Assessment of Climate Change and Livelihood of Fisheries Communities: A Case Study of Alula District, Somalia

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Abstract

Climate change is one of the most recognized challenges in the 21st century, which has severely impacted fisheries communities through declining fish stocks and food insecurity. This study examined the impact of climate change on the livelihoods of fisheries communities in Alula, Somalia, using a cross-sectional research design with a quantitative approach. Questionnaires were distributed among 292 participants selected through simple random sampling. Data were analyzed using descriptive statistics and chi-square analysis via SPSS, version 20. The findings revealed that 51% believed that perception of a decline in fish stocks was significant. Additionally, 46% and 53% reported significant income loss and food insecurity, respectively, and enhancing climate-related information systems was the most common adaptation strategy, as indicated by 35%. A chi-square analysis (χ^2 = 457.020, P-value = 0.000) indicates a strong association between perception change in fish stocks due to climate change and food security status. The study concludes that the decrease in fish stocks has led to a significant amount of food insecurity, diversification of income strategies along with sustainable fishing practices, and ensuring of the resilience and sustainability of the communities in the face of climate change. Key recommendations include that they should implement target awareness campaigns on climate change perceptions affecting fish stocks and marine resources, implement sustainable food security diversifications, and establish regular climate-related information systems.

1. Introduction

Climate change is one of the most recognized challenges in the 21st century, which has affected ecosystems, economies, and communities around the world (Raimi, Vivien, & Oluwatoyin, 2021). The United Nations Sustainable Development Goals has provided a framework addressing these challenges; particularly, goal 13 emphasizes the need to combat climate change, and goal 14 focuses on the sustainable management of oceans and marine resources (Sanchez Rodriguez, Ürge-Vorsatz, & Barau, 2018).

In Africa, the continent accounts for approximately 3-4% of global greenhouse gas emissions, yet it faces

severe consequences, including sea level rise, droughts, floods, and food insecurity (Fonjong, Matose, & Sonnenfeld, 2024). The Intergovernmental Panel on Climate Change (IPCC) has recognized human activities, particularly the burning of fossil fuels, marine habitat destruction, and extreme weather events, as the primary drivers of climate change (Solecki, Roberts, & Seto, 2021).

Somalia has released 0.03% of greenhouse gas emissions as of 2021, which contributed to rising temperatures, ocean acidification, and biodiversity loss. (Boyle, 2024). Additionally, climate change in Somalia has caused significant challenges to the livelihoods of fisher communities, with reports showing that fish populations have declined by approximately 30% due to rising sea temperatures and overfishing 25% decrease in predictable fishing seasons (Abdirahman, 2022). Although the frequency of extreme weather results in economic instability, as reported by 40% of

fisher households in Somalia due to the food security risks and climate variability (Eklöw & Krampe, 2019). Alula District, situated in the northeastern Ras'Asayr region, Puntland State of Somalia, is well-known for its beautiful coastline, fishing hub, and vibrant cultural heritage. The local economy is primarily based on fishing, livestock herding, frankincense harvesting, and palm trees, as well as growing tourism prospects contributed by its natural beauty and historical importance (Omer, 2024). Unfortunately, climate change presents significant challenges for the fisheries communities in Alula, endangering their livelihoods and food security (Mandal, Mukhopadhyay, & Maity, 2023). However, Somalia is an under-researched area, which further compounds the challenges in realizing the climate change impacts. Hence the need to conduct a study assessment of climate change and the livelihood of fisheries communities in the Alula district, Somalia. This forms the basis of the study.

2. Methodological Aspect And Study Area
2.1 Research Design and Study Area
The study used a cross-sectional research design through a quantitative approach utilizing structured questionnaires to collect data from fisher communities in Alula District, Somalia, that have been directly affected by climate change.

Figure 1: A Map of the Study Area   Source: (PEC, 2023).

In Figure 1, show that the study area in Alula District, Somalia, is located in the northeastern Ras'Asayr region, Puntland-Somalia. The Puntland State consists

of 9 regions, which include Bari, Sanaag, Nugal, Sool, Mudug, Karkaar, Ayn, Highland, and Ras'Asayr. (PEC, 2023).

2.2 Sample Size, Data Collection Methods, and Data Analysis
The study used the Slovene's Formula to come up with an appropriate sample size calculation formula to

determine the sample size of this study (Guilford & Frucher, 1973).

The study selected a sample of 292 respondents for participation. A simple random sampling technique was used to select the fisheries communities, like fishermen, cooperative fisheries, and fish traders.

Data were collected through closed-ended questions. Data were analyzed using descriptive statistics such as frequencies and percentages and inferential statistics such as the chi-square test to indicate the relationships between variables through the Statistical Package for Social Science (SPSS).

3. Results

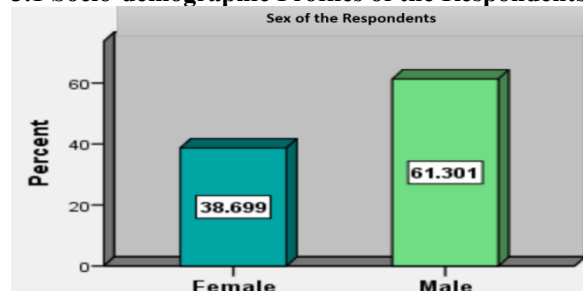### 3.1 Socio-demographic Profiles of the Respondents

Figure 2: Gender of the respondents

The results in Figure 2 show that the majority of the respondents were male, 179 (61%), while the rest were female, 113 (39%).
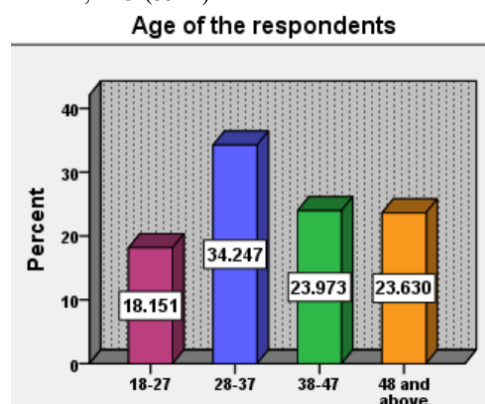

Figure 3: Age of the respondents

Figure 3 shows the age of respondents: 55 (18%) were aged between 18 and 27 years, followed by those in the category of 28-37 years who were 98 (34%). Additionally, 70 (24%) of respondents were aged between 38 and 47 years, while 69 (24%) of respondents were aged 48 years and above.
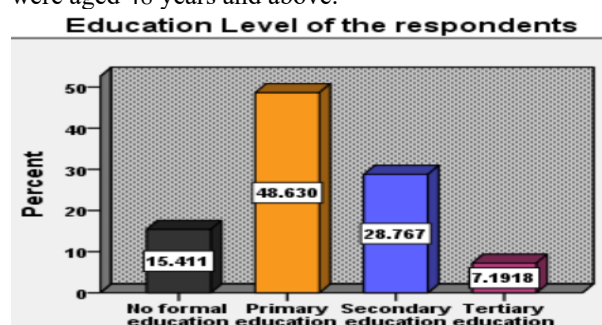

Figure 4: Education level of the respondents Figure 4 shows that the education levels of the ents were that about 45 (15%) had no formal education, followed by those who had primary education, who were 142 (49%), followed by those who had Secondary education, who were 84 (29%) while the rest who had university education were 21(7%).
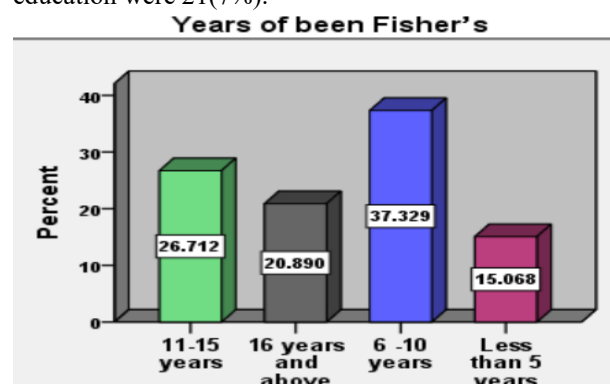

Figure 5: Years of being Fishers

The findings in figure 5 show that the years of being fishers. About 44 (15%) had been less than 5 years, followed by those between 6 and 10 years, who were 109 (37%). In addition, for those been in fisheries 11-15 years were 78 (27%), while the rest, 16 years and above, were 61 (21%).
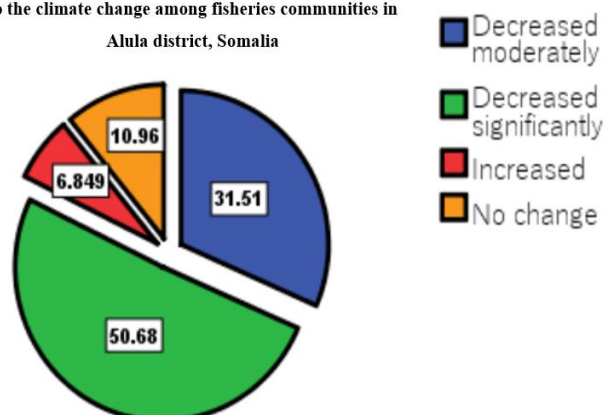

Figure 6: Perception of Change in Fish Stock

The perception of climate change in figure 6 indicates over half of the respondents, 148 (51%), believe that fish stocks have decreased significantly, reflecting a strong perception of negative impacts on marine biodiversity and availability. A significant portion (almost one-third), 92 (31%), also perceived a moderate decrease, suggesting that a majority of participants feel there is some level of decline in fish populations. Only a small number of 32 (11%) believe there has been no change, indicating that the perception of stability in fish stocks is not widely held, while a minimal number of respondents, 20 (7%), feel that fish stocks have increased, which may reflect either a lack of awareness of broader trends or localized positive experiences.
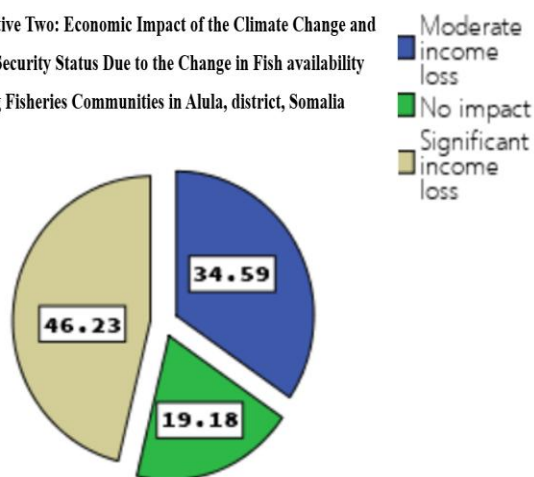

Figure 7: Economic Impact of Climate Change

Figure 7 findings indicate that nearly half of the respondents, 135 (46%), reported significant income loss due to climate change, underscoring the severe economic challenges faced by fisheries communities, followed by a substantial number, 101 (35%), reported moderate income loss, indicating that many fishers were feeling the economic tension, while only 56 (19%) of the respondents felt that climate change had not impacted their income.
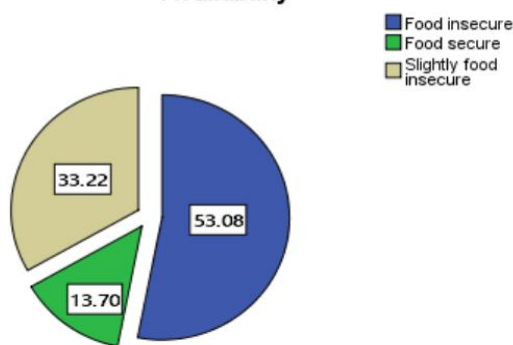

Figure 8: Impact of Food Security

3.2 Chi-square Analysis

Figure 8 indicates that more than half of the respondents, 155 (53%), identify as food insecure, which highlights a critical issue where access to adequate food is compromised. This suggests that changes in fish stocks due to climate change may severely impact nutritional needs and food availability in these communities. A significant portion 97 (33%) of respondents reports being slightly food insecure. This indicates that even those who are not entirely food insecure are still facing challenges in securing sufficient nutrition, which may lead to increased vulnerability over time, whereas only a small number, 40 (14%), consider themselves food secure, emphasizing that reliable access to food is a prevalent concern among fishing communities.
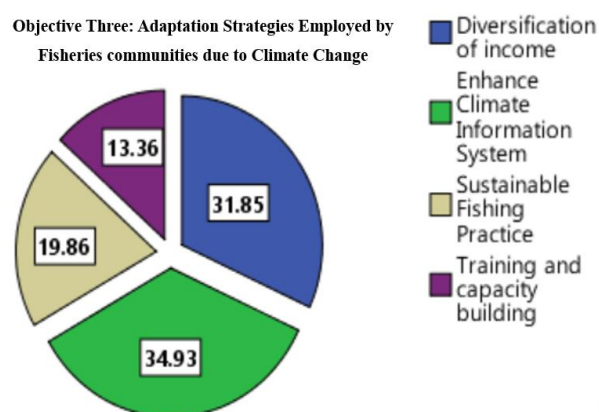

Figure 9: Adaptation Strategies

The findings in figure 9 show that the most common adaptation strategy was enhancing climate-related information systems, as indicated by 102 (35%). In addition, diversification of income was the second strategy, as reported by 93 (32%). This strategy reflects an understanding of the need to reduce dependency on fish stocks, which may be shifting due to climate change, thus enhancing economic resilience. Sustainable fishing practice was the third strategy, as reported by 58 (20%). This indicates long-term ecological health and the sustainability of fish populations, which was crucial for both food security and community livelihoods. While the training and capacity building was the least common strategy, as reported by 39 (13%). This highlights a potential area for growth, as increased training could empower fishers with the skills needed to adapt to changing conditions more effectively.

Table 1: Relationship Between Perception Change in Fish Stocks Due to Climate Change and Food Security Status Among Fisheries Communities in Alula District, Somalia.

Perception Change in Fish Stocks Due to Climate Change	Food Security Status				Total	($\chi2$ – value, P-value)
	Food insecure	Food secure	Slightly insecure	food		
	7	0	85		92	
Decreased moderately	7.60%	0.00%	92.40%		100.00%	
Decreased significantly	148	0	0		148	
	100.00%	0.00%	0.00%		100.00%	(457.020, 0.000)
	0	20	0		20	
Increased	0.00%	100.00%	0.00%		100.00%	
	0	20	12		32	
No change	0.00%	62.50%	37.50%		100.00%	

Source: Field survey, 2024.   *- P<0.05 confirms statistically significant association.

Table 1 shows the findings reveal a strong and statistically significant relationship between perception change in fish stocks due to climate change and food security status using the chi-square test. The Pearson Chi-square value χ^2 = 457.020 indicates a strong association between the two variables. The significant p-value = 0.000 is less than the commonly accepted threshold of <0.05, confirming a statistically significant association.

4. Discussion of Findings

The study revealed that 51% of the fisheries communities in Alula, Somalia, have perceptions that indicate a significant decline in fish stocks attributed to climate change. Comparatively, a previous study conducted in Mogadishu, Somalia, which indicated declining fish storage, led to significant reductions in the availability of marine resources for local fishing communities (Amir, 2024).

The findings also indicate a critical food insecurity rate of 53% among respondents, which contributes to fish availability diminishing and nutritional intake suffering, particularly in vulnerable populations. Comparatively, a previous study conducted in Somalia stated diminishing fish availability directly impacted nutritional intake, particularly among vulnerable groups (Jama, Muhammad, & Selamah, 2022). However, addressing food security challenges is vital for strengthening and reducing poverty for vulnerable populations to obtain the nutrition and basic necessities they need.

5. Conclusion and Recommendations

The study concludes that the decrease in fish stocks has led to a significant increase in food insecurity among fisheries communities. It emphasizes the importance of enhancing climate-related information systems and implementing diversifications of income strategies, along with sustainable fishing practices, to mitigate the impact of climate change on livelihoods, and addressing these challenges is crucial for ensuring the resilience and sustainability of these communities in the face of climate change. The study recommended that they implement targeted awareness campaigns on climate change perceptions affecting fish stocks and the marine environment, including workshops, community meetings, and educational materials tailored for fisheries, local youth, and women, in collaboration with local environmental organizations. Should develop sustainable food security interventions aimed to improve food security status, like training in alternative livelihoods, support for sustainable fishing practices, and freezing facilities to enhance fish storage capabilities.

It should establish and maintain the climate-related information systems, collaborate with local authorities, telecom providers, and community organizations, and provide training and technical support as needed to enhance its effectiveness in supporting climate adaptation efforts.

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