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Adapting to Climate Change: Heat Risks and Coping Strategies for Agricultural Workers in Guatemala

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ABSTRACT

Climate change is an increasingly urgent global issue that continues to escalate, with rising temperatures and unpredictable weather patterns impacting regions around the world. These changes have altered ecosystems, disrupted communities, and intensified natural disasters such as floods, droughts, and wildfires. Though climate change affects everyone, vulnerable communities, particularly those in low-income and rural areas, are impacted disproportionately. These populations not only experience some of the most severe consequences but often lack the attention, resources, and infrastructure needed to adapt and mitigate these challenges effectively. In Guatemala, agriculture plays a crucial role in the livelihoods of many families. However, the effects of extreme heat and unpredictable weather patterns put intense pressure on these workers. These changes threaten not only food security but also the health and well-being of those who rely on agriculture for their income. This study examines the heat-related challenges agricultural workers face in rural Guatemala, focusing on how rising temperatures impact their health and livelihood. Additionally, it aims to gather personal viewpoints on potential measures that could be implemented to better protect workers from these risks. Through a survey that collects demographic details, experiences with heat exposure, existing medical conditions, and coping mechanisms, this research seeks to better understand the personal viewpoints on the risks posed by climate change.

Introduction

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In Guatemala, agriculture plays a crucial role in the livelihoods of many families. However, the effects of extreme heat and unpredictable weather patterns put intense pressure on these workers. These changes threaten not only food security but also the health and well-being of those who rely on agriculture for their income.

This study examines the heat-related challenges agricultural workers face in rural Guatemala, focusing on how rising temperatures impact their health and livelihood. Additionally, it aims to gather personal viewpoints on potential measures that could be implemented to better protect workers from these risks. Through a survey that collects demographic details, experiences with heat exposure, existing medical conditions, and coping mechanisms, this research seeks to better understand the personal viewpoints on the risks posed by climate change.

Background

Temperatures around the globe are rising at an alarming rate and causing significant environmental and economic challenges worldwide. Recent data has indicated that the ten warmest years ever recorded occurred in the past decade, with temperatures rising around 1℃ above pre-industrial levels (Lindsey, 2024). Despite the small size of the temperature increase, raising the average surface temperature of Earth requires an enormous amount of accumulated energy. Warming has led to more frequent extreme weather events, rising sea levels, and disruptions to agriculture, which threaten global economic stability. However, there remains a significant financial adaptation gap, referring to the disparity between the funds required to effectively adapt to the impacts of climate change and the current financial efforts. According to the United Nations, "the gap between the funds needed for adaptation and the funds available to developing countries is set to reach up to $359 billion a year by 2030" (United Nations, 2024). As the climate crisis accelerates, bridging this financial adaptation gap is crucial to safeguarding vulnerable populations and ensuring a sustainable future.

Rising global temperatures cause environmental and economic damage and pose serious health risks. As extreme heat events become more frequent, they can lead to heat exhaustion, heatstroke, and dehydration and exacerbate preexisting conditions. Recent data has revealed that heat-related mortality for people over the age of 65 has increased by approximately 85% between 2000 and 2021 (World Health Organization, 2024). Factors that increase vulnerability to heat include age, health status, economic standing, and occupation, such as agriculture. Heatwaves also exacerbate the income gap between men and women, particularly in rural areas where labor-intensive industries like agriculture are heavily impacted. Compared to male-headed households, female-headed households, on average, lose "8 percent more of their income due to heat stress and 3 percent more due to floods" (Food and Agricultural Organization of the United Nations, 2024). As heat waves intensify, data and disparities highlight the urgent need for targeted interventions to better support vulnerable populations, particularly women and the elderly, in adapting to the growing health risks posed by climate change.

Low-income and underprivileged communities are among the hardest hit by the impacts of climate change due to a combination of financial constraints, lack of government support, and limited resources. Climate change has disrupted rainfall patterns and growing seasons, resulting in crop failures and the death of livestock. However, unlike wealthier countries, farmers in low-income areas lack access to insurance or disaster recovery support, leaving them vulnerable to the devastating effects of extreme weather (Mishra, 2023). Additionally, in underprivileged communities, individuals often lack the means to adapt to extreme weather events or invest in protective measures. This issue is intensified by the inability of governments in these regions to provide adequate support for climate adaptation due to budget limitations and competing priorities. This creates a significant policy gap where members of these communities cannot rely on state assistance for protection and are left to make individual changes to their lifestyles. These alterations can include changing farming practices or seeking alternative water sources. However, without broader systemic support and investment, these self-made adaptations are often insufficient and unsustainable, leaving these vulnerable populations at continued risk.

Research Questions

This research aims to explore how agricultural workers in rural Guatemala are individually adapting to heat-related challenges posed by rising global temperatures, with a focus on both their health and livelihood. The study seeks to understand how these individuals are coping with the increasing heat and how they perceive the risks associated with climate change in their daily lives. By gathering personal viewpoints through surveys, the research will provide valuable insights into the lived experiences of these workers. Understanding these perspectives will be significant in informing policies and support mechanisms, both locally and globally, to address the impacts of heat on agricultural workers and

their communities. Ultimately, this research will contribute to the broader conversation on climate adaptation, particularly in regions where people are most at risk and least equipped to deal with its effects.

Research Methods

This research was an extension of ongoing work conducted as part of a medical team that travels to rural and remote areas of Guatemala each year to provide free healthcare. The team consisted of doctors, medical students, and specialists offering a range of services, including general medicine, pediatrics, dentistry, and physical therapy. The primary mission of these trips was to offer essential medical services to communities with limited access to healthcare. Stations were set up in various locations each day, and patients were seen for several hours. Due to the nature of the medical camps, where women and children were more likely to be present, the participant pool of the surveys was skewed toward these groups. As crowds of patients accumulated and waited for care, the research surveys were distributed to collect data.

These surveys were initially developed in English and then translated into Spanish to ensure clarity and accessibility for participants. Those who were willing to participate were instructed on how to complete the survey. However, some participants were unable to complete them on their own due to literacy barriers. In these cases, translators were present to help facilitate the process and ensure accurate responses. Once completed, the survey papers were collected, and the data was input into a spreadsheet for further analysis. The spreadsheet was then used to organize and analyze the data, identifying key trends and insights related to the heat-related challenges and coping strategies of individual agricultural workers. This method allowed for a comprehensive understanding of survey participants' experiences and perspectives on the impacts of rising temperatures on their health and livelihoods.

Data

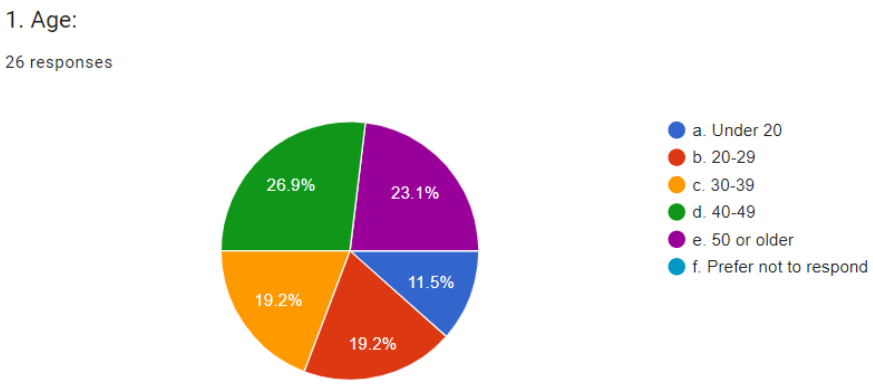

Figure 1. Age Distribution of Survey Participants

The wide age range represented in the survey provides a comprehensive perspective on heat-related challenges faced by agricultural workers, revealing commonalities in responses across all demographics. According to the data, 11.5% of survey respondents were under 20, representing a smaller portion of the workforce, which may indicate fewer young people entering agriculture. The largest group of participants was between the ages of 40–49 years, comprising 26.9% of the total survey group. This group indicates that a significant portion of the agricultural workforce is approaching mid-life. The responses across all age groups shared many similarities, suggesting that heat exposure affects workers uniformly.

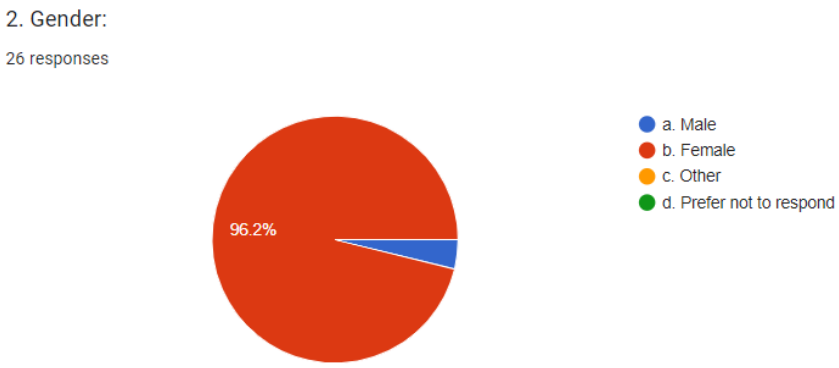

Figure 2. Gender Breakdown of Survey Participants

The survey results revealed that 96.2% of participants were women, a distribution primarily influenced by the context in which the surveys were conducted. Specifically, the surveys were distributed at a medical camp frequented by mothers bringing their children for care. This reflects current gender roles in Guatemala, where men are less likely to seek medical attention. Although this overwhelming disparity may limit the generalizability of the findings, it offers a valuable opportunity to gain insight into the coping mechanisms of women in agriculture, facilitating a more gender-focused analysis.

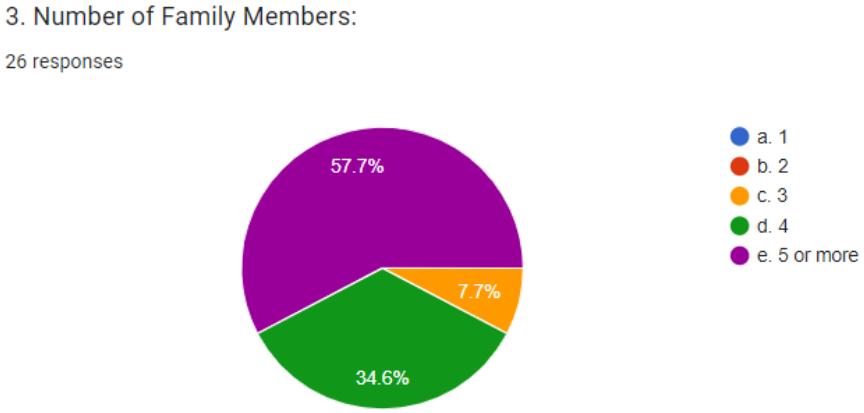

Figure 3. Family Size of Survey Participants

The analysis revealed that a significant portion of participants, 57.7%, reported having five or more family members, while 34.6% indicated having four members, and only 7.7% had three. This demographic data is critical in understanding the economic and social dynamics of these participants within their agricultural households. For larger families, meeting daily needs requires more agricultural labor due to economic and resource demands. Reliance on agricultural labor increases exposure to heat stress, as family members work longer hours in challenging conditions.

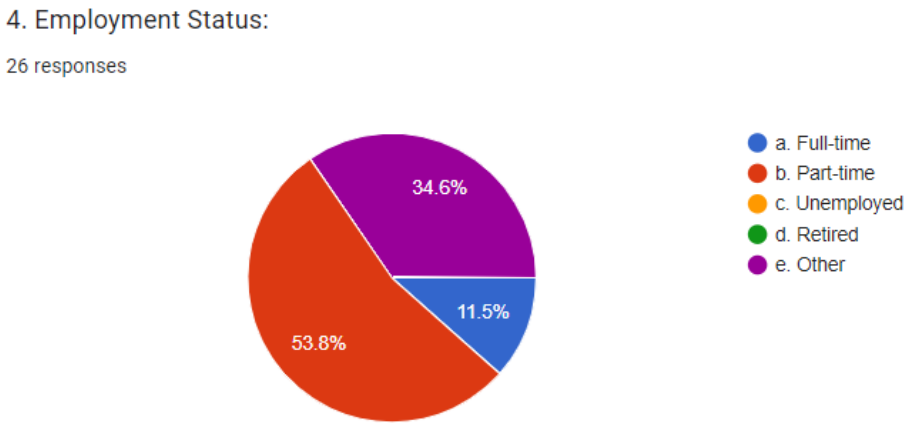

Figure 4. Distribution of Employment Status Among Respondents

The predominance of part-time work, with 53.8% part of this employment group, suggests a potential struggle to secure stable, full-time employment, which can influence financial security and access to resources. The next largest group, 34.6%, reported they were in "other" employment categories, which could refer to varied work arrangements or informal labor practices, further complicating their economic conditions. Analyzing these work patterns provides deeper insight into the current situation of these agricultural workers.

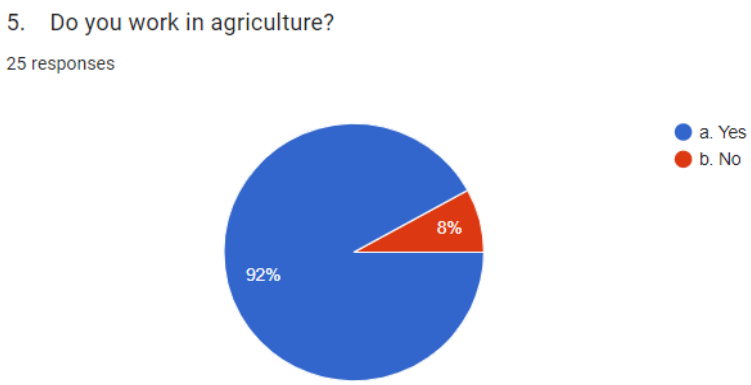

Figure 5. Participation in Agricultural Work

This data reveals that 92% of participants work in agriculture, indicating that this type of employment is exceedingly common in Guatemala. The reliance on agriculture as a primary livelihood highlights the importance of this sector to many families. It also signifies that a large portion of the population is exposed to heat stress, underscoring the urgency of addressing heat-related challenges in this area.

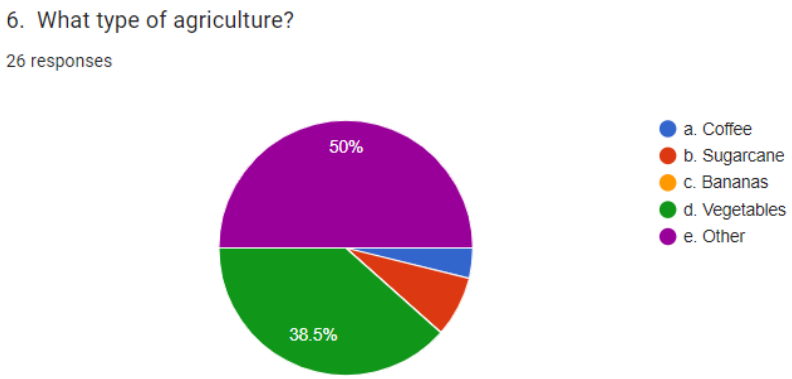

Figure 6. Breakdown of Agricultural Sectors

As noted in the data, there was a diverse landscape of agricultural practices among participants. However, 50% categorized their work as "other," possibly indicating a variety of agricultural activities that may not fit into standard categories. Overall, this diversity is important to consider when analyzing heat exposure and coping strategies, as different crops may entail varying levels of labor intensity.

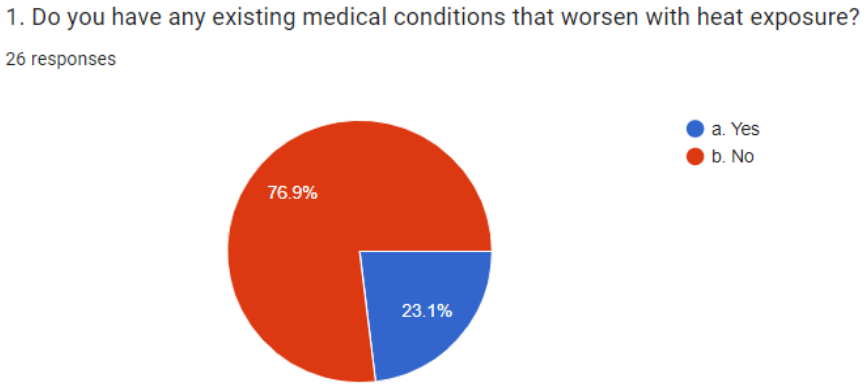

Figure 7. Existing Heat Related Medical Conditions

Survey results revealed that 23.1% of participants noted having existing medical conditions that worsen with heat exposure, highlighting a potential vulnerability among agricultural workers. However, the majority of respondents, 76.9%, do not report such conditions, which could suggest a lack of awareness about the impacts of heat on health. This lack of knowledge could be due to limited access to medical care, making it difficult for individuals to receive proper diagnoses or health education. This pattern is seen throughout this survey.

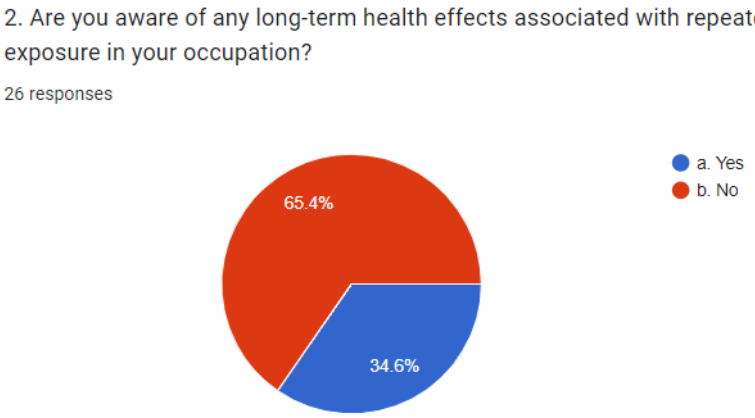

Figure 8. Awareness of Long-Term Health Effects of Heat Exposure

Similar to the previous data, the majority of respondents, 65.4%, reported that they were not aware of any long-term health effects due to heat exposure, displaying a significant lack of awareness and a crucial gap in knowledge. This gap may be exacerbated by limited access to health education and resources, particularly in rural agricultural communities.

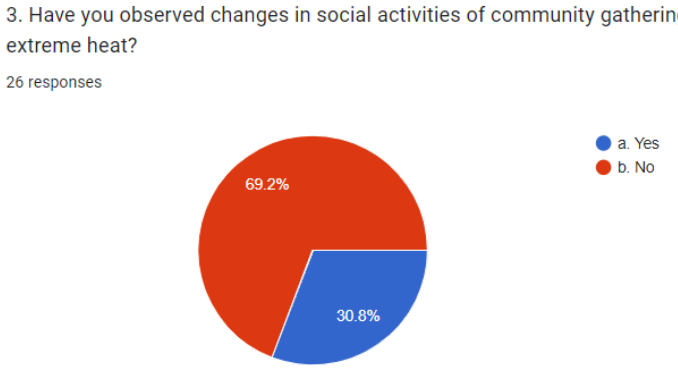

Figure 9. Observation of Changes in Social Activity

With 69.2% of respondents not observing changes in social activities, it appears that many community members continue to engage in social activities despite the challenges posed by heat. However, 30.8% of respondents observed changes in social activities, which is a cause for concern since changes in social gatherings can reflect the community's adaptive response to a changing climate.

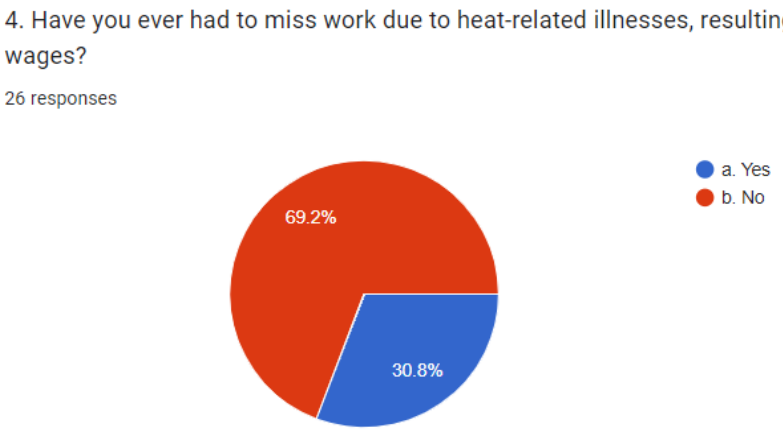

Figure 10. Work Absences Due to Heat-Related Illness

As expected, the majority, 69.2%, have not missed work due to heat-related illnesses, showing both the resilience of agricultural workers as well as their inability to miss work due to economic concerns. Missing work not only affects individual income but can also strain household finances, particularly for large families.

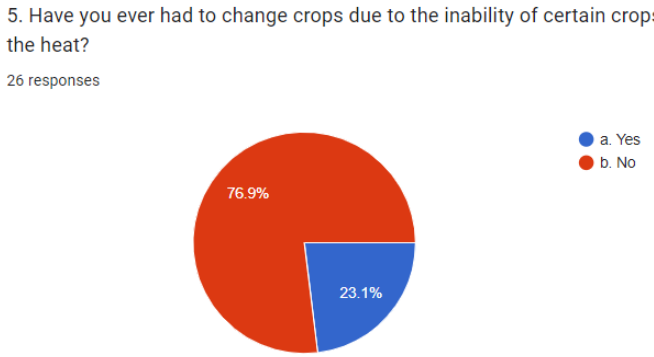

Figure 11. Changes in Crop Selection Due to Heat

Most participants, 76.9%, responded that they had never had to change crops due to the inability of certain crops to survive in the heat. These statistics are understandable as agricultural workers in Guatemala are most likely already aware of which crops are unable to survive in their heat.

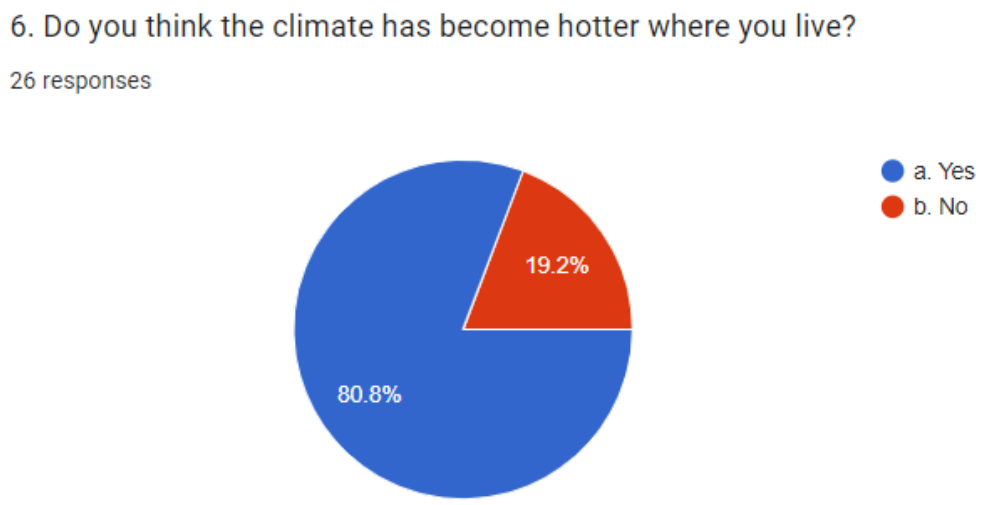

Figure 12. Perception of Increasing Local Temperatures

Despite many of the previous responses expressing that there was a lack of effects due to heat, an overwhelming majority of 80.8% of respondents still recognize that the climate has become hotter where they live. This is crucial to consider as it shows that inhabitants recognize the change in heat. As temperatures rise, heat exposure and its risks will only worsen, underscoring the need for targeted interventions sooner rather than later.

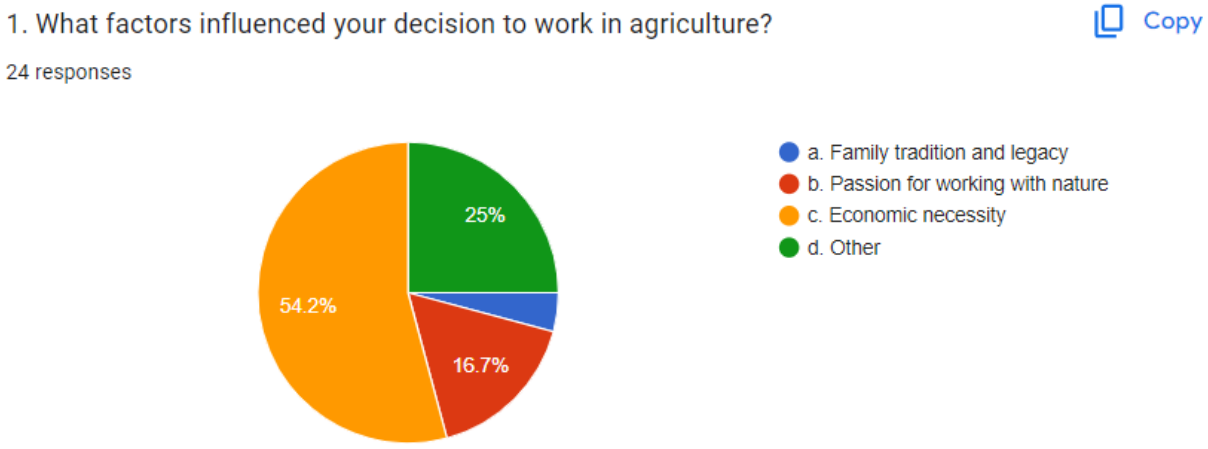

Figure 13. Influencing Factors in Choosing Agriculture as a Career

A majority of respondents, 54.2%, indicated that economic necessity is the primary factor. This suggests that agriculture is often seen as the only viable livelihood option in rural communities, where alternative employment opportunities may be limited. Ultimately, the responses highlight the strong economic motivations behind choosing agriculture as a profession.

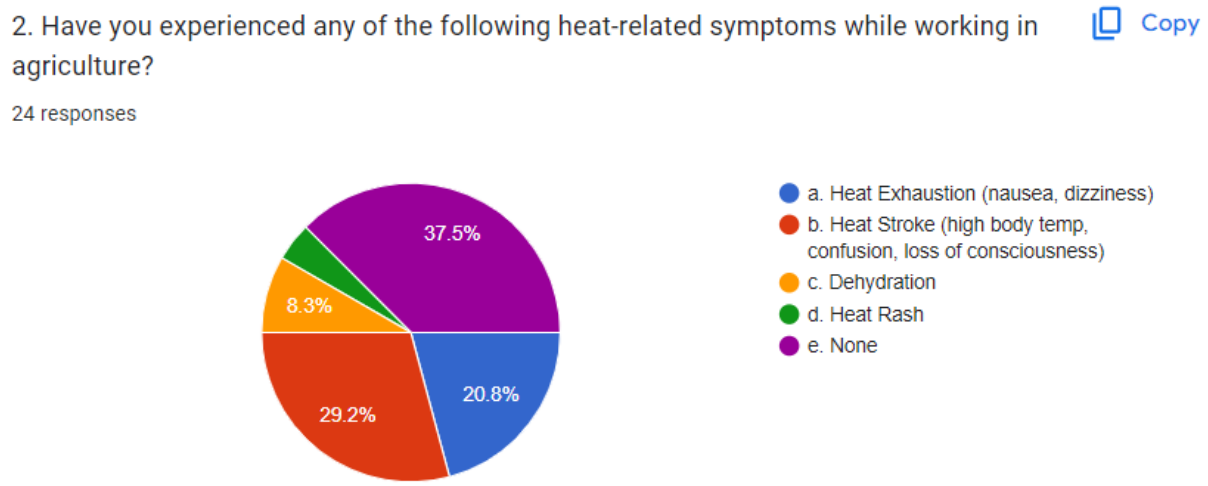

Figure 14. Heat-Related Symptoms Experienced While Farming

The responses to this question reveal a concerning prevalence of serious heat-related health issues. A notable 37.5% of respondents reported experiencing "none" of the symptoms, which could suggest some workers may not recognize the signs of heat stress or may not attribute their discomfort to heat-related causes. However, the rest reporting experiences of heat exhaustion, including nausea and dizziness, as well as heat stroke symptoms, such as high body temperature, confusion, and loss of consciousness, suggest that a significant portion of workers is at risk.

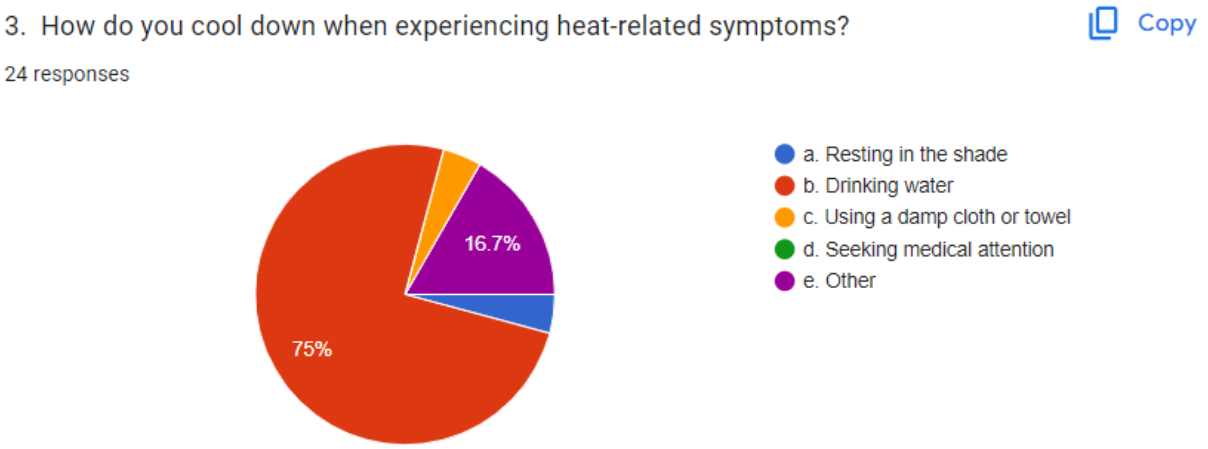

Figure 15. Utilized Methods for Adapting to Heat

The vast majority of workers, 75%, rely on drinking water when experiencing heat-related symptoms, which reflects a common approach to rehydration and managing mild heat stress. The very low percentages of workers who rest in the shade or use damp cloths or towels suggest that more effective or structured cooling strategies are underutilized, possibly due to limited awareness. Notably, the 0% seeking medical attention highlights a concerning gap in access to professional care, suggesting that workers may not recognize the severity of heat-related symptoms or may lack access to healthcare, which will lead to untreated or worsening heat stress.

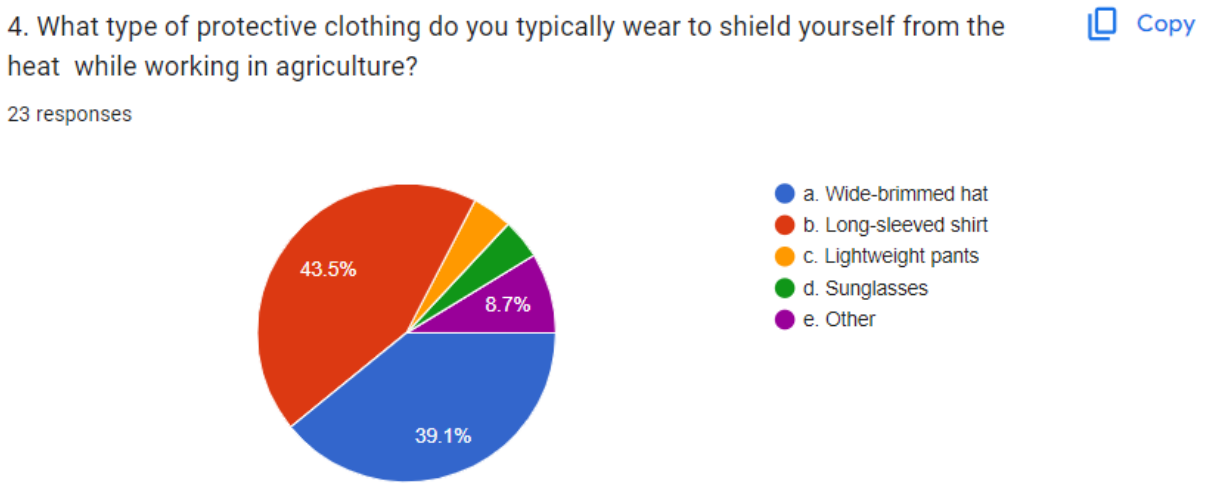

Figure 16. Heat Protective Clothing Worn While Farming

According to 43.5% of workers, long-sleeved shirts are the most commonly used form of protective clothing to protect their skin from direct sun exposure despite the potential discomfort. Also, 39.1% wear wide-brimmed hats, indicating a strong preference for head protection against the sun, which significantly helps reduce the risk of heat-related illnesses. Overall, the data shows a reliance on basic, practical clothing items to reduce heat exposure.

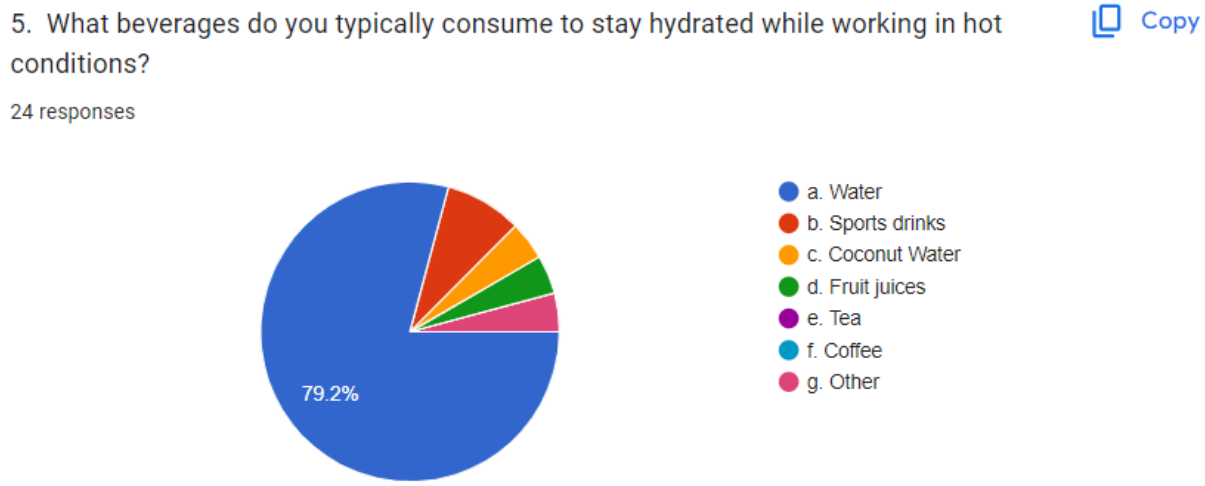

Figure 17. Beverages Consumed for Hydration

This data shows that a vast majority of workers, 79.2%, rely primarily on water to stay hydrated, indicating it as the most accessible and commonly used option for managing dehydration. Water is likely the most affordable and readily available option in these areas of rural agricultural communities. Also, the limited use of electrolyte-rich drinks underscores the need for more education or access to better hydration options that could enhance workers' resilience to heat stress.

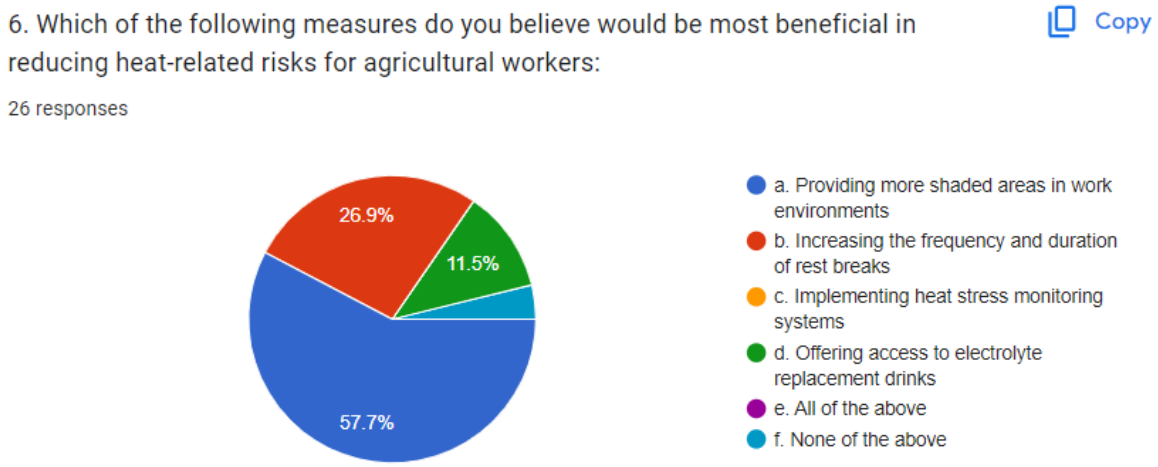

Figure 18. Effective Measures to Reduce Heat-Related Risks for Agricultural Workers

These responses to this question about heat-related risk reduction highlight a clear prioritization of environmental and procedural changes. A majority believe that providing more shaded areas would be the most beneficial, highlighting the preference for reducing direct sun exposure. Additionally, 26.9% advocated for increased frequency and duration of rest breaks, which further emphasizes the need for structured recovery time during work hours to mitigate heat stress.

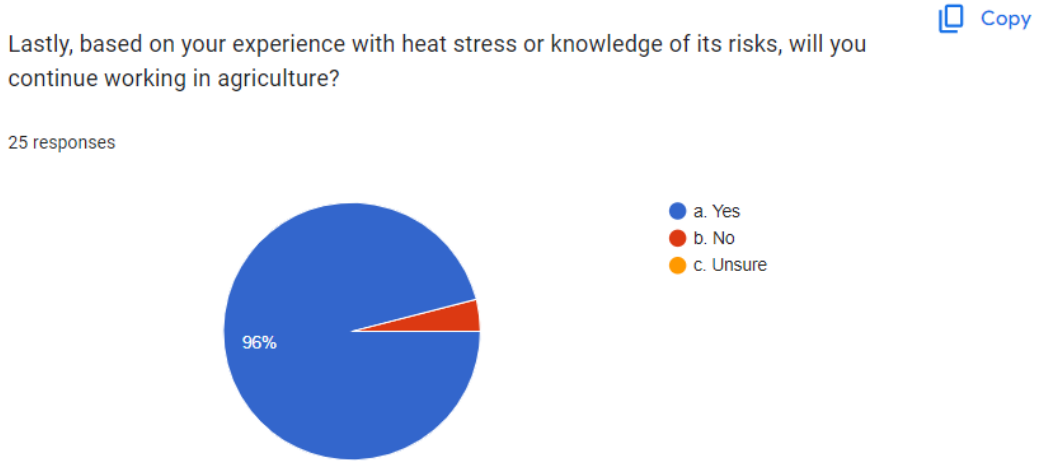

Figure 19. Willingness to Continue Working Despite Heat Risks Among Participants

The overwhelming majority, 96%, indicated that they continue working despite heat stress. This reveals a strong reliance on agricultural labor for economic survival, even in the face of major health risks. It also suggests that rural, impoverished communities in Guatemala are often forced to endure harsh working conditions due to limited alternative employment opportunities.

Discussion

The results of this survey provide a detailed overview of the heat-related challenges faced by agricultural workers in rural Guatemala, offering valuable insights into the socioeconomic and health dynamics of this community. The wide age range of participants highlights the intergenerational nature of agricultural labor, with a notable concentration of workers in their 40s and 50s, indicating many approaching mid-life (Figure 1). Despite this, responses across all age groups were largely similar, suggesting that heat exposure is a universally experienced challenge for agricultural workers, regardless of age. The overwhelming representation of women in this survey, influenced by the setting, allows for a more gender-focused analysis (Figure 2). This viewpoint emphasizes the critical role that women play in agricultural labor and the potential gendered disparities in access to resources and information. The household demographics further illustrate the economic pressures faced by agricultural workers, with a majority of participants reporting large families (Figure 3). Their economic necessity likely contributes to the reliance on agriculture as a primary livelihood, with workers exposed to longer hours in challenging conditions.

A major concern that emerged from the survey responses was the lack of awareness surrounding the long-term health effects of heat exposure (Figure 8). Despite many participants reporting heat-related symptoms, a substantial portion remained unaware of the potential risks, which can be attributed to limited access to healthcare and health education (Figure 14). The reliance on basic coping mechanisms, such as drinking water instead of seeking shade or medical care, reflects a gap in knowledge about more effective heat management strategies (Figure 17). This lack of awareness is compounded by the fact that many workers continue to face extreme heat conditions, yet the majority continue working despite the risks (Figure 19). This underscores the dire economic realities faced by these workers, who feel compelled to continue working in hazardous conditions due to the lack of viable alternative employment opportunities. In a context where economic survival depends on agricultural labor and where alternative livelihood opportunities may be scarce, many workers are forced to prioritize immediate income over long-term health, making it harder to recognize or address heat stress until it reaches a more severe level.

Furthermore, the survey results indicate a growing recognition of the rising temperatures and the impacts of climate change, with 80.8% of participants acknowledging that their local climate has become hotter (Figure 12). This widespread recognition of climate change's impact points to the urgency of addressing the heat-related risks faced by agricultural workers. The survey also highlights the workers' preference for practical solutions, such as providing more shaded areas and increasing rest breaks, as measures that could help mitigate heat stress (Figure 18). These preferences align with workers' daily needs and could be implemented as relatively low-cost interventions to improve working conditions.

In conclusion, the data emphasizes the vulnerability of agricultural workers in Guatemala to the increasing risks of heat stress, driven by both climate change and economic necessity. The survey reveals significant gaps in awareness and access to resources, which leave workers ill-prepared to cope with the escalating heat-related challenges. As workers continue to prioritize their families' economic survival over their health, the need for targeted interventions becomes even more urgent. These findings call for immediate action, including better education on heat stress, improved working conditions, and enhanced access to healthcare to safeguard the health and well-being of this essential workforce as climate change continues to intensify.

Conclusion

This research underscores the significant heat-related challenges agricultural workers face in rural Guatemala due to rising temperatures. The findings reveal a lack of awareness about the long-term health risks of heat exposure, with many workers relying on basic coping strategies like drinking water. Economic necessity drives workers to endure harsh conditions, even as they recognize the worsening climate. The findings also highlight the importance of targeted interventions to address the growing heat-related risks. Practical measures such as increased shaded areas and more

frequent rest breaks, which participants favored, could provide relatively low-cost yet effective solutions to reduce heat exposure. However, these measures alone will not be sufficient. To safeguard the health and livelihoods of agricultural workers, it is crucial to implement broader systemic changes, including better access to healthcare, climate adaptation strategies, and education about the dangers of heat stress.

In conclusion, the research highlights the urgent need to protect agricultural workers in Guatemala from the increasing risks of heat stress and address the broader socioeconomic factors that make them particularly vulnerable. As climate change continues to accelerate, it is vital that policies and interventions are implemented to support the resilience of rural communities and ensure the long-term well-being of those essential to the agricultural sector.

Acknowledgements

I would like to thank my advisor for the valuable insight provided to me on this topic.

References

FAO report: *Heatwaves and floods affect rural women and men differently, widen income gap*. (2024, May 3). Newsroom. https://www.fao.org/newsroom/detail/fao-report--heatwaves-and-floods-affect-rural-women-and-men-differently--widen-income-gap/en

Poor and vulnerable countries need support to adapt to climate change. (2022, March 23). IMF. https://www.imf.org/en/Blogs/Articles/2022/03/23/blog032322-poor-and-vulnerable-countris-need-support-to-adapt-to-climate-change

Climate change: global temperature. (2024, January 18). NOAA Climate.gov. https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature

Mishra, S. (2024, July 9). *Climate Change's Unequal Burden: Why Do Low-Income Communities Bear the Brunt?* Earth.Org. https://earth.org/climate-changes-unequal-burden-why-do-low-income-communities-bear-the-brunt/

World Health Organization: WHO. (2024, May 28). *Heat and health*. https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health