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The Effectiveness of IGAD Climate Prediction and Applications Centre (ICPAC) on Environmental Security in the Greater Horn of Africa

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Abstract
A comprehensive analysis of Inter-Governmental Authority on Development (IGAD) Climate Prediction and Applications Center (ICPAC) initiatives in the Greater Horn of Africa (GHA) is necessitated by the existing climatic challenges in the region. The program was developed with an aim at enhancing environmental security through climate prediction. This review delves into the different initiatives within ICPAC and their impact in addressing environmental threats within the IGAD region. A region that is known for its vulnerability to climate change and variability which has posed significant threat to the environment, livelihoods and sustainable development. This analysis assesses the impact of ICPAC's work on environmental security by thoroughly examining the organization's efforts to increase the accuracy of climate predictions, fortify early warning systems, and encourage adaptive methods. This study emphasizes the significance of scientific innovation and regional cooperation in solving climate-related concerns in the Greater Horn of Africa by combining existing research, reports, and case studies. The study in its findings highlights the need for an elaborate monitoring and evaluation framework that will advise policy and shape up future programs. There has also been an indication of inadequate awareness programs for communities to be able to fully explore the benefits that ICPAC is aimed at delivering.

Keywords: Adaptive strategies, climate prediction, early warning systems, environmental security, Greater Horn of Africa, ICPAC, sustainable development.

1.0 Introduction

The global perspective on environmental security acknowledges the complex relationship between environmental sustainability, geopolitical stability, and human well-being. Challenges like climate change, deforestation, pollution, and natural resource depletion have far-reaching implications. Climate prediction and early warning systems aim to improve understanding of climate dynamics and provide timely information to help communities prepare for and adapt to changing conditions (Barnett 2007). The World Meteorological Organization (WMO) coordinates these efforts, while regional climate centers serve as hubs for climate research, monitoring, and capacity-building. Partnerships between developed and developing countries and public and private sectors are crucial for advancing climate prediction and early warning systems globally. Leading programs include the Pacific Islands Climate Prediction Initiative

(PICPI) and Caribbean Community Climate Change Centre (CCCCC), which enhance climate prediction and adaptation efforts in the Pacific Islands region (UNFCC 2022).

The Climate Prediction and Applications Centre for Southern Africa (SASSCAL) and the West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL) are regional initiatives in the African region that focus on climate research, capacity-building, and adaptation measures. The Greater Horn of Africa, including Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, and Uganda, is a region with significant ecological diversity and geopolitical significance. It faces environmental challenges such as droughts, floods, desertification, and water scarcity, which can impact human well-being, socioeconomic stability, and environmental security (M. Singh 1996). The Intergovernmental Authority on Development (IGAD) is a key regional organization dedicated to fostering economic cooperation, political stability, and socio-economic development among its member states. IGAD has initiated programs addressing environmental security issues in the region, ranging from natural resource management to disaster risk reduction and sustainable energy initiatives. These programs aim to mitigate environmental challenges, strengthen community resilience, and promote sustainable development practices under SDG 13 on Climate Action.

The Climate Forecast and Applications Centre (ICPAC) was established by the Intergovernmental Authority on Development (IGAD) to improve climate forecast capabilities and promote evidence-based decision-making. It adopts a multi-modal approach to environmental security projects, focusing on enhancing climate projection precision, fortifying early warning systems, and encouraging adaptable risk-reduction tactics. ICPAC collaborates with national meteorological agencies, scientific expertise, and technology innovation to improve resilience and adaptive capacity in communities around the Greater Horn of Africa.

The IGAD Climate Prediction and Applications Centre (ICPAC) is vital for enhancing environmental security in the Greater Horn of Africa region. However, the extent to which ICPAC initiatives contribute to regional environmental security remains unclear and warrants a comprehensive evaluative study. A comprehensive evaluation is needed to understand its strengths, weaknesses, and impact. This will help refine strategies, allocate resources, and maximize positive outcomes for diverse communities. The study will identify opportunities, obstacles, and gaps in ICPAC implementation and offer evidence-based suggestions for improving its effectiveness (ICPAC 2023).

2.0 Conceptual Framework

A theoretical review is a critical analysis of current theoretical frameworks, concepts, and models related to a specific study issue. It helps to understand the research's theoretical foundations and place the research within the larger academic discourse. This review examines the role of regional organizations in addressing environmental issues and the concept of "securitization" in environmental security research. The review also discusses the complex adaptive systems theory, which emphasizes the dynamic and interrelated nature of social-ecological systems. The institutional theory suggests that programs for regional environmental security can be evaluated based on the institutional context, focusing on how organizations, rules, and norms influence behavior, decision-making, and outcomes. This theory provides insights into how institutional arrangements and governance structures affect program performance and results in the study of regional environmental security programs (McMillan 2001).

Institutional theory provides a useful framework for understanding program efficacy, but it may not always accurately describe regional variations in political, social, and environmental variables. Factors like

cultural norms, values, and resource accessibility can influence behavior, and institutions may take time to adjust to new situations. Resilience theory, on the other hand, examines the dynamics of adaptability and fortitude in systems, similar to an organism's immune system or a city's ability to reconstruct itself after a calamity. Key concepts include feedback loops, diversity, redundancy, and adaptability. However, resilience theory faces challenges such as trade-offs between resilience and efficiency, scale dependence, and the constant presence of unpredictable situations that require thoughtful action plans. Overall, resilience theory offers a multidisciplinary approach to understanding and managing systems' resilience and resilience (Yu 2022).

Resilience theory is a crucial tool for managing the complexity of dynamic systems, emphasizing the importance of enduring shocks and flourishing in uncertainty. This study examines the impact of ICPAC programs on environmental security in the Greater Horn of Africa and suggests ways to improve their performance. It uses a conceptual framework informed by environmental governance, resilience theory, and sustainable development theories. Successful ICPAC projects can lead to better environmental security metrics and early warning systems for disaster response plans. The framework also considers moderating elements like institutional strength, political stability, socioeconomic conditions, and technology developments. The study uses stakeholder interviews and qualitative assessments to evaluate the success of the ICPAC program (Hayes, et al. 2019).

Lastly, the conceptual framework recognizes any assumptions or restrictions that are included in the model, such as the complexity of environmental systems or the availability of data. In general, it acts as a guide for the procedures of research design, data gathering, and analysis for examining the efficacy of the ICPAC program on environmental security within the context of SDG 13. The conceptual framework for the study was built upon several interconnected concepts and components as indicated in figure 2.1 below:

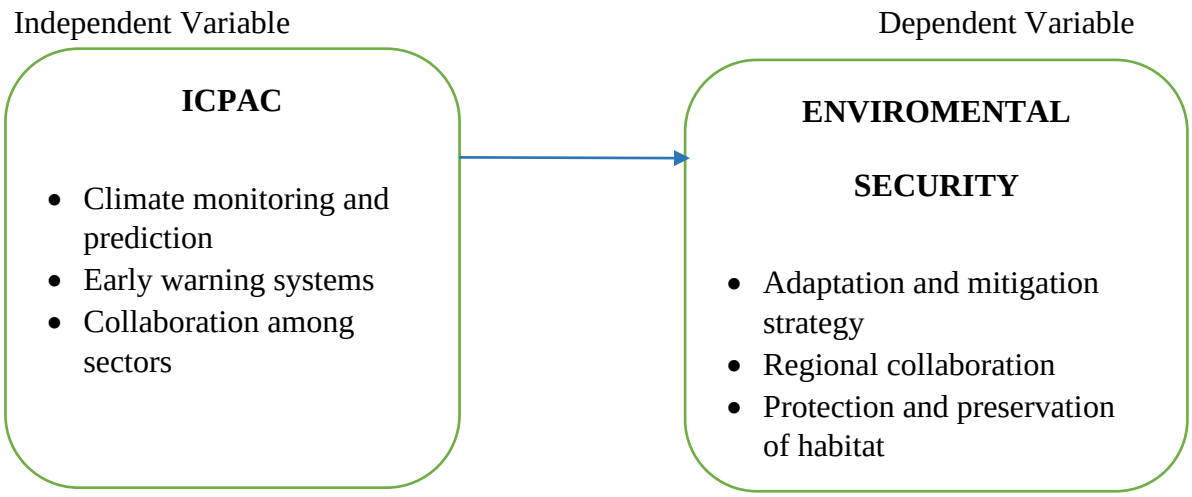


Figure 2.1: Conceptual Framework

2.1 IGAD Climate Prediction and Application Centre (ICPAC)

The IGAD Climate Prediction and Applications Centre (ICPAC) is a regional institution in the Greater Horn of Africa dedicated to climate prediction, monitoring, and adaptation. It uses advanced climate modeling and forecasting techniques to provide accurate climate information, support decision-making, and develop early warning systems for extreme weather events. Its main goals are to help decision-making

processes throughout the IGAD region by enabling the application of climate projections and offering climate information services.

The main objective of ICPAC's operations is to strengthen IGAD member nations' ability to handle climate-related difficulties and adjust to climatic variability and change. It uses a variety of solutions in an attempt to accomplish this:

ICPAC is a global organization that monitors and evaluates climatic data and trends in the IGAD region, creating seasonal climate forecasts and early warning systems. It also organizes capacity-building courses and projects to improve technical skills among regional stakeholders. ICPAC conducts research to advance climate dynamics and provide advanced methods for climate prediction and adaptation. It offers climate information services to various industries, including energy, agriculture, health and disaster risk reduction, and water resources management. It collaborates with international agencies, regional groups, development partners, and national meteorological and hydrological services to ensure efficient use of climate data in planning and decision-making. ICPAC also participates in regional and global programs to address climate challenges and promote sustainable development (Weldesellassie, 2011).

Overall, the ICPAC proposal envisions a dynamic and responsive institution that acts as a focal point for climate information and adaptation initiatives in the Greater Horn of Africa. It is based on the proposition that effective climate prediction and adaptation are critical for establishing resilience and sustainable development in the face of climate variability and change.

2.2 Empirical Review

This review explores the effectiveness of IGAD ICPAC programs in enhancing environmental security in the Greater Horn of Africa. It analyzes literature, including academic papers, studies, and policy documents, and highlights key findings that support the idea that ICPAC initiatives are beneficial. However, it also points out gaps and limitations in the literature, highlighting instances where empirical data may be conflicting or insufficient. The review critiques methodological choices that may affect the validity of the results and suggests future directions for study. It recommends policy and action to strengthen IGAD's role in achieving environmental security in line with SDG 13 targets in the Greater Horn of Africa. The program also emphasizes outreach and efficient communication, impacting policy decisions, agricultural practices, disaster preparedness, and other critical areas of regional development (ICPAC, 2023).

To this end, the IGAD ICPAC initiative is an example of an organized and proactive approach to addressing the intricate problems that climate change in the region has brought about. Through the integration of scientific knowledge, inclusive collaborations, and a dedication to enhancing capacity, ICPAC is a crucial component in assisting the area in managing the consequences of climate change and constructing a more sustainable future.

3.0 Methodology

Research design is a structured process for gathering, analyzing, and interpreting data within a research proposal (Creswell, 2018). It involves selecting locations, participants, and methods to answer questions and produce reliable results (Durrheim, 2004). Key characteristics include impartiality, truthfulness, trustworthiness, and generalizability (Bouchrika, 2024). This study used a descriptive research design to investigate the effectiveness of IGAD ICPAC program on environmental security in the Greater Horn of Africa, using qualitative and quantitative data to explore correlational relationships. This design helped understand people's observations and attitudes, aligning with the study's objectives.

Population refers to all units to which research findings apply (Shukla, 2020). A target is a subset of the population, while a population encompasses all individuals with specific characteristics. Traditionally, a population is often associated with its physical location. However, in this study the population was defined by additional factors such as the specific initiative within the ICPAC program being evaluated and the position of influence a respondent held which provided much needed information (Leroy, 2020).

A sampling frame has been described by Turner (2003) as essentially the pool of source items from which a sample is selected. This frame facilitates the selection of particular members from the target population for interview purposes, aligning with the study's objectives. In this study, the sampling frame was created from a list comprising of IGAD Officials overseeing the designated ICPAC initiatives, national government officials, and community members involved in environmental management in collaboration with ICPAC.

A sample size in research is the number of people or units chosen for study participation from a wider population. To get results that were both statistically significant and generalizable to the larger population from which the sample was taken, it was important to choose the right sample size. Because it directly affects the accuracy and dependability of study findings, sample size is an important factor in research design (Shukla, 2020).

The ideal sample size for a study must balance practical limitations, statistical factors, and precision. Larger samples improve statistical power but may require more time and resources. The sampling technique involves selecting people or units from the population, based on research goals, available resources, and population characteristics. Each technique has unique benefits and drawbacks (Singh & Masuku, 2014).

For the purpose of this study, stratified random sampling was utilized to select the required sample size. The respondents were divided into smaller units according to their departments and sectors and random sampling was employed to select the participants that best represented the other subgroups of the target population. This ensured that the population was well represented and helped to avoid biasness. The target population of the study was 63 respondents from IGAD and IGAD Member States as illustrated in tables

3.1 and 3.2 below: -

Table 3.1: IGAD secretariat representation

Target Population	**No.**
IGAD ICPAC Officials	3

Source: Study, 2024

Table 3.2: IGAD Member States

Target Population	Uganda	Kenya	Somalia	Djibouti	Ethiopia	South Sudan
Ministry Of Foreign Affairs (Focal Point on IGAD matters)	2	2	2	2	2	2
Environmental Department	3	3	3	3	3	3
NGO's	3	3	3	3	3	3
Community Leaders & Members	2	2	2	2	2	2

Source: Study, 2024

The study utilized surveys and telephone interviews to gather quantitative data on environmental security through ICPAC programs. Surveys allowed respondents to express their opinions freely and maintain objectivity, resulting in a diverse dataset. 63 questionnaires were distributed to participants, and qualitative data was obtained through guided telephone interviews with key stakeholders. Data collection was facilitated by an introduction letter from the National Defense University - Kenya, a permit from the National Commission of Science, Technology and Innovation, and appointments with random stakeholders. The research's validity was confirmed through a preliminary trial with seven individuals and consultation with the supervisor.

Validity refers to how well an instrument assesses what it's intended to measure. As stated by Gillham (2008), data must be not only reliable but also truthful and precise. Therefore, if a measurement is valid, it is also reliable.

Reliability is the extent to which measurement of a test is repeated with the expectation that the results of the measuring instrument were similar each time the measurement is repeated (Kothari, et.al., 2014). It indicates the extent to which a measurement tool yields reliable findings when used repeatedly on the same phenomenon under the same circumstances. The uniformity of measurements across time depends on reliability. Since the goal of the study was to assess the efficacy of ICPAC initiatives, the data was gathered in the duration of the study from targeted sources considered reliable enough to provide accurate information of the status of the program. A trustworthy tool guarantees consistent results from measurements made at multiple points in time, enabling insightful comparisons and analyses between different stages of the study.

The information gathered from the surveys was examined for consistency, omissions, and legibility. Statistical Package for the Social Sciences (SPSS) software was used to analyze quantitative data in order to determine the link between the variables under study through the generation of descriptive statistics, comparative analysis, and correlation analysis. Qualitative data was analyzed using themes to identify the recurring ones, their patterns and narratives related to challenges and successes of the ICPAC program initiatives.

The study assessed the performance of ICPAC program on environmental security vis-à-vis SDG 13 targets. It focused on program comprehension, presence of monitoring and evaluation frameworks, resource management, and sustainability initiatives like staff capacity building and community outreach. Each initiative under ICPAC served as an independent variable. Descriptive statistics, including mean, mode, and median, were used to summarize participant demographics, presented through tables, charts, and percentages for clarity.

4.0 Research Findings and Discussion

The research survey that was conducted in this study focused on evaluating the performance of three IGAD ICPAC program initiatives in addressing environmental security with relation to the targets of Sustainable Development Goal 13 (SDG 13). Throughout the study, a wealth of valuable insights and perspectives was gathered. The survey aimed to comprehensively assess the effectiveness, impact, challenges, and alignment of the programs with the objectives outlined in SDG 13, thereby shedding light on their role in enhancing environmental sustainability within the Greater Horn of Africa region.

The study involved a diverse range of participants who represented various organizations and sectors. These participants offered valuable feedback on their understanding of the program, its implementation processes, activities carried out, and their perceptions of its effectiveness in achieving environmental

security goals aligned with SDG 13 targets. The study also sought to assess how well the programs had aligned with the objectives and targets of the SDG 13 global agenda on combating climate change. Furthermore, it examined the extent of stakeholder engagement and collaboration, emphasizing the significance of nurturing partnerships among governments, NGOs, local communities, and other relevant stakeholders to advance environmental sustainability efforts.

The survey findings are analyzed, interpreted, and contextualized to provide a comprehensive understanding of the performance of the ICPAC initiatives in addressing environmental security within the framework of SDG 13. By delving deeply into the survey results, key findings were identified, and implications for future actions and policy development were explored.

The study attained a 60% response rate, with 38 out of the intended 63 respondents successfully completing the interview guide. As per the standards set by Borg and Gall (1996), the respondents' return rate can be deemed satisfactory. The survey questionnaire was disseminated among establishments associated with the three ICPAC initiatives focusing on Environmental Security.

Table 4.1: A representation of participants and number of responses received versus the target

Category	Participants	Percentage
ICPAC Officials	3	5%
Related Institutions	33	52%
Deficit	27	43%
Total	63	100%

Source: Study, 2024

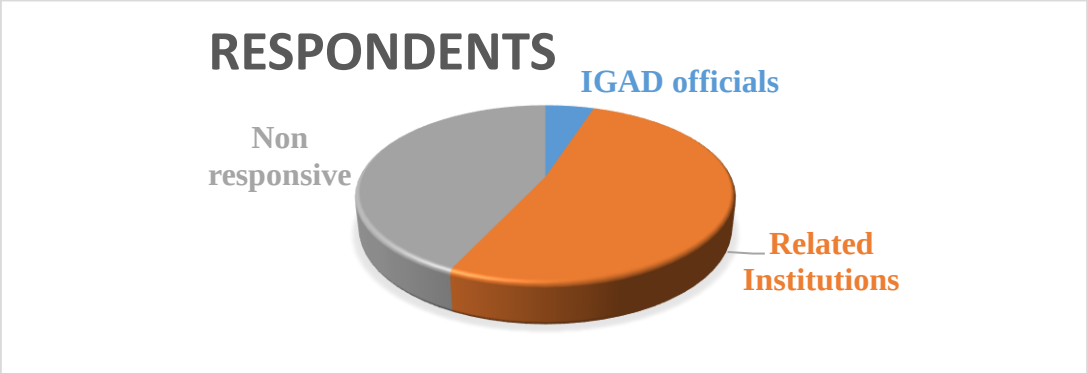


Figure 4.1: An illustration of representation of participation

The response rate is one above 50% implying that a sizeable section of the intended audience actively engaged in the survey and provided feedback. This indicates that the survey was relevant and compelling to most participants. With a response above 50%, its shows that the feedback is a representative of the views of the majority which is likely to provide accurate opinions and perspectives of the broader population. A high response rate increases the reliability of data, raises the statistical power for a more robust analysis and reduces potential for bias and skewed findings.

In order to understand the demographic data from the survey, an analysis of the characteristics of respondents, including nationality, organization type, and duration in the current job position and description was undertaken. This allowed to comprehend any patterns, differences, and the level of awareness of individuals. The results from the demographic analysis could be used to provide future

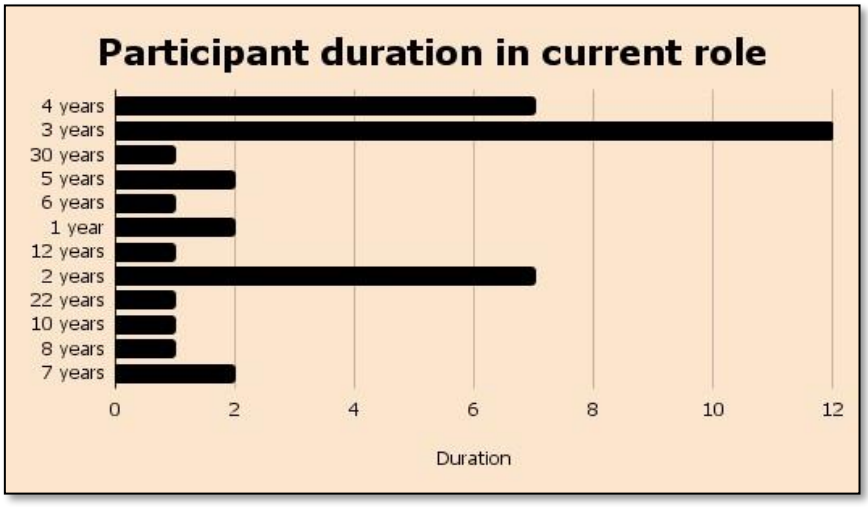
guidance on policy recommendations or research. The study had established that the highest numbers of responses were obtained from Kenya, followed by Uganda and Ethiopia. It was also worth noting that IGAD officials comprised 5% of the participants. The Ministry of Foreign Affairs in Kenya and the IGAD secretariat recorded the highest number of participants by institution. The majority of participants who responded were employees of government and government agencies, but those in nongovernmental organizations followed closely. Since IGAD is a multinational agency, it made sense that most participants with roles in the national or regional offices had an advantage in understanding the programs and the needs of the countries in the region.

The data indicates that the respondents provided all inputs adequately, although there were a few errors that were corrected manually using MS Excel. There was variability in how respondents described their nationalities, with some using the country name directly and others using it as a possessive noun (e.g., Kenya vs. Kenyan). One respondent failed to indicate the number of years in service in their particular role; however, this omission did not significantly impact the overall opinions expressed in the questionnaire.

This research survey drew participants from a variety of institutions contributing to a multitude of viewpoints and specialties that enhance the study's depth and complexity. Their diverse backgrounds, which span a range of academic fields and professional fields, encourage interdisciplinary cooperation and guarantee a thorough comprehension of the research issue. Participant knowledge and methodology complement each other, allowing for a more comprehensive analysis of difficult problems.

The study's findings' validity and dependability are improved by the participation of people from academia (university), government agencies (NEMA, KIPPRA, Embassy, State departments etc.), non-governmental organizations (NGOs), and industrial partners. Diversity lowers bias and improves sample representativeness, which gives the study more legitimacy. Furthermore, the likelihood of stakeholders appreciating and utilizing these study results in their respective fields increases, promoting stakeholder ownership and buy-in.

In this study, it was deemed important to recognize the variety of viewpoints and contributions brought by participants with different levels of experience to a research survey, in order to describe their impact on the study. Seasoned experts in the field provided in-depth understanding and unique perspectives derived from years of expertise and investigation. In this research, 9 participants had been working in their current roles for over 5 years. Their knowledge added rich context, insightful practical advice, and nuanced analyses to the study, which raised the validity and applicability of the research findings.



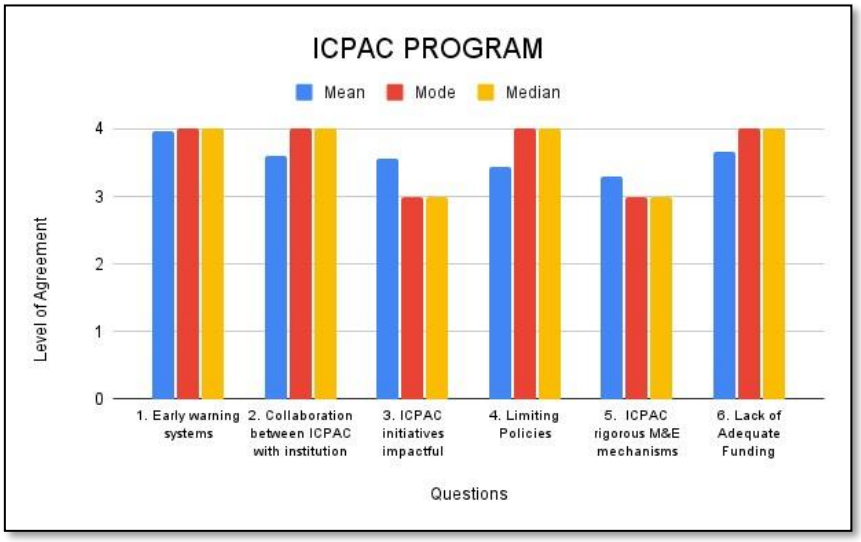
4.1 Measure of central tendency

This involves understanding the average values within the datasets: mean, mode and median. In the feedback collected, each of the variables showed an alignment towards an average where majority of the respondents shared the same opinion.

In understanding the outcomes, the respondents were asked question and whether they agree or not they would indicate the degree of acknowledgement on a strength level of 1 – 5 with 5 being the strongest.

In analyzing the mean, median and mode, it is observable that most respondents shared similar thoughts establishing that the distribution of data is approximately symmetrical and that the information is normally distributed. The lack of adverse opinions in the data sets offers robustness of the information as it shows an opinion of the majority.

The study was based on evaluating performance of the initiatives under ICPAC program to enhance its effect on environmental security with reference to the targets of SDG 13. In this case, the study focused on asking question around the understanding of the programs, whether the program has a monitoring and evaluation framework in place, whether it addresses resource management issues and whether there is a sustainability framework in terms of existing capacity building programs for its staff and information dissemination strategies to the target communities. The responses were as tabulated below:



4.2 Analysis of the IGAD Climate Prediction and Application Centre (ICPAC) program

The study posed to the respondent statements that were directing to the establishment of the level of performance of the ICPAC program in enhancing environmental security. The respondent's reactions were meant to identify the strengths or weaknesses of the systems in place and advice on the way forward borrowing from experiences in other articles of literature. The respondents were reacquired to give their opinions by providing feedback to the following statements on a scale of 1 - 5, with 5= Strongly Agreed, 4= Agreed, 3= Not Sure, 2= Disagreed, 1= Strongly Disagreed.

Statement 1 - Early warning systems have enhanced public awareness to timely plan and respond to extreme weather events such as droughts and floods.

The study sought to establish whether implementation of early warning systems has heightened public consciousness, enabling timely preparation and response to severe weather occurrences like droughts and floods. Figure 4.8 below depicts the outcomes of these responses. The data indicates that a significant majority of participants supported the statement, with 56.8% in agreement and 29.7% strongly agreeing. Conversely, 8.1% expressed disagreement, with none strongly opposing, while 5.4% remained uncertain.

The prevalent trend of agreement suggests a substantial enhancement in awareness levels across IGAD member states, facilitating prompt action in addressing extreme weather events.

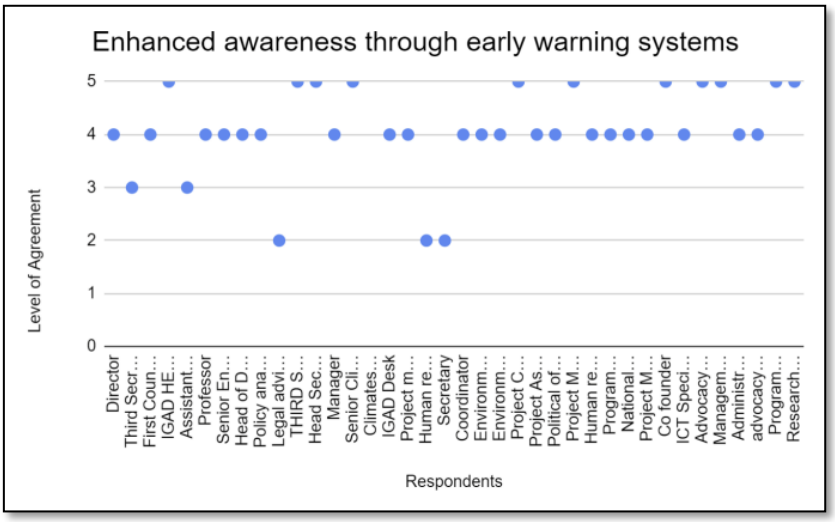


Figure 4.8: Scatter plot diagram showing the participants reaction to the statement

Statement 2 - There is collaboration between ICPAC with governments, academic institutions and NGOs in tackling climate related issues.

Data received from the study reveals mixed results. Data shows that a majority of the respondents were in agreement with 40.5% agreed and 18.9% strongly agreed. The results also show that 8.1% of the respondents disagreed and none of the participants strongly disagreed while 32.4% were not sure. The reaction by the respondents can be attributed to their roles within the program structure and rank. An illustration of the responses is as shown below.

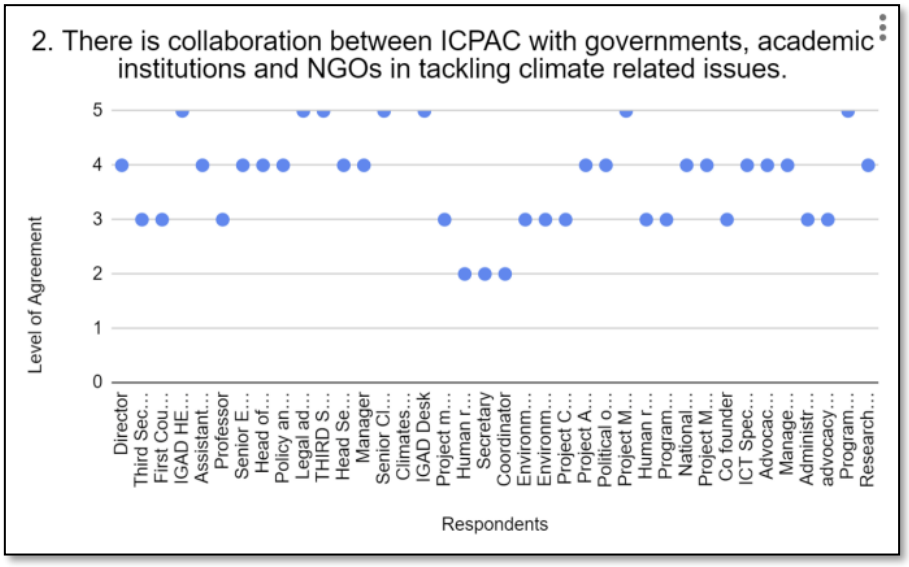


Figure 4.9: Scatter plot diagram showing the participants' reaction to the statement

Statement 3 - ICPAC initiatives have increased the region's ability to withstand the impacts of climate change.

The study aimed to understand stakeholders' perceptions of program initiatives and their societal impact. Results showed that 32.4% agreed, 18.9% strongly agreed, and 5.4% disagreed. 43.2% expressed uncertainty. Respondents from IGAD secretariat, program managers, climate security officers, and

program coordinators were most likely to agree, indicating their expertise in program implementation. However, 43.2% of respondents indicated a lack of information about the initiatives, making it difficult to predict their impacts on regions able to withstand climate change.

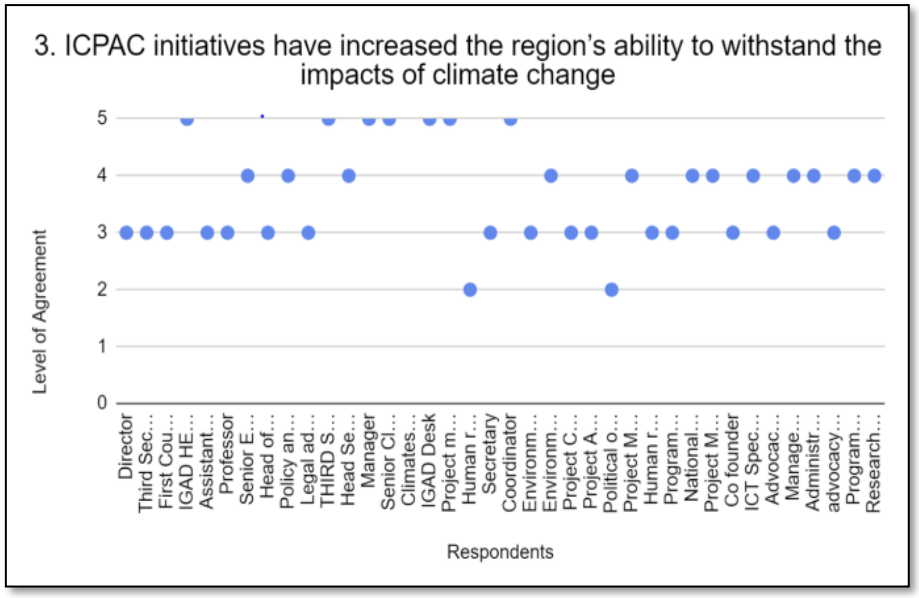


Figure 4.10: Scatter plot diagram showing the participants' reaction to the statement

Statement 4 - Differences in policy priorities among IGAD member states limits the implementation of ICPAC initiatives.

The findings indicate that most of the participants supported the statement, with 43.2% expressing agreement and 16.2% strongly agreeing. Conversely, 5.4% disagreed, and 8.1% strongly disagreed, with 5.4% remaining unsure. Consequently, the majority of respondents, totaling 59.4%, were in consensus that variations in policy priorities among IGAD member states hinder the execution of ICPAC initiatives. Their levels of agreement are shown in the figure 4.11 below.

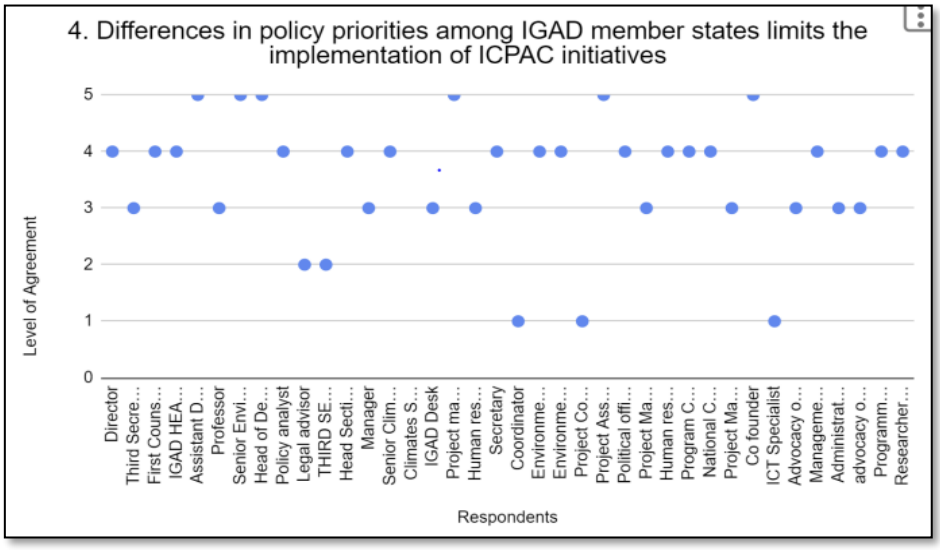


Figure 4.11: Scatter plot diagram showing the participants reaction to the statement

Statement 5 - ICPAC has rigorous monitoring and evaluation mechanisms to assess the effectiveness of its programs.

The study aimed to gauge respondents' opinions on ICPAC's program evaluation and its effectiveness. The results showed that 32.4% agreed and 8.1% strongly agreed, while 5.4% disagreed and 2.7% strongly disagreed. However, 51.4% expressed uncertainty, indicating a lack of understanding of an existing framework, which raises concerns about the impact of ICPAC initiatives on environmental security. The questionnaire delved into participants' knowledge, opinions, and firsthand experiences with monitoring and evaluation processes. The results are shown in figure 4.12 below.

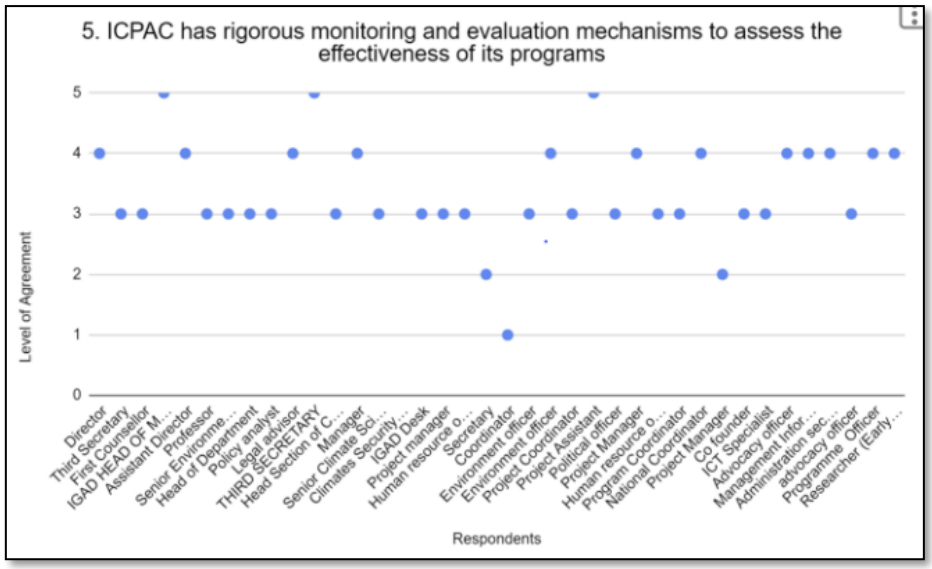


Figure 4.12: Scatter plot diagram showing the participants' reaction to the statement

Statement 6 - Lack of adequate funding limits operationalization of ICPAC initiatives.

The study tried to establish respondent's opinion whether lack of funding is impeding ICPAC's efforts from being operationalized. The statement emphasizes an understanding of the role that financing plays in making ICPAC's plans and programs possible to carry out. It delved into respondents understanding of the budgetary limitations ICPAC faces and how these restrictions impact the efficacy and scope of its activities. It emphasizes how important funding is to the successful implementation of ICPAC initiatives and how that affects its ability to operate. The results are illustrated in figure 4.13 below:

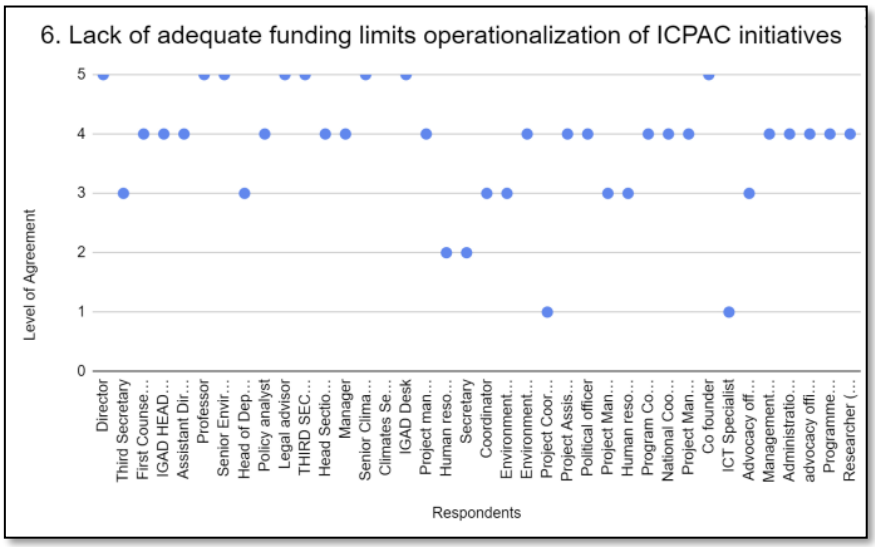


Figure 4.13: Scatter plot diagram showing the participants' reaction to the statement

The results show that a majority of the respondents were in agreement with the statement, 48.6% agreed and 21.6% strongly agreed. The results also show that 5.4% of the respondents disagreed and another 5.4% strongly disagreed while 18.9% were not sure. This implies that most stakeholders appreciated the importance of funding and its role in ensuring efficient implementation of ICPAC programs.

Overall, it appears from the results that most respondents were of the opinion that the existing early warning systems in place have played a huge role in information sharing for timely planning in preparation for the extreme events of floods and drought. This gives an opportunity for development of mitigation strategies, rescue and protection of habitats. However, the respondents were not entirely in agreement about the appreciable level of collaboration between institutions and governments, though a huge inclination towards an existing collaborative mechanism seems in place. This leaves room for further enhancement to improve on information sharing, capacity and strategic support.

Further, most respondents felt that the ICPAC initiatives are necessary even though they are yet to meet their expectations of increasing the ability of the region to withstand climate change impacts. They also shared similar sentiments on existing monitoring and evaluation mechanisms. There was also a varied reaction on policy limitations to the implementation of ICPAC programs while accessibility to funding was cited as important in ensuring efficient implementation of ICPAC program activities.

4.3 Opinions of Key Stakeholders.

In the engagement of key stakeholders in environmental management, the study prepared separate questionnaire as an interview guide to establish what the successes/ challenges are from their perspective. The target population for this exercise was five (5) respondents. Three (3) stakeholders' responders were from institutions within Kenya namely University, National Environmental Management Authority (NEMA) and Kenya Forest Service. The questions were centered around understanding factors that hampered successful implementation of the program, the impacts of conflict over natural resources to program implementation, program impact, policies, outcomes, threats and level of engagement and collaboration between the IGAD and relevant stakeholders (government, NGOs, local communities) in addressing environmental security and proposed interventions.

The responses indicate that common opinions are on basic issues surrounding the ICPAC environmental programs revolve around lack of adequate funding, weak implementation strategies, coordination between different institutions in the member states and lack of proper information dissemination framework for the stakeholders including local communities. In order to improve the situation and enhance environmental security in the IGAD, it was proposed among other initiatives that climate change adaptation and mitigation, capacity building of communities, promotion of blue economy, circular economy, joint biodiversity programs, ecosystem restoration and conservation, improvement of livelihoods of communities, and enhanced collaboration, and implementation of climate change action plans were some of the suitable interventions to enhance environmental security in the IGAD region.

5.0 Conclusion and Recommendations

This study examined the effectiveness of ICPAC (Intergovernmental Commission on Climate Change) and its potential to enhance environmental security in the Greater Horn of Africa. The research involved a literature review and a survey for stakeholders in IGAD programs. The study found that Kenya had the highest number of responses, followed by Uganda and Ethiopia. The Republic of Djibouti had the lowest number of responses. The majority of participants were employees of government and government agencies, with the Ministry of Foreign Affairs in Kenya and the IGAD Secretariat recording the highest

number of participants by institution. The study also assessed the role of existing early warning systems in sharing information for timely planning for extreme events like floods and droughts. 87% of respondents believed that early warning systems increased public consciousness, enabling timely preparation and response to severe weather events. However, there was a strong inclination towards a collaborative mechanism, suggesting room for improvement in information sharing, capacity building, and strategic support. Most respondents felt that ICPAC initiatives were necessary, but they did not meet their expectations of increasing the region's ability to withstand climate change impacts. Access to funding was cited as important for efficient implementation of ICPAC program activities.

The study examines the effectiveness of ICPAC initiatives in managing environmental security in the Greater Horn of Africa. Despite increased awareness and collaboration among IGAD member states and stakeholders, these programs have not met expectations due to insufficient funding, capacity limitations, and inadequate stakeholder engagement. The study emphasizes the need for targeted interventions to enhance the impact of ICPAC's environmental programs. It highlights the critical challenge of managing natural resources and safeguarding the environment, which are essential for the region's socioeconomic progress. IGAD member states must prioritize environmental sustainability in their economic and social endeavors to break the degradation cycle and achieve regional unity, peace, and clean living environments.

Based on the findings of this study, the following recommendations are proposed to enhance efficiency of IGAD programs in addressing environmental security in the Greater Horn of Africa;

Increasing the technical and administrative capabilities of ICPAC in IGAD member nations would help them create and carry out strong environmental policies and programs, which will strengthen their respective institutional ability.

Improving the involvement of stakeholders will encourage enhanced cooperation and alliances between governmental bodies, non-profit organizations, educational institutions, and nearby communities to optimize shared knowledge and assets while tackling environmental issues.

Introducing and extending reach of information on methods for sustainable development by making climate-resilient agriculture, renewable energy, and ecosystem preservation top priorities in order to lessen the negative effects of environmental deterioration.

Commit to establishing robust monitoring and evaluation strategies which will assess the performance of each ICPAC initiative especially focused on environmental security as this will enhance sustainability. It is highly recommended that the mechanisms align with the SDG 13 targets as this is a universal declaration to combat the impacts of climate change.

Cognizant of the fact that research serves as the cornerstone of making well-informed decisions, offering tangible evidence to comprehend intricate environmental challenges, ranging from the effects of climate change to the scarcity of resources. This study makes suggestions that there is need for sustained research efforts in the area of environmental security not just in the Greater Horn of Africa, where this study limited itself to, but to cover the whole of Africa aimed at monitoring patterns, pinpointing emerging hazards, and crafting effective plans to mitigate potential environmental risks to the continent.

References

1. Buzan, B., Wæver, O., & Wilde de, J. (1995). Environmental, Economic and Societal Security. *Centre for Peace and Conflict Research.* , Working Papers 10.
2. Græger, N. (1996). Environmental Security? *Journal of Peace Research*, Vol 33, Issue 1.

3. Hayes, S., Desha, C., Burke, M., Gibbs, M., & Chester, M. (2019). Leveraging socio-ecological resilience theory to build climate resilience in transport infrastructure. *Transport Reviews, 39*(5), 677–699.
4. ICPAC. (2023, November 24). *IGAD Climate Prediction and Applications Centre*. Retrieved from ICPAC: https://www.icpac.net/about-us/
5. Southwick, S. M., Bonanno, G. A., Masten, A. S., Panter-Brick, C., & Yehuda, R. (2014). Resilience definitions, theory, and challenges: interdisciplinary perspectives. *European Journal of Phychotraumatology*.
6. Van Breda, A. D. (2001). Resilience theory: A literature review. *South African Military Health Service*.
7. Varpio, L., Paradis, E., Uijdtehaage, S., & Young, M. (2020). The Distinctions Between Theory, Theoretical Framework, and Conceptual Framework. *Academic Medicine, 95*(7), 989-994.
8. Waver, O. (2000). The EU As A Security Actor. International Relations Theory and the Politics of European Integration. *Power, Security and Community*, 250.
9. Waver, O., Buzan, B., & De Wilde, J. (1998). *Security: A new framework for analysis.* Lynne Rienner Publishers.
10. Weldesellassie, K. I. (2011). IGAD As An International Organization, Its Institutional Development And Shortcomings. *Journal of African Law, 55*(1), 1-29.
11. Willett, J. L. (2015). Exploring the Intersection of Environmental Degradation and Poverty: Environmental Injustice in Nairobi, Kenya. *Social Work Education*, 558-572.
12. Yazdanpanah, D., Q, Y., & E, C. Z. (2020). Global Warming, Environmental Security And Its Geo-Economic Dimensions Case Study: Caspian Sea level Changes On The Balance Of Transit Channels. *Environmental Health Science and Engineering, 18*(2), 541-557.
13. Yu, Z. (2022). Analysis of the Effectiveness of International Law in Global Environmental Relations from the Perspective of International Institutional Theory. *Journal of Environmental and Public Health*.