NAME: BUHLE

SURNAME: BUTHELEZI

SCHOOL: EMPANGENI HIGH SCHOOL

EDUCATORS: MS. JOUBERT & MR VENTER

MOSQUITO BREEDING AND CLIMATE CHANGE

Introduction:

KwaZulu-Natal, a province located in the eastern part of South Africa, is known for its lush vegetation, diverse wildlife, and beautiful coastline. However, this region is also plagued by a significant public health concern: mosquito-borne diseases. Mosquito breeding is a persistent problem in KwaZulu-Natal, particularly during the summer months when temperatures are high, and rainfall is frequent. The province's subtropical climate creates an ideal environment for mosquitoes to thrive, posing a significant risk to human health.

According to statistics from the National Institute for Communicable Diseases (NICD), KwaZulu-Natal is one of the provinces with the highest incidence of malaria cases in South Africa. In 2020, the province reported over 10,000 confirmed malaria cases, with the majority of these cases occurring in the northern and coastal regions. Moreover, the province has also seen a significant increase in the number of cases of other mosquito-borne diseases, such as dengue fever and chikungunya.

The root cause of this problem lies in the proliferation of mosquito breeding sites throughout the province. Mosquitoes require standing water to lay their eggs, and the province's many rivers, streams, and wetlands provide an ideal environment for them to breed. Furthermore, the province's high levels of rainfall during the summer months create numerous temporary breeding sites, such as puddles and flooded areas.

To combat this problem, it is essential to develop innovative solutions that can help prevent mosquito breeding and reduce the risk of mosquito-borne diseases. One such solution is to utilize mobile technology to notify people of potential mosquito breeding sites and conditions that favor mosquito breeding. The Globe Observer app provides a unique platform for achieving this goal.

By utilizing the Globe Observer app, citizens can receive notifications when the climate is conducive to mosquito breeding, such as during periods of high temperature and rainfall. Additionally, the app can provide notifications when air humidity levels are high, which can also contribute to mosquito breeding. By receiving these notifications, citizens can take proactive steps to prevent mosquito breeding, such as eliminating standing water around their homes and applying insecticides.

Furthermore, the Globe Observer app can also provide citizens with access to statistics and data on mosquito breeding in KwaZulu-Natal, including the number of reported cases of mosquito-borne diseases. This information can help raise awareness about the importance of mosquito control and prevention and encourage citizens to take an active role in preventing the spread of these diseases.

Climate change effect on mosquito -borne disease

What is climate change?

Climate change refers to long-term shifts in temperatures and weather patterns. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions.

Climate change is having a large impact on Kwazulu Natal, a province located on the east coast of South Africa. Rising global temperatures are leading to more frequent and intense weather events, such as floods and droughts, which are devastating the region .

One of the most significant effects of climate change in Kwazulu Natal is the increase in rainfall intensity, which causes severe flooding in the province. On the 29th of April 2019, heavy rainfall resulted in flooding that caused widespread damage and displacement of people .

Climate Change Impacts on Kwazulu Natal:

1. Increased frequency and severity of floods and droughts
2. Rising temperatures and changing rainfall patterns
3. Negative impacts on agriculture, and human health
4. Threats to biodiversity

Kwazulu Natal complex landscape, with its diverse physical and biological features, makes it a place vulnerable to the impacts of climate change . It's essential for the province to develop and implement effective climate change adaptation and mitigation strategies to reduce the risks associated with climate change.

How climate change affects mosquito population?

Climate change in Kwazulu Natal is significantly impacting the mosquito population, especially the species that transmit diseases like malaria, dengue fever, and the Zika virus.

Ways climate change is affecting mosquito populations in the region:

Increased Mosquito Breeding Sites

- Flooding and heavy rainfall: Climate change is leading to more intense rainfall events, resulting in an increase in flooding and creation of temporary water bodies. These flooded areas provide ideal breeding sites for mosquitoes.
- Rising temperatures: Warmer temperatures accelerate mosquito development, allowing them to breed and multiply faster.

Changes in Mosquito Distribution and Abundance

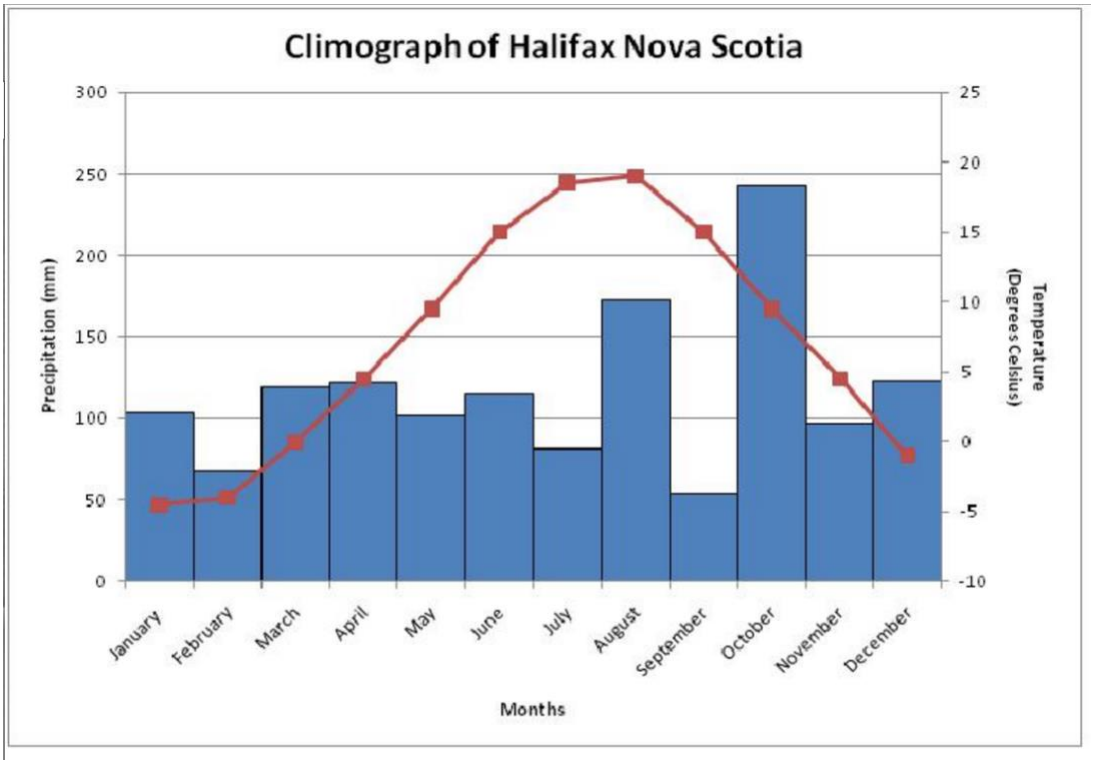
- Shifts in mosquito habitats: Climate change is changing the distribution of mosquito species, with some areas experiencing an increase in mosquito populations while others experience decline.
- Increased mosquito abundance:
  Changes in temperature and the rainfall patterns are leading to an increase in mosquito's, particularly during peak breeding seasons.

  Having better climate change leads to less numbers in terms of spread of disease because the climate would change in a way that makes mosquitoes unable to survive on most cases leading to less number of mosquito present the province. That reduces mosquito malaria borne disease cases.

Impacts on Mosquito-Borne Diseases

- Increased risk of disease transmission:
  Climate change is altering the dynamics of mosquito-borne disease transmission, with increased mosquito populations and a change in distribution patterns leading to a higher risk of disease transmission.
- Changes in disease seasonality:
  Climate change is disrupting the traditional season of mosquito-borne diseases, with some areas experiencing year-round transmission.

See below graph showing the precipitation in KZN



Extracted from: [Weather and Climate - THE GEOGRAPHER ONLINE]

Adaptation and Mitigation Strategies

- Integrated vector management:
  Implementing integrated vector management strategies that incorporate larva control, mosquito control, and biological control methods.
- Mosquito surveillance and monitoring systems:
  Enhancing surveillance and monitoring of mosquito populations to inform control measures and predict disease outbreaks.
- Community engagement and education:
  Educating our communities about the prevention of mosquito-borne disease and controlation , and involving them in vector control efforts.
- Climate-resilient infrastructure:
  Incorporating climate change-resilient design principles into the infrastructure development to reduce mosquito breeding sites.

The Mosquito breeding patterns in Kwazulu Natal are influenced by various factors, including temperature, rainfall, and humidity. The primary malaria vector in the

region is the Anopheles arabiensis, which breeds in temporary water bodies, such as puddles, dams, floodplains, and irrigation channels .

Breeding Sites and Characteristics

Research has shown that Anopheles arabiensis breeding sites in Kwazulu Natal are typically characterized by:

The Temporary water bodies_: Puddles, floodplains, dams, and irrigation channels provide ideal breeding sites for Anopheles arabiensis.

-Vegetation cover: Areas with dense vegetation, such as grasses , provide shelter and food for mosquito larvae.

-Physicochemical properties: The presence of nutrients, such as nitrogen and phosphorus, and suitable pH levels support mosquito breeding .

Seasonal Differences

Mosquito breeding in Kwazulu Natal exhibits seasonal differences, by:

1. Peak breeding season: From November to April, coinciding with the summer months and increased rainfall.

2. Low breeding season:
   From May to October, during winter months and reduced rainfall .

Implications for Malaria Control

Understanding the breeding patterns of mosquitoes in Kwazulu Natal is crucial for effective malaria control. Targeted interventions, such as larva control and indoor residual spraying, can be implemented to reduce mosquito populations and prevent malaria transmission.

What happens if it breeds?

If mosquitoes breed, it can lead to an increase in the population of mosquitoes that can transmit malaria and other diseases.

When mosquitoes breed the implications for mosquito-borne diseases are:

Mosquito Life Cycle

1. Egg stage: Female mosquitoes lay eggs in standing water, which hatch into larvae within 48 hours.
2. Larva stage: Larvae feed on micro-organisms and organic matter in the water, molting several times before pupating.
3. Pupal stage: Pupae rest at the water's surface, emerging as adult mosquitoes after 2-3 days.

Mosquito-Borne Diseases

1. Malaria: Caused by Plasmodium parasites transmitted through the bite of an infected female Anopheles mosquito.
2. Dengue fever: Transmitted by the bite of an infected Aedes mosquito.
3. Zika virus: Also transmitted by Aedes mosquitoes.
4. Chikungunya: Transmitted by Aedes mosquitoes.

Anopheles mosquito

Aedes mosquito

Consequences of Mosquito Breeding:

1. Increased disease transmission: More mosquitoes mean a higher risk of disease transmission.
2. Epidemics and outbreaks: Uncontrolled mosquito breeding can lead to epidemics and outbreaks of mosquito-borne diseases.
3. Public health burden: Mosquito-borne diseases can overwhelm healthcare systems, especially in resource-poor areas.
4. Economic impacts: Mosquito-borne diseases can have significant economic impacts, particularly in areas where tourism and agriculture are important.

Prevention and Control

1. Vector control: Targeted interventions to reduce mosquito populations, such as larval control and indoor residual spraying.
2. Personal protection: Using insecticide-treated bed nets, wearing protective clothing, and applying insect repellents.
3. Eliminating breeding sites: Removing standing water and other breeding sites to prevent mosquito breeding.
4. Community engagement: Educating communities on mosquito-borne disease prevention and control and involving them in vector control efforts.

What is air humidity?

Air humidity: Is the amount of water vapor present in the air, measured as percentage of the maximum amount of water vapor the air can hold at a given temperature.

How does air humidity have an effect in mosquito breeding:

The strong and high air humidity makes it difficult for mosquitoes to fly, as their wings beat slower and are less efficient in dense, moist air. The higher the air humidity the lesser mosquitoes can survive or live in that habitat, meaning that if there is lower air humidity the more mosquitoes fly leading to the disease breeding .

South Africa has high humidity levels hence that's why the mosquito malaria borne disease is spreading.

How can having better air temperature lead to a decrease in disease spreading?

Having better air temperature (low humidity) will reduce the number of mosquitoes able to live in our habitat and decrease the spread of the disease leading to less percentages of people being sick.

The way to reduce this disease can be by:
Alerting people about change in climate and all the necessary precautions they need to take to be safe from mosquitoes.
The people can be alerted by creating a feature on the globe app that will work on climate change including air humidifier, it will alert people by sending messages or notifications once the climate is bad and could lead to more mosquitoes breeding and also if the air humidity is dense and high resulting in the diseases spreading.

Badges applications

I AM A COLLABORATOR BADGE
I'm so excited to apply for the "I am a Collaborator" badge with a project that investigates the relationship between climate change and mosquito breeding. My objective is to research and analyze how rising temperatures and changing precipitation patterns affect mosquito populations and the spread of mosquito-borne diseases. To achieve this, I plan to review existing data, collect and analyze new data on temperature, precipitation, and mosquito populations, and collaborate with local communities to raise awareness and prevent mosquito breeding. Through this project, I hope to gain a better understanding of the complex relationships between climate change, mosquito breeding, and human health, while also engaging with local stakeholders and sharing my findings with the GLOBE community.

I MAKE AN IMPACT BADGE
I'm so thrilled to apply for the "I Make an Impact" badge with my project which I believe will make an impact to the community and environment titled, "Mosquito Breeding and Climate Change," which investigates the impact of climate change on mosquito populations and mosquito-borne diseases. Through this project, I've raised awareness about the risks associated with mosquito-borne diseases and promoted sustainable practices in preventing mosquito breeding, collaborating with local stakeholders, including schools and community groups, to drive education and action. By sharing my project, I aim to contribute to the global conversation on climate change and human health, inspiring others to take action on this critical

issue and demonstrating the positive impact that individuals can make in their communities and beyond.

I AM A DATA SCIENTIST BADGE

Application for “I am a Data Scientist” Badge

As a passionate data enthusiast, I’m showcasing my skills in data collection, analysis, and visualization through my project, “Mosquito Breeding and Climate Change." I've utilized various data sources, including temperature, precipitation, and mosquito population data, to investigate the relationship between climate change and mosquito breeding. By applying statistical models and data visualization techniques, I've uncovered meaningful insights and trends, demonstrating my ability to extract valuable knowledge from complex data sets. I'm proud to share my work and showcase my skills as a data scientist, highlighting the critical role that data plays in understanding and addressing the complex challenges posed by climate change.

I AM A STORYTELLER BADGE

Application for “I am a STEM Storyteller” Badge

As a passionate advocate for STEM education and literacy, I’m glad to be able to share my story about the impact of climate change on mosquito breeding and mosquito-borne diseases. Through my project, I’ve used storytelling techniques to convey complex scientific concepts in an engaging and accessible way, highlighting the real-world implications of climate change on human health. By sharing my story, I aim to inspire others to explore the fascinating world of STEM, demonstrate the power of storytelling in communicating scientific ideas, and showcase my skills as a STEM storyteller.

I AM A STUDENT RESEARCHER BADGE

Will be provided to students automatically (as said)

I WORK WITH A STEM PROFESSIONAL BADGE

Application for “I Work with a STEM Professional” Badge

I’m applying for this badge, highlighting my collaboration with my science teacher, Ms. Helena Jourbet & Mr. Lucas Venter, on my project “Mosquito Breeding and Climate Change.” Ms. Joubert has been an invaluable mentor and guide, providing expert guidance and support throughout my research. Her extensive knowledge and experience in the field of biology have helped me design and implement my project, ensuring that my methods and findings are accurate and reliable. Through our

collaboration, I've gained a deeper understanding of the scientific process, developed my critical thinking and problem-solving skills, and produced high-quality research that I'm proud to share. I'm grateful for the opportunity to work with Ms. Joubert and appreciate her dedication to fostering STEM education and literacy.

Conclusion

The problem of mosquito breeding in KwaZulu-Natal province, exacerbated by climate change, poses a significant threat to human health. Through my project, "Mosquito Breeding and Climate Change," I investigated the relationship between climate variables and mosquito breeding, with a focus on developing a solution to prevent mosquito-borne diseases.

The results of my project indicate a strong correlation between climate variables, such as temperature and precipitation, and mosquito breeding. Specifically, I found that high temperatures and rainfall create ideal conditions for mosquito breeding, leading to an increased risk of mosquito-borne diseases.

To address this problem, I propose utilizing the Globe Observer app to notify citizens of potential mosquito breeding sites and conditions that favor mosquito breeding. By receiving notifications when the climate is conducive to mosquito breeding, citizens can take protective steps to prevent mosquito breeding, such as eliminating standing water around their homes and applying insecticides.

Furthermore, my project highlights the importance of community engagement and education in preventing mosquito-borne diseases. By raising awareness about the risks associated with mosquito breeding and the importance of sustainable practices in preventing mosquito breeding, we can empower citizens to take an active role in preventing the spread of these diseases.

Lastly, my project demonstrates the critical need for innovative solutions to address the problem of mosquito breeding in KwaZulu-Natal province. By leveraging mobile technology and community engagement, we can reduce the risk of mosquito-borne diseases and promote a healthier, more sustainable future for all.

Summary

“Mosquito Breeding and Climate Change”
This project investigates the relationship between climate change and mosquito breeding, focusing on the impact of rising temperatures and changing precipitation patterns on mosquito populations and mosquito-borne diseases. Through data collection, analysis, and visualization, the project aims to contribute to a deeper understanding of this critical issue and inform strategies for mitigating the effects of climate

Reflection

Through this project, I’ve gained invaluable insights into the complex relationship between climate change and mosquito breeding. I’ve learned the importance of data-driven decision-making and the value of community engagement in addressing public health concerns. This project has also taught me the significance of interdisciplinary approaches, combining science, technology, and communication to develop effective solutions. Most importantly, I’ve come to appreciate the impact that individual actions can have on mitigating the effects of climate change and promoting a healthier environment.

Referencing

Anopheles photo- sourced from: https://en.wikipedia.org/wiki/ {accessed on 3 March 2025}

Aedes photo - sourced from: https://www.ecdc.europa.eu {accessed on 3 March 2025}

National Institute for Communicable Diseases (NICD). (2020). Malaria in South Africa.

World Health Organization (WHO). (2020). Malaria

Centers of Disease Control and Prevention (CDC). (2020). Mosquito-Borne Diseases.

South African National Biodiversity Institute (SANBI). (2020). Mosquitoes and Mosquito-Borne Diseases.

Intergovernmental Panel on Climate Change (IPCC). (2013). Climate Change 2013: The Physical Science Basis.

The data was obtained from:

South African Weather Service (SAWS). (2020). Climate Data.

Globe observer app resources site: https://www.globe.gov