



ASSESSMENT OF CLIMATE CHANGE ADAPTATION, UNCERTAINTIES AND HUMAN HEALTH IN THE LEZHA AREA

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ABSTRACT

The region is experiencing extreme weather events, shifts in rainfall intensity, and environmental degradation, which intensify existing challenges and complicate efforts to adapt to climate change. These changes already present significant threats to human health, particularly in vulnerable areas such as Lezha City, Albania. This study aims to explore the importance of adaptation strategies in the context of climate change in Lezha City. Data were collected through questionnaires, ensuring that stakeholders and field observations were used as the primary research tools. The selection of interviewees was designed to include diverse groups within the Lezha community. The results provide valuable insights for urban planners and climate communicators, particularly regarding resource allocation for climate adaptation and education. Participants highlighted several necessary measures to improve climate change adaptation in their area, including enhanced infrastructure to withstand extreme events, public education and awareness, improved financial resources and government support, as well as international cooperation and aid from global organizations. Adaptability is shaped not only by access to technology and learning capacity but also by ethical considerations regarding the treatment of vulnerable populations in decision-making processes. While most individuals believe authorities are making efforts to address the impacts of climate change, a significant number feel these efforts are insufficient.

Keywords: Climate change, vulnerability, adaptation, questionnaires, sustainable development.

1. INTRODUCTION

Climate change has emerged as one of the most pressing global challenges of the 21st century,

with profound implications for human health, ecosystems, and socio-economic systems (IPCC, 2021). Adaptation to climate change is crucial in addressing the adverse impacts and involves adjusting natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001). Adaptation measures encompass changes in practices, processes, or structures of systems to cope with projected or actual changes in climate (Watson et al., 1996). This concept is an integral part of the United Nations Framework Convention on Climate Change (UNFCCC), as outlined in Article 4.4, and spans multiple policy domains. The Intergovernmental Panel on Climate Change (IPCC) has indicated that global net human-caused emissions of CO₂ must decrease by 45% below 2010 levels by 2050 to limit global warming to 1.5°C above pre-industrial temperatures (IPCC, 2018). Recent climate observations from 11 meteorological stations in Albania indicate that the average annual temperature has risen by 2.8 degrees, and rainfall has decreased by 300 mm compared to the long-term average from 1961-1990. During the May-September period, only 18-20% of the annual rainfall occurs, adversely impacting water availability. In mountainous areas, snowfall depth varies from 60-120 cm, with peaks reaching 2-3 meters in regions such as Vermosh, Boga, Theth, Valbona, Curraj, and Lure (Lushaj & Kucaj, 2024).

Despite numerous efforts to mobilize public and policymaker support for climate change mitigation and adaptation, significant regulatory actions at the national and state levels remain limited (Lachapelle, 2017; Mukherjee, 2020). Despite these efforts, major national- and state-level GHG emissions regulations have yet to gain support and are seldom discussed during political campaigns and televised debates (Shanahan, 2017; Newman, 2017). Climate change impacts are already being observed, with communities across the United States experiencing hotter temperatures, increased flooding, and shifts in species distribution (Shahir, 2020). In Albania, regions such as Shkodra, Lezha, Lushnja, Fieri, and Vlora have already experienced negative effects on wheat, maize, and other crop yields due to climate change.

The Lezha region in northwestern Albania is particularly vulnerable to climate change due to its geographic and socio-economic characteristics (European Environment Agency, 2020). The development of effective adaptation strategies in Lezha is challenged by uncertainties in climate projections. While adaptation cannot entirely prevent economic and environmental losses, it can mitigate and delay them (Smit and Pilifosova, 2001). Effective adaptation in Lezha necessitates a comprehensive understanding of climate risks, uncertainties, and health impacts (WHO, 2018). However, adaptation depends not only on the capacity of systems to adapt but also on the willingness and intent to utilize that capacity effectively (Burton and Lim, 2001). In Albania, the majority of the population and economic activities are concentrated in urban areas, where interconnected climate impacts related to water, energy, transportation, land use, buildings, and insurance require coordinated adaptation efforts (Wilson, 2006). In the Kune-Vaini Lagoon near

Lezha, efforts are underway to scale up ecosystem-based adaptation to address more frequent and intense flooding, a serious climate change threat in Albania. Municipal administrations play a critical role in planning and enabling climate change adaptation in urban settings. The agriculture sector, vital for Albania's economic and environmental sustainability, can mitigate climate change by reducing extreme temperatures, curbing air pollution, and lowering atmospheric carbon dioxide levels (Kucaj et al., 2024).

Water resource management in Albania is facing significant challenges due to both supply and demand issues (Kucaj and Lushaj, 2024). Innovative methods, such as using biodegradable coir-logs to stabilize riverbanks and reduce erosion, have been implemented successfully in the Erzen River and should be expanded (Kucaj, 2022; Kucaj et al., 2023). The Regional Climate Change Adaptation Framework for the Mediterranean Marine and Coastal Areas aims to increase resilience by assisting policymakers and stakeholders in developing and implementing coherent adaptation policies. Soil pollution remains a critical issue, with high concentrations of pollutants posing risks to public health and agricultural productivity (Kucaj et al., 2023). Rainfall distribution trends indicate extremes, with occurrences fluctuating between extremely dry and wet conditions across different regions (Gjoni et al., 2024).

Rising temperatures, shifting precipitation patterns, and extreme weather events threaten Albania's environmental and socio-economic stability (UNDP, 2019; McMichael et al., 2006). Albania's climate is characterized by seasonal variations, with 70-80% of annual rainfall occurring between November and April, leading to frequent flooding and soil salination in coastal areas (Lushaj et al., 2024). Conversely, the dry period from May to September sees only 20-30% of annual rainfall, exacerbating water scarcity challenges for various economic sectors.

The challenges faced by Lezha in climate adaptation, including financial constraints, community engagement, and institutional barriers, were compared with findings from similar studies in Tirana, Vlora, and coastal cities in Greece and Italy. This comparison highlights whether Lezha's challenges are unique or part of broader regional patterns. While some adaptation barriers are shared across the Mediterranean, Lezha's vulnerability to extreme weather events and reliance on climate-sensitive economic sectors (e.g., agriculture and tourism) suggest some region-specific risks requiring targeted policy responses.

Addressing climate change adaptation in Lezha requires a multi-sectoral approach that engages stakeholders from public health, urban planning, environmental management, and local governance (Adger et al., 2005). Effective adaptation planning and implementation can help build resilience and reduce vulnerability to the changing climate in Albania.

2. MATERIALS AND METHODS

The first approach to addressing climate change is the prevention of dangerous interference with the climate system by stabilizing greenhouse gas concentrations in the atmosphere, commonly referred to as "mitigation." The second approach involves reducing vulnerability to climate change through the process of "adaptation." The relationships between these approaches are illustrated diagrammatically in Fig. 1. Both approaches require a thorough understanding of the science of impacts and their assessment.

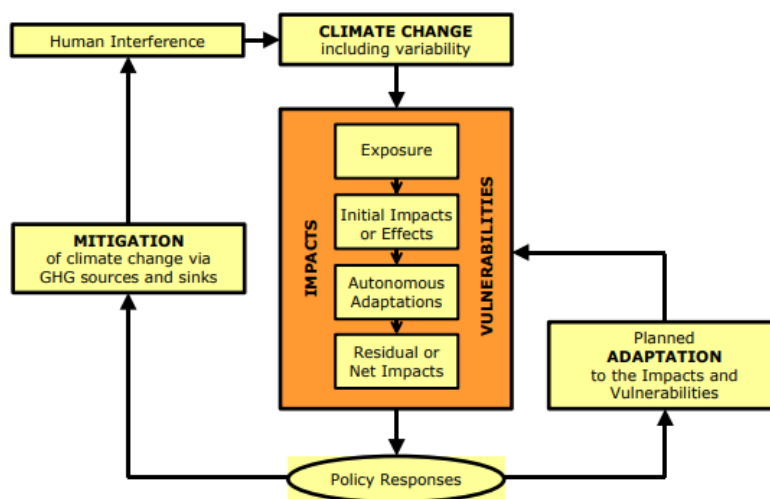


Figure 1: Mitigation and adaption responses to climate change (IPCC, 2001)

The emphasis on mitigation over adaptation can be attributed largely to the initial text of the UNFCCC and the negotiations leading up to the signing of the Kyoto Protocol in 1997.

Based on this context, the research study employed a survey to gather information and support theoretical discussions on the benefits of green infrastructure for community livelihoods. The questionnaire development process took over a month and involved engagement with residents and other stakeholders to refine the survey. A total of 120 surveys were conducted, representing a balanced sample of the urban and rural populations in Lezha city, (Fig. 2), to facilitate a comparative analysis of both contexts. The sample size may not be fully representative of all demographic groups in Lezha. Qualitative analysis relies on interpretation, which, despite reliability checks, may be influenced by researcher perspectives. The survey targeted professionals, experts, municipal employees, students, and other individuals with relevant insights into the topic, particularly about health adaptation and climate change.

The questionnaire included a range of questions, from general inquiries to more specialized topics tailored to the respondents' expertise. This study employed a mixed-methods approach, combining quantitative and qualitative data collection to assess climate change awareness and adaptation strategies in Lezha. The questionnaire included both closed-ended questions (e.g., multiple-choice, Likert scale) and open-ended questions to capture in-depth perspectives on climate adaptation challenges and strategies. Closed-ended survey responses were analyzed using descriptive and inferential statistical methods. Descriptive statistics, such as frequency distributions and mean comparisons, were used to summarize awareness levels and adaptation practices. Inferential analyses, including t-tests and chi-square tests, were conducted to identify significant differences among demographic groups. A multiple regression analysis was performed to assess the impact of socio-economic factors on climate adaptation awareness. The open-ended responses were analyzed using a thematic analysis approach to identify key themes and patterns related to climate adaptation. The following steps were taken to ensure a systematic analysis such as: Data Transcription and Cleaning, Coding and Categorization, Theme Development and Refinement, to enhance credibility, qualitative findings were cross-referenced with quantitative data (for validation and triangulation), NVivo software was used to manage and analyze the qualitative data efficiently.

This approach provided valuable insights into climate variability, the impacts of climate change on agriculture and natural resources, and the associated social implications.

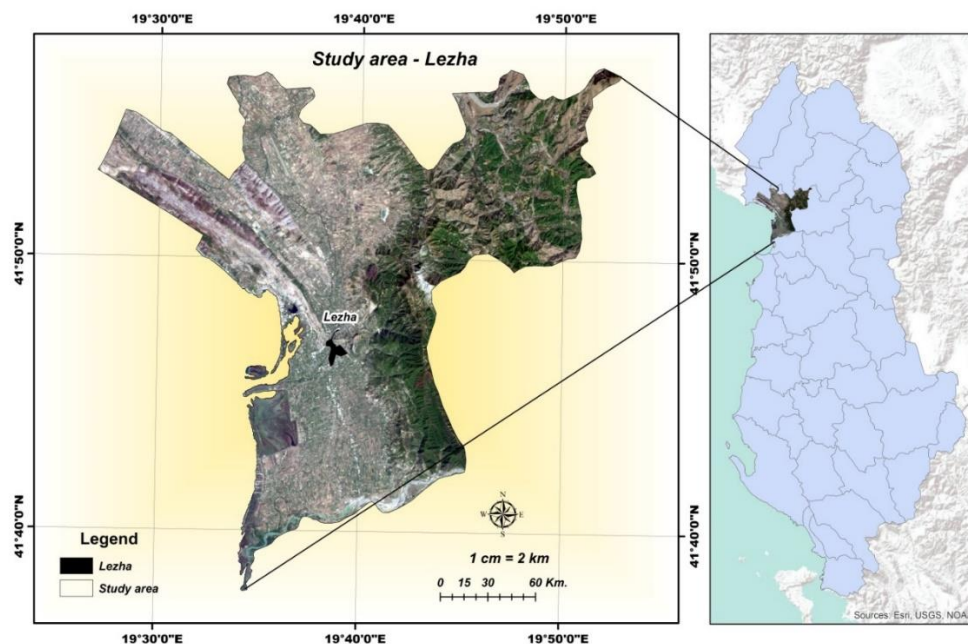


Figure 2: Map of the territory of Lezha District

3. RESULTS

Responses from individuals engaged in various planning efforts addressing climate adaptation and resilience in Lezha City. The questionnaire was divided into six sections focusing on Demographic information, Awareness and perception of climate change, Climate change adaptation strategies, Uncertainties and challenges, Human health and climate change, and prospects. Participants were voluntary and anonymous, adhering to ethical research principles. **Data Collection Methods** were based on one-on-one interviews to gain detailed insights into local climate impacts. Participants described climate-related challenges in their communities and adaptation measures implemented. These interviews also served as a form of qualitative validation of general information through climate change's impact in Lezha City. In each interview, individuals were asked to describe climate-related impacts or challenges being realized in their local communities and any adaptation measures used in their local zone.

The 35-54 age group makes up the majority of respondents (51 %). This age group can often be affected by the impacts of climate change for a longer period and may be more aware of the long-term impacts on their livelihood health and activity. The 18-34 age group represents the younger generation (30.8%), who may have more interest in innovative solutions, while the elderly over 55 (18.2 %) may feel more health impacts due to biological vulnerability (Fig. 3). The number of female respondents (45%) constitutes slightly more than half of the respondents, while males (39 %) and those who did not prefer to answer (16 %) constitute the rest (Fig. 4). This distribution indicates a good gender balance but also suggests the need for a deeper understanding of the role of gender in the perception of and adaptation to climate change.

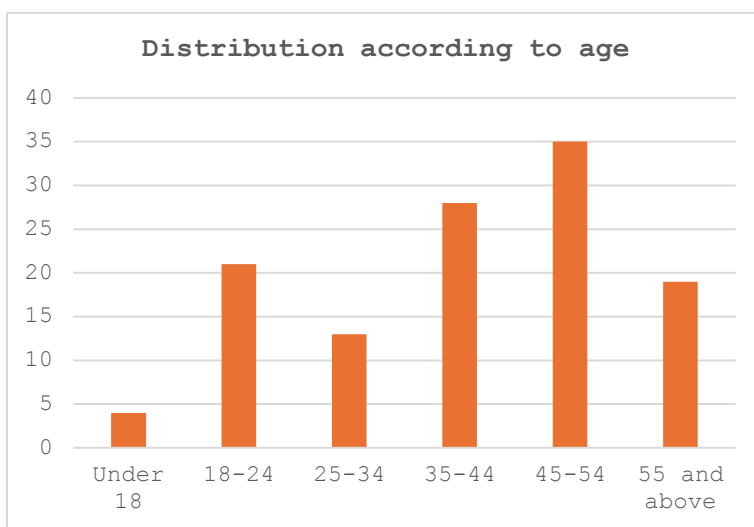


Figure 3: Distribution of respondents by age

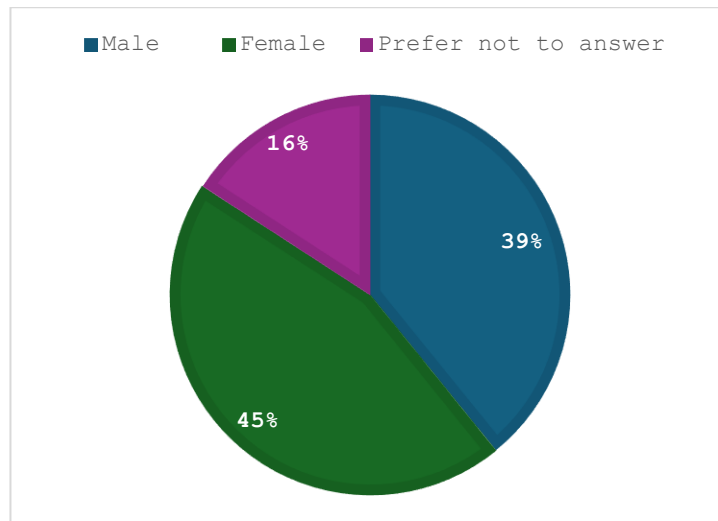


Figure 4: Percentage of respondents by gender

The majority of respondents are employees (45 %) and students (23 %), indicating a strong bias towards educated groups engaged in administrative and scientific matters. Farmers (18 %) and urban workers (14 %) are less represented, but these are groups that are directly affected by climate change (Fig. 5). The majority of respondents (77 people) live in urban areas, while the remainder (43 people) live in rural areas. This split suggests a greater focus on urban impacts, such as extreme heat and pollution, while rural areas feel more agricultural insecurity and changes in natural resources (Fig. 6).

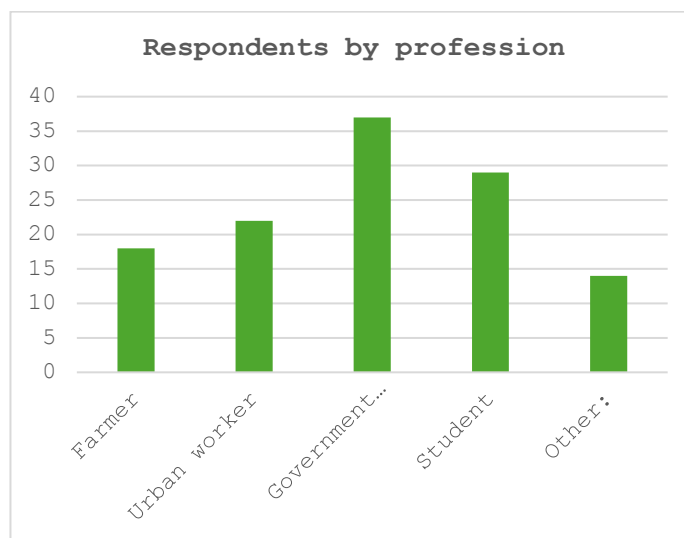


Figure 5: Number of respondents by profession

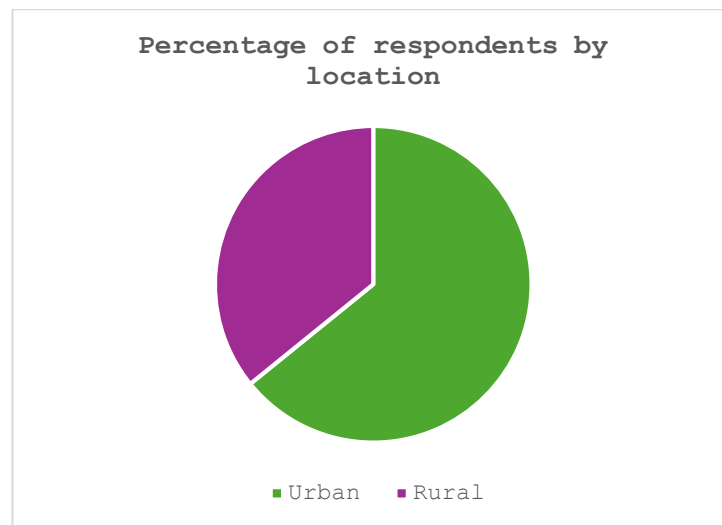


Figure 6: Respondents by location

A small group (20 %) responded as very aware and knowledgeable about climate change, perhaps due to education, personal experience, or exposure to public information. Somewhat aware represents the majority of respondents and indicates moderate awareness (43.3 %), which may include basic knowledge or only some visible aspects of the problem. A large proportion of respondents have little information (36.7 %), which may be a result of a lack of information sources or lack of access to sustainable climate education. Not at all aware (0 people): Indicates that all respondents have at least minimal awareness of climate change (Fig. 7). The most widespread phenomenon reported, indicating the impact of intense rainfall and water management problems on local communities, is flooding (31.6 %). Stronger storms or winds (26.6 %) reflect the increase in climate extremes in the study area. Rising temperatures (19.1 %) are among the first impacts felt by many people. Drought or water shortages (5.8 %) and changes in agricultural seasons (5 %) are less widespread phenomena but can be critical for rural communities and agriculture. A significant number (11.7 %) have observed changes in the surrounding nature, including the extinction of species or changes in vegetation and animals (Fig. 8).

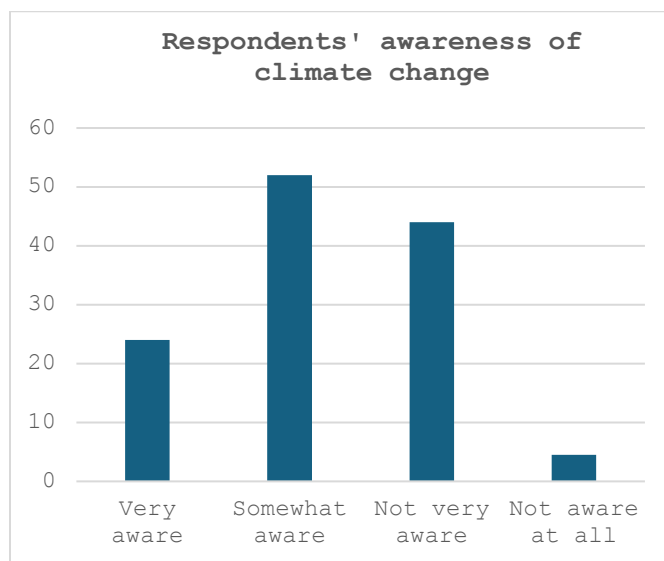


Figure 7: Respondents' awareness of climate change

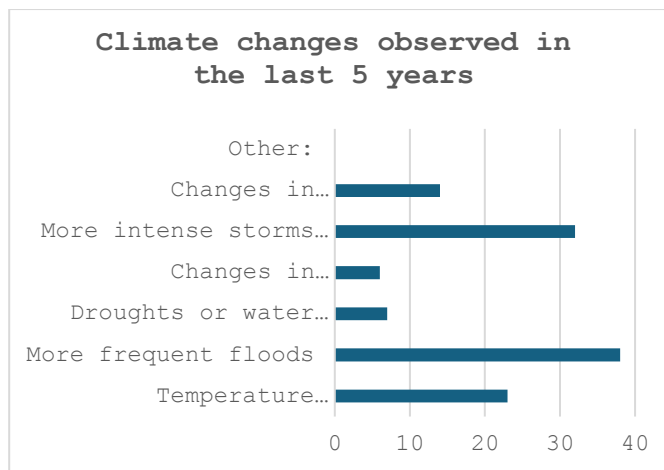


Figure 8: Climate changes observed the last 5 years

A group of (18%) feel strongly about the concrete impacts of climate change, which may be the result of personal experience or advanced knowledge. The majority feel impacts (69 %), but not with a high level of confidence. This result may suggest a lack of complete information or uncertainty about the direct connection of these phenomena to climate change. A small group is undecided about the impacts (10 %), perhaps due to a lack of direct experience or information. A minimal number of individuals (3 %) do not feels significant impacts (Fig. 9).

About the question, if their community has taken any steps to adapt to climate change, the

responses were: - Yes (28.3 %): A relatively small proportion of respondents have taken concrete steps to adapt to climate change. This indicates a low level of action relative to the level of awareness. - no (12.2 %): This group has not taken any adaptation measures, perhaps due to a lack of resources or knowledge. - not sure (59.1 %): Most respondents have no information on the measures taken, suggesting a lack of communication or involvement in local plans. A group of respondents (28.3 %) have taken concrete steps, suggesting limited efforts to adapt. This may be related to awareness and available resources. A group (12.5 %) has not taken any action, highlighting a lack of education, resources, or community involvement. The majority of respondents (59.1 %) are not informed about local efforts, indicating a gap in communication or transparency in climate strategies.

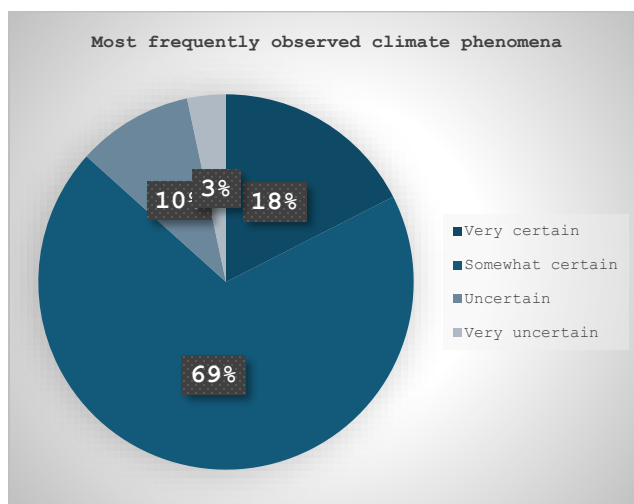


Figure 9: Most frequently observed climate phenomena

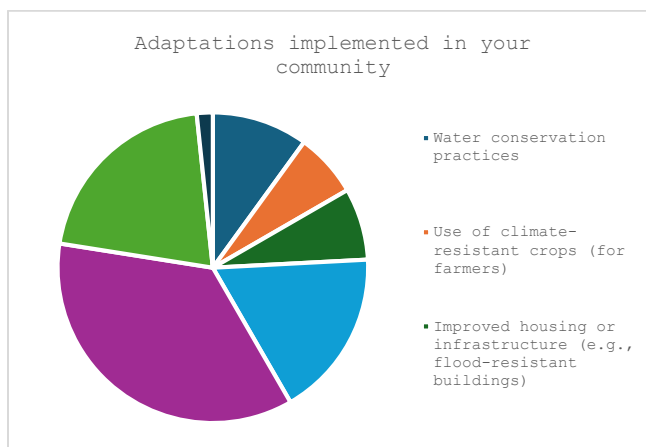


Figure 10: Adaptations implemented in your community

The most common response measure (35.8) is afforestation programs, which suggest a focus on improving biodiversity and reducing temperatures. Green spaces and reflective surfaces for temperature mitigation are important but limited measures for dense urban areas (20.8 %). Preparedness plans (17.5 %) indicate a moderate level of preparedness for emergencies but are not sufficiently distributed. Low involvement suggests a lack of resources or attention to drought-affected areas on water conservation practices (10 %). The low involvement of farmers in these measures indicates the need for more support and education on climate-resilient crops (6.7 %). Resilient housing: Limited measures to improve infrastructure, perhaps due to lack of funds (7.5 %). Other (1.6 %), are specific but rare measures (Fig. 10).

The responses if they believe that current climate change adaptation strategies in their area are sufficient, were:

- Yes (37.5 %): Some feel that current measures are sufficient, perhaps due to visible improvements in infrastructure or environmental practices.
- No (17.5 %): This indicates a negative perception of current strategies and suggests the need for further improvements.
- Not sure (45 %): Most respondents are undecided, indicating a lack of transparency or involvement in strategic plans.

A significant portion (37.5 %) think that the strategies are sufficient, but this may be related to a lack of knowledge about better alternatives. A group of (17.5 %) suggests that there are obvious shortcomings in the strategy and implementation, which may be due to insufficient funds or poor coordination. A group of (45 %) represents the majority, indicating that there is a lack of clarity and communication on the current strategies that can be implemented.

A group of (15 %) indicates that there is a lack of reliability in weather forecasts, which makes long-term preparation and planning difficult. The impacts of this factor are unavoidable for sectors such as agriculture, energy, and transport. The lack of information on how to prepare (31.6 %), is a factor that directly affects the ability of individuals and organizations to take appropriate measures to address the impacts of climate change. The lack of information can create a gap in the implementation of adaptation strategies. Insufficient government or local support (30 %) is assessed as another important factor at the level of governments and local authorities, which can have a key role in providing support for adaptation to climate impacts, including financing, information and legal guidance. The lack of financial resources for the implementation of adaptation strategies (17.5 %) appears as a critical problem, as many adaptation strategies require significant financial investments that are not always available. Financial resources are a major obstacle to the implementation of sustainable measures. Unclear policies or contradictory

regulations (5.8 %) are perceived by residents as confusing and hindering for organizations and individuals seeking to develop and implement climate change adaptation strategies (Fig. 11).

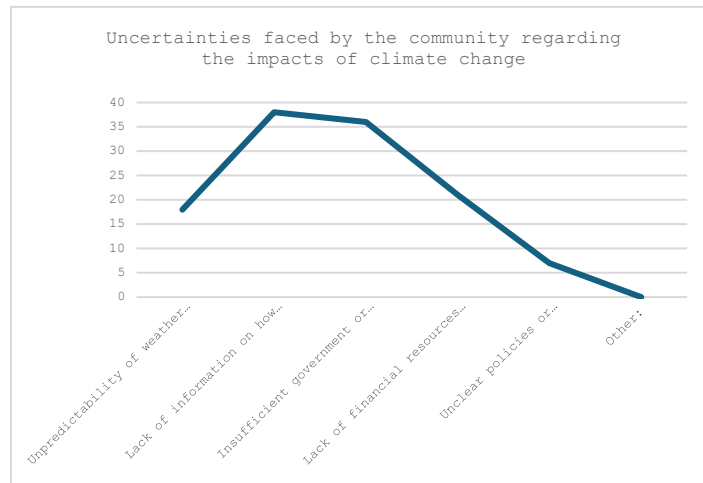


Figure 11: Uncertainties faced by the community regarding the impacts of climate change

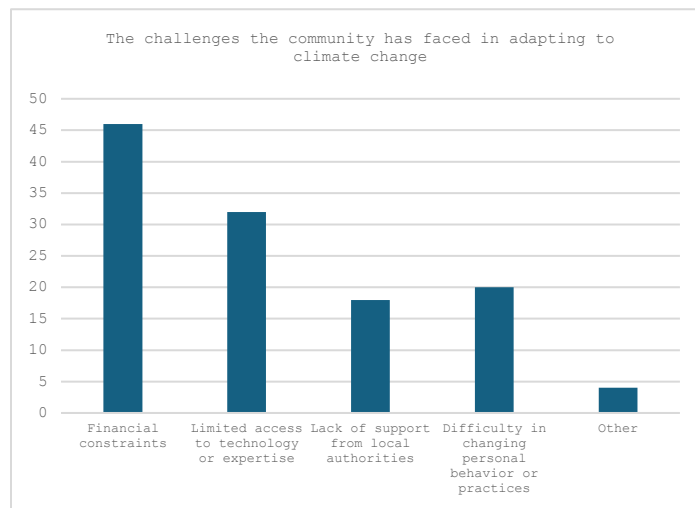


Figure 12: The challenges the community has faced in adapting to climate change

Financial constraints (38.4 %) are identified as the most frequently mentioned factor and indicate that financial resources are a major barrier to implementing adaptation measures. Without adequate financial support, individuals and organizations have difficulty in developing and implementing adaptation strategies. Limited access to technology or expertise (26.7 %) indicates that although technologies and expertise are important for adaptation, they are often not available or accessible to individuals and organizations. This challenge is linked to the need to develop infrastructure and

train the necessary personnel. Respondents to the questionnaire (15 %) mentioned that without strong support from local authorities, many strategies may fail.

Local authorities can provide resources and support at the practical level, such as providing funding and legal guidance.

The indicator of changing personal behavior or practices (16.6 %) is related to resistance to change and the difficulties that occur when individuals and communities try to adapt to new ways of living and working. This may include psychological and cultural aspects that make this process slower. A few participants mentioned other challenges (3.4 %), which may be of a more specific nature to their context (Fig. 12).

About the question if they have noticed any health impacts related to climate change in their area? Response and analysis were:

- Respiratory issues (e.g., asthma, allergies) (25.8 %) – Climate change has worsened respiratory problems, such as asthma and allergies, due to increased air pollution and changes in pollen cycles.
- Heat-related illnesses (e.g., heatstroke, dehydration) (40.8%) – Many participants have noticed an increase in heat-related illnesses, such as heatstroke and dehydration, due to more frequent and severe heat waves.
- Vector-borne diseases (e.g., malaria, etc.) (2.5 %) – Participants have reported fewer cases of vector-borne diseases, such as malaria, although this may depend on the geographic and climatic characteristics of the area.
- Mental health impacts (e.g. stress, anxiety due to climate events) (19.1 %) – Many individuals have experienced impacts on their mental health due to concerns about the consequences of climate change, including anxiety and stress that extreme weather events may cause.
- Food- or water-borne illnesses (11.6 %) – Illnesses related to water and food contamination have also been reported as a consequence of climate change, due to rising temperatures and risks of contamination of water sources and food products.
- Other (0) – No other specific health impacts were reported.

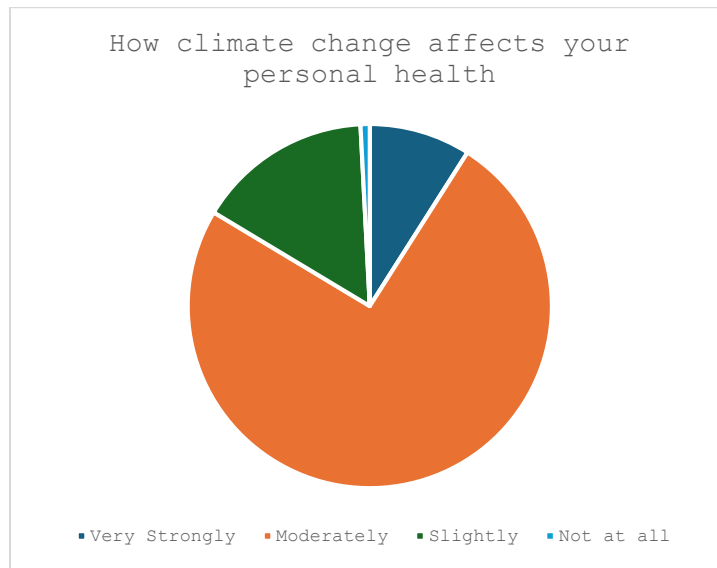


Figure 13: How climate change affects health

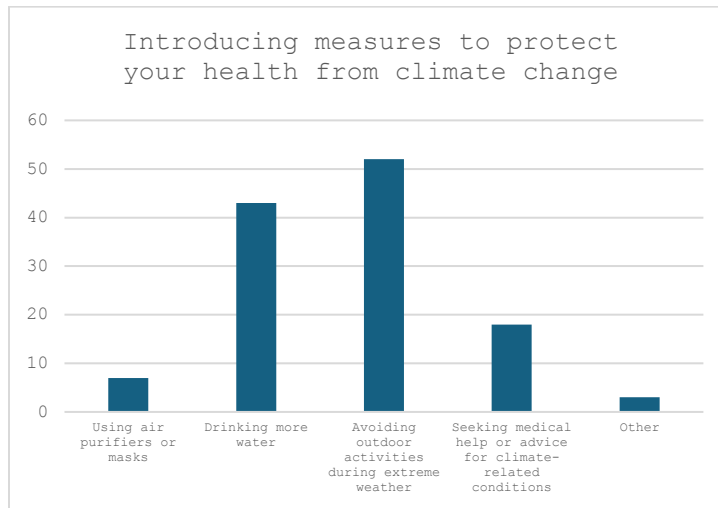


Figure 14: Measures to protect health from climate change

The strong impact is mainly associated with individuals (9.2 %) experiencing direct effects of climate change, such as those related to respiratory diseases or health problems from extreme temperatures. The majority of participants (75.8 %) perceive the impact as moderate, suggesting that, for many individuals, climate change affects their health indirectly, through worsening existing conditions or pollution-related concerns. A few individuals (15.8 %) do not perceive the impact as significant, perhaps due to more favorable climate conditions in their area or due to limited experiences with extreme weather events. One individual (0.8 %) reported not feeling any

direct impact from climate change, which may be an outlier (Fig. 13). Participants who use air purifiers or masks (5.8 %) are aware of air pollution and the harm that can be caused by exposure to polluted air, especially during periods of extreme heat. Participants (35.8 %) have increased their water intake to prevent dehydration during heat waves, which is a common measure to protect their health. Most participants (43 %) avoid outdoor activities during extreme weather conditions, such as hot days or storms, to reduce the risk of heat-related illnesses and weather-related injuries. Some individuals (15 %) seek medical advice to treat climate-related illnesses, such as asthma and allergies. Other measures taken by individuals (2.5 %) are more personalized in nature and may include other health-preserving practices (Fig. 14).

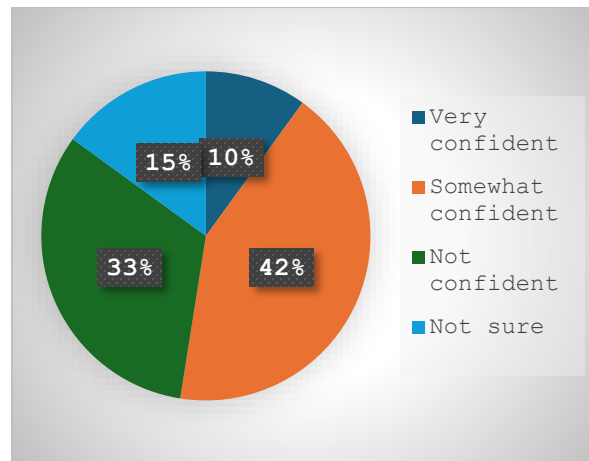


Figure 15: Security that the community presents to adapt to climate change

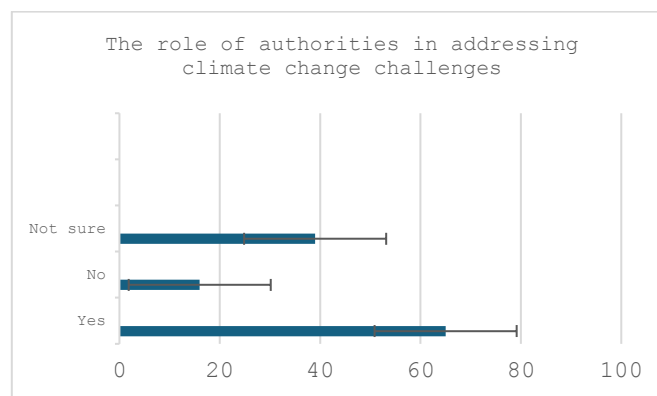


Figure 16: The role of authorities in addressing climate change challenges

This question asks about individuals' confidence in their community's ability to adapt to the impacts of climate change over a long-term period of 10 years. The results show a range of

confidence, with most individuals being “somewhat confident” and a significant number being unsure (Fig. 15). Figure 16, addresses participants’ assessment of the efforts of local authorities and the government in addressing the impacts of climate change. Most individuals believe that the authorities are making efforts, but there are also a significant number who see this as insufficient.

The suggestion for the community on how to improve climate change awareness and education in Lezha, especially given the moderate to low awareness of adaptation strategies among residents is important to: Develop Community Workshops and Seminars to educate residents about climate change impacts and adaptation strategies, promote Ecosystem-based Adaptation (EbA), these strategies can enhance the resilience of local ecosystems and communities Engage Local Environmental Organizations, which focuses on raising public awareness about climate change through various projects and media engagements, etc.

4. CONCLUSION

This study underscores a moderate level of climate change awareness in the Lezha area, along with ongoing adaptation efforts. However, significant challenges persist, particularly in terms of financial resources, community engagement, and health-related impacts. Addressing these challenges requires greater collaboration and strategic improvements to enhance resilience effectively. The research aimed to evaluate the current climate change adaptation efforts in Lezha, identify key uncertainties hindering effective planning and assess the implications for human health. The findings provide valuable insights for policymakers and stakeholders, enabling them to navigate the challenges posed by climate change and work towards a sustainable and healthy future for the region. This study presents a clear understanding of climate adaptation, including different types of adaptation strategies and the concept of adaptive capacity. Timely deployment of adaptation measures can significantly reduce climate change damages, especially in vulnerable regions. Encourage Nature-Based Solutions and Sustainable Land Use. Promote reforestation, wetland conservation, and coastal ecosystem restoration to enhance natural climate resilience. Despite centuries of adaptation to climate variability, the increasing frequency and magnitude of climate-related extreme events continue to pose significant challenges. Communities and sectors generally demonstrate a reasonable ability to adapt to gradual changes in average climatic conditions. Establish dedicated funding mechanisms to support climate adaptation projects, particularly for vulnerable communities. Leverage public-private partnerships to finance infrastructure improvements and nature-based solutions. Provide subsidies and incentives for businesses and households adopting sustainable practices. However, they remain more vulnerable to extreme events, which require targeted adaptation strategies. Effective adaptation efforts should focus on addressing changes in extreme weather patterns, as they are intrinsic to the broader climate change phenomenon. Importantly, adaptation initiatives to current climate-related risks

such as droughts, storms, and floods align with measures needed for future climate conditions. Integrate climate change and adaptation strategies into school curricula and community training programs. Launch targeted awareness campaigns using local media, social platforms, and community engagement activities to encourage behavioral change. Successful adaptation strategies are those integrated with existing policies and programs addressing broader socio-economic stresses. In conclusion, while this study highlights several advantages, including increased awareness and identification of adaptation needs, it also acknowledges limitations such as financial constraints and socio-political challenges.

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