical regions are exacerbated by other anthropogenic

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https://doi.org/10.1016/j.envsci.2024.103846
Received 6 October 2023; Received in revised form 9 July 2024; Accepted 18 July 2024
Available online 24 July 2024

stressors such as overfishing or pollution, which accentuate the overall vulnerability of local communities (IPCC, 2021; UNEP-Nairobi Convention & the Western Indian Ocean Marine Science Association WIOMSA, 2015).

Against this background, there has been a growing interest in studying responses of tropical coastal SES to climate change impacts (Cinner et al., 2012). While most of the research on climate change impacts predominantly originates from the natural sciences (Doblas-Reyes et al., 2021), the Intergovernmental Panel on Climate Change (IPCC) and part of the scientific community have called for greater inclusion of other knowledge forms, especially knowledge held by Indigenous Peoples and local communities (IP & LC) on their environment, also referred to as Indigenous and local knowledge (ILK) (Cai et al., 2017; Reyes-García et al., 2016; Reyes-García et al., 2023a). Indigenous and local knowledge constitute complex knowledge systems embracing knowledge about biological and ecological dynamics, practices shaping environmental use and management, and their socio-cultural dimension (Berkes, 2008; Martin et al., 2009; Puri and Vogl, 2005). Above all, ILK must be understood as a way of life for diverse IP & LC across the world (Latulippe and Klenk, 2020).

In this context, recent efforts have sought to embrace knowledge pluralism in climate research, that is the recognition of plural ways of knowing – or knowledge systems – and the dynamic relations and exchanges between them (Hoelting et al., 2022; Orlove et al., 2023; White and Lidskog, 2023). There have been recent discussions about the conditions under which collaboration and exchange between ILK and scientific knowledge systems can occur (Singleton and Boyd Gillette, 2023; Whyte, 2018). Orlove et al. (2023) suggest that knowledge pluralism has the potential for enabling transformative change through just partnerships between knowledge holders. However, in practice, knowledge pluralism in environmental and climate research has often been translated into the subordination of ILK to scientific knowledge. For instance, reviewing research on climate adaption based on plural knowledge systems, Klenk et al. (2017) show that most studies presented ILK as a data source decoupled from its socio-cultural and environmental context. This instrumental view of ILK in scientific research has been criticized by both Indigenous and non-Indigenous scholars. Latulippe and Klenk (2020) denounce the extractive approach commonly used in knowledge co-production across plural knowledge systems and call for considering ILK as "*embodied, relational and place-based systems*" and constitutive of specific worldviews (p.8). In the same vein, according to Whyte (2018) most scientists that engaged in knowledge exchange with IP & LC have focused on the supplemental value of Indigenous knowledge, that is a supplementary source of data to improve research outcomes, at the expense of its governance value. The author argues that scientists should better consider how their research may contribute to strengthen this governance value, which represents a vector of resurgence and collective continuance for many Indigenous communities.

This tension between the instrumental view of ILK and the recognition of its absolute value is reflected in the three main logics applied to knowledge pluralism in environmental science-policy arenas: integrationism, parallelism, and pragmatism (White and Lidskog, 2023). Most of the recent attempts to bring together ILK and climate sciences have used an integrationist logic based on that aims to integrate elements from plural knowledge systems into a single system. This approach reflects an instrumental view of ILK and has been rejected by some researchers who denounced the risk of exclusion and disempowerment of local knowledge holders (Roue and Nakashima, 2018; Torrents-Ticó et al., 2021). Conversely, the parallelist logic strives to achieve collaboration between knowledge systems by considering each given system as a distinct and autonomous entity, hence recognizing the inherent value of ILK (Snively and Williams, 2016). In this line, Tengö et al. (2014) have proposed the Multiple Evidence Base (MEB) approach as an approach "*whereby indigenous, local and scientific knowledge systems are viewed to generate different manifestations of knowledge, which can generate new insights and innovations through complementarities*" (p. 579). In this approach, the validation process operates within each knowledge system rather than across them or through the lens of a particular one. A third path is the pragmatic logic that is context-dependent and addresses knowledge pluralism by seeking to favor positive impacts and maximize outcome efficiency.

To advance discussions on knowledge pluralism in relation to climate change, feminist theories provide a relevant ground by broadening the understanding of climate change impacts (Bee et al., 2015). Feminist scholars have long criticized dominant techno-scientific discourses and suggested instead to recognize and value plural forms of knowledge and ways of being, as well as a greater focus on embodied and everyday experiences of climate change impacts (Bee et al., 2015; Neimanis and Walker, 2014; Sultana, 2013). Adopting this feminist approach, many scholars have investigated the gendered dimensions of climate change (e.g., Dankelman, 2010; Khan, 2022; Pearse, 2017). Their attention has primarily focused on women's vulnerability to climate change, questioning the common view that climate change impacts are "gender neutral" (WEDO, 2010) and showing how existing power asymmetries may be exacerbated by climate change impacts (Arora-Jonsson, 2011; Goh, 2012; Hemmati and Röhr, 2007; Pearse, 2017). Another strand of the literature on gender and climate change has also explored how gender relations shape climate adaptive responses (Dankelman, 2010; Kaijser and Kronsell, 2014). Findings from diverse case studies around the world suggest that women and men respond differently to climate change impacts and natural disasters (Blomstrom and Burns, 2015; Terry, 2009). In particular, it has been noted that women's local knowledge provides women with distinct perspectives and adaptive strategies (Legesse et al., 2013; Pearse, 2017). For example, a case study based on Northeast Ghana shows that women 's farming practices and knowledge have contributed to their adaption to climate-related floods (Glazebrook, 2011). However, according to Arora-Jonsson (2011), most of the literature on gender and climate change has focused on women's knowledge and experiences of climate change, portraying them either as victims of its impacts or agent of change. This narrowed view of gender issues in the context of climate change may challenge the understanding of the complex, relational and intersecting nature of climate change impacts, and calls for further empirical studies from a greater diversity of viewpoints (Arora-Jonsson, 2011).

Bridging scholarship on gender and climate change and knowledge pluralism, this study aims to tackle the historical power imbalance in climate knowledge production by exploring ILK on climate change impacts through a gender perspective. To do so, we adopt a parallelist logic drawing on the MEB approach. While we acknowledge that ILK has a governance value, irrespective of its global contribution to advance scientific knowledge, we build on recent research highlighting how ILK can also serve an important purpose in improving our understanding of climate change impacts (Belfer et al., 2017; Fernández-Llamazares et al., 2017; Reyes-García et al., 2023a).

Specifically, we investigate how local knowledge relates with scientific knowledge on climate change impacts in the Western Indian Ocean (WIO) through a gender lens. It is estimated that more than 30 % of the population in the WIO lives near the coast and strongly depends on fisheries resources for food and income (Obura et al., 2017). Individuals of diverse gender identities are substantially engaging in the fisheries value chain. In this context, there is a critical need to better understand the gender-differentiated impacts of climate change on the fisheries sector and on local livelihoods (Bell et al., 2016; Taylor et al., 2019). However, to date, only a couple of studies have explored such impacts through a local and emic perspective from small-scale fishing communities themselves in the WIO region. Those that have been undertaken have aimed to link scientific evidence and local reports of environmental changes without applying a gender-sensitive analysis (e.g., Lemahieu et al., 2018; Makame and Shackleton, 2020). Therefore, attempts to cross-fertilize scientific knowledge and ILK that consider the gendered nature of climate change impacts in the region are still in their infancy. This research gap undermines our ability to build comprehensive assessments of climate change impacts on coastal SES and may challenge the formulation of culturally acceptable and equitable adaptation policies (Guodaar et al., 2021). We address this gap by focusing on a case study in coastal Kenya, in the WIO region, where populations largely rely on fish for their protein intake (Taylor et al., 2019) in a context in which the marine fisheries sector is highly vulnerable to climate change (Cinner et al., 2012). The specific objectives of our study are:

(O1) To assess the state of scientific knowledge on climate change impacts on coastal SES in the WIO.

(O2) To examine whether local meteorological measurements for the period 1991–2018 align with regional climate trends reported in the literature.

(O3) To analyze perspectives on climate change impacts by local small-scale fishing communities using a gendered approach.

(O4) To explore the relation between local and scientific knowledge on climate change impacts on coastal SES in the WIO.

This research was carried out within the framework of the Local Indicators of Climate Change Impacts (LICCI) project (https://www.licci.eu/), a research project aiming to bring Indigenous and local knowledge systems into climate research and policy (Reyes-García et al., 2023b). The definitions of the main concepts used in this study are provided in a glossary in supplementary material A (Table S1). We recognize the heterogeneity and diversity that characterize fisherfolk, and the internal differences within women and men groups, in relation with intersectional considerations (Kenny and Tapu-Qiliho., 2022). While we strongly support intersectional research on SSF (e.g., Axelrod et al., 2022; Ferguson, 2021; Rohe et al., 2018), in our study we applied a binary view of gender since this approach was the most relevant given the socio-cultural context of our study site. In addition, we did not explore intersectional aspects of local climate change impacts owing to a lack of time and capacities during our data collection period.

2. Materials and methods

2.1. Study site

This study was conducted in the Kenyan coast ("*pwani*") within the WIO region. Specifically, we worked within the Shimoni-Vanga seascape area of the Kwale county, on the South Coast of Kenya. This study site was selected for four main reasons: i) the SSF sector is essential to the local economy, with up to 100 % of the population relying, at least partially, on fish ("*samaki*") for a living (Government of Kenya (GoK). Ministry of agriculture, livestock and fisheries, 2017), ii) both men and women engage in fishing activities, iii) fisheries management within the site is characterized by a dynamic Beach Management Units (BMU) network that facilitated access to data collection, and iv) the site falls within the nearshore waters along the Kenya-Tanzania border, which are identified as a climate refugia (McClanahan and Kosgei, 2023). Altogether, these characteristics of the Shimoni-Vanga seascape make it a relevant study site to explore local reports of climate change impacts by SSF communities through a gender lens.

The study site lies within the Inter-Tropical Convergence Zone (ITCZ), which is a key element of the Earth's climate system. The study site is characterized by two opposite monsoon seasons – the Northeast (November-March – NEM) and the Southeast monsoons (April-October – SEM) ("*Kaskazi*" and "*Kusi*" respectively). This unique wind reversal pattern influences the physical, biological, and chemical processes in the ocean (McClanahan, 1988). The main marine habitats in the study area include vast mangrove forests, coral reefs, and seagrass beds (WWF, 2001). During low -tides, reef flats get exposed and are commonly strode by foot fishers to catch invertebrates in intertidal areas (Alati et al., 2020). The current population of the Shimoni-Vanga seascape is estimated at 18,000 people (Government of Kenya (GoK). Ministry of agriculture, livestock and fisheries, 2017). While this region is culturally diverse, the Swahili culture predominates in the organization of local social systems. Small-scale fisheries represent the main livelihood activity, followed by small-scale farming, tourism, and seaweed farming.

Gender is a key factor driving fisheries-related activities within the study site. While recognizing the diversity of social factors such as age or ethnicity that may intersect with gender in shaping individuals' roles in SSF, in this study we focus on the influence of gender according to binary categories (i.e., women; men). Women are mostly involved in the post-production sector, either as fish processors, or vendor/traders. Women also engage in the sale of fish in local shops or restaurants, and more rarely in trade as fish dealers. In the production sector, women take part in fishing capture although they are less numerous than men. Women are mostly foot fishers owing to local gender and cultural norms and economic barriers that restrict their access to fishing vessels. They fish mostly during the SEM season, when the conditions are cooler, by contrast with fishermen who prefer the NEM season characterized by calm conditions at sea. Beyond the value chain itself, women are largely in charge of family support and caring duties at home, which are necessary for sustaining the whole SSF sector. Given their gender role as family provider, men have more flexibility in the use of their time and mobility. As such, they engage in most stages of the SSF value chain. They take part in pre-production tasks such as the preparation of boats and net repair. They also engage in direct fishing and post-production as fish dealers, vendors, or traders. These diverse roles held by men and women are fundamental drivers of their respective identities and epitomize their gender-specific connection to the ocean ("*bahari*").

In addition to village chiefs, who represent the main authority at the local level, BMU are a pivotal institution in each studied village. Beach Management Units are responsible for SSF management and governance and exercise an authority on matters related to other livelihood activities such as seaweed farming or tourism. They also represent the main discussion partner for collaboration with other stakeholders on blue economy topics, such as governmental bodies, non-governmental organizations (NGOs), or research institutions. While BMU chairpersons and the members of their executive committee get their legitimacy from their active engagement in SSF management and social capital, a recent study indicates that their power and representativity is contested among fisherfolk in certain villages (Chambon et al., 2024). The same study also reported that BMU within the Shimoni-Vanga seascape contribute to reinforcing social inequalities, especially gender imbalances (Chambon et al., 2024).

Within our study site, we selected five villages that were representative of the site variability in terms of ecological and socio-cultural diversity, while sharing certain characteristics regarding their coastal ecosystems, fishing practices, and fishery management regulations (Fig. 1). The five selected villages are all part of the Shimoni-Vanga Joint Co-Management Area under which the coastal environment and fisheries resources are jointly managed by the local BMU. A commercial fishing port is currently under construction in the study area. The port is expected to have major adverse effects on local marine biodiversity and SSF livelihoods and to reshape the local economic landscape (Envasses Environmental Consultants Limited (EECL), 2020).

2.2. Data collection

We used a mixed-method approach for data collection and analysis, combining qualitative and quantitative research methods. We collected *i)* secondary data from the scientific literature, *ii)* meteorological and ocean surface temperature data, and *iii)* primary data on reports of local indicators of climate change impacts. To ensure comparability between instrumental data and local information, we asked for individual reports of change over the last 30 years.

2.2.1. Scientific literature

We performed a narrative review of the scientific literature on climate change impacts on coastal SES in the WIO. This type of literature

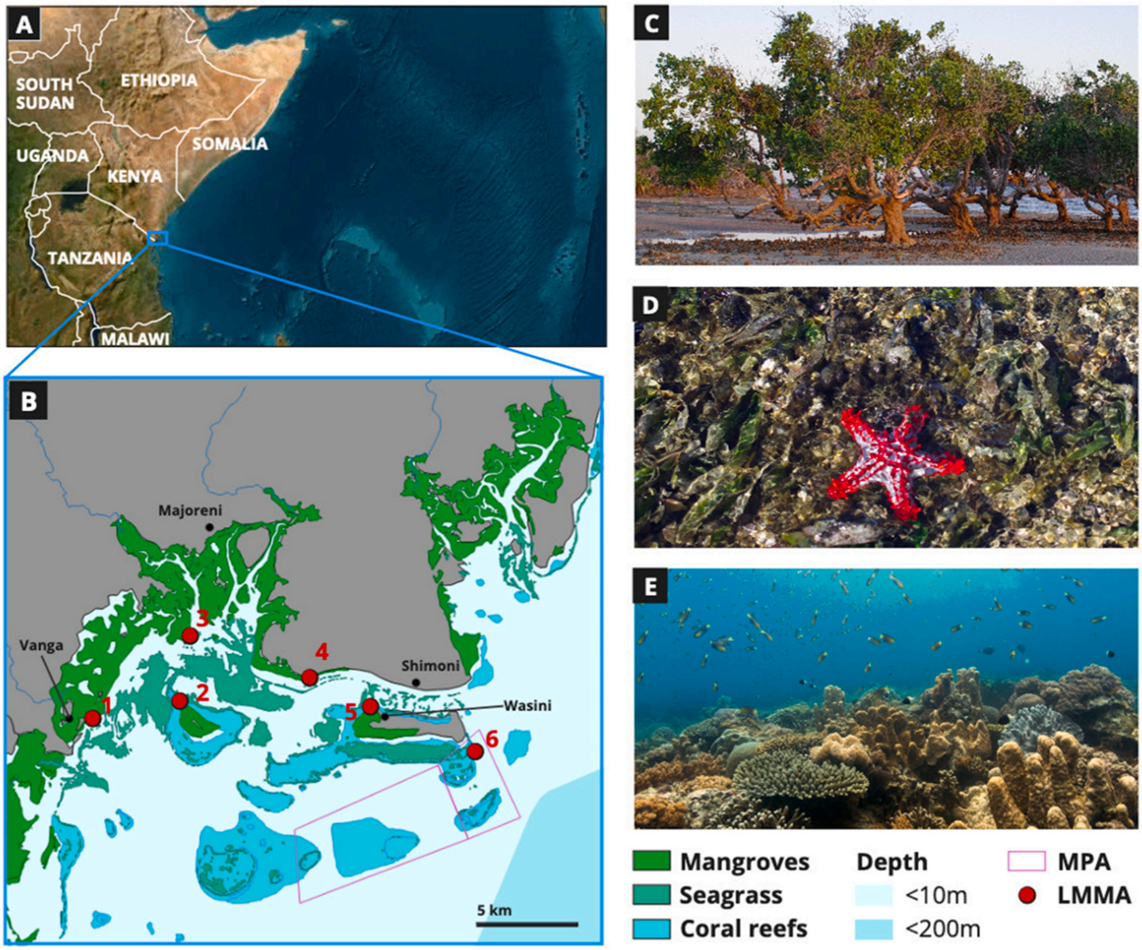

Fig. 1. Location map of the study site. **A)** Location of the study area in East Africa (based on OpenStreetMap, 2024). **B)** Main ecosystems present in the Shimoni-Vanga seascape, including mangroves, seagrass beds, coral reef cover and marine protection tools such as the Kisite-Mpunguti Marine Park and Reserve (MPA) and six Locally Managed Marine Areas: **1**-Vanga, **2**-Jimbo, **3**-Majoreni, **4**-Kibuyuni, **5**-Wasini and **6**-Mkwiro. The three main marine habitats in the Shimoni-Vanga seascape: **C)** mangroves, **D)** seagrass beds/rocky substrate, and **E)** coral reef habitats. The map was built under QGIS 3.28.0. Pictures: M. Chambon (C&D) and D. Knoester of Reefolution Foundation Shimoni (E).

review was chosen because of its relevance for examining the state of the art of a particular research topic and identifying potential research gaps (Snyder, 2019). We applied a topical search (in title, abstract, and keywords) in Web of Science® Core Collection, which is characterized by a multidisciplinary scope that suits our research topic (Birkle et al., 2020). To comprehensively include relevant academic work to the research topic, we adopted a broad search strategy (Aromataris and Riitano, 2014; Atkinson and Cipriani, 2018), and accordingly, used two search strings that were general but included variation: TOPIC: "climate chang*" AND TOPIC: "Western Indian Ocean". Our search did not include any temporal restriction and returned 298 publications. We used two inclusion criteria to select the publications to be reviewed: i) providing an analysis at the WIO level by considering at least two WIO countries; and ii) examining climate change impacts on coastal SES. We screened these publications and decided about their inclusion through a two-step process. First, we read all titles and abstracts and selected 63 publications that were relevant to our research topic based on our inclusion criteria. Second, from the pre-selected publications, we performed a full-text screening using the same criteria. In total, we selected 54 peer-reviewed publications providing information on climate change impacts on coastal SES in the WIO region. We have provided the final list of publications in Table S2.

2.2.2. Meteorological data

The lead author made a request to the Kenya Meteorological Department to obtain meteorological data for the Kwale county. We focused on three main measurements that were openly accessible: *i)* daily minimum temperature; *ii)* daily maximum temperature; and *iii)* daily mean rainfall. We obtained those data for the period 1991–2018. This meteorological data at the county level is obtained from the Enhancing National Climate Services ENACTS approach (Dinku et al., 2018), which aims to provide African countries with quality datasets for meteorological and climate studies. This method optimally merges the discontinuous data (in space and time) from eleven meteorological stations across the Kenyan coast with continuous data from satellite datasets and meteorological re-analyses. Meteorological measurements obtained for the Kwale county are thus continuous in time, but not directly based on local meteorological data, since there is no meteorological station at this specific location. However, estimates can be considered representative of the temperature and precipitation regions over the entire county. We also used the National Oceanic and Atmospheric Administration Daily Optimum Interpolation Sea Surface Temperature (National Oceanic and Atmospheric Administration (NOAA), 2022) dataset to describe the observed warming trends in the WIO for the period 1982–2021. We obtained this data set from the NOAA PSL website (https://psl.noaa.gov/).

2.2.3. Local indicators of climate change impacts

We collected primary data on local reports of climate change impacts using the Local Indicators of Climate Change Impacts data collection protocol (hereafter “LICCI Protocol”) (Reyes-García et al., 2023b). We collected data over five months, from November 2021 to April 2022. Our research was supported at the national level by the Kenya Marine and Fisheries Research Institute (KMFRI) that facilitated collaboration with local people and fishery committees in the studied villages, and with the Kenya Meteorological Department. At the local level, we collaborated with BMU, which represent the core institution for fisheries co-management in Kenya and support local adaptive measures through the Shimoni-Vanga Joint Fisheries co-management area plan (Government of Kenya (GoK). Ministry of agriculture, livestock and fisheries, 2017). To collect field data, we were supported by Kenyan collaborators from KMFRI who ensured the translation from English to Kiswahili and *vice versa*. Throughout the manuscript, we included the local language terminologies for relevant parts describing local livelihoods, fishing activities and reports of local indicators by specifying the Swahili translation in italic and in bracket. According to the guidelines suggested by MacLeod (2021), we cite informants in references, as knowledge holders, although we used pseudonyms to protect their anonymity. From all existing gender identities, we focus on two that were culturally understood and appropriate: women and men. However, we acknowledge gender diversity beyond this binary view and encourage the development of gender-inclusive methodologies in social sciences (Cameron and Stinson, 2019). We collected information on the respondents’ gender identities based on their self-identification and we respected a balance sample between men and women respondents.

We conducted semi-structured interviews (SSI) with 28 key informants (14 women and 14 men) to explore the gendered dimension of local marine knowledge and observed changes in the coastal SES (Fig. 2). We selected individuals who actively engage in SSF in the study site, and we used convenience quota sampling to reflect key informants’ diversity in terms of gender, age and participation in the SSF sector (Rukmana, 2014). We specifically asked the respondents what changes they had noticed in their coastal environment since they were young. For each report of change, we recorded the direction (e.g., stop; start) and the driver of the change (e.g., climate conditions; illegal fishing). In a second step, we conducted a series of focus group discussions (FGD) (N=8) with individuals engaging in SSF including four to nine people in each group, to examine the level of agreement for all reported changes using convenience quota sampling. We organized two FGD per village, except in one village where we did not secure enough participants. Given i) the importance of religious norms in the study site that imply a gender division in public places, and ii) existing gender power imbalances, we organized one FGD by gender in each village (i.e., two in total) to ensure that respondents feel comfortable expressing their views during the group discussions.

We combined reports of local indicators of climate change impacts, hereafter “indicators”, following a two-step process. First, we selected reports of changes for which the driver was directly or indirectly related to changes in elements in the atmospheric system. Then we categorized the reports of change according to the classification by Reyes-García et al. (2023b) (for more details, see: https://www.licci.eu/licci-tree/licci-tree.svg). Finally, we conducted a face-to-face survey with individuals engaging in the SSF sector to assess variation in individual observations of a subset of indicators. We used convenience quota sampling (Rukmana, 2014) to capture gender diversity among respondents at the site level. To select respondents to the survey, we followed a two-stage approach. First, we randomly selected households in each of the five surveyed villages. Then, in each household visited, we interviewed one or two adult(s) using convenience quota sampling. In total, we surveyed 203 individuals, of which 51 % were women (103 women and 100 men). Among the survey respondents, 67 % (n=135) were aged over 35 years old and 71 % (n=145) were fishers (“*wavuvi*”). About 30 % (n=58) of the respondents were not fishers but engaged in the SSF post-production stage. To build the survey, we used the list of indicators compiled from the SSIs and validated through FGD (Table S3). Out of the initial list of 60 indicators agreed, we randomly selected 30 (50 %). We tested them with ten individuals to ensure variation in individual observations. For the final version of the survey, we selected a total of 19 indicators, which corresponded to the ones showing the most variation among respondents during the pilot-testing phase. The final version of the survey is available in supplementary material B.

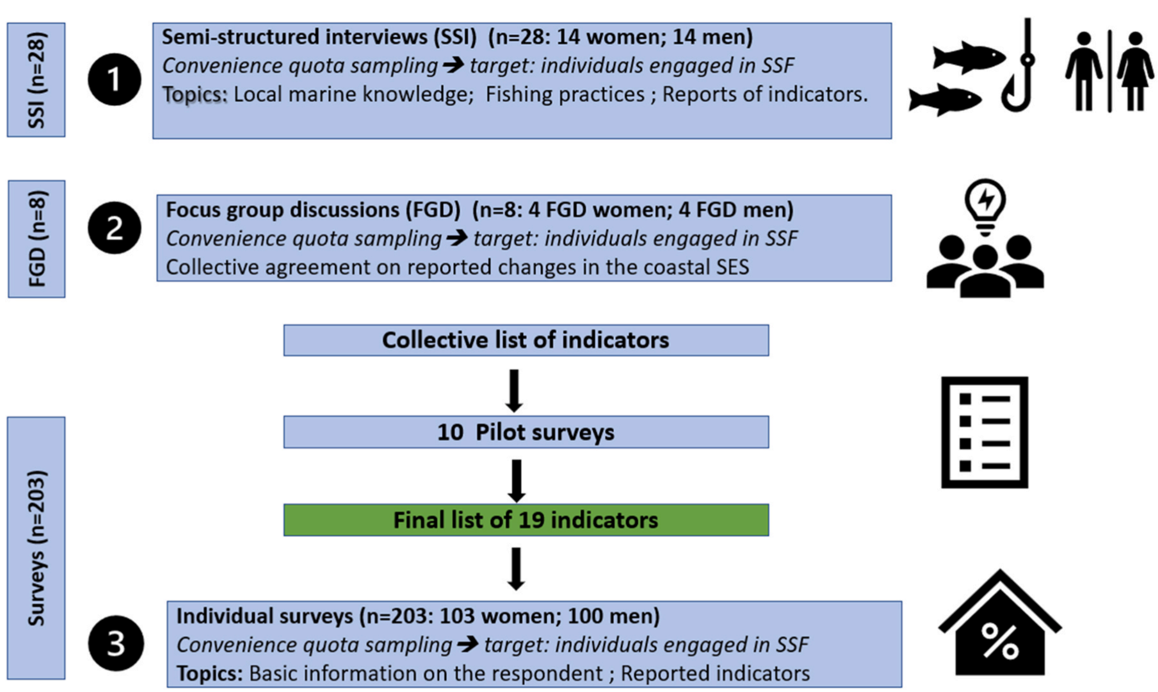

Fig. 2. Summary of the LICCI protocol applied at the study site during the fieldwork period (November 2021-April 2022). Main steps include **1)** semi-structured interviews (SSI); **2)** focus group discussions (FGD); and **3)** individual surveys based on the final list of indicators.

2.3. Data analysis

To assess the state of scientific knowledge on climate change impacts on coastal SES in the WIO (O1), we applied a content analysis to identify and describe key thematic patterns derived from the literature (Braun and Clarke, 2006). We also used the NOAA OI SST V2 High Resolution dataset to compute the anomaly of the sea surface warming trend between 1982 and 2021 using a linear regression of the annual average anomaly relative to the mean warming over the Indian Ocean to time (the anthropogenic signal can be considered quite linear over the 1982–2021 period).

To examine whether local meteorological data for the 1991–2018 period align with regional climate trends reported in the literature (O2), we used available meteorological data for Kwale county from the Kenya Meteorological Department. We first calculated the monthly mean of daily minimum and maximum atmospheric temperatures at 2 m height to reduce the aliasing from high-frequency variations. This gave us a time series of 336 observations of monthly atmospheric temperatures over 28 years. Then we performed a time series analysis on R version 4.2.1 (Core Team, 2021) to estimate linear trends in atmospheric temperature and assess their statistical significance using the Seasonal Decomposition of Time Series by Loess (STL) function. We applied the same method to assess trends in rainfall by considering both monthly mean rainfall and the number of consecutive dry days per month calculated from daily rainfall data.

To analyze perspectives on climate change impacts by local SSF communities using a gendered approach (O3), we first used descriptive statistics to identify the indicators most often reported by respondents. In a second step, we compared the reports of indicators between men and women using data from individual surveys. We analyzed whether there was a difference in the number of indicators reported by women and men using a Welch two-sample t-test (Rasch et al., 2011). We also used a Chi-square test (Agresti, 2007) to assess whether there was a significant relationship between gender and the type of indicators reported.

Lastly, to explore the relation between local and scientific knowledge on climate change impacts on coastal SES in the WIO (O4), we applied the MEB approach (Tengö et al., 2014) as an integrated and qualitative approach to bring together the main findings from the scientific literature and local meteorological measurements with the indicators reported by SSF communities. We examined indicators in the light of the trends reported for the corresponding regional scientific variables as detailed in supplementary material A (Tab. S4). More specifically, we identified cases where indicators were also reported in scientific data sources and coded their alignment (i.e., overlap; divergence), as well as cases of change reported by Shimoni-Vanga SSF communities but not associated with scientific evidence, either because the lack of scientific documentation or lack of scientific consensus. We coded this latter category as "local knowledge".

2.4. Research positionality statement

We are aware that we only provide a partial and situated understanding of local perspectives of climate change impacts on coastal SES in the WIO, mostly shaped by our own epistemological background. Our research team is international, bringing together Kenyan scientists native from other parts of the country than the coast and European scientists of diverse genders, all from an academic background. The lead author acknowledges her positionality as a young woman, trained in Western universities and originating from a European country with a heavy colonial imprint on Africa. It is from this positionality that this work should be read since it shaped the study design, data collection and analysis. In particular, the lead author's positionality may have influenced her interactions with local communities. For instance, as a woman she had an easy access to women's groups and discussions, but as a white person she was granted a special status which may have made some people feel shy to engage with her. Further, when analyzing the data, some dimensions of the local knowledge system, especially those related to cultural values, ethics, and spiritual practices, may not be well reflected in our research work developed from a positivist standpoint despite our effort to adopt an inclusive approach. This limitation should invite caution in the interpretation of our results, while encouraging further studies on the topic to improve the understanding of local knowledge held by coastal societies in Kenya and its connection to scientific epistemology.

3. Results

3.1. Scientific knowledge

3.1.1. Review of scientific literature: climate trends in the WIO

Examining the selected literature, we found a strong climate signal in the WIO, with researchers reporting a significant increase in mean atmospheric temperatures (Vincent et al., 2011). This trend is expected to be amplified in future decades in a "business as usual" scenario (Maina et al., 2021). The long-term change in regional rainfall patterns is more difficult to detect, although current trends suggest a decrease in mean and daily extreme rainfalls (Vincent et al., 2011). Models predict hotter and drier future conditions in the WIO, with more extreme seasons (Maina et al., 2021). Climate change could also amplify the magnitude of a natural mode of climate variability that strongly impacts rains over East Africa and may cause more frequent extreme events (Cai et al., 2013). Climate change may further modify the ITCZ dynamics.

Mean sea surface temperatures in the WIO have increased by up to 1.28 °C at a rate of 0.1 °C/decade since 1900 (Roxy et al., 2014; Vincent et al., 2011). In that sense, the WIO represents a "special case" as it has been warming faster than any other tropical region (Roxy et al., 2014), including the other parts of the tropical Indian Ocean (Fig. 3). In addition to continuous warming, the WIO has also experienced the highest frequency of marine heatwaves recorded for the whole Indian Ocean basin (Saranya et al., 2022). Models predict that this warming trend will continue in the next decades (Jacobs et al.,2021). As in most other basins, the WIO will experience an increased oceanic acidification with a drop of surface pH, and a seasonal reduction of near-surface nutrients available for ocean marine productivity (Jacobs et al., 2021). The WIO region should also experience major changes in ocean circulation and winds (Painter et al., 2021), which in turn are expected to affect ocean currents and coastal upwelling systems (Praveen et al., 2016). A regional sea level rise is more complicated to detect owing to relatively short tide-gauge records and the high natural variability in the WIO region (Church et al., 2006).

In addition, other studies have examined how these anthropogenic climate change effects affect coastal biodiversity. Most publications have focused on the adverse impacts of climate change on coral reef ecosystems (Gudka et al., 2020; McClanahan et al., 2020). Projections suggest an increase in the frequency and severity of bleaching events over the next decades (Couce et al., 2023), representing a major risk of collapse for coral reef ecosystems in the WIO (Obura et al., 2022). While past trends indicate a substantial reduction in net primary production (Roxy et al., 2016), future trajectories are likely to be heterogeneous within the region (Wilson et al., 2021). Combined with increased ocean warming, changes in marine productivity will affect the rest of the food web with an amplified effect at higher trophic levels (Wilson et al., 2021) and lead to potential shifts in species distribution towards cooler regions (Painter et al., 2021) and eventually species extinction (Feare et al., 2007). This situation has severe socio-economic implications for fisheries-reliant coastal communities in the WIO. Several studies anticipate a sharp decline in fish catch in the region by the end of the century (Anildo et al., 2021; Jacobs et al., 2021). Especially, Wilson et al. (2021) project a significant decline in fish species biomass in the Kenyan and Tanzanian EEZs (median reduction of 63–76 % and 56–69 % respectively), as well as in species richness, over the 21st century under the

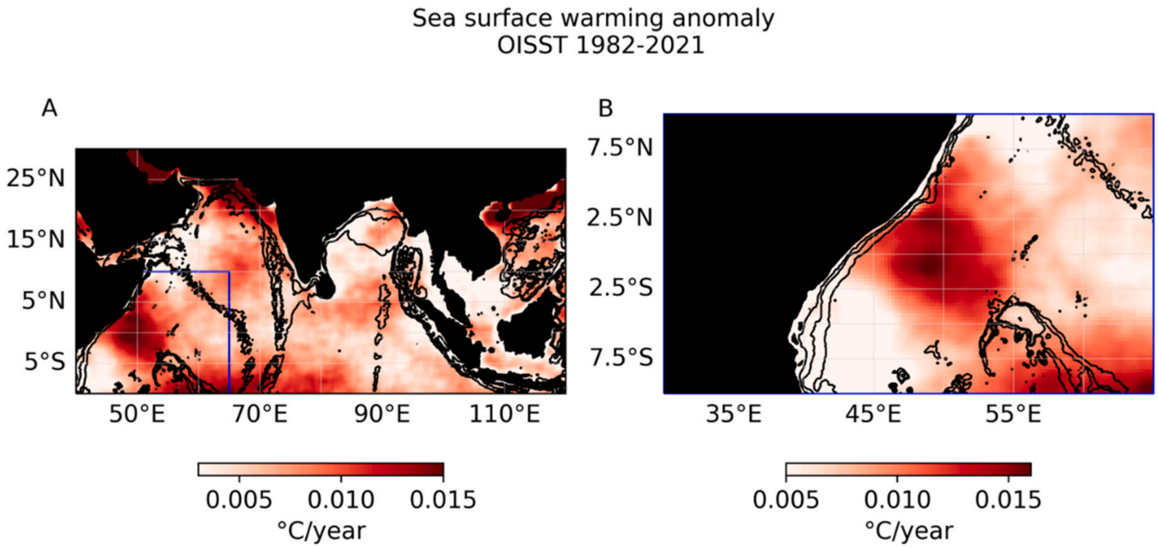

Fig. 3. The WIO is a global warming hotspot within the Indian Ocean basin. The maps represent the anomaly of sea surface warming (relative to the annual mean trend over the Indian Ocean) at **A)** the WIO basin level and **B)** along the East African coast using linear regression on the National Oceanic and Atmospheric Administration ¼° Daily Optimum Interpolation Sea Surface Temperature between 1982 and 2021.

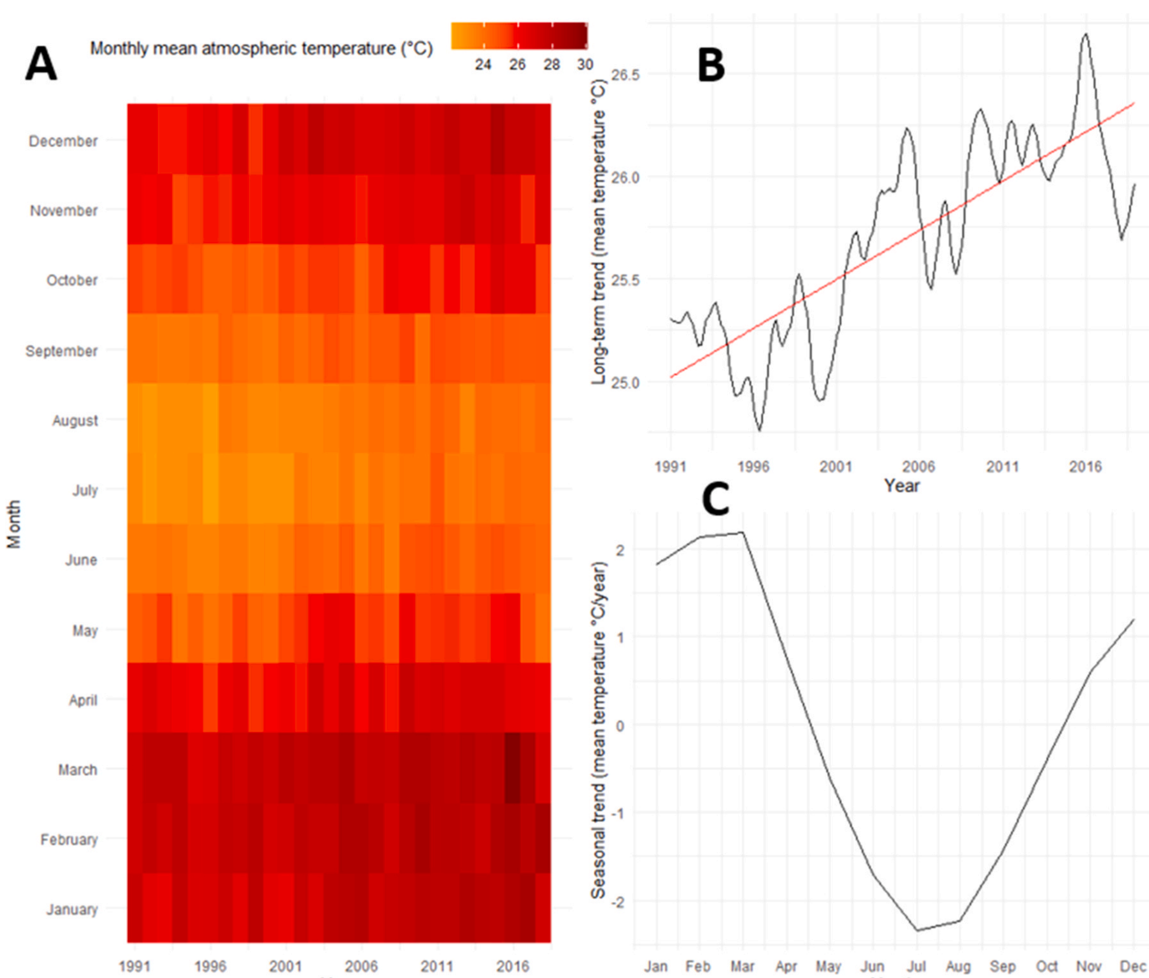

Fig. 4. Significant increasing trend in mean annual atmospheric temperatures for Kwale county.**A)** Heatmap and linear regression showing **B)** long-term and **C)** seasonal trends in monthly mean atmospheric temperatures in Kwale county between 1991 and 2018.

RCP8.5 scenario. This alarming trend is projected to increase regional food insecurity (Painter et al., 2021).

3.1.2. Local meteorological measurements in coastal Kenya

Using available meteorological data from the Kenya Meteorological Department, our statistical analysis indicates an increasing trend in mean atmospheric temperatures of + 0.47°C/decade in Kwale county between 1991 and 2018 (F-statistic=683.8; p- value < 2.2e-16) (Fig. 4). This general trend is in line with the observed increasing mean seasonal temperatures during both the Northeast and Southeast monsoon seasons (F-statistic=244.4; p-value < 2.2e-16; F-statistic=330.8; p-value < 2.2e-16 respectively). However, we did not find any statistically significant trend in rainfall, neither in terms of monthly mean rainfall nor in terms of consecutive non rainy days per month (see supplementary material C, figures S1).

Overall, we found an agreement between regional trends in climate change impacts reported in the reviewed literature and trends found in local meteorological data. These two data sources are consistent in indicating a marked increase of atmospheric temperatures – correlated with rising sea surface temperatures – and an absence of significant signals for long-term change in regional rainfall patterns. The reviewed literature further emphasized how changes in the climate system are increasingly affecting marine biodiversity and, subsequently, coastal livelihoods in the WIO region.

3.2. Local knowledge

3.2.1. The ocean as a way of life

SSF communities from the Shimoni-Vanga seascape [hereafter "Shimoni-Vanga SSF communities"] have a strong connection to the sea. People's lifestyle is fully shaped by their daily interactions with the sea, especially through small-scale fishing activities which play a key role in food security. Across generations, local people have accumulated and maintained in-depth knowledge on the species they fish, sell, or eat, their behavior or marine habitats, as explained by Juma (2021), a local fisherman: "*Here, everyone is doing fishing,* [this knowledge] *is passed on by our parents. It is how I have learned how to fish.*"

Local knowledge on the marine environment is deeply gendered. Fishermen use the whole seascape, from the beach to the open ocean, to harvest fisheries resources, while fisherwomen are restricted to the intertidal areas. This can be summarized in the words of Mariam (2021), a renowned female octopus fisher: "*Men go out in the deep ocean to fish octopus. They use boats to reach their fishing grounds and then diving instruments. But women are restricted to the shoreline since they do not know how to dive and can only get around on foot.*" Consequently, women and men usually target distinct species and hold gender-specific knowledge of marine resources. For example, fisherwomen possess very particular knowledge about the tides, the lunar cycle, and the ecology of their targeted species, which mostly consists of octopus ("*pweza*") and shell species. Conversely, fishermen's knowledge is more centered on currents, winds, and pelagic and demersal fish species since they commonly fish beyond the reef and can access the open ocean by boat. The gendered nature of the local knowledge held by women and men in Shimoni-Vanga SSF communities, combined with long-term interactions with their coastal environment, allow them to detect fine changes in the seascape.

3.2.2. Local indicators of climate change impacts

Shimoni-Vanga SSF communities have observed numerous climate-driven changes in their coastal environment over the last 30 years. The five indicators most frequently reported by Shimoni-Vanga SSF communities from the survey data are 1) a decrease in the amount of catch of marine animal and plant species (reported by 98 % of survey respondents), 2) an increase in the average atmospheric temperatures (97 %), 3) a decrease in average rainfall (97 %), 4) an increase in temperatures during the NEM season ("*Kaskazi*") (94 %), and 5) an increase in the frequency of extreme droughts (92 %). Shimoni-Vanga SSF communities attributed catch reduction to a combination of both climatic – i.e., rising sea surface temperatures – and non-climatic drivers – i.e., the degradation of fish habitats and overfishing. Further, they witnessed an increase in atmospheric temperatures, especially during the NEM season – which corresponds to the high fishing season. Changes in rainfall patterns were also commonly reported and perceived as an additional source of uncertainty for local livelihoods. Overall, Shimoni-Vanga SSF communities perceived that these complex cascading changes resulted in reduced incomes, with implications for the whole local economy.

3.2.3. Gender variation in the report of indicators

The total number of indicators reported by men and women in survey responses was not significantly different (t = −0.32381, df = 198.9, p-value = 0.7464). We found that both women and men reported an average of 14 (74 %) indicators out of the proposed 19 (min = 6 (32 %); max = 19 (100 %)). We also found a similar distribution of reports for each indicator across men and women respondents (Fig. 5). For two indicators, we found a statistically significant difference in the frequency of women's and men's reports. Women had a higher probability of reporting changes in mean rainfall (X^2=7.7909; p-value: 0.02033) and in atmospheric temperatures during the SEM season (X^2=7.5831; p-value: 0.02256) than men.

3.2.4. Insights from scientific and local knowledge

We found an important overlap level between scientific and local knowledge regarding climate change impacts, with 74 % of the indicators reported by Shimoni-Vanga SSF communities found in the scientific literature (Fig. 6). Especially, four of the five indicators most frequently reported (i.e., decrease in the amount of catch, increase in mean and seasonal atmospheric temperatures, and increase in extreme drought events) are also documented in peer-reviewed scientific publications at the WIO scale. We also identified five indicators of change (26 % of the total) reported by Shimoni-Vanga SSF communities that were not documented in the literature. Specifically, Shimoni-Vanga SSF communities reported changes in local coastal dynamics – sea level rise, increase in coastal currents and shifts in temporal tidal patterns – and a decrease in the abundance of marine algae (*Ulva* genus) used as bait ("*chambo*") by fishermen. As explained by Said. (2021), a basket trap fisherman: "*We noticed a lack of green algae because of reduced rains. Then we get less rabbitfish ("tafi") because we need this alga to attract these fish.*" We did not find evidence of such changes in the reviewed literature. Further, Shimoni-Vanga SSF communities reported a decrease in mean rainfall, a trend still debated in the literature for the study area. We did not find cases of divergence between local indicators and scientific evidence from the reviewed literature.

4. Discussion

This study explores the relation between scientific and local knowledge on climate change impacts in the WIO through a gender lens. Scientific literature on the topic documents pronounced climate change impacts in the WIO region with negative implications for the SSF sector, but there is no consideration of impacts differentiated by gender. Indicators of change reported by Shimoni-Vanga SSF communities indicate substantial changes in the coastal SES, with few but noticeable gendered differences. When weaving scientific and local knowledge, we found a great degree of overlap between the two, but also unique insights provided by Shimoni-Vanga SSF communities on fine changes in coastal dynamics, algae abundance, and rainfall. Our results suggest that local knowledge is very insightful on the social and gendered contexts in which climate change impacts are felt and understood.

Before discussing our results, we acknowledge three main limitations in our research methodology. First, owing to the absence of local meteorological stations at our study site, we relied on a hybrid data

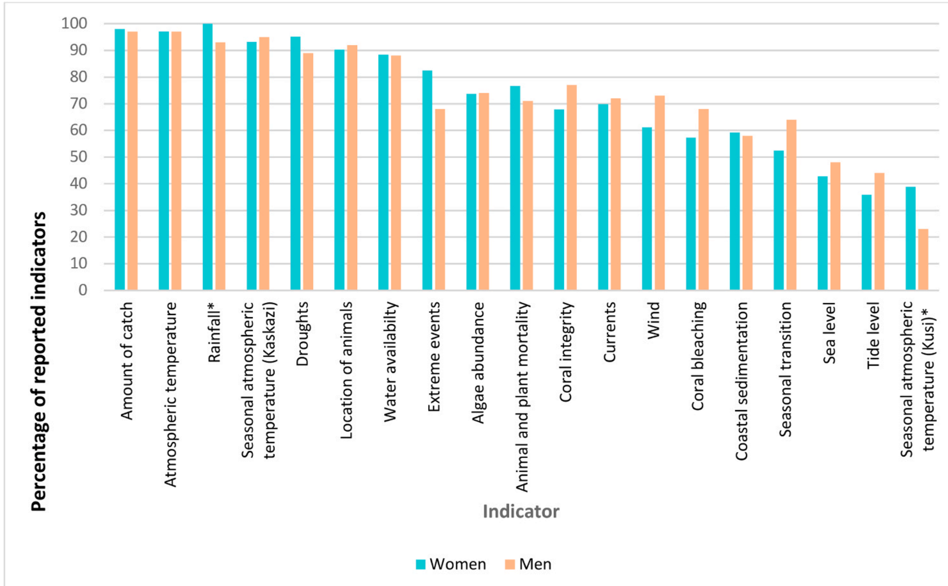

Fig. 5. Gendered distribution of reported indicators. Percentage of indicators of climate change impacts reported by women (N = 103) and men (N = 100). Stars (*) denote indicators for which we found statistically significant differences in reports comparing women and men's samples using a Chi-square test.

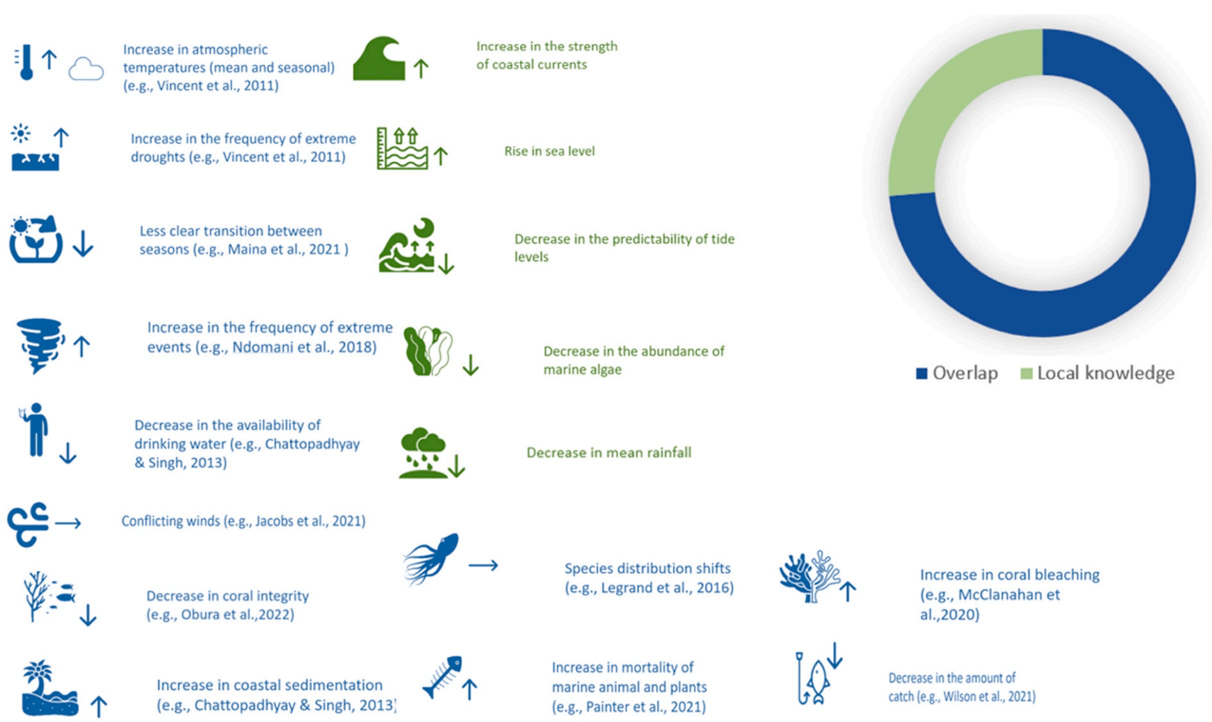

Fig. 6. Picture of climate change impacts on coastal social-ecological systems (SES) in the Western Indian Ocean (WIO) derived from both scientific and local knowledge. Overview of the main climate change impacts on coastal SES in the WIO as reported both in the scientific literature and by local small-scale fishing (SSF) communities from the Shimoni-Vanga seascape. Impacts overlapping between scientific and local knowledge are indicated in blue and those only mentioned by SSF local communities in green.

collection source, combining both *in situ* data and extrapolations. This limitation reveals the difficulty of producing long-term and thorough meteorological datasets in some parts of the African continent (Dinku et al., 2017). Second, since local people were more comfortable speaking in their native languages, which are close but slightly different from Swahili, our use of Swahili as the main research language for convenience purpose may have limited our understanding of respondents' reports of change in all their nuances. This linguistic challenge highlights the value of partnering with local communities when conducting empirical research. Third, owing to limited capacities in the field, we mostly focused on women's and men's categories, reflecting a binary view of gender, and did not include other intersecting power structures that might shape how people experience climate change. This might restrict a thorough assessment of the complex power dynamics of climate change impacts, thus calling for further intersectional approaches in climate research (Djoudi et al., 2016).

4.1. Scientific knowledge

The scientific literature suggests that the WIO is experiencing a stronger warming than the remainder of the Indian Ocean and other tropical ocean basins. This warming trend is expected to intensify in the future with negative knock-on effects on coastal and ocean processes. These findings emphasize the need to improve the accuracy of projections at fine spatial and temporal scales to refine climate change impact projections in the region (Kwiatkowski et al., 2020). Further, the literature documents the detrimental impacts that climate change is having on WIO marine fisheries. This situation is particularly worrying given the considerable importance of SSF for local communities from social, economic, and nutritional standpoints (Savo et al., 2017). Our findings support the call made by scientists (D'agata et al., 2020; Mcleod et al., 2019) and the FAO (Barange et al., 2018) to urgently develop adaptive strategies in the region that are brought forward at the level of local communities, such as developing adaptive fishery management plans and marine protected area networks and reinforcing local capacity building. For example, Rocliffe et al. (2014) suggest that strengthening the existing network of Locally Managed Marine Areas in the WIO region, which are marine protected areas managed by local communities, could represent a solution to climate change and effective fisheries management.

However, one major blind spot highlighted in our study is the absence of gender considerations in the examined climate change impacts on SSF in the reviewed literature. Yet researchers and the IPCC have documented the gender-differentiated impacts of climate change and related vulnerabilities globally (IPCC, 2021; Pearse, 2017). Without developing a "sociology of climate change" that sheds light on the social and gendered nature of climate change (MacGregor, 2010, p. 137), some climate change impacts on WIO local livelihoods may be overlooked (Djoudi et al., 2016; Pearse, 2017). There is thus a critical need to foster gender perspectives in regional climate and ocean research to soundly address gender along other social inequalities in climate policies.

4.2. Local knowledge

Our study provides a general overview of the large bodies of knowledge held by Shimoni-Vanga SSF communities, which were acquired over time through an intimate and deep-rooted connection to the coastal environment. In that regard, our findings corroborate previous ethnobiological work documenting the diversity and richness of knowledge held by various small-scale fishing communities worldwide (Cordell, 1978; Johannes, 1981). We also found that local knowledge systems held by Shimoni-Vanga SSF communities are deeply gendered as reported in many other parts of the world (Ferguson, 2021; Rohe et al., 2018). Since women and men tend to fish in different parts of the seascape with gender-differentiated techniques, they catch different species and may possess gender-distinct knowledge of marine resources. Gender and fisheries research scholars have notably shed light on gender-distinct knowledge on marine habitats and fishing grounds (Thomas et al., 2021), animal behavior (Andrade et al., 2016), or fishing techniques (Tilley et al., 2021). These gendered differences in local knowledge support the need for integrating gender considerations in fisheries research to broadening information about coastal social-ecological systems and guiding their management (Alati et al., 2020).

Shimoni-Vanga SSF communities do report a wide array of indicators of climate change impacts. These results confirm previous research showing that coastal communities worldwide are at the frontline of climate change, which makes them able to detect its direct and indirect impacts on coastal SES (Makame and Shackleton, 2020). As documented in many coastal communities, a decrease in catch is strongly noticeable by fisherfolk. Catch decreases represent a major source of concern for coastal communities as it has direct implications for their daily protein supply (Kawarazuka and Béné, 2010). In addition, climate change is understood by local SSF communities as one of many drivers shaping change in coastal and marine ecosystems, along with overfishing or habitat degradation, thus revealing the multifactorial and synergistic nature of environmental changes. These findings have strong implications for future adaptation decisions and policies and current discussions about loss and damage from climate change. Our findings suggest that Shimoni-Vanga SSF communities are particularly affected by climate change impacts and should thus be included on discussions regarding the design of suitable place-based adaptation strategies (Savo et al., 2017).

Further, our results indicate a high degree of similarity between indicators reported by women and men, suggesting that both genders are aware and observe a broad range of climate change impacts in their surrounding environment. However, we found significant gender differences in the report of two particular indicators. Notably, we found that women report more changes in mean rainfall than men. We argue that this difference can be explained by the fact that women are the primary caregivers and responsible for fetching water for domestic uses. As such, they may be more sensitive to a decrease in rainfall, as it may have direct implications for their capacity to cook and fulfil household needs. Similarly, we found that women also report significantly more changes in atmospheric temperatures during the SEM season than men. We suggest that because this period corresponds to the high catch season for women (but not for men), they may be more exposed to an increase in atmospheric temperature and the related consequences on their catches during this time. Taken together, our findings highlight the importance of the gendered division of labor in WIO coastal communities in relation to people's observations of climate change impacts. These findings illustrate how gender considerations may contribute to drawing a comprehensive picture of the diversity of related impacts and social consequences derived from climate change, improving climate information obtained from instrumental data collection, and guiding adaptation policies.

4.3. Weaving scientific and local knowledge

Importantly, we found a considerable level of overlap between indicators of climate change impacts derived from scientific and local knowledge. This finding is consistent with earlier work documenting consistency between scientific and local knowledge related to climate change (Laidler, 2006; Reyes-García et al., 2023a). The overlap suggests that bringing both knowledge systems together might improve the explanatory power of climate dynamics and help broadening the understanding of climate change impacts and their implications for local SSF livelihoods (Reyes-García et al., 2016; Savo et al., 2017).

Further, we found that five changes reported by Shimoni-Vanga SSF communities were not documented in the literature. That is the case for information regarding coastal dynamics linked to an increase in local currents and shifts in sea and tide levels, a decrease in rainfall, and a decrease in the abundance of green algae used for attracting fish by basket trap fishermen. All these changes directly relate to local fisheries activities. We also found gender differences in the reporting of two indicators, whereas gender differences in the reporting of climate change impacts on SSF had not been identified in the scientific literature. These findings suggest that local knowledge held by SSF communities reflects a holistic perspective on climate change impacts and situate them in a particular socio-cultural and gendered context. Weaving the two knowledge systems together would thus highlights the relational and place-based nature of climate change impacts and their gendered dimension.

This complementarity is much needed to identify adaptation strategies that align with local priorities and needs. As reported in the literature on climate change, adaptive capacities and constraints at the local level are commonly driven by local socio-cultural factors (Adger et al., 2013; Galappaththi and Schlingmann, 2023). For instance, local gender norms in coastal communities of Marovo Lagoon, Solomon Islands, limit women's participation in SSF management and decision making, which may challenge gender-inclusive adaptive strategies (Rabbitt et al., 2022). Considering the local and gendered context, and engaging local communities is thus critical to develop effective adaptive strategies and policies. An example from Inuit fishing communities in Canada illustrates how collaboration between Indigenous communities, government representatives and private stakeholders resulted in enhanced climate resilience (Reyes-García et al., 2024). To that extent, our study falls within the growing literature documenting the value of knowledge pluralism in guiding policies on climate adaptation and risk management (Orlove et al., 2023; Reyes-García et al., 2024).

5. Conclusion

This study demonstrates that weaving scientific and local knowledge together through a gender lens contributes to drawing a holistic and fine understanding of climate change realities in the WIO context. Importantly, local knowledge held by SSF communities illuminate the social and gendered dimensions of climate change impacts. This evidence emphasizes the need for fisherfolk's greater involvement in climate discussions and policies, recognizing and valuing their grounded and gendered experiences, perspectives, and knowledge on the ocean-climate nexus. Engaging local knowledge holders on ocean and marine issues is first a matter of equity, ethics, and respect. In addition, it may be framed in instrumental terms as a way to increase both the legitimacy and efficiency of climate adaptation policies since they would be more relevant to local SSF contexts.

In this regard, and based on our research findings, we suggest three specific recommendations for improving policy making on climate adaptation and risk management. First, policymakers and fisheries practitioners need to tailor context-specific adaptive and risk management strategies in SSF settings. Since there is no one-size-fits-all solution for adapting SSF to climate change impacts, there is a need to conduct place-based and detailed analyses of climate change impacts and vulnerabilities through inclusive and participatory processes prior implementing any adaptive strategy in SSF communities. Second, we encourage the integration of gender considerations in the design of adaptive strategies. As highlighted in this study, gender plays a key role in shaping local knowledge and experiences related to climate change impacts. Climate adaptive strategies should thus integrate analyses of gender differences in climate vulnerabilities and adaptive capacities. Finally, by illustrating the value of knowledge pluralism in climate research, our study calls for reframing science-policy interfaces on climate change. Intergovernmental bodies such as the Intergovernmental Panel on Climate Change (IPCC) should establish more inclusive and just partnerships between knowledge holders of different knowledge systems and go beyond the framing of climate change as a technical problem to recognize its cultural, socio-economic, historical, and political dimensions. Striving towards these directions would contribute to supporting gender equitable and sustainable SSF, while increasing the resilience of coastal and marine SES in the face of climate change.

CRediT authorship contribution statement

Mouna Chambon: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft. **Nina Wambiji:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing, Writing – original draft. **Victoria Reyes-Garcia:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing. **Jérôme Vialard:** Conceptualization, Formal analysis, Methodology, Writing – review & editing. **Patrizia Ziveri:** Conceptualization, Investigation, Methodology, Writing – review & editing, Writing – original draft. **Clara Azarian:** Formal analysis, Writing – review & editing. **Joey Ngunu Wandiga:** Investigation, Methodology, Writing – review & editing. **Santiago Alvarez Fernandez:** Formal analysis.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

Acknowledgements

The authors acknowledge the financial support from the ICTA-UAB "María de Maeztu" Programme for Units of Excellence funded by the Spanish Ministry of Science, Innovation and Universities (CEX2019–000940-M; MDM-2015–055; PRE2019–090126), from the Local Indicators of Climate Change Impacts (LICCI) Project, which is funded by the European Research Council (ERC) under grant agreement No 771056-LICCI-ERC-2017-COG, from the laboratories for the Analysis of Social-Ecological Systems in a Globalized World (LASEG) (2021-SGR-00182) and for the Marine and Environmental Biogeosciences Research (MERS) (2021 SGR 00640) by the Generalitat de Catalunya and from the French Ministry of Ecological Transition. This publication also benefited from the technical support of the Kenya Marine and Fisheries Research Institute (KMFRI), Mombasa, Kenya, and the IPSL Laboratory of Oceanography and Climate: Experiments and Numerical Approaches (LOCEAN), Paris.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2024.103846.

References

Adger, W.N., Barnett, J., Brown, K., Marshall, N., O'Brien, K., 2013. Cultural dimensions of climate change impacts and adaptation. Nat. Clim. Change 3 (2), 112–117. Available from: http://www.nature.com/articles/nclimate1666.

Agresti, A., 2007. An Introduction to Categorical Data Analysis, Second ed. New York: John Wiley & Sons., p. 38

Alati, V.M., Olunga, J., Olendo, M., Daudi, L.N., Osuka, K., Odoli, C., Tuda, P., Nordlund, L.M., 2020. Mollusc shell fisheries in coastal Kenya: Local ecological knowledge reveals overfishing. Ocean Coast. Manag. *195*, 105285 https://doi.org/10.1016/j.ocecoaman.2020.105285.

Andrade, L.P., Silva-Andrade, H.M.L., Lyra-Neves, R.M., et al., 2016. Do artisanal fishers perceive declining migratory shorebird populations. J. Ethnobiol. Ethnomed. 12, 16. https://doi.org/10.1186/s13002-016-0087-x.

Anildo, N., Pennino, M., Lopez, J., Soto, Ma, 2021. Modelling the impacts of climate change on skipjack tuna (*Katsuwonus pelamis*) in the Mozambique Channel. Fish. Oceanogr. 31. https://doi.org/10.1111/fog.12568.

Aromataris, E., Riitano, D., 2014. Systematic Reviews: Constructing a Search Strategy and Searching for Evidence. AJN, Am. J. Nurs. 114 (5), 49-5. DOI: 10.1097/01.NAJ.0000446779.99522.f6.

Arora-Jonsson, S., 2011. Virtue and vulnerability: discourses on women, gender and climate change. Glob. Environ. Change 21, 744–751.

Atkinson, L.Z., Cipriani, A., 2018. How to carry out a literature search for a systematic review: a practical guide. BJPsych Adv. 24 (2), 74–82. https://doi.org/10.1192/bja.2017.3.

Axelrod, M., Vona, M., Novak Colwell, J., Fakoya, K., Salim, S.S., Webster, D.G., de la Torre-Castro, M., 2022. Understanding gender intersectionality for more robust ocean science. Earth Syst. Gov. 13. https://doi.org/10.1016/j.esg.2022.100148.

Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S., Poulain, F., 2018. Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No.627, Rome, FAO, p. 628.

Bee, B.A., Rice, J., Trauger, A., 2015. A feminist approach to climate change governance: everyday and intimate politics. Geogr. Compass 9 (6), 339–350.

Belfer, E., Ford, J.D., Maillet, M., 2017. Representation of Indigenous peoples in climate change reporting. Clim. Change 145 (1–2), 57–70. https://doi.org/10.1007/s10584-017-2076-z.

Bell, J., Cheung, W., De Silva, S., Gasalla, M., Frusher, S., Hobday, A., Lam, V., Lehodey, P., Pecl, G., Samoilys, M., Senina, I., 2016. Impacts and effects of ocean warming on the contributions of fisheries and aquaculture to food security. In: Laffoley, D., Baxter, J.M. (Eds.), Explaining Ocean Warming: Causes, Scale, Effects and Consequences, 2016. IUCN, Gland, Switzerland, p. 456.

Berkes, F., 2008. Sacred ecology: traditional ecological knowledge and resource management. Routledge, New York, New York, USA https://doi.org/10.1558/jsrnc.v3i1.157.
Birkle, D.A., Pendlebury, J., Schnell, J., Adams, 2020. Web of Science as a data source for research on scientific and scholarly activity. Quant. Sci. Stud. 1 (1), 363–376. https://doi.org/10.1162/qss_a_00018.
Blomstrom, E., Burns, B., 2015. Global policy landscape: A supporting framework for gender-responsive action on climate change. In: Aguilar, L., Granat, M., Owren (Authors), C. (Eds.), Roots for the future: The landscape and way forward on gender and climate change. Washington, DC: IUCN & GGCA.
Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3 (2), 77–101. https://doi.org/10.1191/1478088706qp063oa.
Cai, W., Zheng, X.T., Weller, E., et al., 2013. Projected response of the Indian Ocean Dipole to greenhouse warming. Nat. Geosci. 6, 999–1007. https://doi.org/10.1038/ngeo2009.
Cai, X., Haile, A.T., Magidi, J., Mapedza, E., Nhamo, L., 2017. Living with floods – household perception and satellite observations in the Barotse floodplain, Zambia. Phys. Chem. Earth 100, 278–286. https://doi.org/10.1016/j.pce.2016.10.011.
Cameron, J.J., Stinson, D.A., 2019. Gender (mis)measurement: guidelines for respecting gender diversity in psychological research. Soc. Personal. Psychol. Compass 13 (11). https://doi.org/10.1111/spc3.12506.
Chambon, M., Wambiji, N., Ngunu Wandiga, J., Reyes-Garcia, V. & Ziveri, P. (2024). "Men don't feel comfortable with successful female leaders": Exploring participatory exclusion in community-based fisheries management, South Coast of Kenya. *Maritime Studies*. Accepted, pending major revisions.
Church, J.A., White, N.J., Hunter, J.R., 2006. Sea-level rise at tropical Pacific and Indian Ocean islands. Glob. Planet. Change 53 (3), 155–168. https://doi.org/10.1016/j.gloplacha.2006.04.001.
Cinner, J.E., McClanahan, T.R., Graham, N.A.J., Daw, T.M., Maina, J., Stead, S.M., Wamukota, A., Brown, K., Bodin, O., 2012. Vulnerability of coastal communities to key impacts of climate change on coral reef fisheries. Glob. Environ. Change 22 (1), 12–20. https://doi.org/10.1016/j.gloenvcha.2011.09.018.
Cordell, J.C., 1978. Carrying Capacity Analysis of Fixed-Territorial Fishing. Ethnology 17, 1–24.
Core Team, R., 2021. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria (URL https://www.R-project.org/).
Couce, E., Cowburn, B., Clare, D., Bluemel, J.K., 2023. Paris Agreement could prevent regional mass extinctions of coral species. Glob. Change Biol. 00, 1–12. https://doi.org/10.1111/gcb.16690.
D'agata, S., Darling, E.S., Gurney, G.G., McClanahan, T.R., Muthiga, N.A., Rabearisoa, A., Maina, J.M., 2020. Multiscale determinants of social adaptive capacity in small-scale fishing communities. Environ. Sci. Policy 108, 56–66. https://doi.org/10.1016/j.envsci.2020.03.006.
Dankelman, I., 2010. Introduction: exploring gender, environment and climate change. In: Dankelman, I. (Ed.), G*ender and* c*limate change: an introduction*. Earthscan, London, pp. 1–20.
Dinku, T., Thomson, M.C., Cousin, R., del Corral, J., Ceccato, P., Hansen, J., Connor, S.J., 2018. Enhancing National Climate Services (ENACTS) for development in Africa. Clim. Dev. 10 (7), 664–672. https://doi.org/10.1080/17565529.2017.1405784.
Djoudi, H., Locatelli, B., Vaast, C., et al., 2016. Beyond dichotomies: Gender and intersecting inequalities in climate change studies. Ambio 45 (Suppl 3), 248–262. https://doi.org/10.1007/s13280-016-0825-2.
Doblas-Reyes, F.J., Sörensson, A.A., Almazroui, M., Dosio, A., Gutowski, W.J., Haarsma, R., Hamdi, R., Hewitson, B., Kwon, W.-T., Lamptey, B.L., Maraun, D., Stephenson, T.S., Takayabu, I., Terray, L., Turner, A., Zuo, Z., 2021. Linking Global to Regional Climate Change. In: Waterfield, T., Yelekçi, O., Yu, R., Zhou, B. (Eds.), Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, pp. 1363–1512. https://doi.org/10.1017/9781009157896.012.
Eddy, T.D., Lam, V.W., Reygondeau, G., Cisneros-Montemayor, A.M., Greer, K., Palomares, M.L.D., Bruno, J.F., Ota, Y., Cheung, W.W., 2021. Global decline in capacity of coral reefs to provide ecosystem services. One Earth 4, 1278–1285. DOI: 10.1016/j.oneear.2021. 08.016.
Envasses Environmental Consultants Limited (EECL). (2020). Environmental and Social Impact Assessment Study Report for the Proposed Shimoni Port, Kwale County. 137p.
Feare, C.J., Jaquemet, S., Le Corre, M., 2007. An inventory of Sooty Terns (*Sterna fuscata*) in the western Indian Ocean with special reference to threats and trends. Ostrich 78 (2), 423–434. https://doi.org/10.2989/OSTRICH.2007.78.2.49.129.
Ferguson, C.E., 2021. A Rising Tide Does Not Lift All Boats: Intersectional Analysis Reveals Inequitable Impacts of the Seafood Trade in Fishing Communities. Front. Mar. Sci. 8, 625389 https://doi.org/10.3389/fmars.2021.625389.
Fernández-Llamazares, Á., Garcia, R.A., Díaz-Reviriego, I., Cabeza, M., Pyhälä, A., Reyes-García, V., 2017. An empirically tested overlap between indigenous and scientific knowledge of a changing climate in Bolivian Amazonia. Reg. Environ. Change 17 (6). https://doi.org/10.1007/s10113-017-1125-5.
Galappaththi, E., Schlingmann, A., 2023. The sustainability assessment of Indigenous and local knowledge-based climate adaptation responses in agricultural and aquatic food systems. Curr. Opin. Environ. Sustain. 62, 101276.
Glazebrook, T., 2011. Women and climate change: a case-study from Northern Ghana. Hypatia 26 (4), 762–782.
Goh, A.H.X. (2012). A literature review of the gender-differentiated impacts of climate change on women's and men's assets and well-being in developing countries. CAPRi Working Paper No. 106. Washington, D.C.: International Food Policy Research Institute. https://doi.org/10.2499/CAPRiWP106.
Government of Kenya (GoK). Ministry of agriculture, livestock and fisheries, 2017. Shimoni-Vanga Jt. Fish. Co. -Manag. Area Plan 54.
Gudka, M., Obura, D., Mbugua, J., et al., 2020. Participatory reporting of the 2016 bleaching event in the Western Indian Ocean. Coral Reefs 39, 1–11. https://doi.org/10.1007/s00338-019-01851-3.
Guodaar, L., Bardsley, D.K., Suh, J., 2021. Integrating local perceptions with scientific evidence to understand climate change variability in northern Ghana: A mixed-methods approach. ISSN 0143-6228 Appl. Geogr. 130, 102440. https://doi.org/10.1016/j.apgeog.2021.102440.
Hemmati, M., Röhr, U., 2007. A Huge Challenge and a Narrow Discourse. Women and Environments. Women and Gender Studies Institute. New College. University of Toronto, Toronto.
Hoelting, K., Martinez, D.E., Schuster, R.M., Gavin, M.C., 2022. Advancing knowledge pluralism and cultural benefits in ecosystem services theory and application. Ecosyst. Serv. 65, 101583 https://doi.org/10.1016/j.ecoser.2023.101583.
IPCC. (2021). Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K.Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and NewYork, NY, USA, pp. 3−32. DOI:10.1017/9781009157896.001.
Jacobs, Z.L., Yool, A., Jebri, F., Srokosz, M., van Gennip, S., Kelly, S.J., Roberts, M., Sauer, W., Queiros, A.M., Osuka, K.E., Samoilys, M., Becker, A.E., 2021. Key climate change stressors of marine ecosystems along the path of the East African coastal current. Ocean Coast. Manag. 208, 105627 https://doi.org/10.1016/j.ocecoaman.2021.105627.
Johannes, R.E., 1981. Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia. Berkeley: University of California Press.
Kaijser, A., Kronsell, A., 2014. Climate change through the lens of intersectionality. Environ. Polit. 23 (3), 417–433.
Kawarazuka, N., Béné, C., 2010. Linking small-scale fisheries and aquaculture to household nutritional security: An overview. Food Secur. 2 (4), 343–357. DOI: 10.1007%2fs12571-010-0079-y.
Kenny and Tapu-Qiliho, 2022. Exploring the access to, and experiences of people of diverse sexual orientation and/or gender identity engaged in fisheries: A scoping study.ACIAR.55p.
Khan, M.M., 2022. Disaster and Gender in Coastal Bangladesh: Women's Changing Roles, Risk and Vulnerability. Springe Nat.: Berl., Ger.
Klenk, N., Fiume, A., Meehan, K., Gibbes, C., 2017. Local knowledge in climate adaptation research: moving knowledge frameworks from extraction to co-production. Wiley Interdiscip. Rev.: Clim. Change 8 (5), e475. https://doi.org/10.1002/wcc.475.
Kwiatkowski, L., Torres, O., Bopp, L., Aumont, O., Chamberlain, M., Christian, J.R., Dunne, J.P., Gehlen, M., Ilyina, T., John, J.G., Lenton, A., Li, H., Lovenduski, N.S., Orr, J.C., Palmieri, J., Santana-Falcón, Y., Schwinger, J., Séférian, R., Stock, C.A., Tagliabue, A., Takano, Y., Tjiputra, J., Toyama, K., Tsujino, H., Watanabe, M., Yamamoto, A., Yool, A., Ziehn, T., 2020. Twenty-first century ocean warming, acidification, deoxygenation, and upper-ocean nutrient and primary production decline from CMIP6 model projections. Biogeosciences 17, 3439–3470. https://doi.org/10.5194/bg-17-3439-2020.
Laidler, G.J., 2006. Inuit and scientific perspectives on the relationship between sea ice and climate change: The ideal complement. Clim. Change 78, 407–444. https://doi.org/10.1007/s10584-006-9064-z.
Latulippe, N., Klenk, N., 2020. Making room and moving over: knowledge co-production, Indigenous knowledge sovereignty and the politics of global environmental change decision-making. Curr. Opin. Environ. Sustain. 42, 7–14. https://doi.org/10.1016/j.cosust.2019.10.010.
Legesse, B., Ayele, Y., Bewket, W., 2013. Smallholder Farmers' Perceptions and Adaptation to Climate Variability and Climate Change in Doba District, West Hararghe, Ethiopia. Asian. J. Empir. Res. 3 (3), 251–265. Retrieved from https://archive.aessweb.com/index.php/5004/article/view/3088.
Lemahieu, A., Scott, L., Malherbe, W., Tsimanaoraty, P., Mahatante, J., Randrianarimanana, V., et al., 2018. Local perceptions of environmental changes in fishing communities of southwest Madagascar. Ocean Coast. Manag. 163, 209–221. https://doi.org/10.1016/j.ocecoaman.2018.06.012.
MacGregor, S., 2010. A stranger silence still: The need for feminist social research on climate change. Sociol. Rev. 57, 124–140. https://doi.org/10.1111/j.1467-954X.2010.01889.
MacLeod, L., 2021. More Than Personal Communication: Templates For Citing Indigenous Elders and Knowledge Keepers. KULA 5 (1). https://doi.org/10.18357/kula.135. KULA: Knowledge Creation, Dissemination and Preservation Studies.
Maina, J.M., Bosire, J.O., Kairo, J.G., Bandeira, S.O., Mangora, M.M., Macamo, C., Ralison, H., Majambo, G., 2021. Identifying global and local drivers of change in mangrove cover and the implications for management. Glob. Ecol. Biogeogr. 30, 2057–2069. https://doi.org/10.1111/geb.13368.
Makame, O.M., Shackleton, S., 2020. Perceptions of climate variability and change in relation to observed data among two east coast communities in Zanzibar, East Africa. Clim. Dev. 12 (9), 801–813. https://doi.org/10.1080/17565529.2019.1697633.
Mariam, 2021. Vanga-Shimoni seascape, Kwale County, Kenya. Local knowledge of ocean-based resources. Pers. Commun.
Martin, E.A., Ratsimisetra, L., Laloë, F., Carrière, S.M., 2009. Conservation value for birds of traditionally managed isolated trees in an agricultural landscape of

Madagascar. Biodivers. Conserv. 18, 2719–2742. https://doi.org/10.1007/s10531-009-9671-x.
McClanahan, T.R., 1988. Seasonality in East Africa's coastal waters. Mar. Ecol. Prog. Ser. 44, 191–199.
McClanahan, T.R., Kosgei, J.K., 2023. Low optimal fisheries yield creates challenges for sustainability in a climate refugia. Conserv. Sci. Pract. 5 (12), e13043 https://doi.org/10.1111/csp2.13043.
McClanahan, T.R., Darling, E.S., Maina, J.M., Muthiga, N.A., D'agata, S., Leblond, J., Arthur, R., Jupiter, S.D., Wilson, S.K., Mangubhai, S., Ussi, A., Guillaume, M.M., Humphries, A.T., Patankar, V., Shedrawi, G., Pagu, J., Grimsditch, G.D., 2020. Highly variable taxa-specific coral bleaching responses to thermal stresses. Mar. Ecol. Prog. Ser. 648, 135–151. https://doi.org/10.1111/geb.13191.
Mcleod, E., Anthony, K.R., Mumby, P.J., Maynard, J.A., Beeden, R., Graham, N.A., Heron, S.F., Hoegh-Guldberg, O., Jupiter, S.D., MacGowan, P., Mangubhai, S., Marshall, N.A., Marshall, P.A., McClanahan, T.R., McLeod, K.L., Nyström, M., Obura, D.O., Parker, B.A., Possingham, H.P., Salm, R.V., Tamelander, J., 2019. The future of resilience-based management in coral reef ecosystems. J. Environ. Manag. 233, 291–301. https://doi.org/10.1016/j.jenvman.2018.11.034.
National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information, Monthly Global Climate Report for Annual 2022, published online January 2023, retrieved on June 16, 2023 from https://www.ncei.noaa.gov/ccess/monitoring/monthly-report/global/202213.
Neimanis, A., Walker, R.L., 2014. Weathering: Climate Change and the "Thick Time" of Transcorporeality. Hypatia 29 (3), 558–575.
Obura, D., Burgener, V., Owen, S., Gonzales, A., 2017. *Reviving the Western Indian Ocean Economy: Actions for a Sustainable Future – Summary*. WWF International. Gland, Switzerland, pp. 1–20.
Obura, D., Gudka, M., Samoilys, M., et al., 2022. Vulnerability to collapse of coral reef ecosystems in the Western Indian Ocean. Nat. Sustain. 5, 104–113. https://doi.org/10.1038/s41893-021-00817-0.
Orlove, B., Sherpa, P., Dawson, N., et al., 2023. Placing diverse knowledge systems at the core of transformative climate research. Ambio 52 (2023), 1431–1447. DOI: 10.1007/s13280-023-01857-w.
Painter, S., Popova, E., Roberts, M., 2021. An introduction to East African coastal current ecosystems: At the frontier of climate change and food security. Ocean Coast. Manag. 216, 105977 https://doi.org/10.1016/j.ocecoaman.2021.105977.
Pearse, R., 2017. Gender and climate change. In: WIREs Clim Change, 8, e451. DOI: 0.1002/wcc.451.
Praveen, V., Ajayamohan, R.S., Valsala, V., Sandeep, S., 2016. Intensification of upwelling along Oman coast in a warming scenario. Geophys. Res. Lett. 43, 7581–7589. https://doi.org/10.1002/2016GL069638.
Puri, R.K., Vogl, C.R., 2005. A methods manual for ethnobiological research and cultural domain analysis: with analysis using ANTHROPAC. Department of Anthropology, University of Kent, Canterbury.
Rabbitt, S., Tibbetts, I.R., Albert, S., Lilley, I., 2022. Testing a model to assess women's inclusion and participation in community-based resource management in Solomon Islands. Marit. Stud. 21 (4), 1–19. https://doi.org/10.1007/s40152-022-00282-1.
Rasch, D., Kubinger, K.D., Yanagida, T., 2011. Statistics in psychology – Using R and SPSS. John Wiley & Sons.
Reyes-García, V., Fernández-Llamazares, Á., Guèze, M., Garcés, A., Mallo, M., Vila-Gómez, M., Vilaseca, M., 2016. Local indicators of climate change: the potential contribution of local knowledge to climate research. WIREs Clim. Change 7, 109–124. https://doi.org/10.1002/wcc.374.
Reyes-García, V., Álvarez-Fernández, S., Benyei, P., García-del-Amo, D., Junqueira, A.B., Labeyrie, V., et al., 2023b. Local indicators of climate change impacts described by indigenous peoples and local communities: Study protocol. PloS ONE 18 (1), e0279847. https://doi.org/10.1371/journal.pone.0279847.
Reyes-García, V., D. García-del-Amo, S. Álvarez-Fernández, P. Benyei, L. Calvet-Mir, A.B. Junqueira, V. Labeyrie, X. Li, S. Miñarro, V. Porcher, A. Porcuna-Ferrer, A. Schlingmann, C. Schunko, R. Soleyani, A. Tofighi-Niaki, M. Abazeri, E. Attoh, A. Ayandale, J. Avila, D. Babai, R.C. Bulamah, J. Campos-Silva, R. Carmona, J. Cavides, R. Chakauya, M. Chambon, Z. Chen, F. Chengula, E. Conde, A. Cuní-Sanchez, C. Demichelis, E. Dudina, Á. Fernández-Llamazares, E. Balappaththi, C. Geffer-Fuenmayor, D. Gerkey, M. Glauser, E. Hirsch, T. Huanca, J.T. Ibarra, A.E. Izquierdo, L. Junsberg, M. Lanker, Y. López-Maldonado, J. Mariel, G. Mattalia, M.D. Miara, M. Torrents-Ticó, M. Salami, A. Samakov, R. Seidler, V. Sharakhmatova, U.B. Srestha, A. Sharma, P. Singh, T. Ulambayar, R. Wu., & I.S. Zakari. (2023a). Indigenous Peoples and local communities report ongoing and widespread climate change impacts on local social-ecological systems. Communications Earth & Environment. Accepted, pending minor revisions.
Reyes-García, V., García-Del-Amo, D., Porcuna-Ferrer, A., et al., 2024. Local studies provide a global perspective of the impacts of climate change on Indigenous Peoples and local communities. Sustain Earth Rev. 7, 1. https://doi.org/10.1186/s42055-023-00063-6.
Rocliffe, S., Peabody, S., Samoilys, M., Hawkins, J.P., 2014. Towards A Network of Locally Managed Marine Areas (LMMAs) in the Western Indian Ocean. PLoS ONE 9 (7), e103000. https://doi.org/10.1371/journal.pone.0103000.
Rohe, J., Schlüter, A., Ferse, S., 2018. A gender lens on women's harvesting activities and interactions with local marine governance in a South Pacific fishing community. Marit. Stud. 17. https://doi.org/10.1007/s40152-018-0106-8.
Roue, M., Nakashima, D., 2018. Indigenous and Local Knowledge and Science: From Validation to Knowledge Coproduction. In The International Encyclopedia of Anthropology, H. Callan (Ed.). DOI:10.1002/9781118924396.wbiea2215.
Roxy, M.K., Ritika, K., Terray, P., Masson, S., 2014. The Curious Case of Indian Ocean Warming. J. Clim. 27, 8501–8509. https://doi.org/10.1175/JCLI-D-14-00471.1.
Roxy, M.K., Modi, A., Murtugudde, R., Valsala, V., Panickal, S., Prasanna Kumar, S., Ravichandran, M., Vichi, M., Lévy, M., 2016. A reduction in marine primary productivity driven by rapid warming over the tropical Indian Ocean. Geophys. Res. Lett. 43, 826–833. https://doi.org/10.1002/2015GL066979.
Rukmana, D., 2014. Quota Sampling. In: Michalos, A.C. (Ed.), Encyclopedia of Quality of Life and Well-Being Research. Springer, Dordrecht. DOI: 10.1007/978-94-007-0753-5_2393.
Said (2021). Vanga-Shimoni seascape, Kwale County, Kenya. Local indicators of climate change impacts. Personal communication.
Saranya, J.S., Roxy, M.K., Dasgupta, P., Anand, A., 2022. Genesis and trends in marine heatwaves over the tropical Indian Ocean and their interaction with the Indian summer monsoon. J. Geophys. Res.: Oceans 127. https://doi.org/10.1029/2021JC017427.
Savo, V., Lepofsky, D., Benner, J.P., Kohfeld, K.E., Bailey, J., Lertzman, K., 2017. Observations of climate change among subsistence-oriented communities around the world. Nat. Clim. Change 6 (5), 462–473. https://doi.org/10.1038/nclimate2958.
Scheffers, B.R., De Meester, L., Bridge, T.C.L., et al., 2016. The broad footprint of climate change from genes to biomes to people. Science 80. https://doi.org/10.1126/science.aaf7671.
Singleton, B.E., Boyd Gillette, M., 2023. Mutiny on the Boundary? Examining ILK-Based Conservation Collaborations through the Lens of Rubbish Theory. Ethnobiol. Lett. 14 (2), 83–91. https://doi.org/10.14237/ebl.14.2.2023.1830.
Snively, G., Williams, W.L., 2016. Knowing Home: Braiding Indigenous Science with Western Science. University of Victoria. 268p..
Snyder, H., 2019. Literature review as a research methodology: an overview and guidelines. J. Bus. Res. 104, 333–339. Elsevier.
Sultana, F., 2013. Gendering climate change: geographical insights. Prof. Geogr. 66 (3), 372–381.
Taylor, S.F.W., Roberts, M.J., Milligan, B., et al., 2019. Measurement and implications of marine food security in the Western Indian Ocean: an impending crisis. Food Secur. 11, 1395–1415. https://doi.org/10.1007/s12571-019-00971-6.
Tengö, M., Brondízio, E.S., Elmqvist, T., Malmer, P., Spierenburg, M., 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. Ambio 43, 579–591. https://doi.org/10.1007/s13280-014-0501-3.
Terry, G. (2009). Climate Change and Gender Justice. Warwickshire, UK: Practical Action Publishing in Association with Oxfam GB.
Thomas, A., Mangubhai, S., Fox, M., Meo, S., Miller, K., Naisilisili, W., Veitayaki, J., Waqairatu, S., 2021. Why they must be counted: Significant contributions of Fijian women fishers to food security and livelihoods. Ocean Coast. Manag. 205, 105571 https://doi.org/10.1016/j.ocecoaman.2021.105571.
Tilley, A., Burgos, A., Duarte, A., et al., 2021. Contribution of women's fisheries substantial, but overlooked, in Timor-Leste. Ambio 50, 113–124. https://doi.org/10.1007/s13280-020-01335-7.
Torrents-Ticó, M., Fernández-Llamazares, Á., Burgas, D., Cabeza, M., 2021. Convergences and divergences between scientific and indigenous and local knowledge contribute to inform carnivore conservation. Ambio 50 (5), 990–1002, 10.1007/s13280-020-01443-4. Epub 2021 Jan 13. PMID: 33438166; PMCID: PMC8035381.
UNEP-Nairobi Convention & the Western Indian Ocean Marine Science Association (WIOMSA), 2015. *The Regional State of the Coast Report: Western Indian Ocean*. UNEP and WIOMSA, Nairobi, Kenya, pp. 546–pp.
Vincent, L.A., et al., 2011. Observed trends in indices of daily and extreme temperature and precipitation for the countries of the western Indian Ocean, 1961–2008. J. Geophys. Res. 116. https://doi.org/10.1029/2010JD015303.
WEDO. (2010). Press conference of the women and gender constituency to the UNFCCC, April 10, 2010. https://wedo.org/wp-content/uploads/WEDO-statement-pc-10-April.pdf (accessed June 20, 2024).
White, J.M., Lidskog, R., 2023. Pluralism, paralysis, practice: making environmental knowledge usable. Ecosyst. People 19 (1), 2160822. https://doi.org/10.1080/26395916.2022.2160822.
Whyte, K., 2018. What Do Indigenous Knowledges Do for Indigenous Peoples? In: Nelson, M.K., Shilling, D. (Eds.), Traditional Ecological Knowledge: Learning from Indigenous Practices for Environmental Sustainability. chapter, Cambridge: Cambridge University Press.
Wilson, R.J., Sailley, S.F., Jacobs, Z.L., Kamau, J., Mgeleka, S., Okemwa, G.M., Roberts, M.J., 2021. Large projected reductions in marine fish biomass for Kenya and Tanzania in the absence of climate mitigation. Ocean Coast. Manag. 215. https://doi.org/10.1016/j.ocecoaman.2021.105921.
WWF, 2001. Ecoregion conservation strategy. Report prepared by WWF on behalf of the stakeholders of East African Marine Ecoregion conservation process, WWF-EARPO, Nairobi..