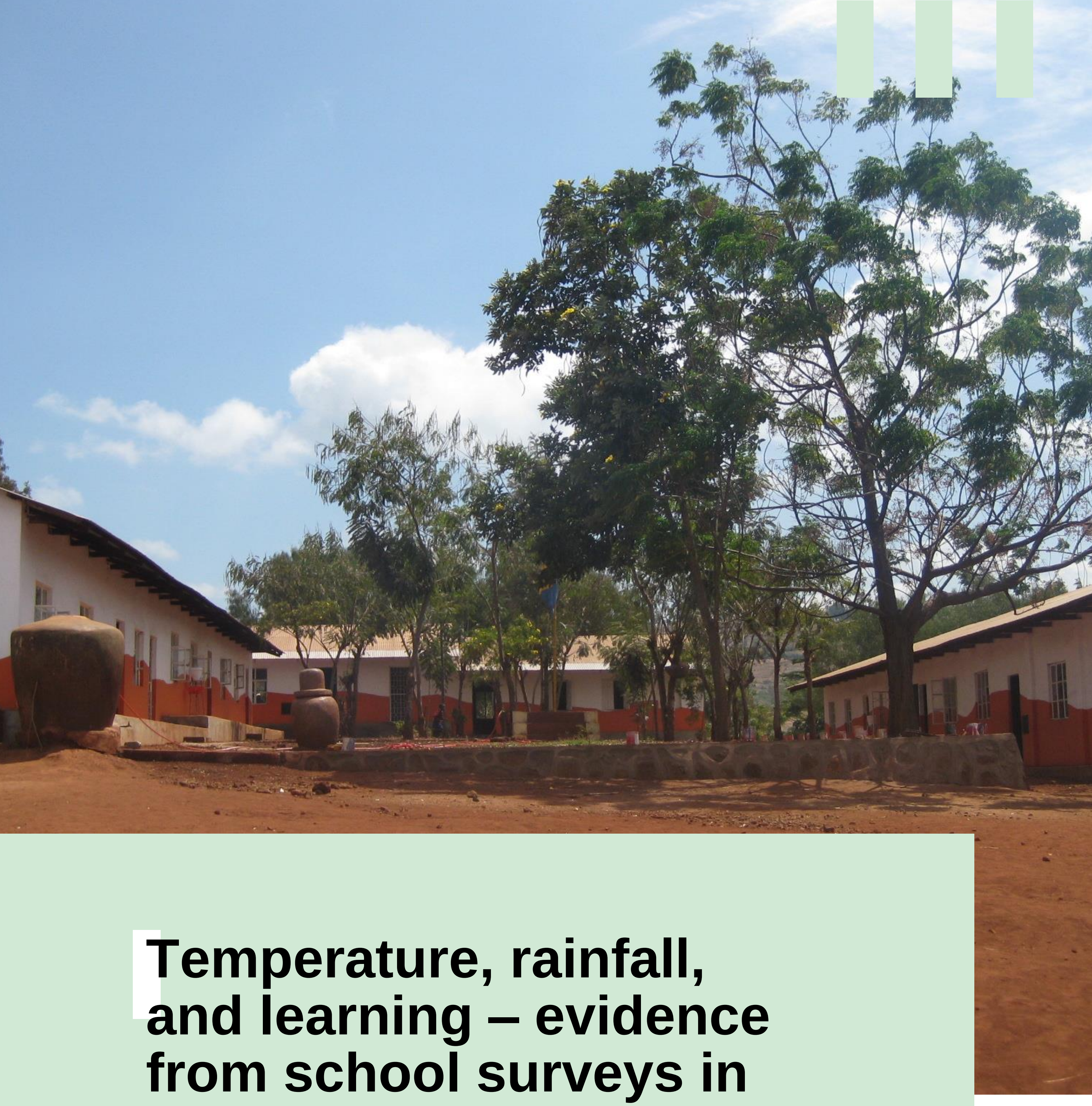

Temperature, rainfall, and learning – evidence from school surveys in Tanzania

July 2024

Temperature, rainfall, and learning – evidence from school surveys in Tanzania

July 2024

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Executive Summary

Introduction

This report focuses on how classroom conditions and children's ability to learn are affected by changes in temperature and rainfall in Tanzania. We show how inadequate infrastructure leads to build up of heat throughout the day and affecting children's ability to learn. We look at how rainfall affects learning outcomes through noise during storms and flooding that can reduce school attendance, damage school infrastructure, and make roads inaccessible. We frame our findings in the need to adapt the education system in Tanzania to the impacts of climate change, which in Tanzania will bring an increase of extreme heat, frequent heatwaves, erratic rainfall, droughts, floods, and more intense extreme rainfall events. By highlighting deficiencies in current classroom infrastructure, we point to the need for interventions based on the idea that classrooms must be made climate-resilient to cope with more extreme weather, especially increased heat and more unpredictable rainfall and flooding.

Method

Analysis and findings were generated from 48 schools across the Pwani, Mara and Dodoma regions. We selected schools from different climactic zones in the coastal, northern, and central areas of Tanzania. We carried out two rounds of headteacher surveys, classroom observations, and captured information from temperature sensors placed in a Grade 3 classroom for four months. We use 26.7 degrees Celsius (80 degrees Fahrenheit) as our anchor temperature for excess heat. The data for this report was collected between August and December 2023, which means that other parts of the year may have yielded warmer classroom temperatures.

Key findings – Heat

Indoor classroom conditions become increasingly warm towards the end of the school day with a roughly two-hour time lag between external and internal temperatures. 23% of headteachers said that classrooms were hot in the afternoon and 44% said that they were very hot.

Dodoma has the highest levels of heat accumulation, Mara and Pwani exhibit lower heat accumulation, suggesting better adaptation to manage heat.

Iron roofs were evident in 47 schools with the other being made from tin. Iron or tin sheets are effective in regulating internal temperatures from external heat. However, the roofs do not prevent internal temperatures from reaching or exceeding external temperatures. Only 15 (31%) of the schools observed have ceiling boards, which are a means of providing insulation that reduces internal temperatures.

Studying a topic at midday can mean it is 3 degrees hotter in the classroom than lessons taking place first thing in the morning. Schools teach the core subjects (and exam topics), Maths, Kiswahili, Science and Technology, and English in the morning when classrooms are cooler.

More than half the lessons take place in temperatures above our 26.7 degrees threshold and therefore are not likely to be conducive to learning.

Key findings – rainfall

Rainfall was cited as an important environmental issue, with 48% of headteachers saying that children's concentration was negatively affected during the rainy season.

Noise from rainfall seems to be one of the biggest problems in reference to environmental factors that inhibit learning in our sample, with 42% of headteachers ranking as the worst condition.

Rainwater entering the classrooms through the roof is a major problem. Classrooms become completely or partly unusable, residual water damages walls and floors. This has serious implications for comfort, ability to learn, and the health and safety of the classroom users.

Flooding has impacts within the classroom and on school accessibility as children travel to school on flood affected roads. About one-third (33%) of classrooms experienced flooding during the rainy season. About two-thirds (65%) of schools say that students and staff have difficulty travelling to and from school during the rainy season. This has implications on learning, student wellbeing, and safety.

Recommendations

With climate predictions for Tanzania suggesting increased heat and extreme rainfall events, there is a strong need for the right investments to create a climate resilient education system. What our findings point to is that impacts on children's ability to attend and learn in school will increase unless action is taken to improve education infrastructure. Without action education outcomes are likely to be adversely affected in the coming years.

We need to pay close attention to classroom environments and the range of factors, from design, construction, shading, and ventilation (amongst others) to keep classrooms cooler and protected from rain.

The design and construction of the roofs contribute greatly to poor learning conditions. Investments are needed as the roofs of these classrooms allow rainwater and allow direct heat from the sun to enter the classrooms. Noise from rain is transmitted into the classrooms through lack of ceiling and insulation, excess heat cannot escape due to a lack of ventilation gaps.

Schools do try and minimise the impacts that flooded roads have on education but often lack the means to do so and require a coordinated approach with the local community and authorities.

1. Introduction

This report builds on previous work by Fab Inc. and Laterite, which looked at the effect of temperature on learning outcomes in Tanzania using secondary data. This work built on nascent literature on temperature and learning outcomes, which in turn built on laboratory and field experiments looking at how temperature affects cognitive performance, including memory.[1 2 3]

The analysis from secondary data identified a correlation between the temperature at the school location, as measured by satellite data, and performance in the national primary school leaving exams (PSLE) between 2019 and 2021. The results were suggestive of a relationship, but challenges in how the data was measured inhibited strong conclusions. This report offers insight into the classroom conditions from a sample of 48 schools in Tanzania and the data was collected between August and December 2023, other parts of the year may have seen warmer classroom temperatures. In this report we address the following research questions:

1. How and in what ways do classroom-level conditions get impacted by temperature and rainfall in a sample of schools in Tanzania?
2. How do these conditions affect the learning experience?
3. How can this information support decision-making to increase schools' resilience to climate change?

We contribute to the literature by exploring how temperature and rainfall affect classroom conditions and connecting these extreme weather forms to children's abilities to learn. Children are more vulnerable than adults to increases in temperature and exposure to extreme heat, due to having less ability to regulate their body temperature.[4] In classroom environments, low concentration and feeling tired and sleepy are common issues when it is too hot, which can impact on both health and ability to learn.[5] Rainfall is also known to affect learning outcomes either through direct or indirect pathways. For instance, rainfall can create flooding that can reduce school attendance and damage school infrastructure, rainfall can also create classroom conditions that are not conducive to learning primarily through noise.[6] Focusing on the school level, our work aims to enhance the understanding of classroom conditions and

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[1] Ramsey, J. D. Task performance in heat: a review. Ergonomics 38, 154–165 (1995).
[2] Hocking, C., Silberstein, R. B., Lau, W. M., Stough, C. & Roberts, W. Evaluation of cognitive performance in the heat by functional brain imaging and psychometric testing. Comp. Biochem. Physiol. A Mol. Integr. Physiol. 128, 719–734 (2001).
[3] Park, R. J. Hot temperature and high stakes performance. J. Hum. Res. https://doi.org/10.3368/jhr.57.2.0618-9535R3 (2020)
[4] UNICEF. 2021. Healthy Environments for healthy children Global Programme Framework
[5] Bidassey-Manilal S, Wright CY, Engelbrecht JC, Albers PN, Garland RM, Matooane M. Students' Perceived Heat-Health Symptoms Increased with Warmer Classroom Temperatures. Int J Environ Res Public Health. 2016 Jun 7;13(6):566. doi: 10.3390/ijerph13060566
[6] Y. Bekkouche & Kenneth Houngbedji & Oswald Koussihouede, 2023. "Rainy days and learning outcomes: Evidence from sub-saharan Africa," Working Papers hal-03962882, HAL.

learning outcomes by examining the effect of extreme weather on school infrastructure and classroom environments.

Whilst improving infrastructure is important for improving classroom conditions in the present, climate change will bring an increase of extreme heat caused by warmer days and nights alongside more frequent heatwaves.[7] Therefore, in Tanzania, we can expect hotter classrooms in general, more days of extreme heat in classrooms, and more heat stress on children. Whilst rainfall will become more erratic, leading to droughts as well as floods, extreme rainfall events will become more frequent and intense, which will make schools more vulnerable to their impacts.

Our report highlights the importance of assessing classroom conditions, the effect that infrastructure has as a result of these conditions, and perceptions from headteachers of how extreme weather affects learning. These insights can support climate resilient adaptation of the education system in Tanzania, with insights that are useful for other low - and- middle income countries. Through building an understanding of classroom conditions and climate conditions we seek to inform decision-making to increase the resilience of the education system in Tanzania to the range of extreme weather events that the country faces.

In Section 2, we outline the methods for data collection that underpin this report. To explore classroom conditions, we conducted primary research in 48 schools across three regions in Tanzania. We placed temperature data loggers[8] in classrooms to measure the temperature and humidity levels within these classrooms every 30 minutes, conducted surveys with the head teachers, and took observations of the classroom infrastructure.

In Section 3, we explore the temperatures within classrooms, overlaying this with information on the school timetables, classroom infrastructure, and findings from headteacher responses to our surveys. We look at the ways that school timetables are structured to reduce the effect of heat, in what ways infrastructure is or is not conducive to creating environments that aid or inhibit learning, how headteachers think about the problem, as well as some of the effects of heat on learning and classrooms.

In Section 4, we use similar techniques to explore the effect of rain. We analyse the observation data, including photographs taken from the field visits and headteacher survey responses to create an outline of the extent to which rainfall creates a myriad of problems – from noise, flooded or leaking classrooms, damp classrooms, and school access issues.

Section 5 draws together the previous sections and frames the data and findings in the context of climate change. We explore what headteachers think of climate change, how it intersects with other problems that they identify, and some of the key things that they think are needed to make education infrastructure more climate resilient.

[7] UNICEF. 2021. Healthy Environments for healthy children Global Programme Framework.
[8] Lascar EasyLog EL-SIE-2

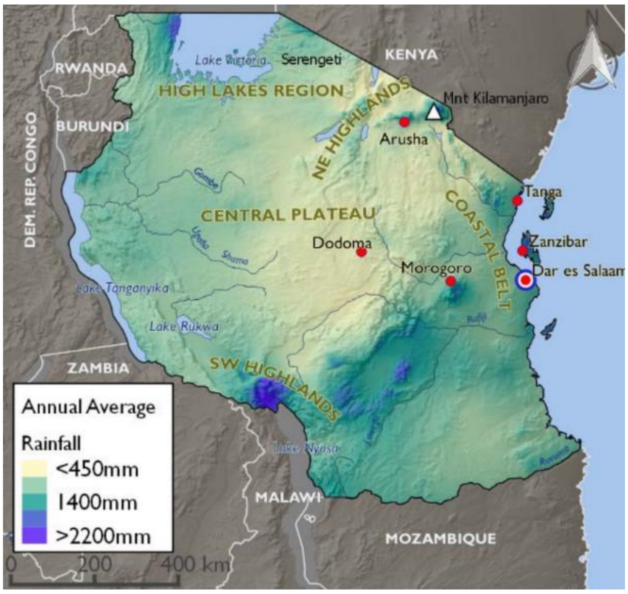
1.1 Background – the Tanzanian climate

Tanzania is a tropical country where temperatures are higher between December and March, and coolest between June and July, with two defined rainy seasons - the long rains between March to May and the short rains from October to early December.[9] The period of analysis for this report was August to December 2023 which covered a period between the dry and rainy season when temperatures were rising. The school year runs from January to December, with the Primary School Leaving Examination (PSLE)sat in September each year – prior to the high heats.

Tanzania's climate varies across four distinct climate zones. These are:

1. The hot and humid coastal belt. The average temperature across the year ranges between 27°C and 29°C[10] and it is generally the hottest part of Tanzania.
2. The hot and arid central plateau. Temperatures range between 20°C and 30°C with around 550 mm of annual rainfall.[11]
3. The cooler semi temperate high moist lakes region. Temperatures range between 20°C and 30°C.
4. The highlands. Temperatures range between 20°C and 30°C. This is generally the wettest part of Tanzania with annual rainfall around 3,690 mm in parts of the highlands.[12]

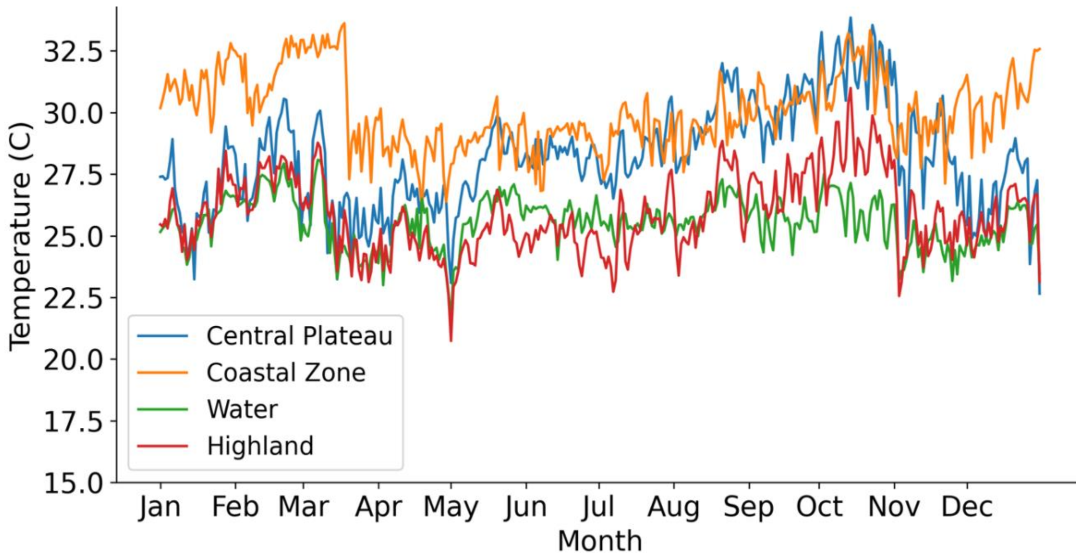
Figure 1 - Annual average rainfall in Tanzania



[9] The World Bank Group. 2021. Climate Change Knowledge Portal. https://climateknowledgeportal.worldbank.org/country/tanzania/climate-data-historical
[10] Average temperature is gauged by taking the daily minimum and maximum and finding the midpoint. This is then aggregated by month and then by year.
[11] The World Bank Group. 2021. Climate Change Knowledge Portal. https://climateknowledgeportal.worldbank.org/country/tanzania/climate-data-historical
[12] The World Bank Group. 2021. Climate Change Knowledge Portal. https://climateknowledgeportal.worldbank.org/country/tanzania/climate-data-historical

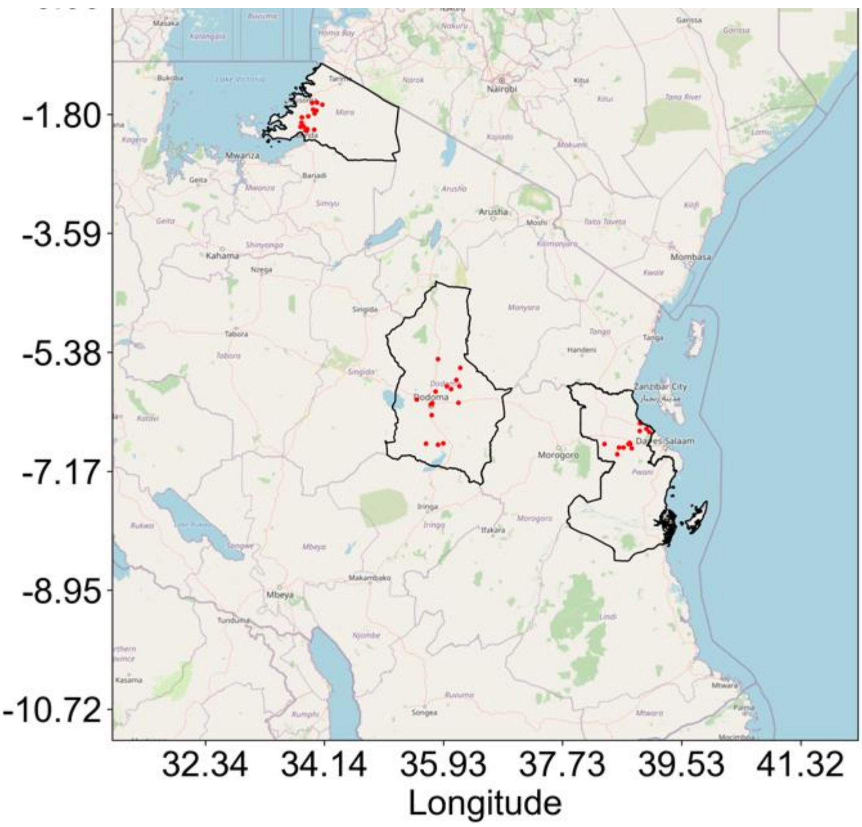
Averages give a guide to climate conditions but as we show in Section 3.1, mornings are generally cooler and peak temperatures in the classroom are at around 2 pm. Another important dimension of temperature is exposure to 'hot days', as we showed in our first report, this impacted test scores when children were exposed to extreme heat in the term of the exam. Figure 2 below shows the daily maximum temperatures for each climactic zone in 2023. It shows that in the coastal area in January to March and September to November daily maximum temperatures regularly exceeded 30 degrees Celsius. In the Central Plateau the highest recorded temperatures are from September to November, with temperatures regularly exceeding 30 degrees Celsius.

Figure 2 - Daily maximum temperature in Tanzania (2023), by climatic zones



The 48 schools that make up the analysis of this report (shown in Figure 3) were in the Pwani region, which is part of the hot and humid coastal belt, Dodoma region, which is part of the hot and arid central plateau, and Mara region, which is in the cooler semi-temperature high moist lake regions in the north. While our sample does not give complete coverage across all zones, our analysis provides a snapshot into different parts of the Tanzanian climate areas.

Figure 3 - Location of schools included in this study in Tanzania



The rains during the period of this report were particularly heavy from mid-October, especially in the Eastern, Northern, and Northwest regions where overflowing rivers, flash floods, and landslides have disrupted communities and killed many people.[13] Whilst the schools in this sample were not adversely affected in the worst of the flooding, these floods highlight Tanzania's vulnerability to extreme weather events. This report seeks to inform decision-making to increase the resilience of the education system to the range of extreme weather events that Tanzania faces.

1.2 The Climate Change Context

This project focuses on conditions in the classroom and the links to learning, access to school and what this can contribute towards understanding the impact on education outcomes. However, it is important to frame this analysis within the broader challenge of climate change and how to ensure that schools in Tanzania are resilient to extreme weather conditions now and in the future. Whilst in some respects the focus of this report is on highlighting where there are deficiencies in current classroom infrastructure to support interventions that improve them in the present, it is also based on the idea that classrooms must be made more resilient to a

[13] https://crisis24.garda.com/alerts/2023/12/tanzania-disruptions-due-to-flooding-ongoing-across-much-of-the-country-as-of-dec-4-update-1

future with more extreme weather, especially increased heat and more unpredictable rainfall and flooding.

In their 2021 climate change strategy, The Government of Tanzania noted that there is already evidence of climate change impacting on the country, in-line with global changes, with an

"Increase in frequency and intensity of extreme events such as strong wind, heavy rainfall, hailstorm and higher temperatures. Between 1981 and 2020 several incidences of droughts, floods and record-breaking rainfall have been observed in many parts of the country." [14]

Most of the extreme weather events have been seen in the latter part of this period and unusually heavy rains caused loss of life and large-scale damage in October 2023 to March 2024.

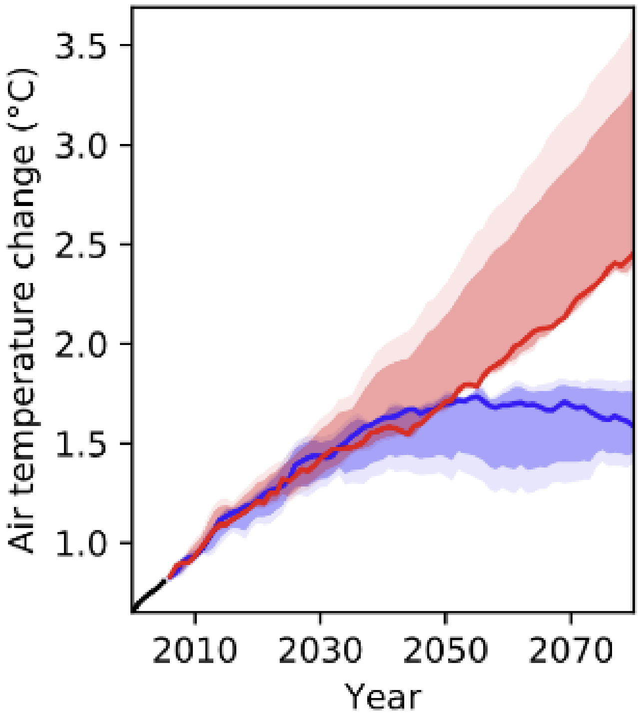
As well as dealing with extreme weather in the present, we must take account of future climate projections. We detailed in our first report the climate projections for Tanzania and summarise them below.

Heat

Tanzania's warming on pre-industrial levels was around 1 degree by 2020.[15] The projections are not definitive due to uncertainty over whether global emissions will decrease in line with the UNFCCC Paris Accord, whether they will decrease more slowly, or will continue to rise. However, warming is expected to be around 1.4 degrees by 2030 under a low emissions scenario, as highlighted in Figure 4, below. There will be an increase in the number of days above 30 degrees, with most years seeing between 40 to 60 days of extra excessive heat by 2040.[16] This will include increases in both the maximum and minimum temperatures, which will continue to rise during the period of 2040 to 2070.[17] As Figure 4 highlights, a scenario that sees rapid reductions in emissions temperatures should stabilise through the latter half of the century, as illustrated by the purple line. However, under a scenario where emissions reductions are slow, or emission continue to rise, Tanzania will be subjected to warming between 2.5-3.5 degrees (red line), which will have catastrophic consequences.

[14] Government of Tanzania. 2021. National Climate Change Response Strategy. https://cdn.climatepolicyradar.org/navigator/TZA/2021/national-climate-change-response-strategy-2021-2026_28025faccd8ea6db201d4b5305b7c7cb.pdf
[15] Source: https://www.migrationpolicy.org/article/tanzania-climate-change-migration-conflict
[16] FCFA. 2017. Country Climate Brief. https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2017/11/FCFA_Tanzania_SummaryWeb.pdf
[17] Luhunga PM, Kijazi AL, Chang'a L, Kondowe A, Ng'ongolo H and Mtongori H.2018. Climate Change Projections for Tanzania Based on High-Resolution Regional Climate Models From the Coordinated Regional Climate Downscaling Experiment (CORDEX)-Africa. Front. Environ. Sci. 6:122. doi: 10.3389/fenvs.2018.00122

Figure 4 - Air temperature projections for Tanzania for different GHG Emissions Scenarios[18]



Rainfall

Rainfall projections for the period until 2040 are a little less certain than temperature projections. However, the following likely scenarios are predicted:

1. There is likely a decrease in average rainfall but there will also be an increase in extreme rainfall events.[19]
2. Tanzania will become more susceptible to both droughts and floods.

The findings of this study must be viewed in the context of increasing temperatures and extreme events in the coming decades. Increased temperatures will lead to warmer classrooms and put heat stress on existing infrastructure. As we will highlight in Sections 3 and 4 this infrastructure is already, in our sample, in a poor state and unlikely to be able to cope with further rises in temperature and hotter days. More uncertainty regarding rainfall, with periods of drought as well as an increase in extreme rainfall, judging by our findings, presents a major challenge in the Tanzanian context through indirect impacts from drought and the potential of direct impacts on educational infrastructure from heavy rain and flooding. This suggests that without action in the coming years to make education infrastructure more climate resilient, children's ability to attend school or learn in a safe and appropriate classroom environment will be negatively impacted across our sample schools.

[18] Federal Ministry of Economic Cooperation and Development. Climate Risk Profile Tanzania. Federal Republic of Germany, p4.
[19] FCFA. 2017. Country Climate Brief. https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2017/11/FCFA_Tanzania_SummaryWeb.pdf

2. Methods

This report is based on two rounds of quantitative data collection generated through surveys, classroom observations, and information captured from temperature sensors that were placed in 48 primary schools across the Pwani, Mara and Dodoma regions. 16 out of the 48 schools are in urban districts of Mara and Dodoma while the rest are in rural districts. More details of the schools are available in Annex 1.

The first round of data collection was conducted between 26th July 3rd and August 2023, when the temperature was cooler. The second round of data collection was conducted between 27th November and 4th December 2023, during the rainy and hotter season.

Box 1: Overview of the sample

48 schools sampled in the Pwani, Mara and Dodoma regions. Two districts per region were purposively sampled for logistical feasibility. Eight schools were randomly selected per district.

48 headteachers interviewed. Two rounds of headteacher interviews with the same headteacher were carried out to collect administrative, school-level infrastructure, and climate change perception data

48 classroom observations – including temperature. One grade 3 classroom was randomly selected by the enumerator to observe the classroom infrastructure and building materials and mount a remote temperature sensor. Three sensors were stolen, giving us sensor data from 45 schools, and survey data from all 48.

2.1 Data collection process and team

Laterite's approach to data collection was two-pronged. Laterite and Fab Inc. collaborated with the Foreign Commonwealth and Development Office team to develop the survey instruments for this study. The survey instruments were developing keeping the learning questions at the forefront. Upon the finalization of the survey instruments in English and Kiswahili, Laterite submitted an expedited IRB approval and research permit applications.

Upon obtaining the necessary approvals and permit, the Laterite team selected three enumerators (one for each region) from a database for over 200 enumerators for this project. The enumerators underwent extensive training for two days to obtain comprehensive information about the study objectives and data collection method. After the training, the enumerators conducted a 1-day pilot in Bagamoyo to test the survey instruments in real life conditions. At the end of the pilot, the team conducted a debrief to inform changes to the data collection protocol and survey instruments.

Laterite was responsible for planning and leading the field logistics. On average, each enumerator completed the data collection in two to three schools per day. The enumerators were only working during the school hours to prevent keeping the headteachers in school until late.

For the second round of data collection, Laterite worked with the same enumerators. The enumerators participated in a 1-day refresher training. During the training, the enumerators were trained on the new survey instrument and the process of extracting data from the temperature sensors. The same data collection process and field protocol were used as in the first round.

2.2 Data collection objectives and design

Our objective was to draw a sample of schools from areas of Tanzania that experience different climatic conditions. We selected schools from regions in the coastal, northern, and central areas of Tanzania to generate evidence on different climatic zones. Our sample was limited in its geographic scope due to budget constraints but aimed to maximize insights.

Within this purposeful sample we selected two districts per region (for logistical reasons, to fit within our fieldwork budget). We then randomly sampled eight schools within each district. The overview of this is described in Box 1.

The first survey was designed to gain a general understanding of the current state of school infrastructure and the headteachers' perceptions of the impact of heat and rain (see the survey in Annex 3). The target respondents of the survey were headteachers because we assumed that they would be able to provide administrative data and reflect the perception of an average teacher in the classroom given that they are leading the teachers in their respective school. One headteacher per school (total 48) was interviewed face-to-face using a survey programmed on SurveyCTO on a tablet.

As we conducted two surveys, we iterated on the survey and adapted the second round to consider the findings from the first. Based on an initial round of analysis, we developed a follow up survey that sought to explore initial findings around flooding further, particularly the resilience to it (see Annex 3 for the follow-up survey). We decided to collect detailed class timetables to understand more about how schools structured their studies around the hotter times of the day. We also sought to gain more data from headteachers' perceptions (48 headteachers) to dig into how they responded to extreme heat and rainfall. This helped to understand their current approaches to building resilience and how extreme weather tested that resilience.

We collected classroom observation data from one randomly selected grade 3 classroom per school (see the classroom observation survey in Annex 3). A temperature sensor was also mounted in the classroom selected for the observation survey. The temperature sensors were configured to record temperature and humidity measurements every 30 minutes across four months, August to November (see Annex 1 for a breakdown of our method). However, due to operational challenges in some schools, the recordings were not available on a consistent basis across all schools. This challenge is largely attributed to the headteachers turning off the sensors after they were mounted in the classrooms. This led to missing observations for some schools over a period until our team revisited the schools in November 2023.

3. Results – How hot are the classrooms?

One important question considered was "how hot is too hot?". Surprisingly, there is little discussion about what threshold to use for safe classrooms – and very little legislation on maximum temperatures, even in developed countries. For example, the UK does not have classroom or workplace regulations for maximum temperatures, though the National Education Union suggests a maximum classroom temperature of 26 degrees Celsius.[20] The World Health Organization recommends 24 degrees Celsius as a maximum working temperature. The UK Government has laid out different temperatures, with overheating occurring at 28 degrees Celsius and a maximum temperature in an occupied classroom not exceeding 32 degrees Celsius.[21] This highlights that answering the question of "how hot is too hot?" is not straightforward and much of the evidence and focus is from moderate climates, rather than tropical ones.[22]

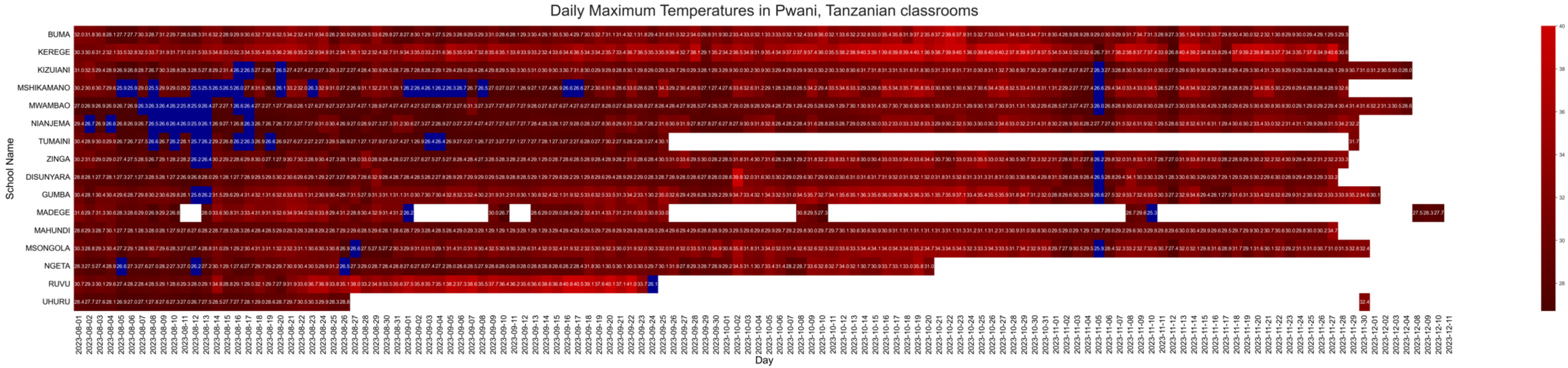
Some studies have looked at excessive heat in hotter climates, with much of the focus being on children's perceptions of heat, as well as testing physical and cognitive skills when exposed to different temperature levels. Where our study adds to this literature is through looking at exposure to different forms of extreme weather over a longer period and connecting this to children's ability to learn. These studies highlight a variety of observed temperatures and thermal preferences amongst children, with optimum/neutral temperatures ranging from 26.8°C (Hawaii), 28.8°C (Singapore), and 31.3°C in Vietnam. However, the preferred temperature amongst children was generally 2-3.5°C lower.[23] The aim of our study was not to measure thermal comfort and cognitive and physiological impacts directly. We focused on links to performance, as suggested by education outcomes. With that in mind, a study of school children in Costa Rica suggested that optimal performance for completing a range of education tasks was a classroom temperature of around 25°C and that for comfort levels of children, which we associate with their ability to learn, temperatures under 30°C were beneficial. This provides important context for understanding our findings. For our study, we benchmark back against the 26.7 degrees Celsius (80 degrees Fahrenheit) used by Park et al. (2020) in their study of the cross-country impact of heat.[24] While imperfect, this is a good anchor temperature given the discussion highlighted abo

[20] https://neu.org.uk/advice/health-and-safety/work-environment/hot-weather-and-classroom-temperature
[21] Bidassey-Manilal S, Wright CY, Engelbrecht JC, Albers PN, Garland RM, Matooane M. Students' Perceived Heat-Health Symptoms Increased with Warmer Classroom Temperatures. Int J Environ Res Public Health. 2016 Jun 7;13(6):566. doi: 10.3390/ijerph13060566.
[22] Porras-Salazar JA, Wyon DP, Piderit-Moreno B, Contreras-Espinoza S, Wargocki P. Reducing classroom temperature in a tropical climate improved the thermal comfort and the performance of elementary school pupils. Indoor Air. 2018; 28: 892–904. https://doi.org/10.1111/ina.12501
[23] Bidassey-Manilal S, Wright CY, Engelbrecht JC, Albers PN, Garland RM, Matooane M. Students' Perceived Heat-Health Symptoms Increased with Warmer Classroom Temperatures. Int J Environ Res Public Health. 2016 Jun 7;13(6):566. doi: 10.3390/ijerph13060566.
[24] Park, R.J., Goodman, J., Hurwitz, M. and Smith, J. 2020. Heat and Learning. American economic journal. Economic policy. 12(2), pp.306–339.

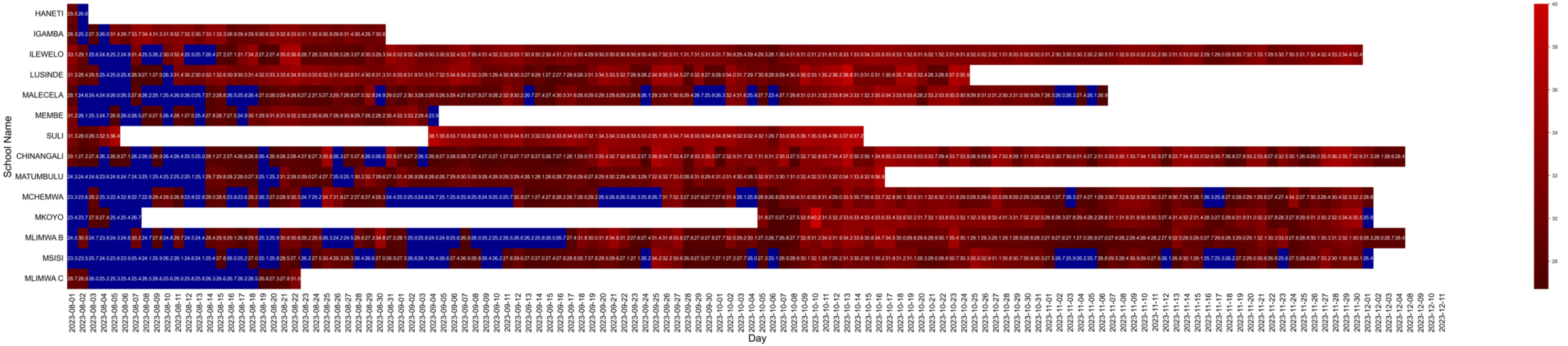
3.1 Temperature data from the sensors

We first summarise the data received from the sensors positioned within the classrooms of 45 schools. Due to the data collection challenges highlighted above, the data is patchy, but nevertheless provides an insight into the conditions. The heatmaps below in Figure 5 shows the maximum daily (within school hours) temperature in each school for which we received data. Here, the colour chart turns red at the 26.7 degrees threshold highlighted above – with higher temperatures being brighter. Schools in the Pwani region experience more days where the maximum daily temperature is above the 26.7 degrees threshold.

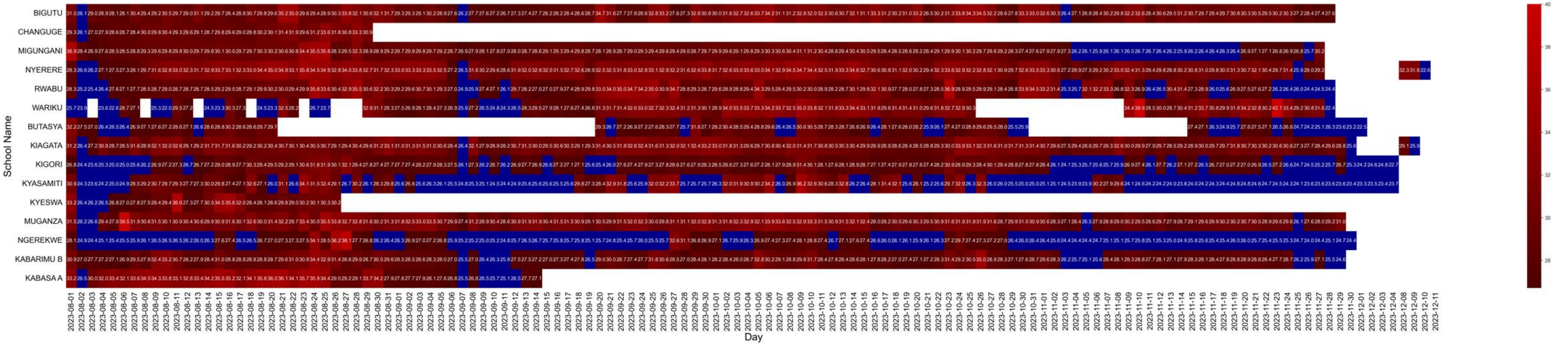
Figure 5 - Daily Maximum Temperatures in Tanzanian classrooms in this study



Daily Maximum Temperatures in Dodoma, Tanzanian classrooms

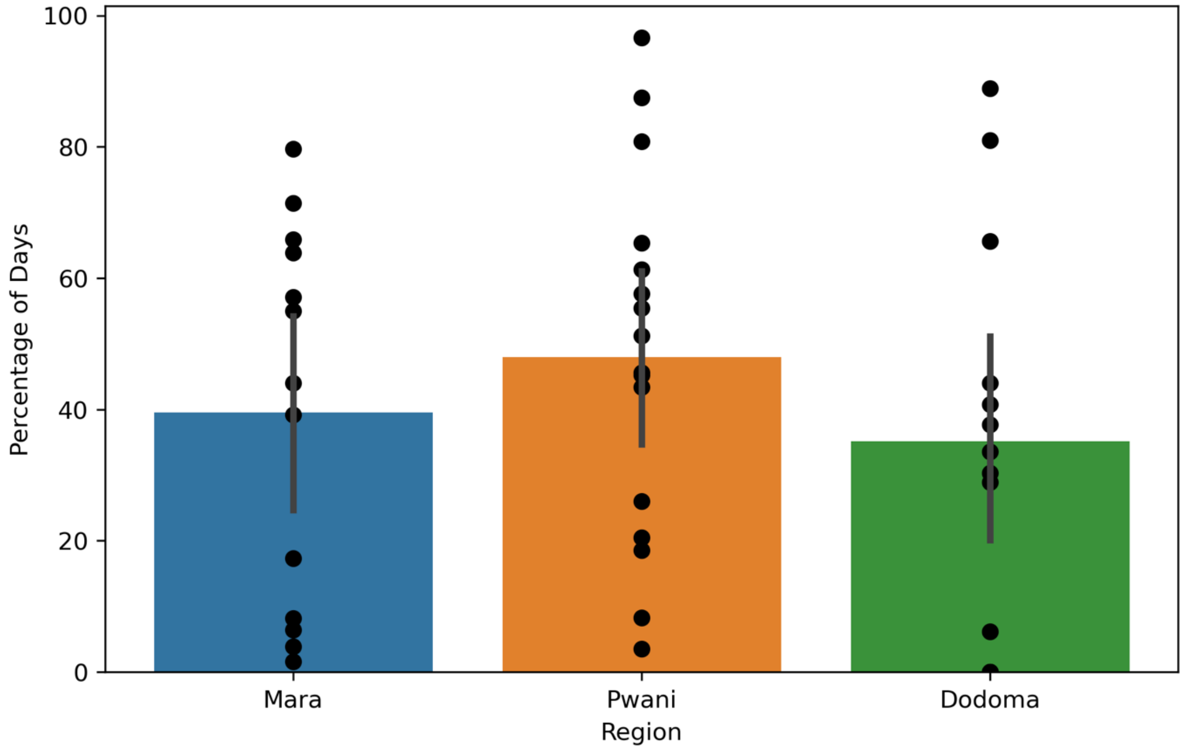


Daily Maximum Temperatures in Mara, Tanzanian classrooms



For many schools, as Figure 5 highlights, the temperatures were rising over the period, and the maximum school time temperature exceeded our benchmark increasingly often. Of the 3,961 days (across all schools) we had data from during this period, the maximum temperature exceeded 26.7 degrees for 1,716 days or 43% of the total days as shown in Figure 6.

Figure 6 - Percentage of days exceeding 26.7 degrees Celsius by region

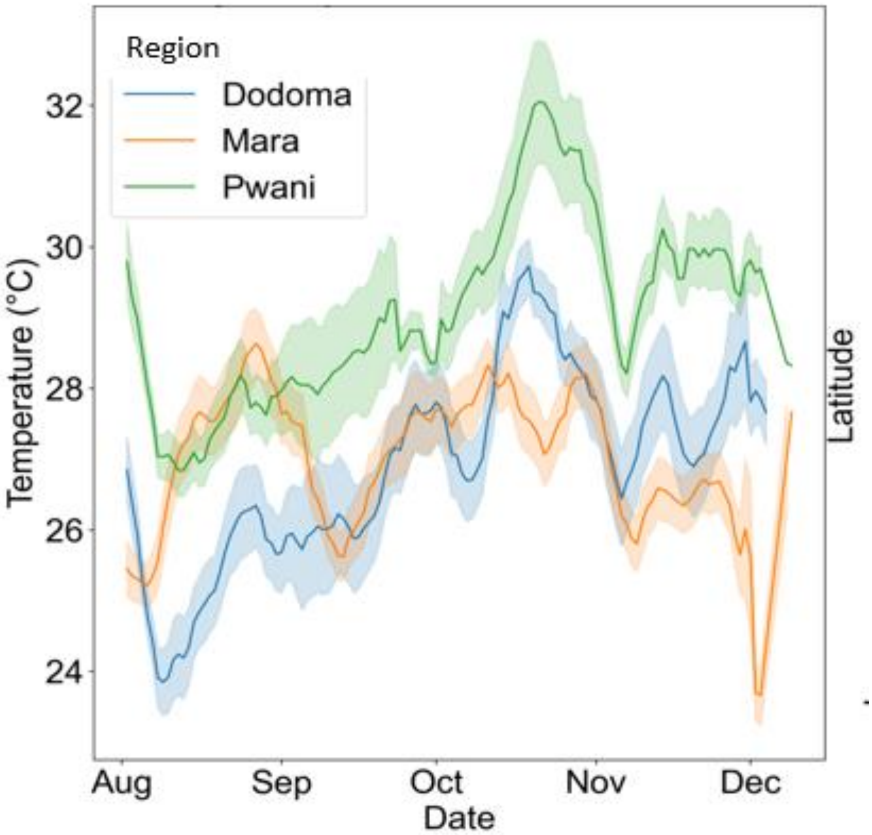


The maximum temperature is not indicative of the temperature throughout the day. To explore this further, we first look at midday temperatures, then temperatures across the school day.

Looking at the average temperature at midday over the period, we see that temperatures were rising across the months in two out of the three regions, peaking in October. Here we average across schools within each region for simplicity (though show the variance in the charts).

The plotted lines in Figure 7 below, differentiated by colour, trace the thermal trajectory over the period, showing the changing climate conditions in the classrooms for each region. This graph clearly shows a higher temperature among schools in Pwani and the temporal peak in October. It also shows that in Pwani, the average school temperature was hotter than the threshold at all times – and in October were hotter than 30 degrees consistently at midday.

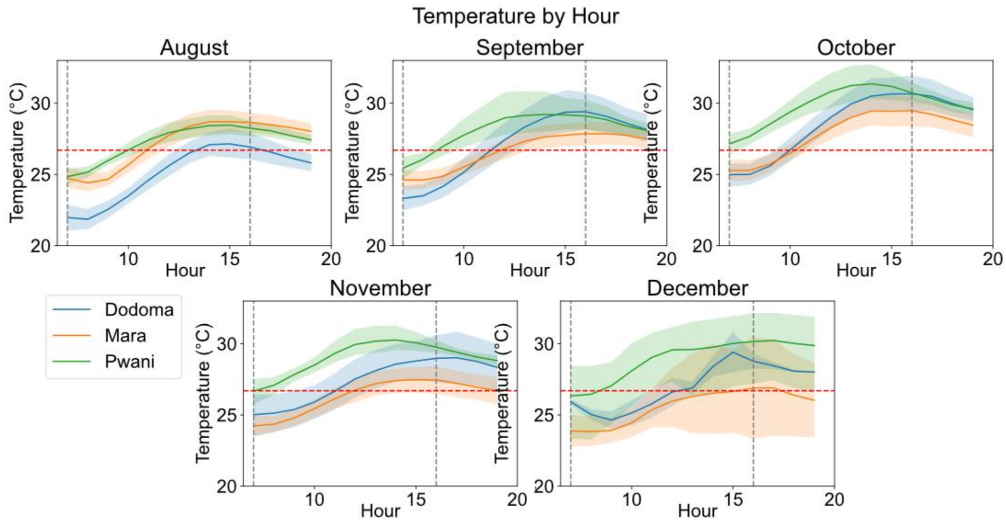
Figure 7 - Daily temperature for each region



While the temperatures in schools are certainly high at midday and have high maximums, this is not indicative of the whole experience. We are also interested in how the schools deal with the changing temperatures in the day – specifically if their construction and building materials allow them to mitigate against the temperature gains from the midday sun.

To do this we looked at the average temperature by school days across each month for each school, again splitting by region (see Figure 8).

Figure 8 - Average temperature by hour



In Figure 8, the two grey vertical lines on the graph represent the beginning and end of common school hours. As the school day progresses heat gradually accumulates, reaching its peak during the early afternoon hours at around 2 to 3 pm, which coincides with the last hour of the common school day. This suggests that as the school day approaches its conclusion, the indoor conditions become increasingly warm, potentially impacting the learning environment and student comfort. Across our sample of schools, there was no example of “double shift” schools and the school start and end times vary between 6am and 4pm, see Figure 10 below.

Dodoma stands out with the highest levels of heat accumulation during the period of analysis, implying less effective heat mitigation strategies in its schools. Mara and Pwani exhibit lower heat accumulation, suggesting better adaptation to manage heat.

3.1.1 Heat and teaching – subject timetabling

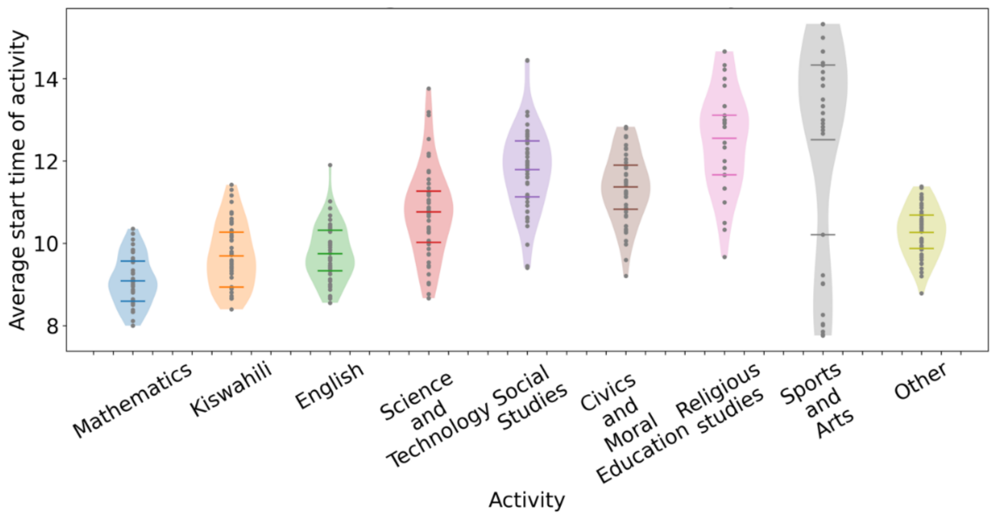
As the mornings are relatively cooler, this offers a natural opportunity to mitigate the impact of heat through scheduling. To understand this, we collected data on the typical weekly lesson timetable.

Tanzania does not have a standardized timetable, making processing difficult. To overcome this, we use sunburst graphs (shown in Figure 10) to see the most common subjects across our sample – which we then merge with the temperature sensor data, which indicates the actual classroom temperature, alongside class timetables.

By taking the average temperature on every day of the week we can get an average across the four months of collected data and show this alongside the subjects that were taught at each point in the day.

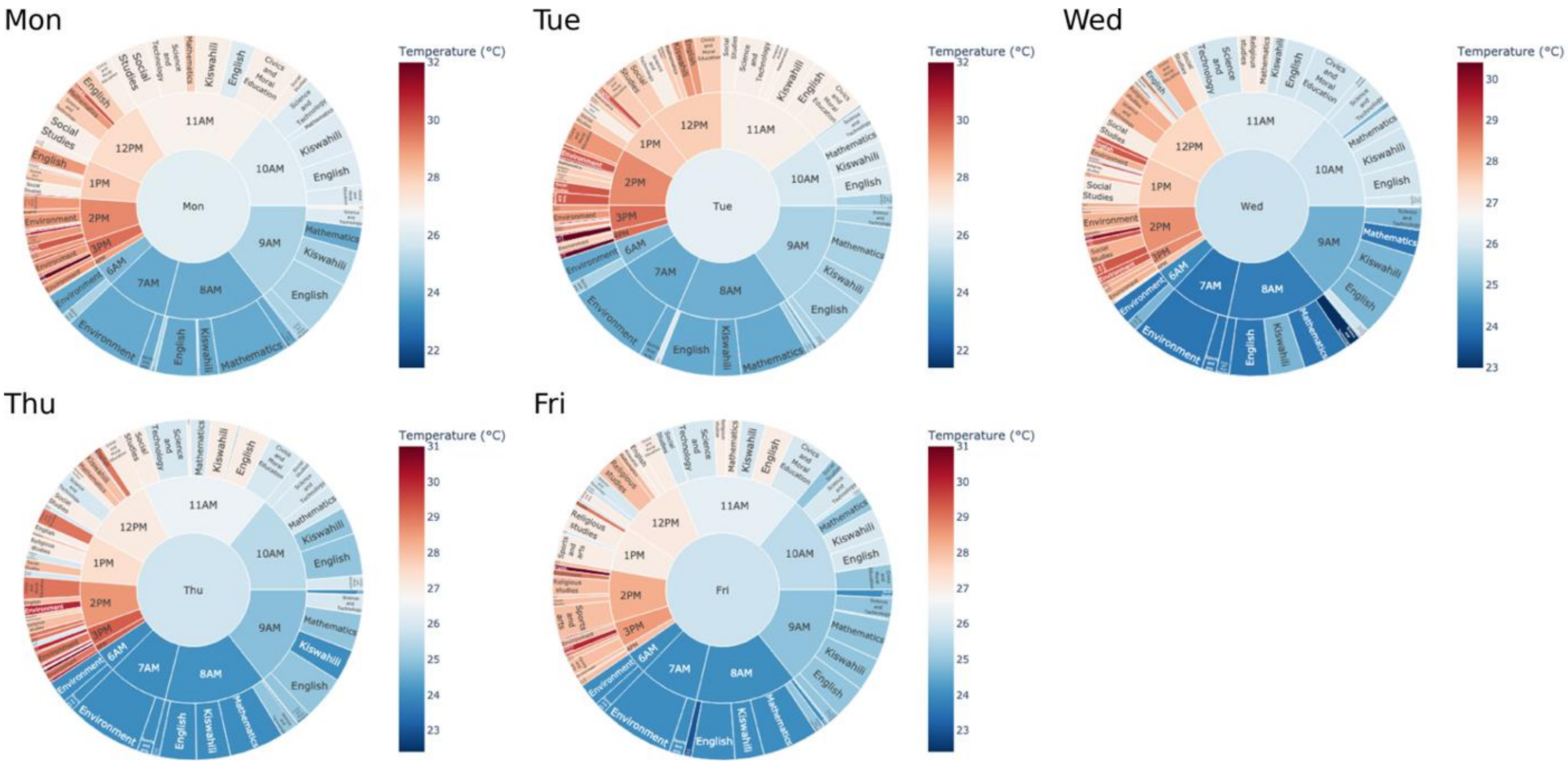
The core subjects (and exam topics), Maths, Kiswahili, Science and Technology, and English are all scheduled to happen in the morning, when classroom conditions are cooler. This is highlighted in Figure 9 in which we show the average start time for each subject. The difference between studying a topic first thing and at midday can mean studying under temperatures that are 3 degrees hotter.

Figure 9 – Average start time of each activity in the schools



The afternoons, when classrooms are considerably warmer, are more likely to see students doing art, games, or religious and social studies. This has implications for the measurement of the relationship between heat and learning outcomes, as it means that the average daily temperature could overstate the effect of temperature at the time of studying the subject or be misunderstood. This is something to explore more in future research.

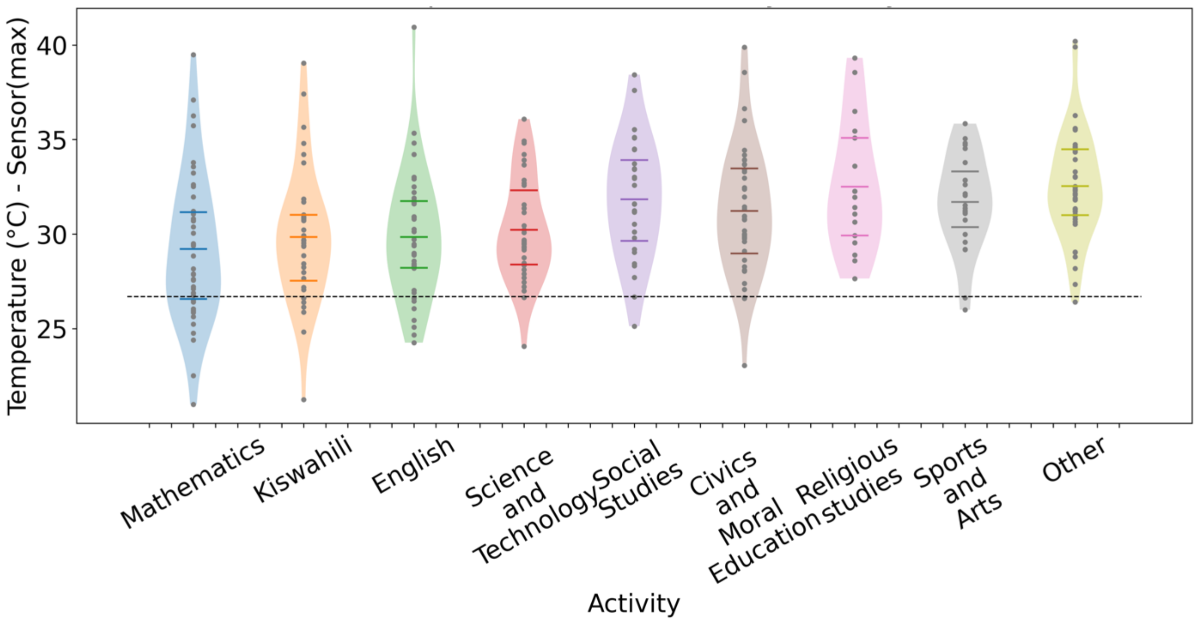
Figure 10 - Days and times of the school week with their corresponding subject and classroom temperature



We can reshape the data in Figure 10 to look at the temperature distribution across subjects. While there are obvious gains from teaching core subjects in the mornings, many lessons still take place in conditions above the 26.7 degrees threshold. This is seen in the violin plots below (Figure 11) – where the violin width shows the share of classes at that time (wider means more classes, narrow means fewer). The middle lines show the median time of the subject lesson, while the top and bottom lines show the range between which half the data is found – e.g. for mathematics, the median temperature is ~29 degrees, while half the lessons take place at temperatures between 26.7 degrees and 31.5 degrees.

The violin plots highlight a key issue, as even though the schools are teaching core subjects during the cooler parts of the day, the median temperatures in the classroom are still above the 26.7 temperature threshold and more than half the lessons take place in temperatures that are not conducive to learning. This highlights that we need to pay close attention to classroom environments and the range of factors, from design, construction, shading, and ventilation (amongst others) that either keep classrooms cooler or contribute to them heating up, even for the subjects that are taught during the cooler times of the day.

Figure 11 - Temperature distribution by activity in the school



3.2 School infrastructure – how does this help/hinder learning in high temperatures?

It is expected that schools in Tanzania experience high temperatures, given that Tanzania is a country with a tropical climate. With this context in mind, we are interested in exploring the extent to which the school infrastructure helps or hinders learning in this regard.

One way to see this is to look at the differences between the measured temperatures in schools and the outside temperatures (as measured by satellite data). To do this, we use temperature data from the European Centre for Medium-Range Weather Forecasts (ECMWF). Their ERA5 satellite data provides land surface temperature data measured in °C with approximately 9 km2 (0.1° X 0.1° latitude and longitude) granularity for each hour. This level of granularity allowed us to match the sensor data to the satellite data at each hour.

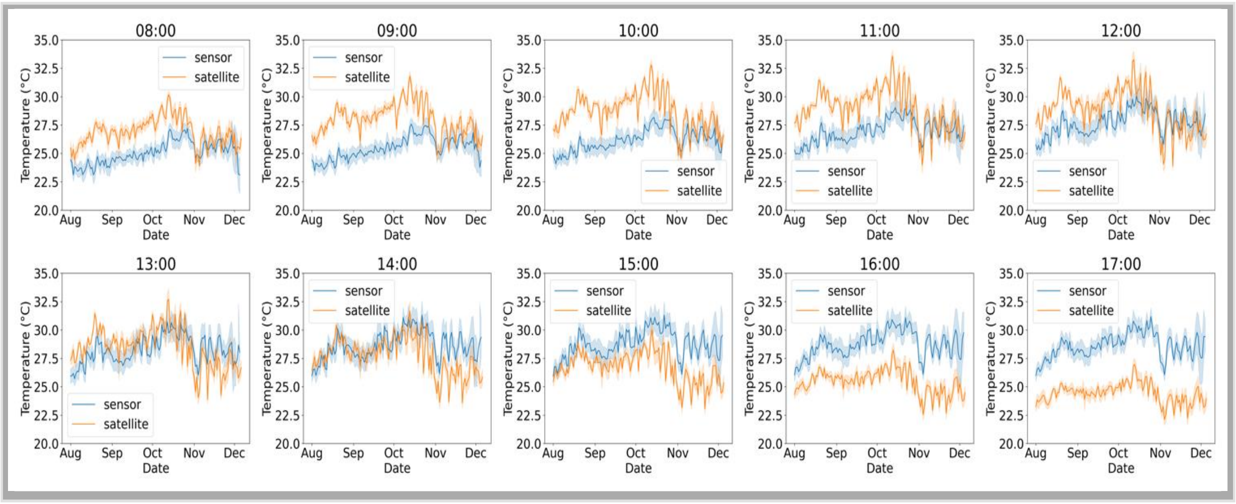
While this is not perfect since the temperature is measured for a wider area, it allows us to begin to explore indoor versus outdoor temperatures and the role played by infrastructure.

Firstly, we visualized the daily temperature pattern between these measurements between 8 am to 5 pm. The analysis is presented visually below in Figure 12 (the blue line represents the sensor data while the orange line represents the satellite data).

Between August and mid-October, temperatures recorded at 8 am by both sensor and satellite were closely aligned. As the morning progressed, satellite temperatures tended to exceed those recorded indoors, with the largest differences observed before noon. The gap narrowed around midday, with both readings aligning closely by 3 PM. After this time, indoor temperatures were generally higher than satellite readings.

From mid-October to November, sensor and satellite temperatures aligned closely from 9 AM to 2 PM, with sensor recorded temperatures being higher at other times.

Figure 12 - Classroom sensor and satellite temperature measurements during school hours



The results above show how the external temperature is higher through the morning but that the internal temperature gradually catches up and catches the external temperature before exceeding it in the early afternoon. However, it is not clear if this is due to protection provided by the infrastructure. To understand this, we tested it in two steps.

First, we measured the speed of heat increase within the room and externally, with the hypothesis being that if the highest indoor temperatures are reached slower indoors compared to externally, then the buildings did provide some protection. Specifically, we measured the increased temperature from 8 am to midday with the indoor and outdoor temperature. By calculating the ratio between increased temperature indoor divided by outdoor, we quantified the ability of the room to mitigate the heat, i.e., the lower the value the better, when the ratio = 1 there is no protection. We calculated the average ratio across schools and found that 24 schools have a ratio lower than 1, meaning the indoor temperature increases slower than outdoor temperature, whereas 21 have a ratio higher than 1, showing the opposite. These results showed that generally there was a slower temperature rise indoors compared to outdoors, showing that the school infrastructure did provide some protection from heat. We show this in Figure 13 and Figure 14, below.

Figure 13 - Raised temperature ratio (sensor vs. satellite) and number of schools

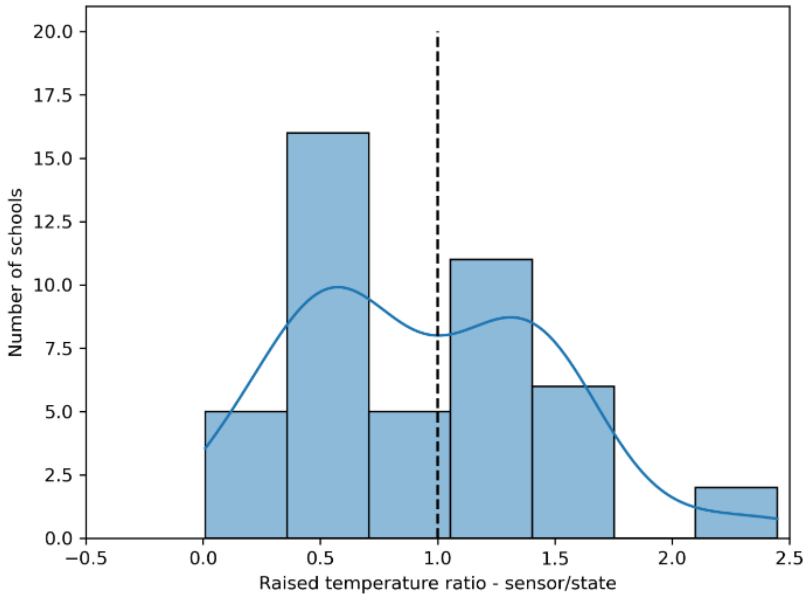
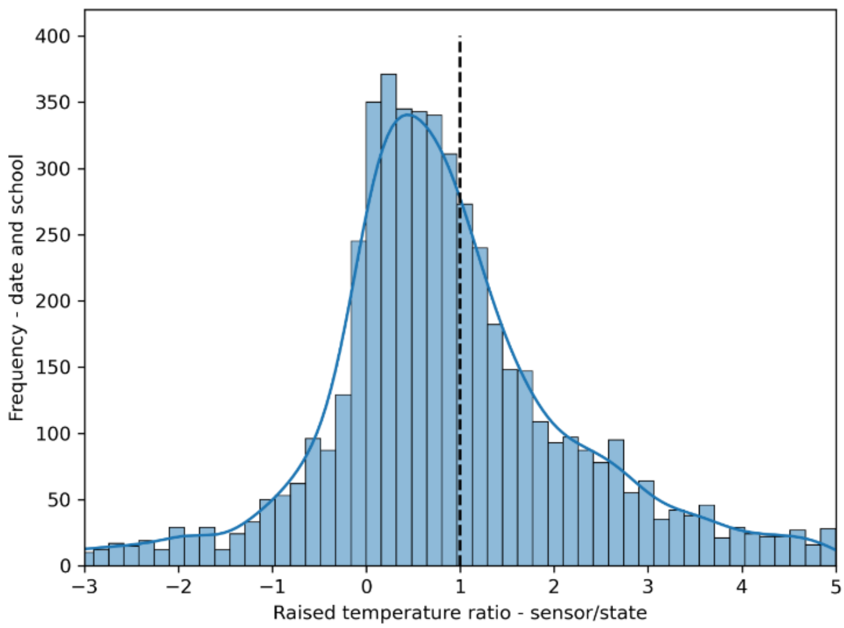
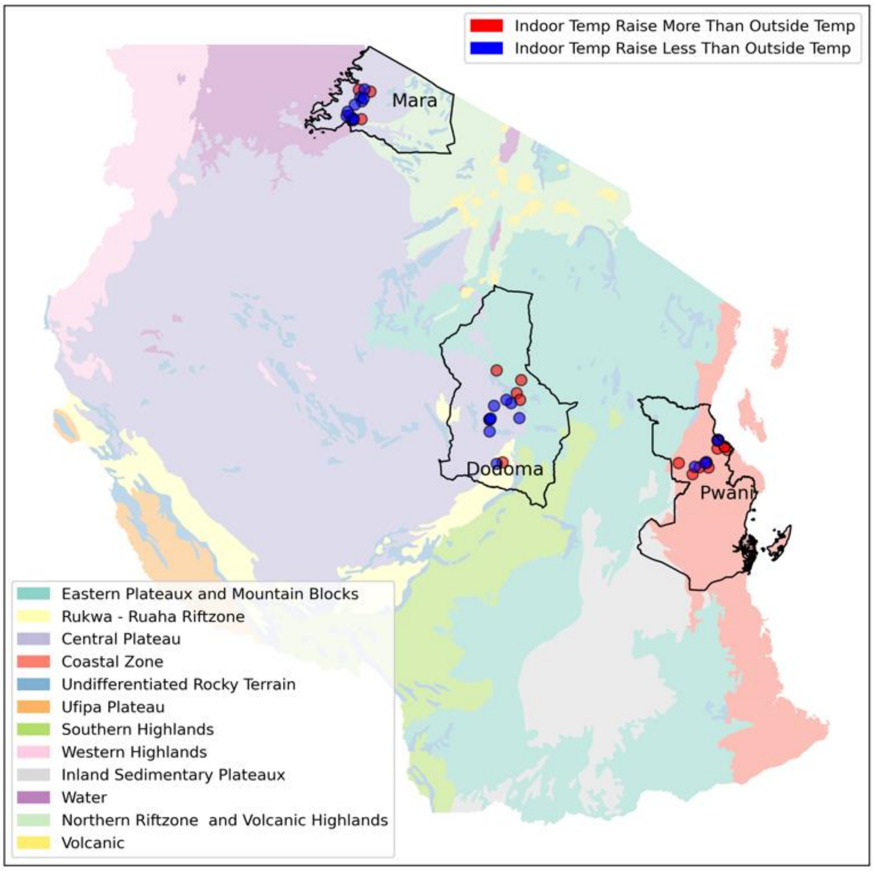


Figure 14 - Raised temperature ratio (sensor vs. satellite) and school frequency (i.e., school X days)



We further explored potential factors behind the school-level difference in the heat increasing ratios but as Figure 15 highlights, there was no clear differences between regions or school in similar locations.

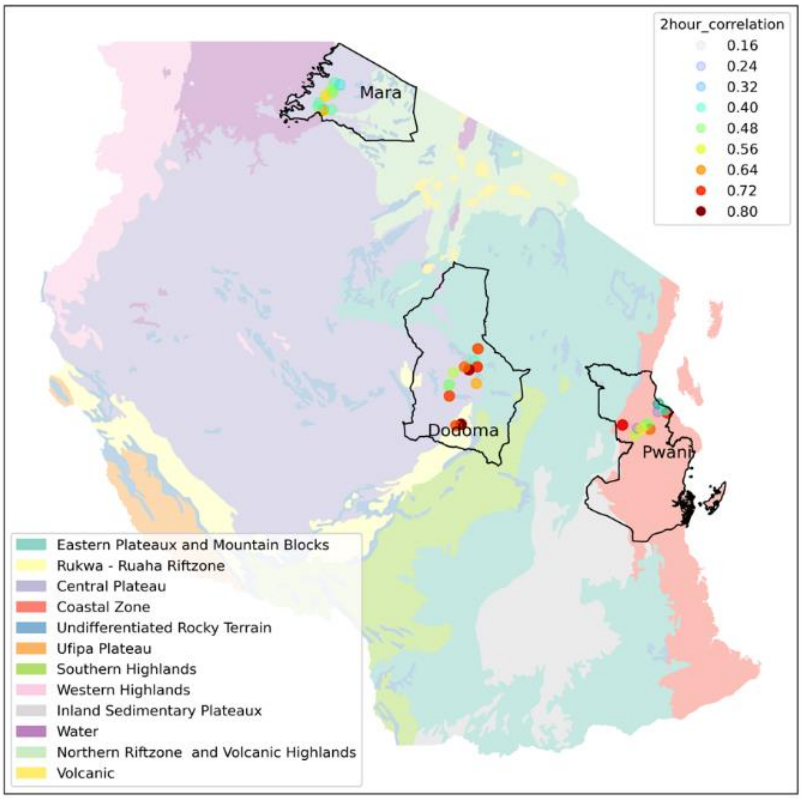
Figure 15 - School indoor-outdoor time lag correlation



Next, we looked at how long the time delay provided protection. To do so, we measure the correlation between indoor and outdoor temperatures varied with a time lag. Delays with the highest correlation show how infrastructure slows down heat accumulation in classrooms.

To do the time lag correlations, we offset the satellite data's timing relative to the sensor data and analysed the correlation between the two datasets (so we compare 11 am on the satellite with midday on the sensor etc.). By visualizing Figure M (below) and the correlation between indoor and outdoor temperatures, we can see that there is a maximum two-hour time lag when the indoor and outdoor temperatures correlate. This underscores that the building materials and infrastructure provide some cushioning against rising temperatures throughout the day, but the temperatures regularly still exceed the threshold of 26.7 degrees during the school day. Further, we calculated the correlations for each school with the two-hour delay to check the school-level consistency for this effect. From the visualization in Figure 16, we show that the schools in Dodoma have a higher correlation and schools in Mara have moderate correlation with the time lag. Multiple factors can contribute to the regional difference, e.g., distance to the sea or the general temperature within the ecological zones.

Figure 16 - Lag of indoor and outdoor temperatures for each school



Next, we analyse how classroom infrastructure contributes to the warming or cooling of classrooms and what this means for children's ability to learn in this environment. We do this by combining observation data and survey responses from the sample of 48 schools.

3.2.1 Heat and roof/ceiling

Lack of ceilings (seen in the image to the right) greatly impacts temperature and acoustics in classrooms. Metal roofs are very poor insulators of heat and sound. In tropical settings the sun is overhead for most of the day, directly heating the roof to very high temperatures. This heat is emitted into the classroom and will build up throughout the day. A ceiling, particularly made of an insulative material or with insulation added, prevents this heat from entering the classroom. From our sample, iron roofs were evident in 47 schools with the other being made from tin. Iron or tin sheets are effective in regulating internal temperatures from external heat. This links to our findings from the temperature sensor and offers a possible explanation for why there is a time lag between outside and inside temperatures. However, the roofs do not prevent internal temperatures from reaching or exceeding external temperatures.

Only 15 (31%) of the schools observed have ceiling boards, which are a means of providing insulation that reduces internal temperatures and prevent noise from rain on the roof penetrating the classrooms. Therefore, ceiling boards can improve the classroom conditions and make them more conducive to learning.

Of the classrooms with ceiling boards, seven were made from gypsum board, seven from plaster and one from wood panel. In terms of acoustics and temperature, wood is the best material, followed by plaster/gypsum board, and finally metal is the worst for reducing noise and temperature.

In terms of the outside of the roofs, in our sample the roofs are either red or grey in colour (as highlighted in the image left). The key factor with roof colour is whether it is light or dark. Lighter colours are better for reflecting sunlight so should provide cooler internal temperatures. However, colours will change over time due to exposure to rain and sun. As already discussed, the roofs are made from iron/tin sheet and therefore will probably start out reflective, however low-cost metal will become rusty dark red or brown and matt. The roof in the image (left) gives a good example of these effects, which is common across our sample. The roof shown in the image will help to increase internal temperatures as it gets older. The red paint has become darker due to weathering, which means it will absorb rather than reflect heat. This example is indicative of the state of the infrastructure as demonstrated in the images, which suggests that roofs in our sample will increase overall internal temperatures.

From our sensor data we can see that the highest temperatures are from 2 to 3 pm, the final hour of the school day. There is also a broad two-hour time lag from the highest temperatures outside to inside, which supports the idea of how the classrooms heat up due to poor roof infrastructure.

3.2.2 Heat and the classroom walls

Insufficient shading of windows and walls (as shown in the image left) allows direct sunlight to enter the classrooms and hit the external walls. Direct sunlight will heat up the building materials. In the case shown the material is concrete / earth and will retain the heat, continuing to emit it into the classroom space throughout the day even when sunlight is no longer directly heating the classroom.

Lack of ventilation gaps at the top of the walls and roof will keep the heat captured through the windows, on the walls and floor, and through the roof within the classroom.

Through our observations we can see that the main materials of classroom walls are the following:

- In Dodoma all walls are made of cement or mud, and unburnt bricks;
- In Pwani all walls are made of cement block; and
- In Mara most walls are made of cement and burnt bricks or cement and unburnt bricks.

Across the sample of schools, the most significant materials used are broken down as follows:

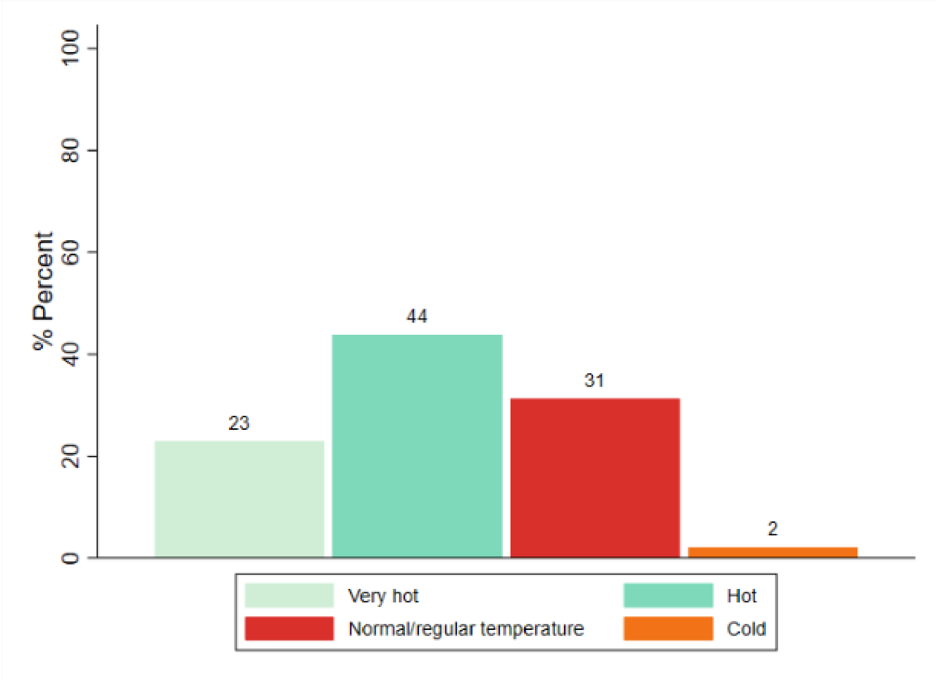
- Cement + Unburnt bricks, Mud + Unburnt bricks – 23 schools;
- Cement + Burnt bricks – 6 schools; and
- Cement blocks – 17 schools

Earth, stone, unburnt and burnt bricks and to a slightly lesser extent concrete can be good materials for school buildings due to their high thermal mass. Buildings with high thermal mass can be useful because the walls and floors take a long time to heat up. By the time they have heated up, school has finished and through the night the heat is released so that by the morning the space is cool. Therefore, the materials used are useful in terms of keeping classrooms cooler during the school day, with heat rising into late in the afternoon or evening.

The materials used keep classrooms cooler in the morning. This is backed up by the survey that we conducted with headteachers. In the morning, no headteachers said that classrooms were very hot or hot, 32 said that they were 'normal/regular', 12 said they were cold and 5 said they were very cold.

The perception of cool mornings contrasts with the perceived conditions in the afternoons (shown in Figure 17). 11 headteachers said that classrooms were very hot and 21 said that they were hot in the afternoon. This means that two-thirds of classrooms are hot and could use infrastructural improvements to create an environment more conducive to learning.

Figure 17 - Perceptions of 48 headteachers to classroom temperatures in the afternoon



There are potential infrastructural improvements that could be made through using alternative materials. Alternative materials in tropical regions involve structures using lightweight building materials with lots of well-positioned openings so that air is constantly circulating and cooling the space. Timber (wood), bamboo, mats, reeds and grass can be used for keeping buildings cool as these are all insulating materials, so help prevent the transmission of heat into a building. Plant materials can be used in walls, floors, and ceilings, either mixed within other materials in walls, for instance in earth blocks, or plaster. They can provide an extra layer of insulation as the ceiling or placed on top of a ceiling to provide insulation. In the case of thatch, this can be built as an external layer. Timber and bamboo can be used in a multitude of ways, as a structural frame, as infill, or as internal or external cladding.

When thinking specifically about walls, factors that are as important as material type for internal temperatures are thickness of walls, the extent to which walls are shaded either mechanically or by trees, the number of windows or other types of ventilation that are built into the wall, and roofs with big overhangs (for shading and rain protection). Thicker walls are also good for increasing the thermal mass of the building.

As discussed in Section 2, core subjects are mainly taught in the morning when our sensor data supports the view of headteachers that classrooms are relatively cool. This could help to explain the findings of our first report that there is only a small correlation between external temperature and learning outcomes. However, what our analysis of walls and roofs reveal is that existing infrastructure in our sample of schools is inadequate for keeping classrooms cool, something that will become more important as temperatures rise and there are more days of extreme heat due to climate change. Whilst planning the timetable around cooler temperatures is a sensible approach, our heat data suggests that the window in which this can take place during the school day is quite small and likely to be further reduced as average temperatures increase. Therefore, investments are needed to make classrooms more resilient to extreme heat and bring internal temperatures down during the hottest months and times of the day.

3.2.3 Windows and ventilation

A good ventilation system is important in hot and tropical countries to keep buildings at a comfortable temperature and ensure indoor air quality that keeps occupants healthy.[25] Many tropical countries rely on mechanical ventilation to keep buildings cool and improve indoor air quality but without these systems, as is evident in the schools from our sample, then a passive ventilation system (natural ventilation) is essential to ensure a good flow of air into buildings, keeping spaces cool and the air fresh.[26]

A common cause of poor indoor air quality is that sufficient fresh air is not able to enter the classroom alongside inadequate systems for air to flow out of the classroom.[27] This means that within the classroom rates of CO2 often exceed a healthy level for extended periods of time.[28] A recent study in Tanzania asked students in a school in Dar Es Salaam about indoor air quality and found that 75% of students wanted classrooms to have better air quality.[29]

Poor ventilation can impact on learning, education outcomes, and on the health and wellbeing of students.[30] As we have already highlighted, students in tropical countries are often more comfortable with warmer temperatures than students from cooler climates. However, unhealthy classrooms that do not provide comfortable environments produce both direct and indirect impacts on education. Direct impacts include reduced performance, attendance, and concentration.[31] Indirect impacts can be an increase in respiratory health conditions such as asthma from dampness, exposure to external pollutants, or increases in CO_2 and NO_2 from inadequate ventilation.[32]

School children can be vulnerable to poor classroom conditions for several reasons. Firstly, often classrooms have high occupancy rates in relation to the size of the classroom. Secondly, students are in classrooms for extended periods in which their activities and clothing are to an extent regulated and outside of their control.[33] To increase thermal comfort and air quality

[25] Daghigh, R. 2015. Assessing the thermal comfort and ventilation in Malaysia and the surrounding regions. Renewable & sustainable energy reviews. 48, pp.681–691.
[26] Daghigh, R. 2015. Assessing the thermal comfort and ventilation in Malaysia and the surrounding regions. Renewable & sustainable energy reviews. 48, pp.681–691.
[27] Wargocki, P. and Wyon, D.P. 2013. Providing better thermal and air quality conditions in school classrooms would be cost-effective. Building and environment. 59, pp.581–589.
[28] Wargocki, P. and Wyon, D.P. 2013. Providing better thermal and air quality conditions in school classrooms would be cost-effective. Building and environment. 59, pp.581–589.
[29] OpenDevEd. 2023. IMPROVING TANZANIAN CLASSROOMS: Conducting surveys in Tanzanian Schools – Second pilot. OpenDevEd. [Online] Available at: https://opendeved.net/2023/09/11/ilce-conducting-surveys-in-tanzanian-schools-second-pilot/
[30] Mohamed, S., Al-Khatri, H., Calautit, J., Omer, S. and Riffat, S. 2021. The impact of a passive wall combining natural ventilation and evaporative cooling on schools' thermal conditions in a hot climate. Journal of Building Engineering. 44, pp.102624-.
[31] Mohamed, S., Al-Khatri, H., Calautit, J., Omer, S. and Riffat, S. 2021. The impact of a passive wall combining natural ventilation and evaporative cooling on schools' thermal conditions in a hot climate. Journal of Building Engineering. 44, pp.102624-.
[32] Mendell, M.J. and Heath, G.A. 2005. Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. Indoor Air, 15, pp.27-52.
[33] Wong, N.H. and Khoo, S.S. 2003. Thermal comfort in classrooms in the tropics. Energy and buildings. 35(4), pp.337–351.

through passive ventilation, operable windows, cross-ventilation, shading, and ensuring air can leave the classroom are important characteristics of a well-ventilated classroom.

Figure 18 highlights another important dimension of how heat can impair lessons, as improving ventilation was cited by 31% of headteachers as the most important factor in classroom conditions. From the survey that we conducted, only 6 schools had all classrooms containing windows that opened to the outside (see Figure 19, below) and 21% of schools had most of their classroom windows opening to the outside. Twenty schools (42%) had no windows that opened to the outside. Furthermore, 10 schools had 100% of their classrooms with ‘broken windows (either glass is broken, or shutters are broken).

Figure 18 - Headteachers' perceptions of the most important factor in classroom conditions

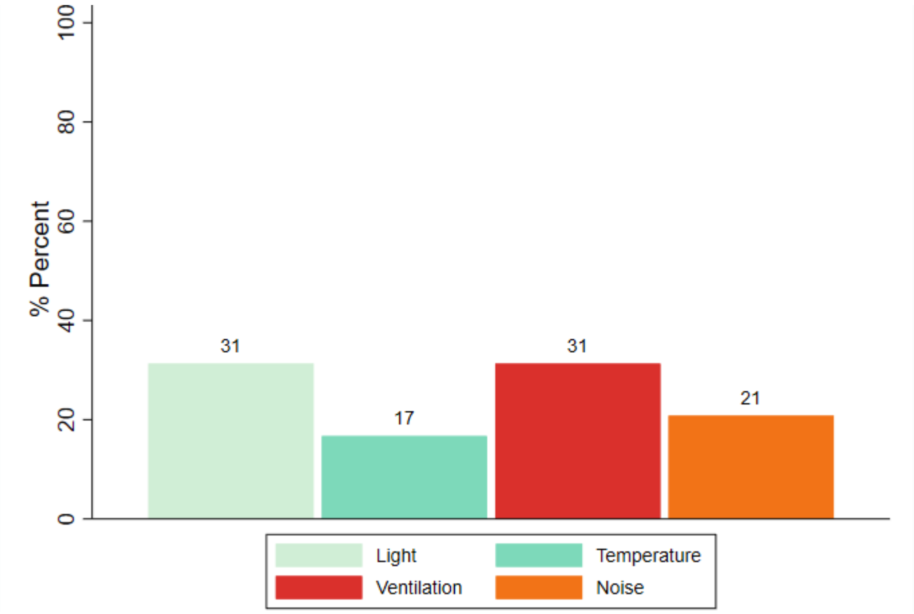
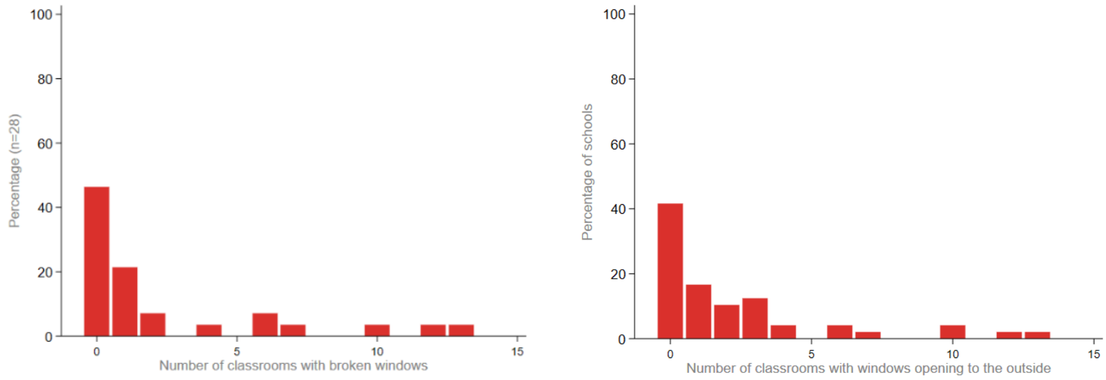


Figure 19 – Condition of classroom windows



When combining the latter figure with the number of schools that did not have windows, it means that 63% of our sample do not have any adequate windows in their school. Furthermore, only 21% of schools in our sample had all their windows working. Functioning windows are important and have implications for heat, light, and ventilation. Without a steady flow of air, classrooms will heat up through the day and create uncomfortable and stifling atmospheres that are not conducive to learning.

With the right improvements to windows infrastructure, teachers could potentially modify internal classroom temperatures with shading that can be controlled, such as moving louvers. For instance, if it is too cold in the morning, headteachers could deliberately allow morning sun in to heat up the classroom, and then prevent it from hitting the building for the rest of the day.

3.2.4 Heat and infrastructure discussion

When we asked headteachers to rank the conditions of light, temperature, ventilation and noise in their classrooms, temperature was jointly ranked the worst (alongside noise) by 42% of headteachers. This highlights that the temperature of classrooms is an important issue that needs resolving to create environments that are conducive to learning. Even though our temperature sensor data, observations, and headteachers perceptions data all point to the fact that temperature is an important issue, only 4 out of 48 schools (8%) said that classrooms became unusable due to excessive heat. Temperature was also the lowest ranked in terms of importance of the different environmental factors that we looked at, see below. Whilst heat did not make classrooms unusable, when we conducted the second survey, 33% of headteachers said that classrooms become unusually hot at different points, which can in part be explained by the inadequate infrastructure, especially roofs and windows, the fact that many classrooms were without ceiling boards, and through either a lack of windows or windows that cannot open.

We also explored what impact heat had on learning when classrooms became unusually hot. Unsurprisingly, of those that responded to this, most of the impacts were seen in terms of children's ability to concentrate, as highlighted in the following quote:

"Lack of stability in the classroom and children falling asleep and failing to focus on what is being taught."

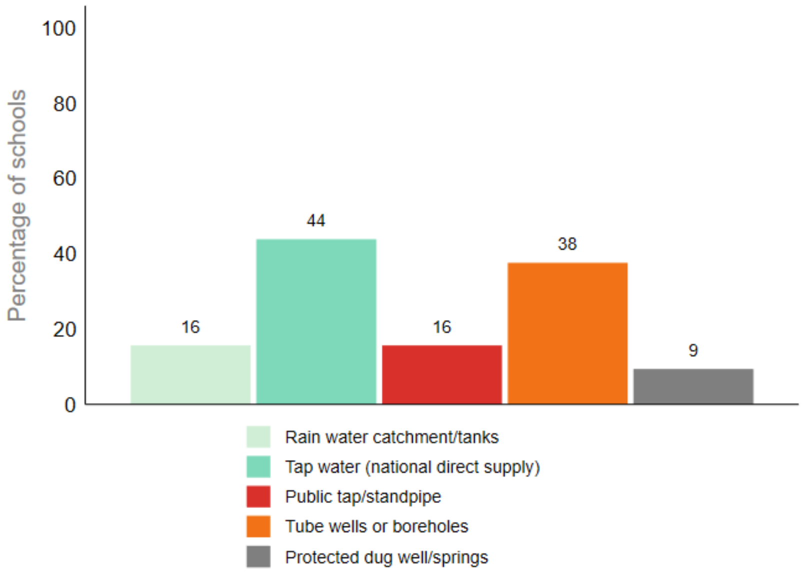
This was also expressed as children becoming restless, 'sleepy', or unable to understand what was happening in the lesson. One headteacher commented that children skip lessons if it is too hot in class and one commented that it impacts on teachers' ability to deliver lessons. Therefore, whilst heat does not stop lessons taking place, it does impair the effectiveness of lessons through children being unable to concentrate, absenteeism, or teachers being unable to teach properly. These insights tie into the literature discussed in Section 1, as they are based on the idea of classrooms being unusually hot and that these have physiological and cognitive impacts to students and teachers. Furthermore, the comment about children sitting together is interesting as our observations highlight that parts of classrooms become unusable, either through degraded floors or lack of shade from direct sunlight, and so large classes may be forced into small areas of the classroom, thus making the classroom feel hotter and more uncomfortable.

The final point to discuss is the link between heat and water in reference to our sample of schools. A child's water requirement per day depends on their weight but an average 8-year-old girl (weighing 25 kilograms) will require about 1600 ml of water per day.[34] Adequate hydration is especially important in tropical countries such as Tanzania. As our findings demonstrate, the classroom infrastructure in our sample schools is inadequate for keeping temperatures low. In many instances direct sunlight can enter the room, and this means that a basic level of safe drinking water becomes vital for children's health and learning abilities.

Our survey revealed that one-third of schools did not have access to a source of clean water. 10 schools that had water access said that it was disrupted at points by extreme weather, with 2 schools being disrupted for 6 to 7 months, 2 schools for 2 to 3 months, and 2 for less than or equal to a month. This suggests that the other four schools who said that water access was disrupted have intermittent disruptions. This means that of our sample of schools, 54% do not have a constant supply of clean water throughout the school year. In the context of high average external and internal classroom temperatures, alongside the risk of more days of extreme heat due to climate change, the picture that our research creates has worrying implications for child health, wellbeing and ability to learn.

We also looked at school's sources of water, which is shown in Figure 20.

Figure 20 - Sources of water



Safe water should be "protected from outside contamination".[35] Private connection, boreholes, protected wells/springs, and rainwater collection are all within this definition (dependent on the state of the infrastructure). As can be seen from the results of the survey, tap water and wells or boreholes are the most common sources of water for schools in our survey. Rainwater catchments are also a common source of water, which is potentially vulnerable in a drought.

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[34] Unaiza Faizan; Audra S. Rouster. 2023. Nutrition and Hydration Requirements In Children and Adults.
[35] World Health Organization. 2024. Improved sanitation facilities and drinking-water sources.

Public taps, also used by some schools, have potential health risks as it is difficult to ensure their sanitation.[36]

Further research is needed to understand whether the amount of water infrastructure is adequate, the state of the infrastructure, the school's ability to maintain the infrastructure, and how vulnerable the water sources are to climate change and extreme weather conditions.

[36] World Health Organization. 2024. Improved sanitation facilities and drinking-water sources.

4. Rainfall

Rainfall can have an impact on education and education outcomes, through several ways. Firstly, "weather shocks" comprising of positive or negative deviations from the rainfall average lead to impacts through droughts or floods. A key area of analysis within this field is on education outcomes being impacted by school attendance. This can be through direct or indirect causes of disruption to education. Droughts can have a big impact on attendance as households develop coping strategies, especially in areas that rely on agriculture for livelihoods, often linked to reduced income, which means many children undertake work to support the family, or families cannot pay school fees.[37]

Outside of extreme flooding events, in many tropical country's small increases in rainfall above the average can be associated with increased education outcomes. This is often linked to childhood development where lack of rain leads to poor nutrition in early life, which impacts on physical and cognitive development.[38] This may be outside the scope of this study but it highlights some of the complexity and ambiguity that extreme weather and climate change creates.

A second important way in which rainfall can negatively impact on education is through school closures due to floods. Flooding can damage school infrastructure, leading to short- or long-term school closure depending on the severity. Floods can also damage the roads that students rely on to get to school.[39] Noise is another important factor that can mean that classroom conditions are not conducive to learning.[40] Whilst there is extensive research on the impacts of large-scale flood disasters, there is limited evidence on the impact of small-scale and localised flooding events, including the number of days that are lost either through school closure, student absenteeism, teacher absenteeism, or impact on learning facilities.[41] In this section we focus on how rainfall impacts on the classroom environment and on children's ability to attend school.

What our primary research demonstrated was that rainfall presents several challenges to education and requires a range of different responses to mitigate the impacts, depending on the challenge identified in individual schools. In this section, we outline the current problems in reference to infrastructure, the classroom experience, headteacher perceptions of the

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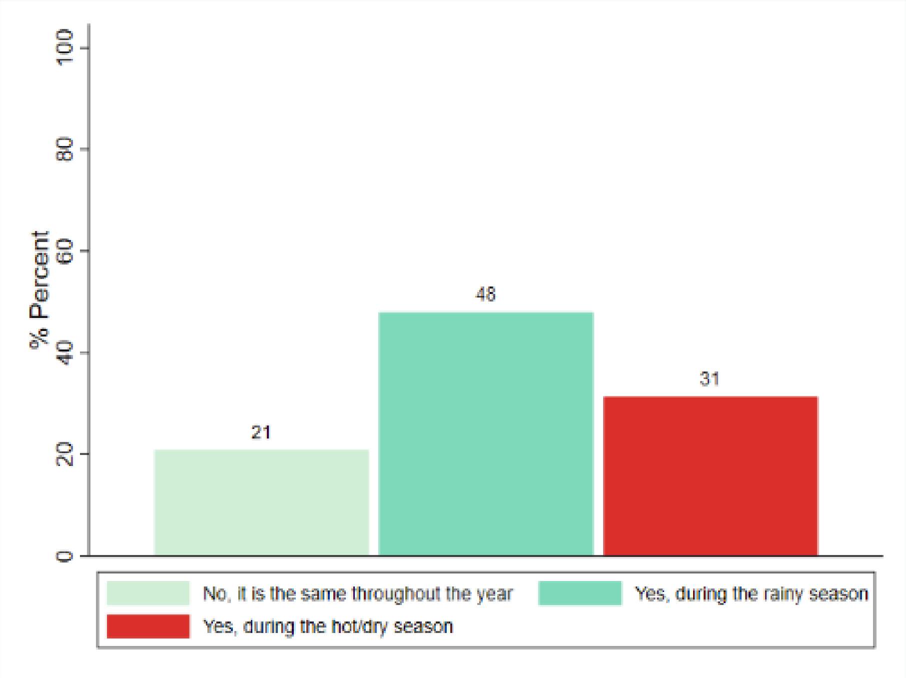
[37] Agamile, P., & Lawson, D. 2021. Rainfall shocks and children's school attendance: evidence from Uganda. Oxford Development Studies, 49(3), 291-309. https://doi.org/10.1080/13600818.2021.1895979
[38] Randell H, Gray C. Climate change and educational attainment in the global tropics. Proc Natl Acad Sci U S A. 2019 Apr 30;116(18):8840-8845.
[39] Paola Palacios, Libardo Rojas-Velásquez. 2023. Impact of weather shocks on educational outcomes in the municipalities of Colombia, International Journal of Educational Development, Volume 101
[40] Y. Bekkouche & Kenneth Houngbedji & Oswald Koussihouede, 2023. "Rainy days and learning outcomes: Evidence from sub-saharan Africa," Working Papers hal-03962882, HAL.
[41] Lassa, J., Petal, M. and Surjan, A. 2023. Understanding the impacts of floods on learning quality, school facilities, and educational recovery in Indonesia. Disasters. 47(2), pp.412–436.

impact of rainfall, and the broader issues that rainfall and flooding create in terms of school access.

Figure 21 highlights that 48% of our sample of headteachers felt that children's concentration was negatively impacted during the rainy season. As already discussed in Section 3.2.1, we can see that all the classrooms' roofs are constructed with iron or tin sheets. In many cases, they also have poor insulation internally which means that noise from rainfall impacts lessons during the rainy season.

Figure 21 - Headteachers' perception of children's concentration in different season



4.1 Rainfall and infrastructure

4.1.1 Rainfall and noise from roofs

Returning to a previous image (right), the noise from heavy rain hitting the metal roof will impair the classroom's learning environment since teachers and pupils cannot hear each other. A ceiling will greatly reduce this noise from entering the classroom, making it usable during heavy rains.

Noise was ranked as the worst classroom condition in our headteacher survey by 42% of headteachers. When we look at sources of noise, "noise outside of school" (12) and "noise from other classes" (16) are identified as the most common sources of noise. 16% ranked rain as the most common source of noise and 26% had rain as their second most common source. Collectively, 42% of respondents had rain in the top two most common sources of noise.

As rainfall is only prevalent in two distinct seasons, we can still conclude from these rankings that noise from rainfall seems to be one of the biggest problems in reference to environmental factors that inhibit learning in our sample. As shown in Section 1, rainfall projections for Tanzania suggest that as well as less frequent rains climate change will create more intense rainfall events, which judging by the state of infrastructure in our sample schools will be disruptive to learning through increased noise and water entering the classroom. As the image above highlights, the material of the roof, lack of ceiling boards, and other forms of insulation are key factors that need to be addressed, which as outlined in Section 3 would also provide the benefit of cooler classrooms in the afternoons.

4.1.2 Rainwater entering the classroom

Rainwater entering the classrooms through the roof is a major concern and is evident in many of the classrooms that we observed. It makes all or part of the classroom unusable during downpours. Residual water on floors and walls can continue to make the spaces unusable for some time after it rains. Wet walls and floors will have long-term serious impacts on the condition of the classrooms. In turn, this negatively affects the comfort, ability to learn and the health and safety of the classroom users.

There is evidence of several reasons why the roofs are failing to protect the building and its users from rainfall. From our observations we can see that many classrooms have holes in the roof due to; insufficient overlaps between roof sheets, holes from badly positioned nails, corrosion due to poor quality materials, insufficient number of fixings, and weathering of roof materials.

The problems most likely arise from poor design, materials, and construction. Once there are holes in metal sheeting it is very hard to remedy other than to replace the sheets. In this image (left) it looks as if the sheet has been re-used from elsewhere. The holes are in a line, as if it was originally nailed along a purlin, then taken off and put in a new location where the holes made previously did not line up with the purlins anymore.

Another issue that arises from heavy rainfall is that roofs do not shed water effectively. A common reason for this is the pitch (gradient) of the roof, as the image on the right demonstrates. Many roofs are fixed at a shallow pitch which allows rainwater to enter between the roof sheets and sit on the roof, causing corrosion of the metal and eventually holes.

In this photo (left) water from the roof has been pooling on the top of the ceiling boards down the centre of the classroom. This is most likely caused by an insufficient overlap between the ridge piece and the roofing sheets.

Rainwater pooling on the floor of the classroom makes it unusable. Stagnant water will breed mosquitoes carrying malaria creating additional health risks linked to water-borne diseases. Unprotected or non-stabilised (without cement) earth floors will break up under water. Floors need to fall very gently towards a drain or gulley to allow any water that does enter to escape.

The photos show water pooling and the effect this eventually has on the floor. Here, 50% or even less of the classroom is usable. Deterioration of the floor will add to the build-up of dust in the air which also has a negative impact on the health of the occupants. As was discussed in Section 4.1.1, this also has an impact on how comfortable classrooms are in terms of heat, as students are forced into more cramped conditions in the small sections of the classroom that are usable.

Dampness and mould are caused by building elements getting wet and remaining wet. Using buildings in this condition is dangerous, as exposure to mould and dampness can cause long-term health problems.

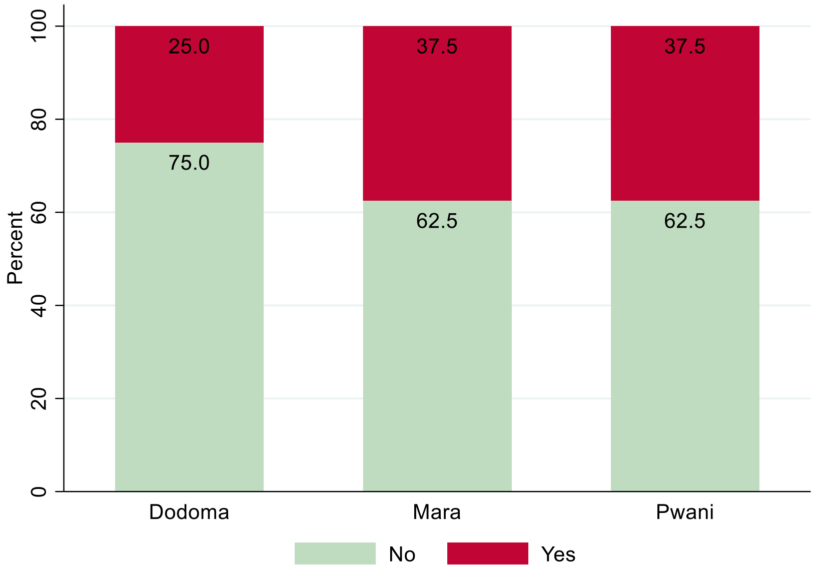
Classrooms should have roofs that have sufficiently long overhangs to prevent rainwater from entering the classrooms through openings or through walls getting wet from rainwater runoff.

As extreme rains and winds become stronger and more frequent due to climate change, it may not be possible to prevent the external walls (particularly nearer the ground) from getting wet. Walls should be able to shed water and to dry out once wet. Factors that contribute to the walls remaining damp and growing mould in the classrooms assessed here are poor ventilation, poor mix used for walls (possibly including organic material), adding cement render and/or oil-based paint on top earth blocks, and poor maintenance.

4.2 Flooding and effects on learning

Another element where we see rainfall having a significant impact is through flooding (see Figure 22, below), which can be linked to the conditions of school infrastructure. This has impacts within the classroom and on school accessibility as children travel to school on flood affected roads.

Figure 22 - A high share of schools reported flooding during the rainy season



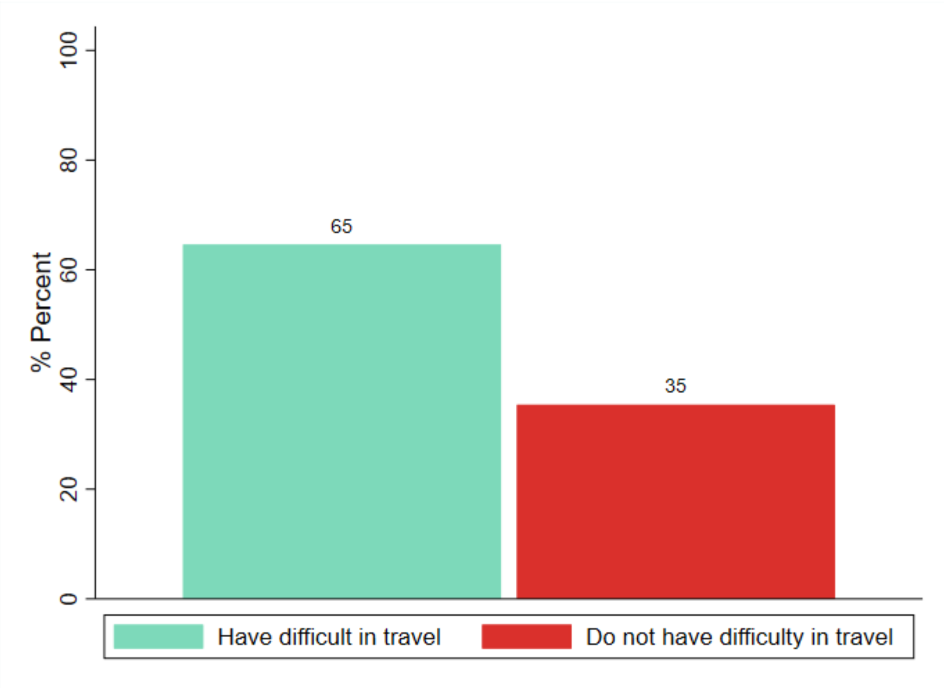
On average, about one-third (33%) of classrooms experienced flooding during the rainy season. However, headteachers reported a few classrooms becoming unusable due to flooding. However, what the observations in this section highlight is that whilst classrooms are still in use, they are not necessarily in good condition. Many of the classrooms we observed are damp, have floors in a state of disrepair, have pools of water in them, or have a part of the classroom made unusable due to water, as in the image on the left. Therefore, whilst classrooms are still being used, we should not assume that they are in a fit state for learning. Combining this with our observation data that we have highlighted in this report, we see that many of the school roofs are old, not well-positioned for rain run-off, or have gaps where water can enter the classrooms and create mould. One headteacher summarized it as follows:

"The rain makes noise, and the notebooks get wet to a large extent, teachers are unable to come to the classrooms for fear of getting wet, wetness in the classroom."

This quote shows how rain creates several different types of impact. Firstly, noise caused by the rain can affect teachers' and students' concentration and ability to hear. Secondly, there is also possible degradation of the classroom as a result of the dampness. Lastly, flooding can impact teachers' and students' ability to get to school.

An important issue that impacts learning was highlighted when discussing flooding in relation to travelling to and from school. As Figure 23 indicates, about two-thirds (65%) of schools say that students and staff have difficulty travelling to and from school during the rainy season. This has implications for impacts on learning, student wellbeing and safety.

Figure 23 - Percentage of students that have difficulty getting to and from school during the rainy season



We decided to dig into these numbers with a second survey. Just over a third (35%) of schools were impacted in the latest rainy season in terms of the roads that children travelled on becoming flooded. Schools affected reported increased absenteeism, children missing periods, or being unable to learn when they were able to attend. This is summarized well in this quote:

"Students do not come to school, so they miss periods. Students arrive very late. When they arrive, they are not in a good learning condition."

Aside from the impact on students, headteachers also highlighted that teachers were impacted by floods which led to lessons being cancelled. This shows that flooded roads can have an impact on learning even if students themselves are not personally affected or can still get to school. Two headteachers highlighted (unprompted) that flooding and access led to more children failing exams. The quote below summarises the impacts:

"Students miss lessons, students fail to arrive at school on time and students fail exams for failing to attend some study days."

When headteachers discussed strategies to minimize disruptions, 12% of them advised parents to accompany children to school, end classes early or advised children to stay at home ahead of heavy rains. This highlights that school-parent interaction is an important element of minimising flood impacts in terms of student safety, and that flooding does impact on learning. Other mitigating strategies discussed include repeating lessons, altering the timetable for key classes and having extra sessions for students preparing for exams. One respondent even said that during exam periods students should stay with teachers. This demonstrates that schools are responding to try and minimize the impacts that flooding has on child safety, education and learning outcomes.

An important consideration is that the majority (60%) of schools that reported being impacted by flooding felt unable to support students facing travel difficulties. A common response from headteachers was that roads were outside of the control of schools so 27% of affected schools talked about engaging with different local authorities either on road maintenance, increased school budgets, and even on building new schools that would be more accessible to children. This demonstrates the limitations of schools' capacity to devise strategies that can effectively support learning to continue during heavy rains.

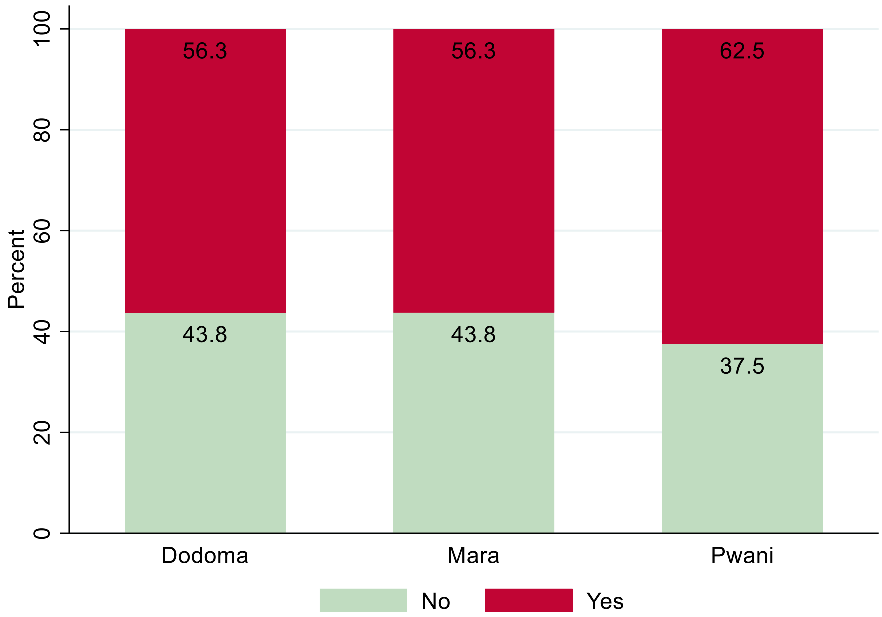
What our surveys show is that school accessibility during rainy season is deemed an important issue by headteachers and needs to be addressed in several ways. This includes parent-teacher coordination, improved information, and work to reduce the vulnerability of roads to flooding.

5. Climate change and intersecting challenges

For this report, we were interested in headteachers' perceptions of climate change and how this ranked alongside other concerns. We restricted our survey to headteachers due to a combination of budget restrictions and because we felt that headteachers would have a good understanding of the conditions in their schools. Their responses help us to understand more about how climate responses can be crafted to tackle the intersecting challenges schools face.

As Figure 24 shows, more than half of the interviewed headteachers (58%) believe that climate change negatively impacts the schools either through extreme heat (41%), increased rainfall (57%), or increased flooding (18%).

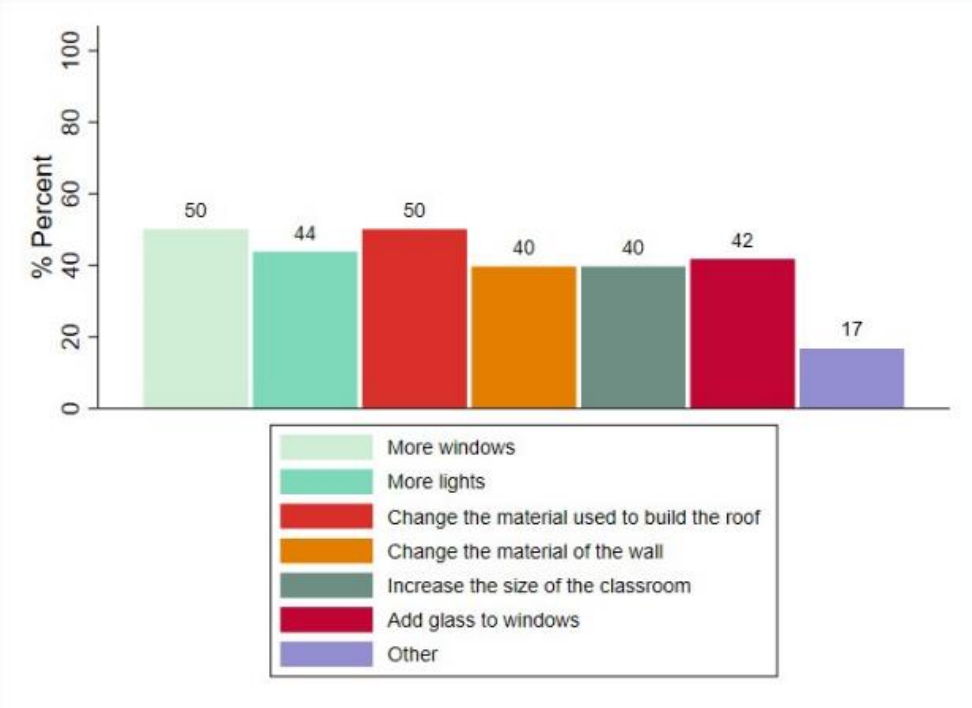
Figure 24 - Percentage of headteachers who think climate change negatively impact the school



Despite a majority of headteachers showing concern about climate change, only one teacher considered climate change as a main concern. Other issues, such as students' nutrition, school budget, and school infrastructure were considered more important concerns. Whilst this is unsurprising, fixing inadequate school infrastructure alongside investing in more climate resilient education infrastructure should become a priority area for the Government of Tanzania. This is key to creating an environment conducive to learning in the present and will be central to the development of a climate resilient education system in Tanzania.

We asked headteachers what they felt were the priority improvements that could be made to their classrooms. As can be seen in Figure 25, there is a fairly even split across the categories with "more windows" and "change the materials used to build the roof" being mentioned by half the headteachers. Whilst in previous answers teachers suggested there were enough windows for their basic needs, the state of those windows is questionable, with a significant percentage being broken. This suggests that concern about windows is related to their functioning.

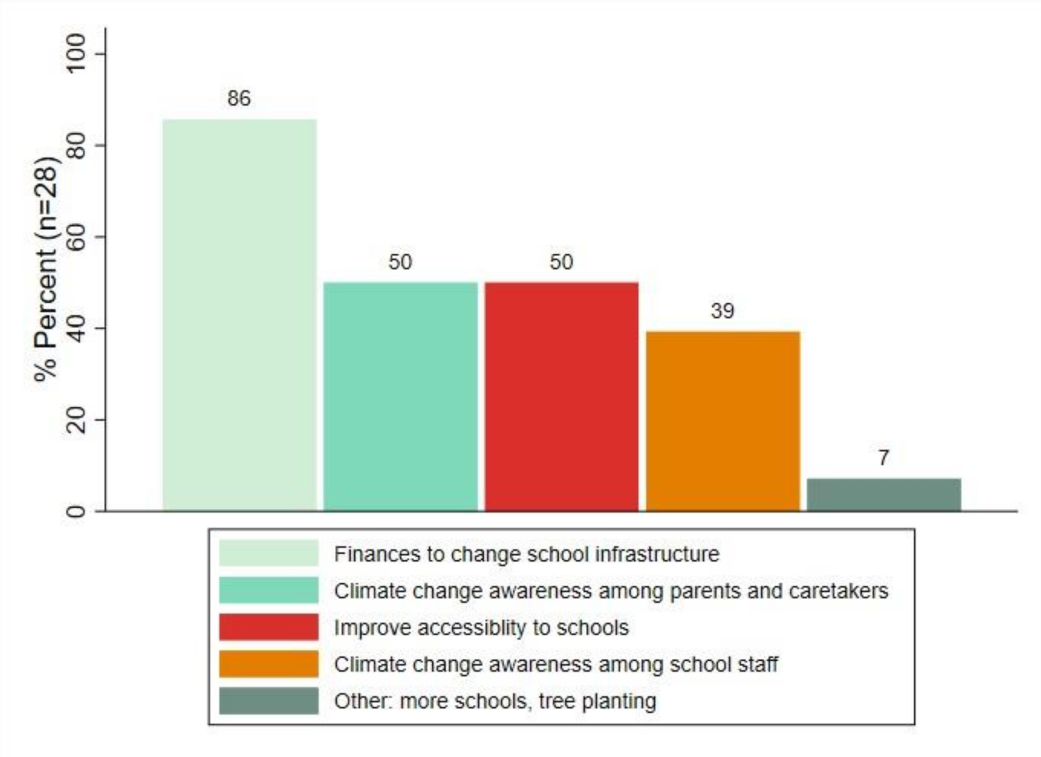
Figure 25 - Headteachers' top priorities for improvement



When asked specifically which improvement “would make the biggest difference in the learning conditions?” there was a fairly even split between the categories (10-15%) but 23% opted for “change the material used for the roof”. This priority solution would potentially improve classroom conditions in relation to reducing temperature, increasing ventilation, reducing noise, and preventing leaking during the rainy season. If improved in the right way, with the right materials, addressing school roofs could improve learning environments and make classrooms more resilient to increased extreme weather associated with climate change.

The final aspect that we explored was what was needed to make improvements in the context of climate change. As Figure 26 shows, resources to improve school infrastructure was highlighted by 86% of headteachers.

Figure 26 - What do you need to ensure that your school can adapt to the impacts of climate change?



Half of the headteachers surveyed also talked about increasing climate change awareness amongst parents and caretakers, whilst 39% spoke of increasing awareness amongst staff. This shows that a programme of climate awareness aimed at teachers, parents, and communities would be welcomed by our sample of schools. This is, in our view, something that the Government of Tanzania could develop as part of curriculum reforms, teacher training, as well as through community focused programmes.

Improving accessibility to schools was also highlighted by 50% of head teachers. This shows an important role that the national and local government can play in addressing this issue. As the report has demonstrated, in our sample of schools, there were many examples of inadequate, deteriorating, and poor infrastructure that makes classrooms vulnerable to heat and rain. The graph below highlights that funds are the largest barrier, followed by access to workers, both of which indicate a need for schools to access external support to make themselves more climate resilient. This supports our earlier findings in reference to flooding and accessibility, where many headteachers felt powerless to tackle the challenges these present as schools are not responsible for road maintenance.

Therefore, this points to the need for a coordinated response of investment by Government and development partners in school infrastructure and roads and a curriculum for climate awareness amongst staff, students, and parents.

6. Conclusion

The schools which were assessed as part of this research study failed to provide classroom spaces that were comfortable, healthy, safe, and conducive for concentration and learning. The schools and classrooms in this study are vulnerable to the impacts of extreme heat and rainfall. This was apparent from the temperature sensor data, the headteacher perceptions, and through the observations that we conducted. Our evidence highlights that in a range of ways schools' attempt to minimise the impacts of climate factors, from teaching core subjects in the cooler mornings, through to putting on extra lessons when flooding prevents children getting to school. However, in the context of climate change and more extreme weather events, there are limits to how climate conditions can be mitigated. Our evidence suggests that without the right investments now, child wellbeing and learning outcomes will be adversely impacted in the coming years by more extreme temperatures and rainfall.

The design and construction of the roofs contribute greatly to poor learning conditions. This was evident in the observations that we assessed, as well as in the responses from the headteachers. Currently, the roofs of these classrooms are:

- allowing rainwater to enter;
- allowing direct heat from the sun to enter the classrooms both through conduction and radiation of heat through the metal and insufficient overhangs to shade walls and windows;
- allowing noise from rains to be transmitted into the classrooms through lack of ceiling and insulation; and
- preventing excess heat from escaping due to a lack of ventilation gaps.

An ineffective roof leaves other building elements (windows, doors, floors, and walls) unprotected from weather. If these building elements are also poorly designed and constructed, then they will deteriorate leaving the classrooms partially or completely unusable.

Extreme temperatures and higher, stronger, and more frequent rainfall and winds predicted due to climate change makes improving these built environments even more important if safe, healthy and productive learning spaces are to be achieved.

Another important aspect that this report highlights is the need to improve school accessibility during the rainy season. Schools do try and minimise the impacts that flooded roads have on education but often lack the means to do so and require a coordinated approach with the local community and authorities.

With climate predictions for Tanzania suggesting increased heat and extreme rainfall events, there is a strong need for the right investments to create a climate resilient education system. Our findings indicate that children's ability to attend and learn in school will suffer unless improvements are made to education infrastructure. Without action to address this, education outcomes are likely to deteriorate in the coming years.

Finally, we propose further research to build on the foundations of this report. Future studies could focus on analyzing which children are most affected, gender differences, age-related impacts, disabilities, geographical disparities (rural vs. urban), and the proximity of children to their schools.

ANNEXES

Annex 1: Sampling strategy

Sampling strategy

Our sampling frame consists of all primary schools in six districts (two districts per region) which were selected to minimize data collection costs, spanning the three target regions of Tanzania. We purposively sampled two districts per region such that they were not too far from each other yet were diverse in terms of their development and distance from the main city.

Table 1 - Overall survey completion by region

Region	District	Number of schools
Dodoma	Chamwino	8
	Dodoma City Council (CC)	8
Mara	Bunda Town Council (TC)	8
	Butiama	8
Pwani	Bagamoyo	8
	Kibaha	8

Our sample was stratified at the district level, with two levels of clustering at the school-level and the classroom-level. This means that we drew a random sample of schools from each of the six targeted districts. We ensured that eight schools per district were randomly selected as part of the main sample and an additional four schools per district were randomly selected for the replacement sample, in case the headteachers in the main sample were not available for the interview. This ensured that we reached our target of 48 schools.

We collected classroom observation data from one randomly selected Grade 3 classroom per school. The temperature sensor was mounted in the classroom selected for the observation survey. The temperature sensors were configured to record temperature and humidity measurements every 30 minutes.

Annex 2: Sensor analysis

Timetable analysis

To analyse the collected data, we first organised the school activities into a structured format, creating a pivot table that includes the start time, duration, and name of each activity for every day across the weeks observed. The analysis reveals that the average number of activities per school is between 13.5 and 13.72, with the highest activity count being 19 at Zinga Primary School and the lowest being 11 at Mkoyo Primary School. The start times vary across schools; the median and most frequent start time is 7 am, observed in 24 schools. The earliest start time recorded is 4:30 am at Malecela Primary School, while the latest is 7:30 am at Chinangali Primary School.

While break and non-academic activity durations differ among schools, all academic sessions, such as Mathematics, consistently last for 40 minutes. We employed treemaps and sunburst diagrams to effectively summarise the timetable data across schools.

Matching sensor data with activities

The objective here is to align sensor data—specifically, temperature and humidity measurements—with the corresponding activities. To accomplish this, we matched the sensor recording dates (spanning from August 1, 2023, to December 15, 2023) with the weekdays, creating a comprehensive list that details the activity, date, time, and sensor readings for the given period. This alignment enables us to investigate specific questions related to environmental conditions during school activities.

Standardisation of activity names

Given the variability in how similar or identical activities are named across different schools, we first standardized the names of these activities to ensure consistency in our analysis. This involved grouping various terms under unified categories, as detailed below:

1. Student Inspection and Announcements
    a. Includes terms like Announcement, Student inspection and announcement(s)
2. Health and Personal Hygiene
    a. Covers Cleaning, Cleanliness inspection, Personal hygiene, Health and nutrition
3. Independent Studies
    a. Encompasses Independent learning, independent studies, independent studies for farm work, learning by doing
4. Break
    a. Comprises Lunch break, Lunch, Home time, Free period

5. Sports and Arts
    a. Includes Sports, Sports and arts
6. Educational Support and Review
    a. Consists of Marking and corrections, Assignment time, Assignments, Revision, Advice and guidance, Teacher professional development

These standardized categories were used to organize the timetables and highlight the educational activities by excluding breaks. Further refining the activity categories, we focused on eight main academic subjects, placing all other activities into an 'others' category for a more detailed activities-time-temperature analysis.

Summarising timetables

To illustrate the timing patterns of activities across schools, we utilized a consistent hourly timestamp approach. This method ensured that main courses, typically lasting 40 minutes, were accurately represented without duplicating or overlooking shorter activities. Through this, we generated visualizations such as treemaps and sunburst charts to display the distribution of activities by day and hour.

Sensor-activity correlation

For correlating sensor data with specific activities, we matched the start times of activities to sensor recordings, rounded to the nearest half-hour. This allowed us to ascertain the temperature conditions for each activity across the recorded dates. After excluding activities without sensor data, we calculated the average temperature for each activity at each school. Analysing the temperature distribution provided insights into the typical environmental conditions experienced during different school activities. Additionally, we assessed the impact of high temperatures, identifying the proportion of days with temperatures exceeding 26.7°C, to gauge which activities were most affected by heat.

Satellite temperature data

Similarly, we matched activity schedules with satellite temperature readings, averaging temperatures between two closest hourly points for half-hour intervals. Despite the lower accuracy compared to sensor professional development data, this method paralleled our approach with the sensor-based analysis, offering an additional perspective on the environmental conditions during school activities.

Annex 3: Round 1 survey

Headteacher survey

Field	Question	Answer
1. Enumerator Identification		
enum_name *(required)*	2. ENUMERATOR: Please select your name	1 2 3
enum_name_confirm *(required)*	3. Enumerator name: [enum_name_str]. Is this information correct? *Question relevant when: ${enum_name} != nullResponse constrained to: .=1*	1 Yes 0 No
5. Section 0: Introduction		
5. Section 0: Introduction > 6. Introduction Text and Consent		
availability *(required)*	7. Hi, my name is [enum_name_str] and I am from Laterite Tanzania Ltd, a data, research and advisory firm that is based in Dar es Salaam. Do you have time to speak with me today?	1 Yes 0 No
note_rights	8. Today we will ask questions to get to know you a little better, about your role, the environment ofthe classrooms where you teach, and ideas on how to improve the classroom environment to support teaching and learning outcomes of students. The focus of our research is to understand how classroom environment can affect the learningoutcomes of students. We are speaking with teachers like yourself, who have experience as teachers, to get some context of classrooms and school in your district and region. Before we start, I will walk you through your rights, and you will be given the chance to ask anyquestions and/or decline to participate if you decide not to. PARTICIPATION: Today we are requesting your authorization to participate in our research. Participation in this research is voluntary and there will be no negative consequences if you choosenot to participate. You are free to refuse to participate at all in today's interview or change your mindabout your participation after the interview has started. Any decision you make will not affect you or how you stand to benefit from the school. I would like to stress that participation in this interview is voluntary. If there are any questions that you do not understand, feel free to ask for clarification at any point during the interview. If you get uncomfortable answering a question, please let the us know and we will be happy to skip it. AIM OF THE RESEARCH: This study was commissioned by the UK government to understand therelationship between classroom environmental factors such as light, temperature and sound on thelearning outcomes of students in Tanzania. The general objective of the session is to identify the existing classroom environment, how they affect you and the students, and ways in which this can be improved. RISKS & BENEFITS: There is no risk of harm to you because of your participation in this researchstudy. There will be no penalty or consequence for not participating. We truly value your experiences and information. Your perspectives will be used to better understand the status of teachers and students in the classroom with respect to teaching and learning. PRIVACY AND CONFIDENTIALITY: To respect your privacy and to keep your answers confidential,we will not share any of your responses linked to personally identifiable information with persons who are not essential members of the project research team. We will be recording the interview to ensure we capture all the valuable information shared. The information you share today will be safely stored and password protected. In addition, we will not identify you by name during our analysis or in the reports we produce. Your information, anonymized, along with everyone else's data who participates in this survey, will be used in the final reports of our findings. Laterite has obtained ethical approval from the National Health Research Ethics Review committee to ensure that the study is completed ethically – their office can be contacted for further evidence of approval.If you have questions about the research in general or about your role in the study, please feel freeto contact Laterite's data team lead John Patrick Mbozu on 0684377892. Please let me know if you have any questions before we begin.	
5. Section 0: Introduction > 6. Introduction Text and Consent > 9. Initial Participant Questions *Group relevant when: not(selected(${availability} ,'0'))*		

record *(required)*	10. Do you agree that we record your consent for our ethical records?	1	Yes
		0	No
consent *(required)*	11. **ASK THE INDIVIDUAL:** Do you consent to take part in the research?	1	Yes
		0	No
12. Respondent Consented *Group relevant when: ${consent} =1*			
12. Respondent Consented > 13. Section 1: General Information			
gps_coord *(required)*	14. GPS coordinates *GPS coordinates can only be collected when outside.*		
school_id *(required)*	18. School name	1816	ILEWELO
		1810	LUSINDE
		1822	MEMBE
		1865	MALECELA
		1831	KALENGA

Field	**Question**	swer	
		1773	HANETI
		1769	SULI
		1765	IGAMBA
		2045	MCHEMWA
		2004	MSISI
		1984	NGHAMBALA
		2000	MKOYO
		1979	CHINANGALI
		2062	MLIMWA 'C'
		2049	MATUMBULU
		2033	MLIMWA B
		1834	MGUNGA
		1762	MONDOMELA
		1774	HUMEKWA
		1853	NDEBWE
		2072	CHISICHILI
		2112	KITELELA
		1983	MSEMBETA
		2056	CHIHIKWI
		8118	KINYAMBWIGA 'A'
		8121	NYABEHU
		8148	CHANGUGE
		8178	WARIKU
		8127	KABARIMU 'B'
		8177	RWABU
		8108	BIGUTU
		8133	KABASA 'A'
		8191	KYESWA
		8260	KYASAMITI
		8228	NGEREKWE
		8263	KIAGATA
		8241	KIHUZU
		8242	MUGANZA
		8203	KIGORI
		8233	NYAMAGANA
		8106	NYERER

			E
		8172	USHASHI
		8113	MIGUNGANI
		8152	NYAMATOKE
		8212	BUTASYA
		8245	NYAMIKOMA A
		8206	BARANGA
		8237	MADARAKA
		13033	KONDO
		13038	MSHIKAMANO
		12991	KEREGE
		12982	MWANAMAKUKA
		12995	BUMA
		13028	TUMAINI
		12981	MWAMBAO
		13002	KIZUIANI
		13170	UHURU
		13176	NGETA
		13178	DISUNYARA
		13201	RUVU
		13182	MAHUNDI
		13165	MADEGE
		13172	MSONGOLA
		13166	GUMBA
		13026	NIANJEMA
		13005	MAJENGO
		13008	BIGILO
		13040	ZINGA
		13179	KILANGALANGA
		13205	SOGA
		13183	MPERAMUMBI
		13184	MSUA
ht_name *(required)*	19. Headteacher name - first and last		
ht_gender *(required)*	20. Headteacher gender	1	
		0	

Field	Question	Answer
12. Respondent Consented > 13. Section 1: General Information > 31. Enrollment by grade (total) (5) > 32. Enrollment by grade, total and gender		
enrollment_note	33. What is the number of children enrolled **([e1_02])** as of January 2023?	
enrollment_tot *(required)*	34. Total *Response constrained to: .< ${enrollment_school}*	
enrollment_m *(required)*	35. Male *Response constrained to: .<= ${enrollment_tot}*	
enrollment_f *(required)*	36. Female *Response constrained to: .<= ${enrollment_tot}*	
enrollment_error *(required)*	37. **ERROR:** The sum of male and female students does not equal the total number of students entered. Please return to the previous screen and correct the numbers provided. *Question relevant when: ${enrollment_tot} != ${enrollment_m_f_grade_check}*	

12. Respondent Consented > 13. Section 1: General Information > 31. Enrollment by grade (total) (6)		(Repeated group)
12. Respondent Consented > 13. Section 1: General Information > 31. Enrollment by grade (total) (6) > 32. Enrollment by grade, total and gender		
enrollment_note	33. What is the number of children enrolled **([e1_02])** as of January 2023?	
enrollment_tot *(required)*	34. Total *Response constrained to: .< ${enrollment_school}*	
enrollment_m *(required)*	35. Male *Response constrained to: .<= ${enrollment_tot}*	
enrollment_f *(required)*	36. Female *Response constrained to: .<= ${enrollment_tot}*	
enrollment_error *(required)*	37. **ERROR:** The sum of male and female students does not equal the total number of students entered. Please return to the previous screen and correct the numbers provided. *Question relevant when: ${enrollment_tot} != ${enrollment_m_f_grade_check}*	
12. Respondent Consented > 13. Section 1: General Information > 31. Enrollment by grade (total) (7)		(Repeated group)
12. Respondent Consented > 13. Section 1: General Information > 31. Enrollment by grade (total) (7) > 32. Enrollment by grade, total and gender		
enrollment_note	33. What is the number of children enrolled **([e1_02])** as of January 2023?	
enrollment_tot *(required)*	34. Total *Response constrained to: .< ${enrollment_school}*	
enrollment_m *(required)*	35. Male *Response constrained to: .<= ${enrollment_tot}*	
enrollment_f *(required)*	36. Female *Response constrained to: .<= ${enrollment_tot}*	
enrollment_error *(required)*	37. **ERROR:** The sum of male and female students does not equal the total number of students entered. Please return to the previous screen and correct the numbers provided. *Question relevant when: ${enrollment_tot} != ${enrollment_m_f_grade_check}*	
enrollment_f_error *(required)*	38. **ERROR:** The female students entered for each grade does not equate to the total number of female students. *Question relevant when: ${enrollment_f_tot_check} != ${enrollment_school_f}*	
enrollment_m_error *(required)*	39. **ERROR:** The male students entered for each grade does not equate to the total number of male students. *Question relevant when: ${enrollment_m_tot_check} != ${enrollment_school_m}*	
12. Respondent Consented > 13. Section 1: General Information > 40. Promotions by total and gender		
promo	41. What is the number of children who are promoted to the next grade/level at the end of last school year (2022)?	
promo_tot *(required)*	42. Total *Response constrained to: .<= ${enrollment_school}*	
promo_m *(required)*	43. Male *Response constrained to: .<= ${promo_tot}*	
promo_f *(required)*	44. Female *Response constrained to: .<= ${promo_tot}*	
promo_error *(required)*	45. **ERROR:**The sum of male and female students does not equal the total number entered. Please return to the previous screen and correct the numbers provided. *Question relevant when: ${promo_m_f} != ${promo_tot}*	
12. Respondent Consented > 13. Section 1: General Information > 46. Grade 7 promotions by total and gender		
grade7_promo	47. What number of children who are promoted to grade 7 at the end of last school year (2022)?	
grade7_promo_tot *(required)*	48. Total *Response constrained to: .<= ${enrollment_school}*	
grade7_promo_m *(required)*	49. Male *Response constrained to: .<= ${grade7_promo_tot}*	
grade7_promo_f *(required)*	50. Female *Response constrained to: .<= ${grade7_promo_tot}*	
grade7_error *(required)*	51. **ERROR:** The sum of male and female students does not equal the total number entered. Please return to the previous screen and correct the numbers provided. *Question relevant when: ${grade7_m_f} != ${grade7_promo_tot}*	
12. Respondent Consented > 13. Section 1: General Information > 52. Secondary School Continuation by total and gender		
secondary_cont	53. What is the number of children in the final year who continued to secondary school at the end of last year (2022)?	
secondary_cont_tot *(required)*	54. Total *Response constrained to: .<= ${enrollment_school}*	

Field	Question	Answer
secondary_cont_m *(required)*	55. Male *Response constrained to: .<= ${secondary_cont_tot}*	
secondary_cont_f *(required)*	56. Female *Response constrained to: .<= ${secondary_cont_tot}*	
secondary_cont_error *(required)*	57. **ERROR:** The sum of male and female students does not equal the total number entered. Pleasereturn to the previous screen and correct the numbers provided. *Question relevant when: ${secondary_cont_tot} != ${secondary_cont_m_f}*	
12. Respondent Consented > 13. Section 1: General Information > 58. Dropouts by total and gender		
dropout	59. What is the number of dropout children last school year (children who left school permanently) (2022)?	
dropout_tot *(required)*	60. Total *Response constrained to: .<= ${enrollment_school}*	
dropout_m *(required)*	61. Male *Response constrained to: .<= ${dropout_tot}*	
dropout_f *(required)*	62. Female *Response constrained to: .<= ${dropout_tot}*	
dropout_error *(required)*	63. **ERROR:** The sum of male and female students does not equal the total number entered. Pleasereturn to the previous screen and correct the numbers provided. *Question relevant when: ${dropout_tot} != ${dropout_m_f}*	
dropout_reason *(required)*	64. What are the main reasons for children to have dropped out of school? (Mention the top 3) *Question relevant when: ${dropout_tot} > 0 Response constrained to: count-selected(.) = 3*	1 Lack of awareness on education matters 2 Lack of education in families 3 Low income of parents and family 4 Early marriage 5 Early pregnancy for female students 6 Unable to access school (for example, due todistance) 7 Burden of working during school hours -98 Other, specify
dropout_reason_oth *(required)*	65. Other, please specify *Question relevant when: selected(${dropout_reason} , '-98')*	
dropout_trend *(required)*	66. Has the number of children that dropped out of school been rising over the last 10 years? (Since 2013)	1 Yes 0 No
12. Respondent Consented > 13. Section 1: General Information > 67. Special needs students by total and gender		
special_needs	68. What is the number of children with special needs (individuals who require assistance for physical or mental disabilities)?	
special_needs_tot *(required)*	69. Total *Response constrained to: .<= ${enrollment_school}*	
special_needs_m *(required)*	70. Male *Response constrained to: .<= ${special_needs_tot}*	
special_needs_f *(required)*	71. Female *Response constrained to: .<= ${special_needs_tot}*	
special_needs_error *(required)*	72. **ERROR:** The sum of male and female students does not equal the total number entered. Pleasereturn to the previous screen and correct the numbers provided. *Question relevant when: ${special_needs_tot} != ${special_needs_m_f}*	
12. Respondent Consented > 13. Section 1: General Information > 73. Number of teachers, total and gender		
teacher	74. What is the number of teachers currently in the school?	
teacher_tot *(required)*	75. Total *Response constrained to: .>0*	
teacher_m *(required)*	76. Male *Response constrained to: .<= ${teacher_tot}*	
teacher_f *(required)*	77. Female *Response constrained to: .<= ${teacher_tot}*	

teacher_error *(required)*	78. **ERROR:** The sum of male and female teachers does not equal the total number entered. Pleasereturn to the previous screen and correct the numbers provided. *Question relevant when: ${teacher_tot} != ${teacher_m_f}*	
travel_time *(required)*	91. Approximately how long does it take to arrive at the school for children travelling by foot from thelongest distance to school? (in minutes) *Response constrained to: .>=0*	
school_budget *(required)*	92. What is your annual school budget for the year 2023? (in Tsh.)? *Response constrained to: .>0*	
12. Respondent Consented > 93. Section 2: Improved quality of literacy instruction		
attendance_teachers *(required)*	94. What is the number of teachers who attended and taught during at least 90% of school days inlast school year (2022)?	

Field	Question	Answer
	Response constrained to: .>0	
children_absent *(required)*	128. Number of children absent from school more than 20% of school days in the last term *Response constrained to: .<= ${enrollment_school}*	
children_absent_reason *(required)*	129. What are the factors causing students to miss school? *Question relevant when: ${children_absent} > 0*	1 Children falling sick 2 Unable to pay school fees 3 Unable to access school (transportation) 4 Heavy rains or extreme weather 5 Children lack motivation 6 Children supporting parents at home -98 Other, specify
children_absent_reason_oth *(required)*	130. Other, please specify *Question relevant when: selected(${children_absent_reason} ,'-98')*	
travel_difficulty_rainy_season *(required)*	131. Do any of your children and staff have particular difficulty travelling to and from school in the rainy season?	1 Yes 0 No
classroom_flooding *(required)*	132. Do any of your classrooms leak/get flooded during the rainy season?	1 Yes 0 No
classroom_flooding_unusable *(required)*	133. Do any classrooms get unusable due to leaks/flooding in the rainy season? *Question relevant when: ${classroom_flooding} =1*	1 Yes 0 No
classroom_flooding_resp *(required)*	134. What is the usual response to continue learning? (tick as many as apply) *Question relevant when: ${classroom_flooding_unusable} =1*	1 Continue the lesson outside 2 Continue the lesson in another empty classroom 3 Continue the lesson in a shared classrom 4 Send the children home 5 Learning does not continue -98 Other, specify
classroom_flooding_resp_oth *(required)*	135. Other, please specify *Question relevant when: selected(${classroom_flooding_resp} ,'-98')*	
classroom_noise_rainfall *(required)*	136. Do any classrooms get unusable due to noise from rainfall?	1 Yes 0 No
classroom_noise_rainfall_resp *(required)*	137. What is the usual response to continue learning? (tick as many as apply) *Question relevant when: ${classroom_noise_rainfall} =1*	1 Continue the lesson outside 2 Continue the lesson in another empty classroom 3 Continue the lesson in a shared classrom

		4 Send the children home to continue learning 5 Learning does not continue -98 Other, specify
classroom_noise_rainfall_resp_oth *(required)*	138. Other, please specify *Question relevant when: selected(${classroom_noise_rainfall_resp} ,'-98')*	
classroom_extreme_temp *(required)*	139. Do any classrooms get unusable due to extreme classroom temperatures?	1 Yes 0 No
classroom_extreme_temp_resp *(required)*	140. What is the usual response to continue learning? (tick as many as apply) *Question relevant when: ${classroom_extreme_temp} =1*	1 Continue the lesson outside 2 Continue the lesson in another empty classroom 3 Continue the lesson in a shared classrom 4 Send the children home 5 Learning does not continue -98 Other, specify
classroom_extreme_temp_resp_oth *(required)*	141. Other, please specify *Question relevant when: selected(${classroom_extreme_temp_resp} ,'-98')*	
school_closure_reason *(required)*	142. In the last school year have you had to close the school due to: *Response constrained to: not(count-selected(.)>1 and selected(.,0))*	1 Heat 2 Flooding 3 None of the above
school_closure_heat_duration *(required)*	143. Roughly how many days have you lost **due to heat**? *Question relevant when: selected(${school_closure_reason} ,'1')*	1 1-10 2 11-20 3 21-30 4 31-40 5 41-50 6 More than 50

Field	**Question**	**Answer**
	Response constrained to: not(selected(.,'-99') and count-selected(.) >= 2)	2 Climate change awareneess among parents and caretakers 3 Finaces to change school infrastructure 4 Improve accessibility to schools -99 Don't know -98 Other, specify
climate_change_school_adapt_needs_oth *(required)*	157. Other, please specify *Question relevant when: selected(${climate_change_school_adapt_needs} ,'-98')*	
concerns_rank1 *(required)*	158. Please rank the following as priority concerns for you at the moment. What is your primaryconcern?	1 School budget 2 Teacher retention 3 Teacher training 4 School infrastructure 5 Learning materials 6 Climate change 7 Children being hungry at school 8 School attendance
concerns_rank2 *(required)*	159. Which option is your second concern?	1 School budget 2 Teacher retention 3 Teacher training 4 School infrastructure 5 Learning materials

		6	Climate change
		7	Children being hungry at school
		8	School attendance
concerns_rank3 *(required)*	160. Which option is your third concern?	1	School budget
		2	Teacher retention
		3	Teacher training
		4	School infrastructure
		5	Learning materials
		6	Climate change
		7	Children being hungry at school
		8	School attendance
12. Respondent Consented > 166. Section 6: Perceptions on classroom conditions			
classroom_furniture *(required)*	167. Considering an average classroom, how would you rate the condition of the furniture (eg.Tables, chairs, and blackboards)?	1	Poor: The furniture isin poor condition, with significant damage or wear and tear.
		2	Fair: The furniture isin fair condition, with some signs of wear and tear but still functional.
		3	Good: The furnitureis in good condition, with minimal signs of wear and tear.
		4	Very Good: Thefurniture is in very good condition, with little to no signs of wear and tear.
		5	Excellent: The furniture is in excellent condition, with no visible signs of wear and tear.
classroom_space_sufficiency *(required)*	168. Considering an average classroom, do you think there is sufficient space or not for thestudents?	1	Yes, there is enough space
		0	No, there is not enough space
classroom_window_sufficiency *(required)*	169. Considering an average classroom, do you think there are sufficient windows or not to allow forventilation?	1	Yes, there are enough windows
		0	No, the windows are not enough
classroom_window_ventilation *(required)*	170. Considering an average classroom, do you think the windows are sufficiently large or not forventilation?	1	Yes, the windows are large

Field	Question	Answer	
		0	No, the windows are not large
classroom_window_rainy_season *(required)*	171. During the rainy season, are the teachers able to keep the windows to the classroom open orare they closed?	1	Windows are open
		0	Windows are closed
		2	Windows cannot be opened or closed
classroom_window_rainy_season_closed_impact *(required)*	172. If windows are closed, do you think this is problematic or not problematic for the learning ofstudents? *Question relevant when: ${classroom_window_rainy_season} =1*	1	Yes, it is problematic for the students
		0	No, it is not problematic for the students

teaching_aid_availability *(required)*	173. On a scale from 1 to 5, how would you rate the availability of teaching aid (paper, pens,blackboard) in your classrooms?	1	1. Not Available: There are no teaching aidsavailable for use in the classroom.
		2	2. Scarce: There areonly a few teaching aids available, and they are not sufficient to meet the needs of all students.
		3	3. Adequate: Thereare enough teaching aids available to meet the basic needs of students, but additional resources would be beneficial.
		4	4. Plentiful: Thereare more than enough teaching aids available to meet the needs of all students, and the teacher has a wide range of resources to choose from.
		5	 5. Abundant: Thereis a wealth of teaching aids available, and the teacher has many resources at theirdisposal to support student learning.
classroom_lighting_sufficiency_blackboard *(required)*	174. Considering an average classroom, is there sufficient light for the students to see theblackboard from all the desks?	1	Yes, there is sufficient light inthe classroom for all the desks
		0	No, some desks do not have sufficient light
classroom_lighting_sufficiency_desks *(required)*	175. Considering an average classroom, is there sufficient light for the students to read at eachdesk?	1	Yes, there is sufficient light to read at all desks
		0	No, some desks do not have sufficient light to read
classroom_lighting_changes *(required)*	176. Considering an average classroom, does the level of lighting change in the classroomthroughout the day (morning to afternoon) while the students are learning?	1	Yes, the lighting level changes as it becomes brighter or darker outside
		0	No, the lighting level does not change throughout the day
classroom_teacher_sound *(required)*	177. Considering an average classroom, can the teacher always be heard sitting at all the desks inthe classroom?	1	Always
		2	Frequently
		3	Sometimes
		4	Rarely
		5	Never
classroom_sunlight *(required)*	178. Does direct sunlight enter the average classroom?	1	All the time
		2	Sometimes
		3	Never
classroom_noise_source_1 *(required)*	179. Other than the students in the classroom, what is the most common source of noise in youraverage classroom?	1	Wind
		2	Rainfall
		3	Loose ceiling materials
		4	Noise from outside the school (vehicles on theroad, factory, market)
		5	Noise from other classrooms

Field	Question	Answer
		-98 Other, specify
classroom_noise_source_1_oth *(required)*	180. Other, please specify *Question relevant when: selected(${classroom_noise_source_1} ,'-98')*	
classroom_noise_source_2 *(required)*	181. Other than the students in the classroom, what is the second most common source of noise inyour average classroom?	1 Wind 2 Rainfall 3 Loose ceiling materials 4 Noise from outside the school (vehicles on the road, factory, market) 5 Noise from other classrooms -98 Other, specify
classroom_noise_source_2_oth *(required)*	182. Other, please specify *Question relevant when: selected(${classroom_noise_source_2} ,'-98')*	
classroom_temp_morning *(required)*	183. Considering an average classroom, how would you consider the temperature in the classroomon average in the morning hours?	1 Very hot 2 Hot 3 Normal/regular temperature 4 Cold 5 Very cold
classroom_temp_afternoon *(required)*	184. Considering an average classroom, how would you consider the temperature in the classroomon average in the afternoon hours?	1 Very hot 2 Hot 3 Normal/regular temperature 4 Cold 5 Very cold
learning_factors_rank1 *(required)*	185. If you were to rank the conditions of light, temperature, ventilation and noise in your classroom,which one would you rank as the most important factor to least important for the students' learning experience? *1. Performing best*	1 Light 2 Temperature 3 Ventilation 4 Noise
learning_factors_rank2 *(required)*	186. If you were to rank the conditions of light, temperature, ventilation and noise in your classroom, which one would you rank as the most important factor to least important for the students' learningexperience? *2. Performing second best*	1 Light 2 Temperature 3 Ventilation 4 Noise
learning_factors_rank3 *(required)*	187. If you were to rank the conditions of light, temperature, ventilation and noise in your classroom,which one would you rank as the most important factor to least important for the students' learning experience? *3. Performing second worst*	1 Light 2 Temperature 3 Ventilation 4 Noise
learning_factors_rank4 *(required)*	188. If you were to rank the conditions of light, temperature, ventilation and noise in your classroom,which one would you rank as the most important factor to least important for the students' learning experience? *4. Performing worst*	1 Light 2 Temperature 3 Ventilation 4 Noise
learning_conditions_rank1 *(required)*	189. If you were to rank the conditions of light, temperature, ventilation and noise in your classrooms, which one would you rank as the one that is performing best to worst in your school? *1. Performing best*	1 Light 2 Temperature 3 Ventilation 4 Noise
learning_conditions_rank2 *(required)*	190. If you were to rank the conditions of light, temperature, ventilation and noise in your classrooms, which one would you rank as the one that is performing best to worst in your school? *2. Performing second best*	1 Light 2 Temperature 3 Ventilation 4 Noise
learning_conditions_rank3 *(required)*	191. If you were to rank the conditions of light, temperature, ventilation and noise in your classrooms, which one would you rank as the one that is performing best to worst in your school? *3. Performing second worst*	1 Light 2 Temperature 3 Ventilation 4 Noise
learning_conditions_rank4 *(required)*	192. If you were to rank the conditions of light, temperature, ventilation and noise in your classrooms, which one would you rank as the one that is performing best to worst in your school? *4. Performing worst*	1 Light 2 Temperature 3 Ventilation 4 Noise

Field	Question	Answer
learning_exp_light *(required)*	193. In your opinion, how do light conditions in a classroom affect students' learning experience?	1 Students are able to concentrate well 2 Students are able to see the blackboard well 3 Students are able to read/write well -98 Other, specify
learning_exp_light_oth *(required)*	194. Other, please specify *Question relevant when: selected(${learning_exp_light} ,'-98')*	
learning_exp_temp *(required)*	195. In your opinion, how do temperature conditions in a classroom affect students' learning experience?	1 Students are able to concentrate well 2 Students are able to read/write well -98 Other, specify
learning_exp_temp_oth *(required)*	196. Other, please specify *Question relevant when: selected(${learning_exp_temp} ,'-98')*	
learning_exp_noise *(required)*	197. In your opinion, how do noise conditions in a classroom affect students' learning experience?	1 Students are able to concentrate well 2 Students are able to read/write well -98 Other, specify
learning_exp_noise_oth *(required)*	198. Other, please specify *Question relevant when: selected(${learning_exp_noise} ,'-98')*	
poor_concentration_time *(required)*	199. Is there a time of day when you find students' concentration levels to be worse in the classroom?	1 Yes, the concentration level is worse in the morning 2 Yes, the concentration level is worse in the afternoon 0 No, the concentration level is the same
poor_concentration_cause *(required)*	200. What do you attribute this low concentration levels to? *Question relevant when: not(selected(${poor_concentration_time} ,'0'))*	1 The classrooms get hotter 2 The amount of light changes 3 The level of noise changes -98 Other, specify
poor_concentration_cause_oth *(required)*	201. Other, please specify *Question relevant when: selected(${poor_concentration_cause} ,'-98')*	
poor_concentration_season *(required)*	202. Is there are time of the year you find students' concentration levels to be worse in the classroom?	1 Yes, during the rainy season 2 Yes, during the hot/dry season 0 No, it is the same throughout the year
learning_improvements *(required)*	203. In general, what could be improved in the classroom to help students learn?	1 More windows 2 More lights 3 Change the materials used to build the roof 4 Change the material of the walls 5 Increase the side of the classroom 6 Add glass to windows -98 Other, specify
learning_improvements_oth *(required)*	204. Other, please specify *Question relevant when: selected(${learning_improvements} ,'-98')*	
improvement_most_impact *(required)*	205. Of all the improvements mentioned in the previous question, which one would make	1 More windows 2 More lights

	thebiggest difference in the learning conditions?	3 Change the materials used to build the roof 4 Change the material of the walls 5 Increase the side of the classroom 6 Add glass to windows -98 ...
improvement_most_impact_oth *(required)*	206. Other, please specify *Question relevant when: selected(${improvement_most_impact} ,'-98')*	
improvement_support_needed *(required)*	207. What support is needed in order to make this improvement?	1 Access to funds 2 Access to individuals that can make these improvements (workers) 3 Government approval for infrastructure changes 4 Parents' approval for infrastructure changes -98 Other, specify
improvement_support_needed_oth *(required)*	208. Other, please specify *Question relevant when: selected(${improvement_support_needed} ,'-98')*	
215. No availability *Group relevant when: ${availability} =0*		
ptcp_reschedule *(required)*	216. Would you like to reschedule this interview?	1 Yes 0 No
reschedule_time *(required)*	217. When would you like to reschedule this interview? *Question relevant when: selected(${ptcp_reschedule} ,'1')* *Response constrained to: decimal-date-time(.) > decimal-date-time(now())*	
reschedule_not *(required)*	218. Would you like to share with me why you do not want to take part in this study?	

Field	Question	Answer
	Question relevant when: selected(${ptcp_reschedule} , '0')	
219. Not Consented *Group relevant when: ${consent} =0*		
no_consent_why	220. Would you like to share with me why you do not want to take part in this study?	
end_survey	221. Thank you for completing this survey today. *Question relevant when: selected(${consent} ,'1')*	
enum_comment	222. ENUMERATOR: Enter any comments you have on this survey. Please also write down if you have any other notes or feedback.	

Classroom observation survey

Field	Question	Answer	
Enumerator Identification			
enum_name	ENUMERATOR: Please select your name	1	Brian
		2	Neema
		3	Ramadhan
enum_name_confirm	Enumerator name: [enum_name_str]. Is this information correct? *Question relevant when: ${enum_name} != null* *Response constrained to: .=1*	1	Yes
		0	No
school_id	School name	1816	ILEWELO
		1810	LUSINDE
		1822	MEMBE
		1865	MALECELA
		1831	KALENGA
		1773	HANETI
		1769	SULI
		1765	IGAMBA
		2045	MCHEMWA
		2004	MSISI
		1984	NGHAMBALA
		2000	MKOYO
		1979	CHINANGALI
		2062	MLIMWA 'C'
		2049	MATUMBULU
		2033	MLIMWA B
		1834	MGUNGA
		1762	MONDOMELA
		1774	HUMEKWA
		1853	NDEBWE
		2072	CHISICHILI
		2112	KITELELA
		1983	MSEMBETA
		2056	CHIHIKWI
		8118	KINYAMBWIGA 'A'
		8121	NYABEHU
		8148	CHANGUGE
		8178	WARIKU
		8127	KABARIMU 'B'
		8177	RWABU
		8108	BIGUTU
		8133	KABASA 'A'
		8191	KYESWA
		8260	KYASAMITI
		8228	NGEREKWE
		8263	KIAGATA
		8241	KIHUZU
		8242	MUGANZA
		8203	KIGORI
		8233	NYAMAGANA
		8106	NYERERE
		8172	USHASHI
		8113	MIGUNGANI
		8152	NYAMATOKE
		8212	BUTASYA
		8245	NYAMIKOMA A
		8206	BARANGA
		8237	MADARAKA
		13033	KONDO

13038	MSHIKAMANO
12991	KEREGE
12982	MWANAMAKUKA
12995	BUMA
13028	TUMAINI
12981	MWAMBAO
13002	KIZUIANI
13170	UHURU
13176	NGETA
13178	DISUNYARA

Field	Question	Answer	
		13201	RUVU
		13182	MAHUNDI
		13165	MADEGE
		13172	MSONGOLA
		13166	GUMBA
		13026	NIANJEMA
		13005	MAJENGO
		13008	BIGILO
		13040	ZINGA
		13179	KILANGALANGA
		13205	SOGA
		13183	MPERAMUMBI
		13184	MSUA
School Observation			
classroom_pic *(required)*	5. Please take a picture of the entire classroom from the entrance *Stand in the doorway of the main entrance to the classroom and capture as much of the classroom as possible*		
roof_mat *(required)*	6. LOOK: What is the main material of the roof of the classroom?	1	Corrugated iron sheet
		2	Tin sheet
		3	Tiles
		4	Concrete
		5	Thatch/Dried grass/Palm leaf
		6	Palm/Bamboo/other wood
		7	Cardboard
		8	Plastic sheets
		-98	Other - specify
roof_mat_oth *(required)*	7. Other, please specify *Question relevant when: ${roof_mat} =-98*		
roof_color *(required)*	8. LOOK: What is the color of the main material of the roof of the classroom?	1	White
		2	Gray
		3	Brown
		4	Beige
		5	Blue
		6	Green
		7	Red
		8	Orange
		9	Yellow
		-98	Other, specify
roof_color_oth *(required)*	9. Other, please specify *Question relevant when: ${roof_color} =-98*		
ceiling_board *(required)*	10. LOOK: Does the classroom have ceiling boards installed?	1	Yes
		0	No
ceiling_board_mat *(required)*	11. LOOK: What is the main material used for the ceiling board? *Question relevant when: ${ceiling_board} = 1*	1	Gypsum board
		2	Plaster (gypsum and water)
		3	Wood panel
		4	Metal panel
		-98	Other, specify
ceiling_board_mat_oth *(required)*	12. Other, please specify *Question relevant when: ${ceiling_board_mat} = -98*		

roof_crack_leak *(required)*	13. LOOK: Does the classroom have any cracks/leaks on the roof?	1	Yes
		0	No
roof_pic *(required)*	14. Please take a picture of the classroom roof.		
vent *(required)*	15. LOOK: Are there any provisions for ventilation to allow for fresh air circulation?	1	Yes
		0	No
vent_type *(required)*	16. LOOK: What are the types of ventilation used? *Question relevant when: ${vent} = 1*	1	Natural ventilation - open doors and windows
		2	Exhaust fans
		-98	Other, specify
vent_type_oth *(required)*	17. Other, please specify *Question relevant when: selected(${vent_type} ,'-98')*		
vent_source *(required)*	18. LOOK: Where are the sources of ventilation within the classroom? *Question relevant when: ${vent} = 1*	1	On the walls
		2	On the ceiling
		-98	Other, specify
vent_source_oth *(required)*	19. Other, please specify *Question relevant when: selected(${vent_source} ,'-98')*		
vent_covering *(required)*	20. LOOK: Are the ventilation/openings covered with mesh? *Question relevant when: ${vent} = 1*	1	Yes
		0	No
vent_pic *(required)*	21. Take a picture of the ventilation/openings that allow for light and fresh air circulation *Question relevant when: ${vent} = 1*		
floor_mat *(required)*	22. LOOK: What is the main material of the floor of the classroom?	1	Cement + Burnt bricks
		2	Mud + Burnt bricks

Field	**Question**	**Answer**	
		3	Cement + Unburnt bricks, Mud + Unburnt bricks
		4	Cement + Stones
		5	Cement block
		6	Hollow blocks
		7	Mud + Stones
		8	Cement Overlay/Plaster + Mud + Wood
		9	Mud + Wood
		10	Mud + Poles (from any tree)
		11	Tin/Iron Sheets
		12	Reeds + Bamboo
		13	Grass + Wood
		14	Only Mud and Dirt
		15	Cardboard / Plastic sheets / Plywood
		-98	Other - specify
floor_mat_oth *(required)*	23. Other, please specify *Question relevant when: ${floor_mat} = -98*		
floor_cracks *(required)*	24. LOOK: Does the classroom have any cracks/holes on the floor?	1	Yes
		0	No
classroom_dusty *(required)*	25. OBSERVE: Is the classroom dusty?	1	Yes
		0	No
floor_pic *(required)*	26. Take a picture of classroom floor.		
wall_mat *(required)*	27. LOOK: What is the main material of the classroom walls?	1	Cement + Burnt bricks
		2	Mud + Burnt bricks
		3	Cement + Unburnt bricks, Mud + Unburnt bricks
		4	Cement + Stones
		5	Cement block
		6	Hollow blocks
		7	Mud + Stones
		8	Cement Overlay/Plaster + Mud + Wood

		9	Mud + Wood
		10	Mud + Poles (from any tree)
		11	Tin/Iron Sheets
		12	Reeds + Bamboo
		13	Grass + Wood
		14	Only Mud and Dirt
		15	Cardboard / Plastic sheets / Plywood
		-98	Other - specify
wall_mat_oth *(required)*	28. Other, please specify *Question relevant when: ${wall_mat} = -98*		
wall_color_int *(required)*	29. LOOK: What is the color of the internal walls?	1	White
		2	Gray
		3	Brown
		4	Beige
		5	Blue
		6	Green
		7	Red
		8	Orange
		9	Yellow
		-98	Other, specify
wall_color_int_oth *(required)*	30. Other, please specify *Question relevant when: ${wall_color_int} = -98*		
wall_color_ext *(required)*	31. LOOK: What is the color of the external walls?	1	White
		2	Gray
		3	Brown
		4	Beige
		5	Blue
		6	Green
		7	Red
		8	Orange
		9	Yellow
		-98	Other, specify
wall_color_ext_oth *(required)*	32. Other, please specify		

Field	Question	Answer	
	Question relevant when: ${wall_color_ext} = -98		
wall_cracks *(required)*	33. LOOK: Does the classroom have any cracks/leaks on the wall?	1	Yes
		0	No
wall_picture *(required)*	34. Please take a picture of the classroom wall.		
classroom_l *(required)*	35. MEASURE: What is the **LENGTH** of the classroom? (Internal length) *NOTE: Use a tape measurer (cm)*		
classroom_w *(required)*	36. MEASURE: What is **WIDTH** of the classroom? (Internal width) *NOTE: Use a tape measurer (cm)*		
classroom_height *(required)*	37. MEASURE: What is the **HEIGHT** of the wall from floor to ceiling or top of the classroom? *Note: If the height varies then take the minimum and maximum height*		
classroom_windows *(required)*	38. LOOK: Does the classroom have windows?	1	Yes
		0	No
window_mat *(required)*	39. LOOK: What are the windows made of? *Question relevant when: ${classroom_windows} =1*	1	Glass
		2	Wood
		3	Iron sheets
		4	Reeds
		-98	Other, specify
window_mat_oth *(required)*	40. Other, please specify *Question relevant when: selected(${window_mat} , '-98')*		
window_q *(required)*	41. LOOK: How many windows do you see? *Question relevant when: ${classroom_windows} =1* *Response constrained to: .>0*		

window_spacing *(required)*	42. LOOK: Are the windows evenly spaced on the wall? *Question relevant when: ${window_q} >1*	1 Yes 0 No
window_loc *(required)*	43. LOOK: Are any of the windows placed on the front or back walls of the classroom? *Question relevant when: ${classroom_windows} =1*	1 In the front of the classroom 2 In the back of the classroom 3 In the front and back of the classroom
window_pos *(required)*	44. LOOK: If more than one window, what are the positions of the windows relative to one another? *Question relevant when: ${window_q} >1*	1 The windows are opposite each other 2 The windows are next to each other on the same wall
window_railing *(required)*	45. LOOK: Do the windows have a burglar railing? *Question relevant when: ${classroom_windows} =1*	1 Yes 0 No
window_vent *(required)*	46. LOOK: Do the windows have louvres or ventilators? *Question relevant when: ${classroom_windows} =1*	1 Yes 0 No
window_opening *(required)*	47. LOOK: Do the windows fully open or open half-way? *Question relevant when: ${classroom_windows} =1*	1 Fully 2 Partially 3 Windows do not open 4 Broken
window_l *(required)*	48. MEASURE: What is the size of the window length? *NOTE: Use a tape measurer (cm)* *Question relevant when: ${classroom_windows} =1*	
window_w *(required)*	49. MEASURE: What is the size of the window width? *NOTE: Use a tape measurer (cm)* *Question relevant when: ${classroom_windows} =1*	
door *(required)*	50. LOOK: Does the classroom have a door?	1 Yes 0 No
door_opening *(required)*	51. LOOK: Does the door open outwards? *Question relevant when: ${door} =1*	1 Yes 0 No
blackboard *(required)*	52. LOOK: Does the classroom have a blackboard?	1 Yes 0 No
blackboard_height *(required)*	53. MEASURE: At what height is the blackboard from the floor (distance from the floor to the lowest part of the blackboard) *NOTE: Use a tape measurer (cm)* *Question relevant when: ${blackboard} =1*	
blackboard_repairs *(required)*	54. LOOK: Does the blackboard need repairs? *Question relevant when: ${blackboard} =1*	1 Yes 0 No
electricity *(required)*	55. LOOK: Does the classroom have access to electricity?	1 Yes 0 No
electricity_source *(required)*	56. OBSERVE: What is the source of electricity? *Question relevant when: ${electricity} =1*	1 Main electricity (TANESCO) 2 Community generator 3 Solar panels 4 Own generator
light_source *(required)*	57. LOOK: What are the sources of light in the classroom?	1 External - sunlight 2 Tubelight 3 Bulb -98 Other, specify
light_source_oth *(required)*	58. Other, please specify	

Round 2 Survey – Headteacher follow-up survey

Field	Question	Answer
Enumerator Identification		
enum_name *(required)*	1. ENUMERATOR: Please select your name	1 Christopher 2 Neema 3 Ramadhan
enum_name_confirm *(required)*	2. Enumerator name: [enum_name_str]. Is this information correct? *Question relevant when: ${enum_name} != null*	1 Yes 0 No
Section 0: Introduction		
Section 0: Introduction > Introduction Text and Consent		
availability *(required)*	3. Hi, my name is [enum_name_str] and I am from Laterite Tanzania Ltd, a data, research and advisory firm that is based in Dar es Salaam. Do you have time to speak with me today?	1 Yes 0 No
note_rights	4. Today we will ask questions to get to know you a little better, about your role, the environment of the classrooms where you teach, and ideas on how to improve the classroom environment to support teaching and learning outcomes of students. The focus of our research is to understand how classroom environment can affect the learning outcomes of students. We are speaking with teachers like yourself, who have experience as teachers, to get some context of classrooms and school in your district and region. Before we start, I will walk you through your rights, and you will be given the chance to ask any questions and/or decline to participate if you decide not to. PARTICIPATION: Today we are requesting your authorization to participate in our research. Participation in this research is voluntary and there will be no negative consequences if you choose not to participate. You are free to refuse to participate at all in today's interview or change your mind about your participation after the interview has started. Any decision you make will not affect you or how you stand to benefit from the school. I would like to stress that participation in this interview is voluntary. If there are any questions that you do not understand, feel free to ask for clarification at any point during the interview. If you get uncomfortable answering a question, please let the us know and we will be happy to skip it. AIM OF THE RESEARCH: This study was commissioned by the UK government to understand the relationship between classroom environmental factors such as light, temperature and sound on the learning outcomes of students in Tanzania. The general objective of the session is to identify the existing classroom environment, how they affect you and the students, and ways in which this can be improved. RISKS & BENEFITS: There is no risk of harm to you because of your participation in this research study. There will be no penalty or consequence for not participating. We truly value your experiences and information. Your perspectives will be used to better understand the status of teachers and students in the classroom with respect to teaching and learning. PRIVACY AND CONFIDENTIALITY: To respect your privacy and to keep your answers confidential, we will not share any of your responses linked to personally identifiable information with persons who are not essential members of the project research team. We will be recording the interview to ensure we capture all the valuable information shared. The information you share today will be safely stored and password protected. In addition, we will not identify you by name during our analysis or in the reports we produce. Your information, anonymized, along with everyone else's data who participates in this survey, will be used in the final reports of our findings. Laterite has obtained ethical approval from the National Health Research Ethics Review committee to ensure that the study is completed ethically – their office can be contacted for further evidence of approval. If you have questions about the research in general or about your role in the study, please feel free to contact Laterite's data team lead John Patrick Mbozu on 0684377892. Please let me know if you have any questions before we begin.	
Section 0: Introduction > Introduction Text and Consent > Initial Participant Questions *Group relevant when: not(selected(${availability} ,'0'))*		
record *(required)*	5. Do you agree that we record your consent for our ethical records?	1 Yes 0 No
consent *(required)*	6. **ASK THE INDIVIDUAL:** Do you consent to take part in the research?	1 Yes 0 No
Respondent Consented *Group relevant when: ${consent} =1*		
Respondent Consented > Section 1: General Information		

gps_coord *(required)*	7. GPS coordinates *GPS coordinates can only be collected when outside.*	
school_id *(required)*	8. School name	1765 IGAMBA 1769 SULI 1773 HANETI 1810 LUSINDE 1816 ILEWELO 1822 MEMBE 1831 KALENGA 1865 MALECELA

Field	Question	Answer
		1979 CHINANGALI 1984 NGHAMBALA 2000 MKOYO 2004 MSISI 2033 MLIMWA B 2045 MCHEMWA 2049 MATUMBULU 2062 MLIMWA 'C' 8106 NYERERE 8108 BIGUTU 8113 MIGUNGANI 8127 KABARIMU 'B' 8133 KABASA 'A' 8148 CHANGUGE 8177 RWABU 8178 WARIKU 8191 KYESWA 8203 KIGORI 8212 BUTASYA 8228 NGEREKWE 8241 KIHUZU 8242 MUGANZA 8260 KYASAMITI 8263 KIAGATA 12981 MWAMBAO 12991 KEREGE 12995 BUMA 13002 KIZUIANI 13026 NIANJEMA 13028 TUMAINI 13038 MSHIKAMANO 13040 ZINGA 13165 MADEGE 13166 GUMBA 13170 UHURU 13172 MSONGOLA 13176 NGETA 13178 DISUNYARA 13182 MAHUNDI 13201 RUVU
ht_name *(required)*	9. Headteacher name - first and last	
Respondent Consented > Class schedule		

note_schedule	10. As part of this study, we will observe a Grade 3 classroom. We will now ask you about the daily class schedule for Grade 3 in your school. Please provide the time the subject is taught for each day of the week and the duration of each subject.		
weekday *(required)*	11. What days of the week are subjects taught to students?	1	Monday
		2	Tuesday
		3	Wednesday
		4	Thursday
		5	Friday
instruct_note	12. **INSTRUCTIONS:** Swipe forward and press "Add group".		
Respondent Consented > Class schedule > 13. Days of the Week (1)		(Repeated group)	
weekday_note	14. **On [weekday_label]:**		
activities_roster *(required)*	15. How many subjects or activities take place on **[weekday_label]**? This includes a subject or a break. Please add every step of the school's typical routine		
Respondent Consented > Class schedule > 13. Days of the Week (1) > Classroom Time Allocation (1)		(Repeated group)	
activity *(required)*	16. Select the subject or activity number **1** of the day Start with the first subject or activity and continue in a chronological order	1	English
		2	Mathematics
		3	Kiswahili
		4	Social Studies
		5	Civics and Moral Education
		6	Science and Technology
		7	Break
		8	Reading/library
		9	Environment
		10	Extracurricular clubs
		11	Human rights
		12	Religious studies

Field	Question	Answer	
		13	Revision
		-98	Other, specify
activity_time *(required)*	17. At what time does [activity_lab] take place? *Provide your response using the following format: 000 or 0000 (for example, 930 or 1030).* *Question relevant when: not(selected(${activity} , '-98'))*		
activity_duration *(required)*	18. What is the duration in minutes of the [activity_lab] subject or activity? *Question relevant when: not(selected(${activity} , '-98'))*		
activity_other *(required)*	19. Fill in OTHER activity from the previous screen. *Question relevant when: selected(${activity} ,'-98')*		
activity_time_oth *(required)*	20. At what time does [activity_other] take place? *Question relevant when: selected(${activity} ,'-98')*		
activity_duration_oth *(required)*	21. What is the duration in minutes of [activity_other] subject or activity? *Question relevant when: selected(${activity} ,'-98')*		
Respondent Consented > Section 3: Improved school insfrastructure			
latrines *(required)*	22. Does the school have latrines/toilets?	1	Yes
		0	No
latrines_access *(required)*	23. Are they accessible by people with disabilities? *Question relevant when: ${latrines} =1*	1	Yes
		0	No
latrines_functioning *(required)*	24. Number of functioning latrines on school ground *Question relevant when: ${latrines} =1*		
clean_water *(required)*	25. Does the school have access to a clean and safe water source for drinking?	1	Yes
		0	No
clean_water_source *(required)*	26. What are the sources? *Question relevant when: ${clean_water} =1*	1	Rain water catchment/tanks
		2	Tap water (national direct supply privately available in school)
		3	Public tap or standpipe
		4	Tube wells or boreholes

		5 Protected dug well/springs 6 Bottles -98 Other, specify
clean_water_source_oth *(required)*	27. Other, please specify *Question relevant when: selected(${clean_water_source} ,'-98')*	
clean_water_disruptions *(required)*	28. How many months in a year are there disruptions to access? *Question relevant when: ${clean_water} =1*	8 0 months (access all year round) 1 < or equal to 1 month 2 2-3 months 3 4-5 months 4 6-7 months 5 8-9 months 6 10-11 months 7 12 months (no access all year-round)
clean_water_disruptions_weather *(required)*	29. Do extreme weather conditions affect access to water in the school? *Question relevant when: ${clean_water} =1*	1 Yes 0 No
electricity *(required)*	30. Does this school have a source of electricity?	1 Yes 0 No
electricity_source *(required)*	31. What is the source? *Question relevant when: ${electricity} =1*	1 Main electricity (TANESCO) 2 Community generator 3 Solar panels 4 Own generator -98 Other, specify
electricity_source_oth *(required)*	32. Other, please specify *Question relevant when: selected(${electricity_source} ,'-98')*	
electricity_battery *(required)*	33. Does the school have a battery to store excess power that is generated? *Question relevant when: ${electricity} =1*	1 Yes 0 No
electricity_interruptions *(required)*	34. Does the school ever have power interruptions during the school day? *Question relevant when: ${electricity} =1*	1 Yes 0 No
electricity_outage_freq *(required)*	35. On average, how frequently does your school experience power cuts that last more than 1 hour? *Question relevant when: ${electricity_interruptions} =1*	1 Once in a day 2 2-3 times in a day 3 4-5 times in a day 4 6-7 times in a day 5 8-9 times in a day 6 10 or more times in day
electricity_outage_duration *(required)*	36. If more than 1 day, are there particular periods of time that power cuts occur? Read out alound and select all options that apply	1 At the beginning of the

Field	Question	Answer
	Question relevant when: ${electricity_interruptions} =1	school term (January) 2 During school breaks (midterm and long holidays) 3 On the day of the exams 4 During the exam term (just before the exams)
electricity_outage_weather *(required)*	37. Do power cuts coincide with extreme weather conditions such as extreme rainfall and/or extreme heat? *Question relevant when: ${electricity_interruptions} =1*	1 Coincides with extreme rainfall only 2 Coincides with extreme heat only 3 Coincide with extreme rainfall and heat

		4 Does not coincide with either -99 Don't know
Respondent Consented > Section 7: Nutrition, health and dietary practices		
school_handwash_facility *(required)*	38. Does the school have soap and water at a hand washing station/facility?	1 Yes, only water 2 Yes, both 0 No
school_feeding_program *(required)*	39. Does the school have a school feeding program?	1 Yes 0 No
school_feeding_program_disruption *(required)*	40. Are there disruptions in the feeding program? That is, there are times where the feeding program stops *Question relevant when: ${school_feeding_program} =1*	1 Yes 0 No
school_feeding_program_disruption_cause *(required)*	41. What causes the disruptions? *Question relevant when: ${school_feeding_program_disruption} =1*	1 Lack of finances for the feeding program 2 Lack of food during different seasons (harvest versus non-harvest season 3 Extreme weather conditions -98 Other, specify
feeding_program_disruption_cause_oth *(required)*	42. Other, please specify *Question relevant when: selected(${school_feeding_program_disruption_cause} ,'-98')*	
Respondent Consented > Section 8: Flooding and extreme temperature follow-up		
flood_recent_school *(required)*	43. Did your school flood in the recent rainy season?	1 Yes 0 No
flood_impact_school *(required)*	44. Can you tell us what impacts this flooding had on students' learning? *Question relevant when: ${flood_recent_school} = 1*	
flood_recent_roads *(required)*	45. Did the roads that students travel on for school experience flooding in the recent rainy season?	1 Yes 0 No
flood_impact_roads *(required)*	46. Can you tell us what impacts this flooding had on students' learning? *Question relevant when: ${flood_recent_roads} = 1*	
flood_round1_repeat *(required)*	47. In the last survey in July, you said that the school experiences flooding but that learning continues, is that still true? *Question relevant when: ${flood_round1} = 1*	1 Yes 0 No
flood_round1_explain_no *(required)*	48. Can you explain why this is not true? *Question relevant when: ${flood_round1_repeat} = 0*	
flood_round1_explain_yes *(required)*	49. Can you give us more detail on how you are able to continue learning when there is flood water in the school? *Question relevant when: ${flood_round1_repeat} = 1*	
travel_round1_impact *(required)*	50. In the last survey in July, you said that students experience travel difficulties due to floods, can you explain what impact this has on learning? *Question relevant when: ${travel_round1} = 1*	
travel_round1_support *(required)*	51. When students experience travel difficulties how does the school support them when they experience this? *Question relevant when: ${travel_round1} = 1*	
minimize_impact_plan *(required)*	52. Can you explain what strategies the school has to minimise the impact of flooding on learning - for example do you have plans ahead of floods, how do you clean up after the flood, support children to remain safe? *Question relevant when: ${flood_round1} = 1 or ${travel_round1} = 1*	
village_flood *(required)*	53. Do the villages where teachers and students live also flood when the school floods? *Question relevant when: ${flood_round1} = 1*	1 Always 2 Frequently 3 Sometimes 4 Rarely 5 Never
flood_impact_infra *(required)*	54. When thinking about the worst flood that you experienced what were the impacts on the school infrastructure (buildings, grounds etc) when flooding occured? (tick all that apply) *Question relevant when: ${flood_round1} = 1*	1 School buildings are damaged but can be easily fixed

Field	Question	Answer
		2 School buildings become unsafe after the floods 3 Classrooms are damaged structurally 4 Issues such as damp remain after the flood 5 School grounds, such as play areas, remain damaged and unusable 6 We return to normality quickly after a flood -98 Other, please specify 0 School is never flooded
flood_impact_infra_oth *(required)*	55. Other, please specify *Question relevant when: selected(${flood_impact_infra} ,'-98')*	
flood_risk_perc *(required)*	56. Do you ever feel the safety of the children is at risk due to flooding of the school ?	1 Always 2 Frequently 3 Sometimes 4 Rarely 5 Never
flood_risk_road_perc *(required)*	57. Do you ever feel the safety of the children is at risk due to flooding of roads that they travel on to connected to the school?	1 Always 2 Frequently 3 Sometimes 4 Rarely 5 Never
unusually_hot *(required)*	58. Do any of the classrooms in this school get unusually hot during the school year?	1 Yes 0 No
unusually_hot_impact *(required)*	59. When classrooms are unusually hot, how does it impact students' learning? *Question relevant when: ${unusually_hot} = 1*	
unusually_hot_response *(required)*	60. What is the usual response to continue learning? (tick as many as apply) *Question relevant when: ${unusually_hot} = 1*	1 Continue the lesson outside 2 Continue the lesson in another empty classroom 3 Continue the lesson in a shared classrom 4 Send the children home 5 Learning does not continue -98 Other, specify
response_oth *(required)*	61. Other, please specify *Question relevant when: selected(${unusually_hot_response} ,'-98')*	
No availability *Group relevant when: ${availability} =0*		
ptcp_reschedule *(required)*	62. Would you like to reschedule this interview?	1 Yes 0 No
reschedule_time *(required)*	63. When would you like to reschedule this interview? *Question relevant when: selected(${ptcp_reschedule} ,'1')*	
reschedule_not *(required)*	64. Would you like to share with me why you do not want to take part in this study? *Question relevant when: selected(${ptcp_reschedule} , '0')*	
Not Consented *Group relevant when: ${consent} =0*		
no_consent_why	65. Would you like to share with me why you do not want to take part in this study?	
end_survey	Thank you for completing this survey today. *Question relevant when: selected(${consent} ,'1')*	
enum_comment	66. ENUMERATOR: Enter any comments you have on this survey. Please also write down if you have any other notes or feedback.	

Field	Question	Answer
	Question relevant when: selected(${light_source} ,'-98')	
tubelights_q *(required)*	59. LOOK: How many tubelights are in the classroom? *Question relevant when: selected(${light_source} , '2')*	
bulbs_q *(required)*	60. LOOK: How many bulbs are in the classroom? *Question relevant when: selected(${light_source} , '3')*	
light_placement *(required)*	61. LOOK: Where are the tubelights or bulbs placed in the classroom? *Question relevant when: selected(${light_source} , '2') or selected(${light_source} , '4')*	1 In the front of the classroom 2 In the back of the classroom 3 In the middle of the classroom 4 Evenly spread in the classroom
noise_obs *(required)*	62. OBSERVE: Outside the classroom, can you observe any noise?	1 Yes 0 No
noise_source *(required)*	63. OBSERVE: What are the sources of noise you hear? *Question relevant when: ${noise_obs} =1*	1 Traffic noise 2 Air traffic noise 3 Construction sites 4 Catering and night life 5 Animals 6 Major road -98 Other - specify
noise_source_oth *(required)*	64. Other, please specify *Question relevant when: selected(${noise_source} ,'-98')*	

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