Public Disclosure Authorized
Public Disclosure Authorized
Public Disclosure Authorized
Public Disclosure Authorized

EASTERN AND
SOUTHERN AFRICA

UNITED REPUBLIC OF TANZANIA

Education and Climate Change Background Paper

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

November 2024

© 2024 The World Bank Group
1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

This work is a product of the staff of the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA), collectively known as The World Bank Group, with external contributors.

The World Bank Group does not guarantee the accuracy, reliability or completeness of the content included in this work, or the conclusions or judgments described herein, and accepts no responsibility or liability for any omissions or errors (including, without limitation, typographical errors and technical errors) in the content whatsoever or for reliance thereon. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of any of the organizations of The World Bank Group concerning the legal status of any territory or the endorsement or acceptance of such boundaries. The findings, interpretations, and conclusions expressed in this volume do not necessarily reflect the views of IBRD/IDA, IFC and MIGA, their respective Boards of Executive Directors, and the governments they represent.

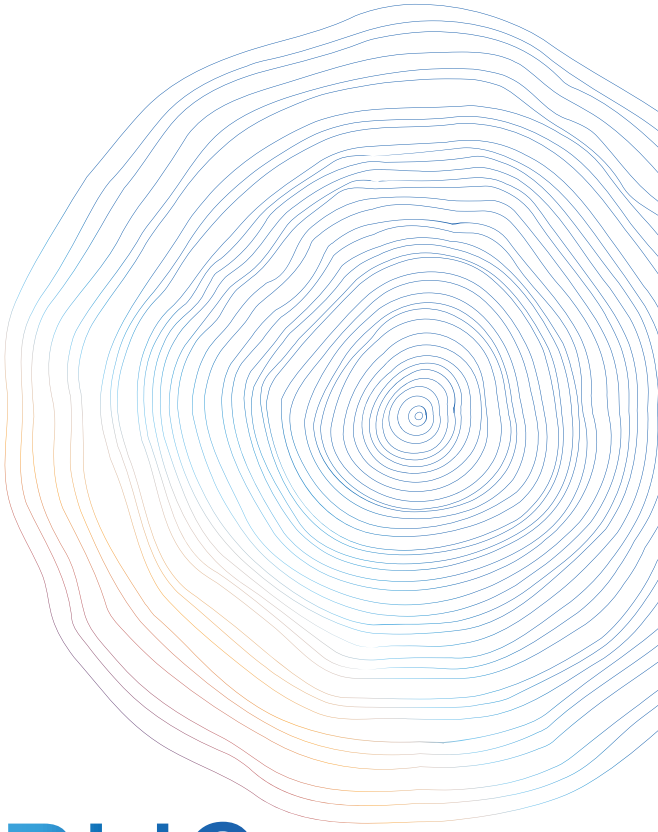
The contents of this work are intended for general informational purposes only and are not intended to constitute legal, securities, or investment advice, an opinion regarding the appropriateness of any investment, or a solicitation of any type. Some of the organizations of The World Bank Group or their affiliates may have an investment in, provide other advice or services to, or otherwise have a financial interest in, certain of the companies and parties named herein.

Nothing herein shall constitute or be construed or considered to be a limitation upon or waiver of the privileges and immunities of any of IBRD/IDA, IFC and MIGA, all of which are specifically reserved.

Rights and Permissions

The material in this work is subject to copyright. Because the World Bank Group encourages the dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given and all further permissions that may be required for such use (as noted herein) are acquired. The World Bank does not warrant that the content contained in this work will not infringe on the rights of third parties, and accepts no responsibility or liability in this regard.

All queries on rights and licenses should be addressed to World Bank Publications, The World Bank, 1818 H Street NW, Washington, DC 20433, USA; e-mail: pubrights@worldbank.org.



UNITED REPUBLIC OF TANZANIA

Education and Climate Change Background Paper

COUNTRY CLIMATE AND DEVELOPMENT REPORT

TABLE OF Contents

Acknowledgments

The Tanzania Country Climate and Development Report (CCDR) was prepared by a multisectoral World Bank Group team led by Diji Chandrasekharan Behr (Lead Environmental Economist, East Africa Environment Department), and William Battaile (Lead Economist, Macroeconomics, Trade and Investment, Eastern and Southern Africa), under the supervision of Paul Jonathan Martin (Manager, East Africa Environment Department) and Abha Prasad (Manager, Eastern and Southern Africa Macroeconomics, Trade and Investment Department), and the direction of Iain Shuker (Regional Director, Planet vertical, Eastern and Southern Africa).

The Tanzania CCDR Education Paper was prepared by the World Bank Education Practice. This report was developed by Innocent Najjumba Mulindwa (Senior Education Specialist), Eliot Faron Goer (Consultant), and Henry Michael Kulaya (Consultant). Special thanks to Revocatus Paul (Extended Term Consultant) for availing the data that enabled the analysis done in this paper. The World Bank Team received valuable guidance from Diji Chandrasekharan Behr (Lead Environmental Economist) and was supervised by Muna Salih Meky (Practice Manager, HAEE1).

The team greatly thanks the Ministry of Education, Science and Technology officials for providing the data and information used in this report under the leadership of, Prof. Carolyne Nombo, Permanent Secretary, Ministry of Education, Science, and Technology. Appreciation also goes to the colleagues Mathus Kaboko Nkahiga (Senior Education Specialist), Gemma Todd (Education Specialist) and Caroline Kingu (Program Assistant) for the support provided during the preparation process of the education paper.

Abbreviations and Acronyms

ARU	Ardhi University
ATC	Arusha Technical College
CCE	Climate Change Education
BA	Bachelor of Arts
BSc	Bachelor of Science
CCDR	Country Climate and Development Report
DHS	Tanzania Demographic and Health Survey
GDP	gross domestic product
IFRC	International Federation of the Red Cross and Red Crescent Societies
MSc	Master of Science
PhD	Doctor of Philosophy
PTR	pupil-to-teacher ratio
SUA	Sokoine University of Agriculture
TVET	Technical, Vocational Education and Training
UDOM	University of Dodoma
UDSM	University of Dar es Salaam

All dollar amounts ($) are US dollars

1. Introduction and Background

This paper highlights the impacts of climate change on education outcomes in Tanzania through an analysis of the education landscape, ongoing government response to climate change through education programs, and suggests recommendations for government consideration going forward.

Tanzania is the most flood-affected country in East Africa, and flooding is estimated to be the costliest hazard, causing 62 percent of losses from natural disasters between 1990 and 2014.[1] In April 2023, severe flooding affected villages around Ruvuma River, affecting about 1,900 people of whom 1,400 sought shelters in schools with high elevation.[2] In November 2023, Arusha, Dar es Salaam, Geita, Kagera, Kigoma, Manyara and Unguja were hit by floods; while Hanang district[3] in the Manyara Region was further hit by torrential rains that led to both flooding and landslides mixed with stones and trees from the Hanang Mountains. An estimated 5,600 people from 1,150 households were evacuated to three schools in the Manyara Region. Access to basic services including education and water was disrupted.

Climate change affects education access in several ways. Flooding affects school communities most directly through school shutdown. This makes entire schools inaccessible for weeks or months until water levels drop, with resultant damage to educational infrastructure and facilities. This makes student access to education inconvenient or even impossible, especially in low-resource settings without remote learning facilities or programs that target all school age groups. Children or students who cannot access their schools during periods of floods, for example, are more likely to drop out of school. Participatory mapping tools based on the location of flood zones applied to Dar es Salaam indicate that 6 percent of schools and education institutions in Dar es Salaam are in the flood zone.[4] The monetary impacts associated with housing repairs, asset losses and long periods of time each rainy season when life is disrupted by floods could result in deprivation of basic requirements for school going children in addition to non-access to home-based support on learning. In Zimbabwe, for example, flood-affected children noted a range of experiences from food insecurity to being withdrawn from school including forced marriages for the girls.[5] Lack of requisite school heating in cases of extreme cold or cooling options in case of extreme heat also, affects learner access to school. Malnourished children are susceptible to infections and diseases affecting their regular attendance of school, while floods, high temperatures, hurricanes, and wildfires cause serious risks to health impacting learner attendance.

Climate change impacts education quality. Bad learning environments compromise education. Floods or extreme heat conditions affects the regular presence of instructors in schools, colleges or institutions affecting learners' ability to effectively engage in their education. Overtime, comprehension, and retention levels decline with resultant negative effects on learning outcomes. Research also shows that floods impact the quality of education through various channels including loss of learning hours, loss of qualified personnel, high absenteeism of both learners and teachers leading to low curriculum coverage.[6]

The negative impact of climate change impacts learning outcomes through various channels. For example, as high temperatures, floods, heat waves and droughts persist, household food production reduces. This results in poor diets resulting in child malnutrition and its cascading effects on brain development for young children and slow learning at school.

---

1 Erman, A, Tariverdi, M, Obolensky, M, Chen, X, Vincent, R C, Malgioglio, S, Rentschler, J, Hallegatte, S and Yoshida, N (2019) *Wading Out the Storm. The Role of Poverty in Exposure, Vulnerability and Resilience to Floods in Dar Es Salaam*. World Bank Group.

2 International Federation of the Red Cross and Red Crescent Societies (2023) *DREF Final Report Tanzania, Mtwara Flood*.

3 Hanang district has 37 secondary schools with an enrolment of 13,956 students (58% girls).

4 Laird, B (n.d.) Analyzing Flood Risk of Schools in Dar es Salaam, Tanzania. https://brookelaird.github.io/daressalaam/report.html.

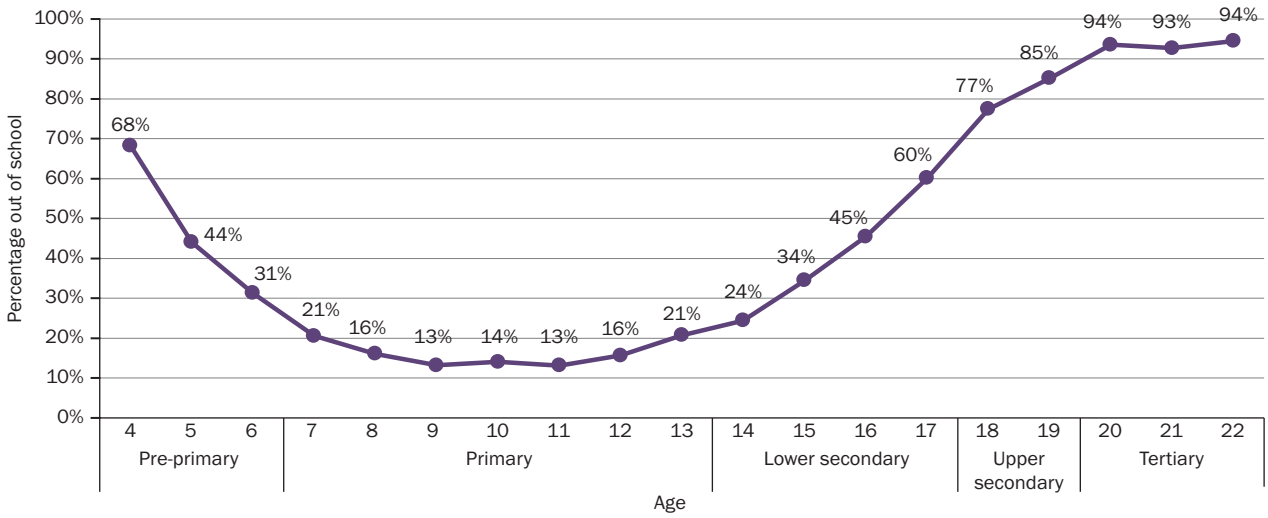
5 Mudavanhu, C (2014) "The impact of flood disasters on child education in Muzarabani District, Zimbabwe." *Jàmbá: Journal of Disaster Risk Studies* 6(1): 138. https://doi.org/10.4102/jamba.v6i1.138.

6 Mudavanhu, C (2014) "The impact of flood disasters on child education in Muzarabani District, Zimbabwe." *Jàmbá: Journal of Disaster Risk Studies* 6(1): 138. https://doi.org/10.4102/jamba.v6i1.138.

2. The Education Landscape in Tanzania is Unequal Across Regions

At the national level, many students do not transition from primary to lower secondary, and many more drop out during secondary. While enrolment rates are high in primary, they drop in lower and then further in upper secondary, such that approximately 40 percent of children aged 14 to 17 (lower secondary age) and 81 percent of children aged 18 and 19 (upper secondary age) are out of school (figure 1). By tertiary level, very few young adults are enrolled in school, with 94 percent of the population outside of the education system.

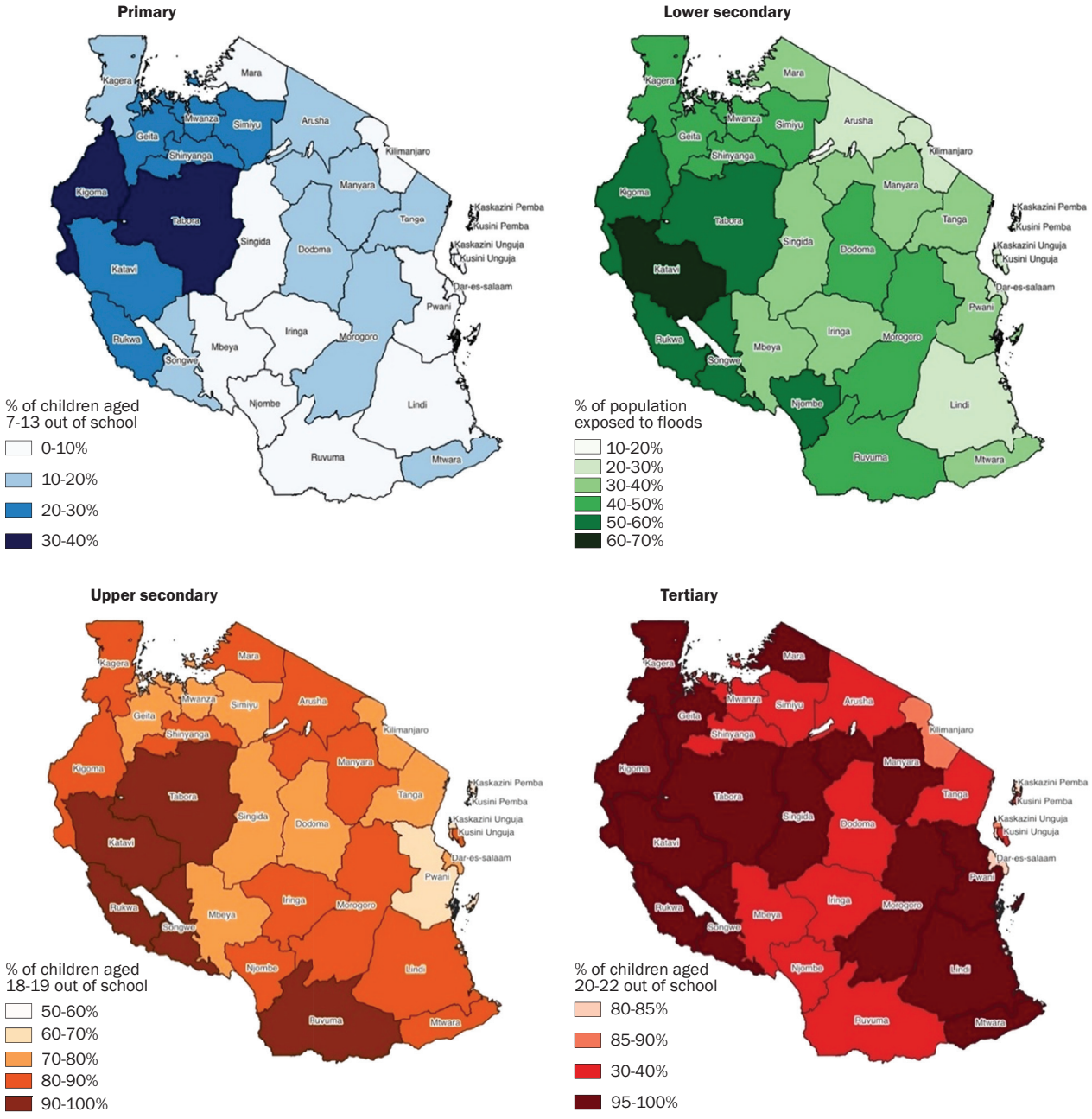
Figure 1: Proportion of out-of-school children by age, 2022



Source: World Bank staff calculations, based on data from Tanzania Demographic and Health Survey (DHS) 2022.

Regionally, education outcomes are lowest in the west of Tanzania. Across all education levels, western Tanzania has the highest proportion of out-of-school children, and hence the lowest participation rates. In Tabora, 35 percent of children aged 7–13 are not currently attending primary school, against 2 percent in Dar es Salaam and 3 percent in Kilimanjaro. The difference in out-of-school rates reduces as age increases, as all regions perform worse in secondary compared to primary. While Katavi and Songwe lead the country in out-of-school rates in lower and upper secondary respectively (61 percent for Katavi in lower secondary, and 96 percent for Songwe in upper secondary), the best performing regions are not well off either. Kilimanjaro (24 percent, lower secondary) and Pwani (68 percent, upper secondary) have the lowest respective out-of-school rates among lower and upper secondary-aged children, but these rates remain high, meaning that the entire country faces an issue for access to education in lower secondary—and more acutely in upper secondary and tertiary (figure 2).

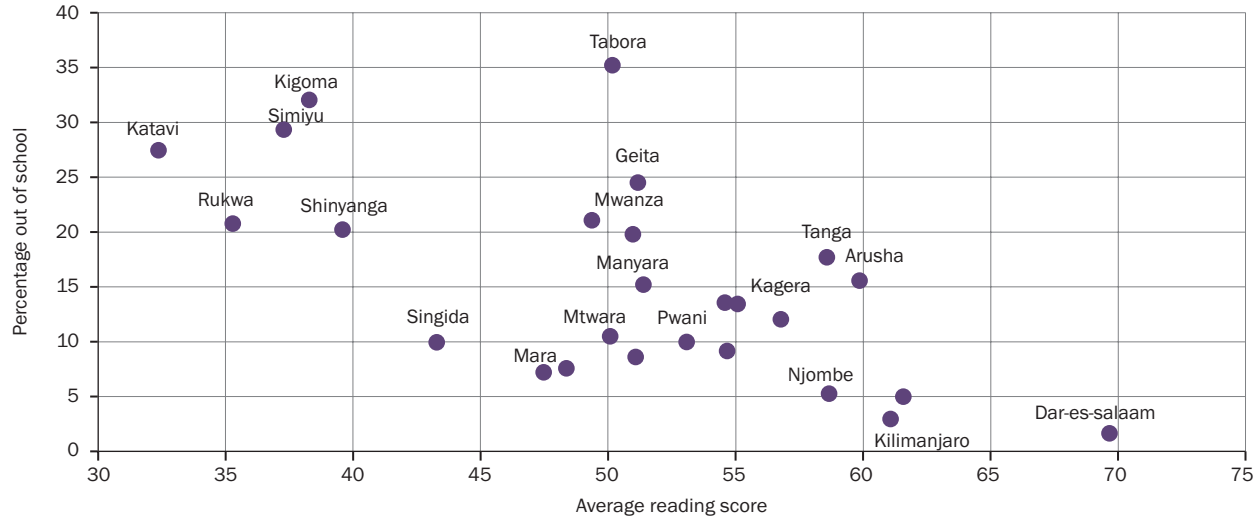
Figure 2: Out-of-school children by region and level, 2022



Source: World Bank staff calculations, based on data from DHS 2022

There is a strong correlation between access to education and learning outcomes in primary. Regions with high levels of absenteeism in primary school are also regions that score poorly on learning outcomes in primary such as Katavi, Simiyu, Kigoma and Tabora (figure 3). On the other hand, Dar es Salaam, Iringa, and Kilimanjaro pupils score highest on reading comprehension and oral fluency tests in Standard 2, and are also the three regions with the lowest out-of-school rates in primary. This indicates that most of the following analysis can rely on access to education as a proxy for learning outcomes too.

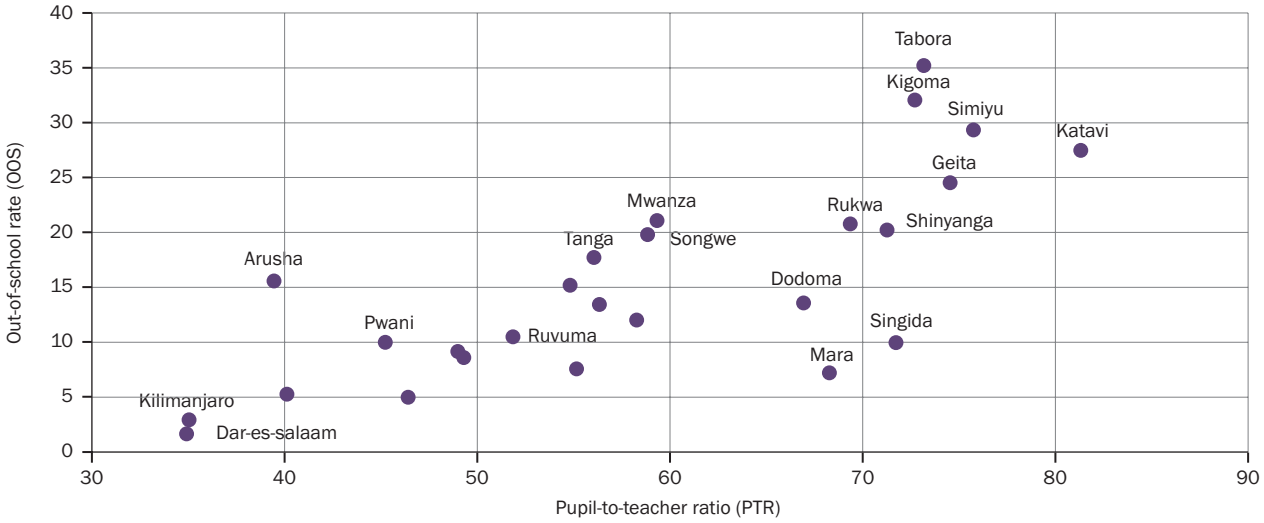
Figure 3: Out-of-school rates and reading scores in primary by region, 2022



Source: World Bank staff calculations, based on data from the Ministry of Education, Science and Technology National Examination Council of Tanzania 2022 Standard 2 National Assessment Report on Reading, Arithmetic and Writing Assessment

Supply-side issues compound with demand-side problems. The most understaffed regions are those of Katavi and Simiyu with pupil-to-teacher ratios (PTR) of respectively 81 and 76, on average in primary schools within these regions (figure 4). There is a large cluster in the northwest of Tanzania of understaffed classrooms, from Kigoma in the west to Singida in the east. This cluster maps to high levels of out-of-school children at the primary level: the regions with the highest PTRs are also those with the largest percentages of out-of-school children in primary. Katavi, Simiyu, Geita and Tabora constitute the worst four regions in terms of both PTR and out-of-school rates in primary, while Kilimanjaro and Dar es Salaam are the best performing for both variables. The correlation between supply- and demand-side constraints is apparent.

Figure 4: Out-of-school rates and PTRs by region, 2022

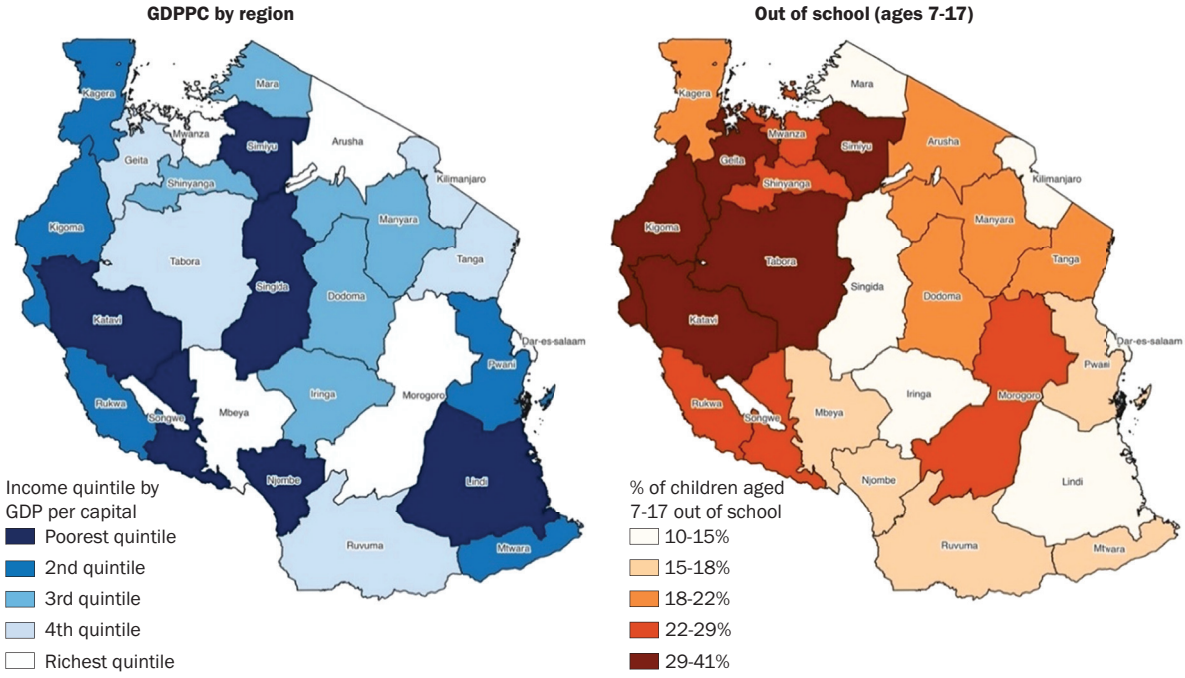


Source: World Bank staff calculations, based on data from Ministry of Education, Science and Technology National Examination Council of Tanzania 2022 Standard 2 National Assessment Report on Reading, Arithmetic and Writing Assessment.

Income is not the only determinant of school participation. While there is a link between gross domestic product (GDP) per capita regionally and out-of-school rates (the two poorest regions of Katavi and Simiyu also have the highest out-of-school rates among 7–17-year-olds, 36 and 34 percent respectively), a few

outliers exist (figure 5). For example, Morogoro has an out-of-school rate of 24 percent for primary and lower secondary combined, despite having the 4th highest GDP per capita, while Njombe's out-of-school rate is only 17 percent, despite having the 4th lowest GDP per capita.

Figure 5: GDP per capita and out-of-school rates by region, 2022



Source: World Bank staff calculations, based on data from Ministry of Education 2022; National Accounts 2022.

Being from a rural household is not a predeterminant for being out of school. As highlighted by the complexity of the relationship between income and school attendance, regression analysis highlights no causal relationship between being living in a rural setting and being out-of-school (table 1). However, children with more siblings are more likely to be out of school, and so are boys relative to girls. Richer households are less likely to have their children out of school. Owning agricultural land is negatively correlated with being out of school, even when controlling for wealth, meaning that landowners do not seem to be pulling their children out of school for labor help on the family farm.

Table 1: Determinants of being out-of-school, 2022, for children aged 7–17

Variable	Out-of-school	
Rural	-0.00841	(0.0708)
Female	-0.159***	(0.0404)
Wealth score	-4.74e-06***	(3.62e-07)
Landowner	-0.287***	(0.0478)
Household size	0.0549***	(0.00488)
Region	0.00188	(0.00170)
Constant	-1.509***	
Observations	21,440	

Source: World Bank staff calculations, based on data from DHS 2022.

Notes: Standard errors in parentheses; *** p<0.01.

3. Climate Change will Worsen Educational Outcomes for the Least Fortunate

Adverse weather effects caused by climate change, such as droughts, floods and heatwaves, are directly associated with lower education outcomes. There is evidence to support the idea that people living in hotter climates complete less formal schooling and score lower on standardized tests than those living in cooler climates: for every day students spent above 80°F (26°C) in the three years preceding an exam, test scores decreased by 0.018 standard deviations.[7] This reduction in learning is led by hot school days, and not by hot non-school days, meaning that heat likely interferes with the learning process in the classroom rather than hindering brain development. Another study also found strong adverse short-term effects of heat above 26°C (79°F) in India.[8]

Evidence also suggests that droughts reduce educational participation.[9] In Cote d'Ivoire, a drought event in 1986–87 is estimated to have caused school enrollment to fall by approximately 20 percentage points in villages that were affected by droughts relative to those unaffected.[10] In Malawi, a rainfall shock of 10 percent below the long-run average in 1994–95 was associated with an increase of 23 percent in the fraction of students with absenteeism.[11] And in Mozambique, adverse weather events, including droughts, are also associated with lower human capital accumulation.[12] In some contexts, droughts can increase participation, but ultimately reduce overall learning, as in South Africa.[13] The increase in schooling is likely due to a lower opportunity cost of schooling due to the drought and absence of farming work to be done, while the lower learning is likely caused by negative physical and mental health consequences associated with the climate shock, which hinders human capital development despite increased progressing through school.

Floods are negatively associated with educational outcomes too. In Zimbabwe's Muzarabani District, where floods are mainly caused by localized heavy seasonal rainfall and runoff, the authors found through qualitative research that floods are causing low learning.[14] Most teachers no longer have the time to cover the school syllabus, and many students can no longer attend school during the three months of rainy season (January to March), where attendance drops by 50 percent. Learning poverty can lead to economic poverty, through early dropouts, fewer job opportunities and more reliance on agricultural sector jobs, which in turn are more likely to be affected by climate change. Floods also damage infrastructure, which can make the return to school post-climate event longer and have sustained negative impacts on access to education.

Adverse climate change effects on education will likely be disproportionately felt by the poorest Tanzanians. The least advantaged economically already have the lowest participation rates and are also most prone to changing education attainment due to these weather-related events. In Malawi during the 1994–95 drought, adverse school attendance effects were concentrated among children in the poorest households.[15] In Uganda, negative rainfall shocks reduce school attendance by close to 10 percent, and

---

7 Park, R J, Behrer, A P and Goodman, J (2021) "Learning is inhibited by heat exposure, both internationally and within the United States." *Natural Human Behaviour* 5: 19–27. https://doi.org/10.1038/s41562-020-00959-9.

8 Garg, T, Jagnani, M and Taraz, V (2020) "Temperature and human capital in India." *Journal of the Association of Environmental and Resource Economists* 7(6): 1113–1150.

9 Ferreira, F H G and Schady, N (2009) "Aggregate Economic Shocks, Child Schooling, and Child Health." *The World Bank Research Observer* 24(2): 147–181. https://doi.org/10.1093/wbro/lkp006.

10 Jensen, R (2000) "Agricultural Volatility and Investments in Children." *American Economic Review, Papers and Proceedings* 90(2): 399–404.

11 World Bank (2007) *Malawi Poverty and Vulnerability Assessment: Investing in Our Future*. Washington D.C.

12 Baez, J E, Caruso, G and Niu, C (2020) "Extreme Weather and Poverty Risk: Evidence from Multiple Shocks in Mozambique." *Economics of Disasters and Climate Change* 4: 103–127 (2020). https://doi.org/10.1007/s41885-019-00049-9.

13 Nordstrom, A and Cotton, C (2020) "Impact of a severe drought on education: More schooling but less learning." Queen's Economics Department Working Paper, No. 1430, Queen's University, Department of Economics, Kingston (Ontario).

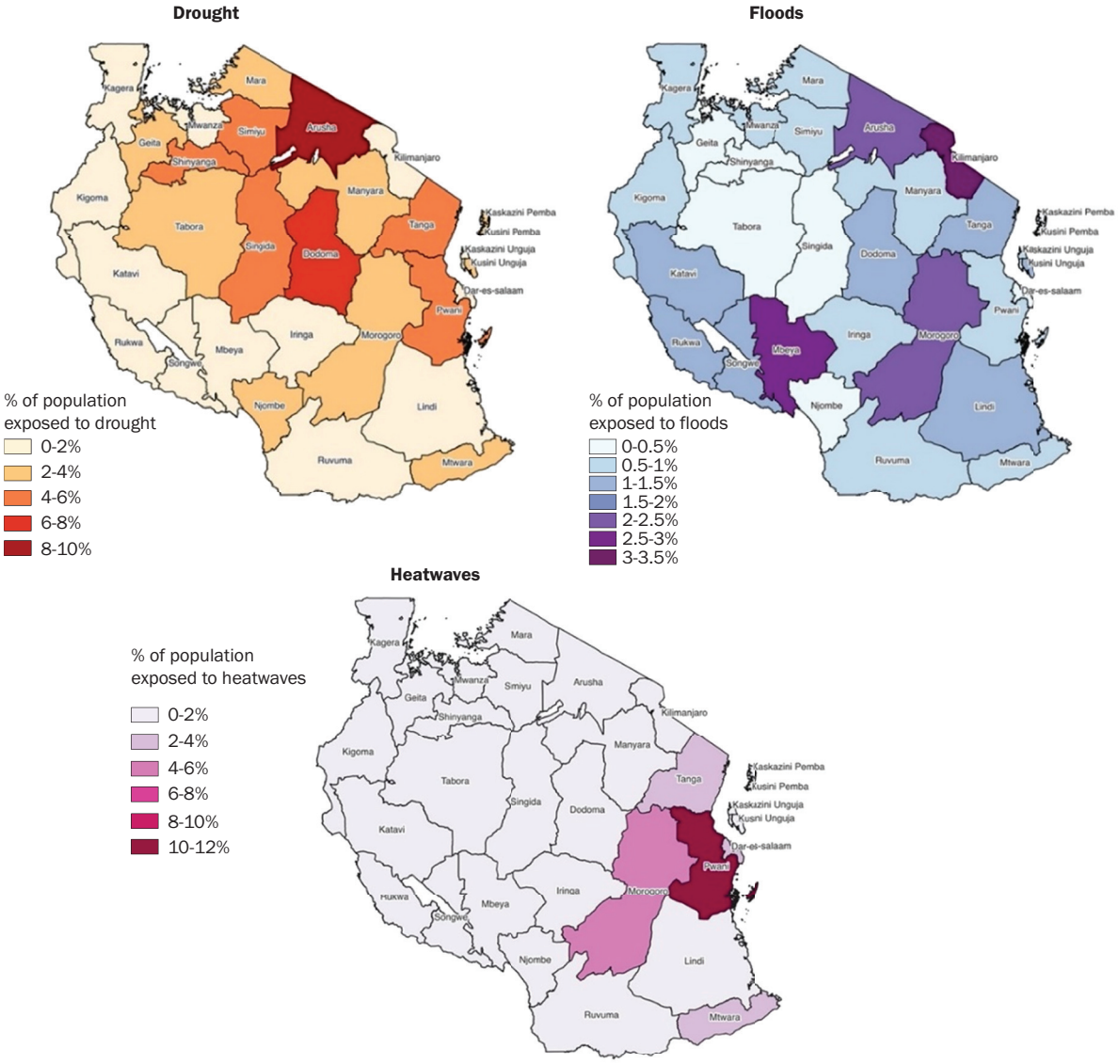
14 Mudavanhu, C (2014) "The impact of flood disasters on child education in Muzarabani District, Zimbabwe." *Jàmbá: Journal of Disaster Risk Studies* 6(1): 138. https://doi.org/10.4102/jamba.v6i1.138.

15 World Bank. 2007. Malawi Poverty and Vulnerability Assessment: Investing in Our Future. Washington, D.C.

effects are significantly larger for children in rural areas and in primary schools.[16] The mechanism is most likely an income effect: in rural areas, which are predominantly agriculture-based, exposure to negative rainfall shocks significantly increases children's participation in wage work by 0.9 percent in Uganda. Conversely, in urban areas where employment is predominantly in services and industry, income effects caused by climate change will likely be smaller.

Drought, floods and heatwaves pose different threats to different populations across Tanzania. An estimated 1.7 million citizens are expected to be exposed to droughts in the future, against 620,000 for floods and 660,000 for heatwaves (figure 6). Drought risks are concentrated in the northern half of the country, with up to 10 percent of the population affected annually (Arusha). Nationally, 24 of the 31 regions have more than 1 percent of their population exposed to drought risk, and 11 regions have more than 3 percent of their population exposed. Many Tanzanians are exposed to flood risk, but these risks are more

Figure 6: Proportion of population exposed to climate shocks in Tanzania



Source: Olinto, Brunckhorst and Paul (2024) data on exposure to shocks in Tanzania, February 2024.

16 Agamile, P and 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.

spread across the population, with no region having a portion greater than 3.2 percent of its population (Kilimanjaro) exposed to flood risks per year. Exposure to heatwaves is far more concentrated, but with potentially large populations impacted. While only 8 of the 31 regions are affected, up to 11.4 percent of the Pwani population could be exposed to heatwave climate shocks soon.

Climate effects on educational outcomes will be regionally specific. Tabora has the highest out-of-school rate for children of primary age (35 percent), which is 19 percentage points higher than the national average of 16 percent (table 2). In this region, the main risk posed by climate change to the population is through increased drought periods: 3.6 percent of its population—or 117,000 people—are exposed to droughts annually, against none to heatwaves and 0.5 percent to floods. This entails different policy recommendations than are region such as Katavi, for example, where floods pose the main threat, but affecting only 8,500 people annually. Furthermore, some regions have lowered their out-of-school rates at the primary level, but not at the lower secondary level, such as Songwe, while others struggle on both fronts, such as Kigoma.

Table 2: Deviation from national rate of out-of-school children by region and exposure type, 2022

Region	Main exposure type	Population exposed annually	Deviation from average national out-of-school rate	
			Primary	Lower secondary
Tabora	Drought	116,851	19.0	14.2
Kigoma	Flood	19,802	15.8	13.1
Simiyu	Drought	103,271	13.1	8.4
Katavi	Flood	8,585	11.2	21.0
Geita	Drought	100,278	8.3	2.5
Mwanza	Drought	64,345	4.8	5.1
Rukwa	Flood	18,442	4.5	13.0
Shinyanga	Drought	97,284	4.0	2.2
Songwe	Flood	16,517	3.6	14.7
Tanga	Drought	127,640	1.5	-4.3
Arusha	Drought	223,277	-0.7	-13.0
Manyara	Drought	79,544	-1.0	-8.1
Dodoma	Drought	194,989	-2.7	0.8
Morogoro	Heatwave	171,038	-2.8	5.8
Kagera	Drought	64,000	-4.2	1.3
Mtwara	Heatwave	44,057	-5.8	-1.6
Pwani	Heatwave	164,615	-6.3	-8.7
Singida	Drought	108,642	-6.3	-7.2
Mbeya	Flood	66,784	-7.1	-5.8

Region	Main exposure type	Population exposed annually	Deviation from average national out-of-school rate	
			Primary	Lower secondary
Lindi	Drought	16,711	-7.6	-11.5
Ruvuma	Flood	12,721	-8.7	5.4
Mara	Drought	91,530	-9.0	-7.2
Njombe	Drought	21,986	-11.0	14.8
Iringa	Drought	16,647	-11.3	-5.9
Kaskazini Pemba	Drought	6,307	-11.7	-19.9
Kusini Pemba	Drought	4,819	-13.0	-18.3
Kilimanjaro	Flood	66,039	-13.3	-15.9
Kaskazini Unguja	Drought	3,892	-13.4	-18.2
Mjini Magharibi	Flood	3,385	-14.0	-19.6
Kusini Unguja	Drought	3,826	-14.2	-11.1
Dar es Salaam	Heatwave	212,496	-14.6	-11.2

Sources: World Bank staff calculations, based on data from DHS 2022 and Olinto, Brunckhorst, and Paul (2024).

Notes: The main exposure for Tabora's population is with drought, and the regional average out-of-school rate for those aged 7–13 years old is 19 percentage points higher than the national average.

As a result, policy implications are heterogeneous across regions. There is no one-size-fits-all recommendation to help adapt to the effects of climate change, when the country is facing a mix of droughts, floods, and heatwaves, and when some regions are more prone to secondary dropouts despite higher income levels than other regions. Appropriate infrastructure is a priority to mitigate absenteeism and learning losses due to adverse climate effects. Climate infrastructure can provide schools that are usable even in the events of extreme heat, for example. School infrastructure too can be adapted to reduce overheating of classrooms through bioclimatic architecture, which allows for naturally cool buildings even in extreme heat environments.

When school and road infrastructure fail, remote learning opportunities must exist to serve as emergency learning measures. Remote learning proves extremely valuable when school infrastructure cannot keep up with extreme weather events, such as flooding of roads that cut access to schools. The COVID-19 crisis has taught the world the importance of remote learning to exist as a failsafe in case of emergency shutdown of schools, and in order to mitigate learning losses for children. These same mechanisms can prove extremely valuable as the climate crisis intensifies.

4. Government of Tanzania Response to Climate Change in the Education Sector

The 2014 Education and Training Policy articulates climate change as a key priority area for the education sector. In addition to the policy, priority investments in education are focused on developing climate change knowledge and skills at the foundational level, developing skilled personnel in climate change adaption at technical and higher education levels, and the Regional Flagship Technical Institute in Renewable Energy at Arusha Technical College (ATC).

The human competencies, knowledge, motivation and skills of people, all mostly acquired through education systems are critical to adapting to and mitigating climate change, but developing them requires focus and specialization.[17] Climate change education calls for equipping people with knowledge and skills, understanding and ethical frameworks that enable them to mitigate, adapt and reverse climate change. The impacts of climate change have led to a demand for climate change education across the globe to enable a correct understanding of what climate change, with studies finding that climate change is deeply related to the norms and values in students' societal and daily contexts,[18] and that primary school students aged 11–12 in Tanzania had good understanding of the concept of climate change, its severity, and its atmospheric processes, knew that planting trees mitigates climate change through its cooling effect, had not lost hope, and could imagine themselves playing future roles in mitigation; but they also held misconceptions about the causes and consequences of climate change which teachers could rectify.[19] During the preparation of this CCDR report, further study of the curriculum for basic education in Tanzania was done and the findings are highlighted below by the subsector.

Basic education level – Standard 1 to Form IV

Like previous research,[20] the study for this report found that the basic education curriculum does not include climate change as a specific topic; rather it is a cross-cutting theme in subjects such as geography (which is compulsory), biology, civics, and history. Key thematic areas include: (i) understanding the relationship between human activities and environmental conservation; (ii) description of methods of environmental conservation including waste management for a clean environment; (iii) understanding economic activities that negatively impact climate; and (iv) the relationship between climate, population distribution and economic activities. International evidence points to project-based pedagogies as being most effective in climate change education programs. The extent to which this is done in Tanzania could not be extensively assessed. However, the country rolled out the competency-based curriculum at the primary and lower secondary education level a few years back; and a review of the teaching methods for primary education indicate practical lessons on tree planting and environmental management.

17 Reimers, F M (editor) (2021); Education and Climate Change. The Role of Universities. International Exploration of Outdoor and Environmental Education. DOI https://doi.org/10.1007/978-3-030-57927-2.

18 Monroe, M.C., Plate R.R., Oxarart, A., Bowers, A., and Chaves, W.A, (2019) Identifying effective climate change education strategies: a systematic review of the research. In Environmental Education Research. Volume 25 – Issue 6: Climate Change Education Research.

19 Sjoblom, P, Wolff, L, Vuorenpaa, S and Grahn, R (2022) "Primary school students and climate change – an interview study in Finland and Tanzania." *Journal of Cleaner Production* 380 (2): 135099.

20 Kiwonde, F (2019) "Effectiveness of ICT teachers' training programs in enhancing the teaching and learning of environmental education in primary schools." Unpublished PHD Thesis. Dar es Salaam: The Open University of Tanzania, Tanzania; Kimaryo, L.A. (2011). Integrating Environmental Education in Primary School Education in Tanzania Teachers' Perceptions and Teaching Practices Abo Akademie University Press. https://www.doria.fi/bitstream/handle/10024/67481.

Table 3: Climate change education at basic education level

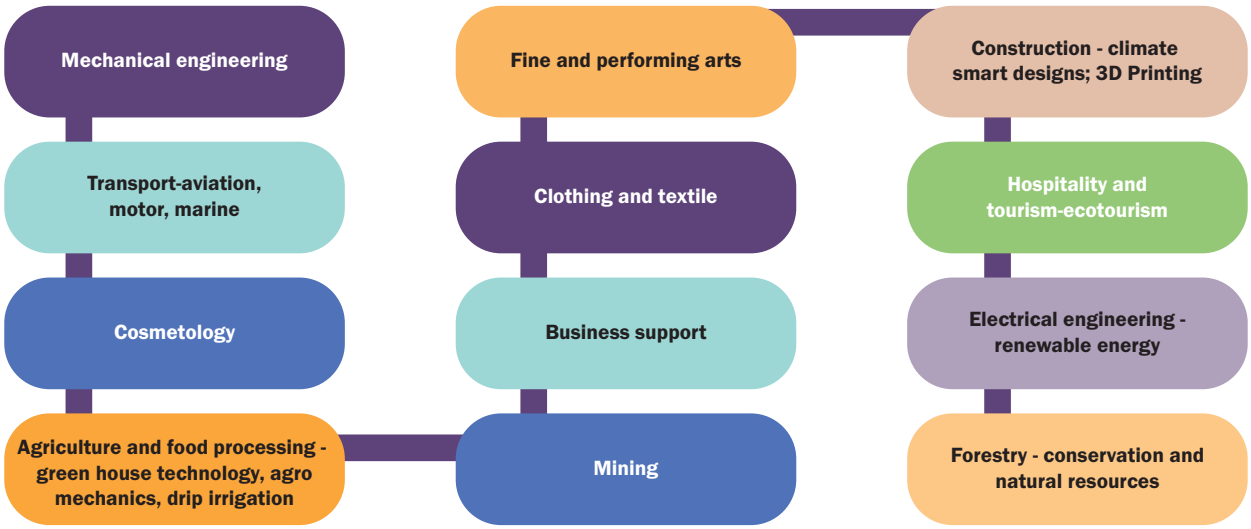
Great proficiency	Specialized expertise on climate change mastered in Standards 3–6 of Tanzania's primary education
Foundational skills in basic map and solar system	Using maps in daily life
	Basic understanding of the solar system
Foundational skills in the geography and available resources of a country	Basic understanding of the country's geography
	Basic understanding of the main natural resources
	Basic understanding of the relationship between natural resources and development
Foundational skills in human geography	Basic understanding of sources of population and housing information
	Basic understanding of the relationship between population distribution and resource use
Fundamentals of environmental conservation	Demonstrating understanding of environmental conservation education
	Demonstrating understanding of the concept of climate and its relationship with economic activities

Source: Tanzania Institute of Education (2019). Curriculum for Primary Education Standard I – VII. Dar es Salaam: Ministry of Education, Science and Technology, United Republic of Tanzania

Technical, vocational education and training (TVET) level

At the TVET level, climate-smart technologies are adopted through the delivery of inputs especially construction of lecture rooms and training workshops in the vocational training colleges and technical institutes, as well as regional offices. The training programs cover 12 occupational sectors (figure 7). For the respective programs, there is room for the use of renewable energy and specifications of the material used focusing on environmental conservation and protection. For example, ecotourism is one of the units on offer under the tourism programs; use of greenhouse technology is promoted in the agromechanics programs including the promotion of technologies that conserve the use of natural resources like drip irrigation, vertical gardens, green architecture, solar systems, adoption of designs with more open aeration to reduce use of air conditioners and other equipment that emit more carbon.

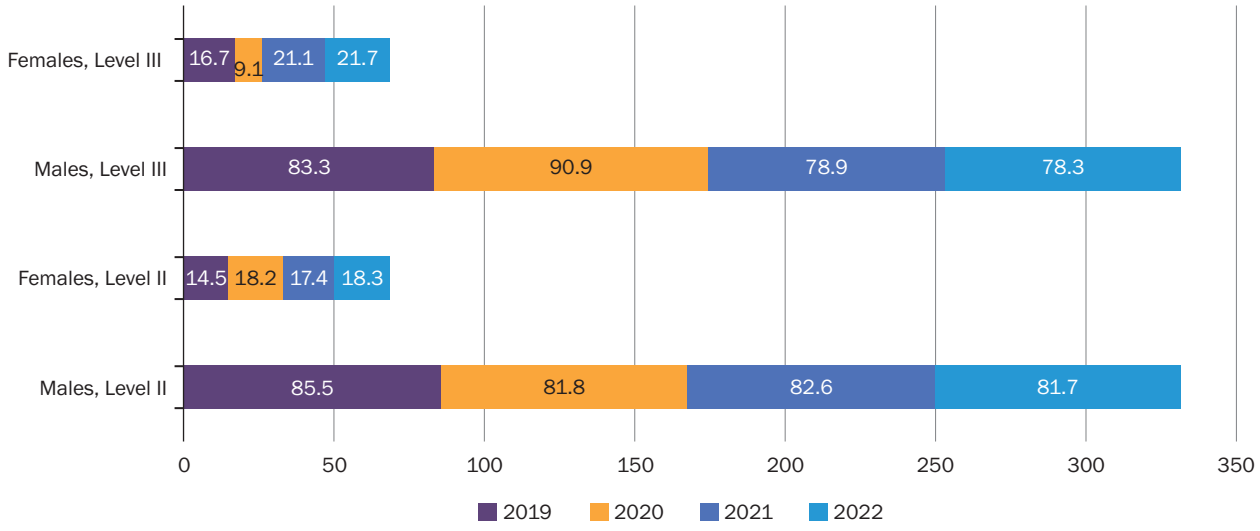
Figure 7: TVET occupational sectors in Tanzania



Source: Olinto, Brunckhorst and Paul (2024) data on exposure to shocks in Tanzania, February 2024.

Student enrolment in climate change related courses at TVET level is low and male-dominated (figure 8). Strategies to address the imbalance are ongoing, with pilot programs and appropriate incentives provided through ongoing World Bank and other development partner-supported operations. Equitable expansion would be recommended across programs. With support from the World Bank, Tanzania is implementing the $75 million Eastern Africa Skills for Regional Integration Project –P163399, of which $16.24 million is toward the establishment of ATC's Kikuletwa Campus into a Regional Renewable Energy Training and Research Center. The center focuses on hydropower, solar, wind, and bioenergy. Key programs on offer include ordinary diplomas in electrical and solar photovoltaic systems engineering; electrical and wind energy systems engineering; hydropower engineering; and mechanical and biomechanical engineering all equip the graduate with knowledge and skills with the ability to identify challenges as well as the need for urgent workable solutions to climate change. By 2024, the center had enrolled 643 students (regional and national) in the 26 newly developed, demand-driven programs accredited by the national and regional TVET accreditation agencies; extended staff training including international exchanges and industrial attachments for their academic staff; signed 14 memoranda of understanding with the industry, as well as conducted annual tracer studies to assess the relevance of the programs on offer.

Figure 8: Trends in enrolment in agromechanics at TVET level



Higher education level

With support from the World Bank-supported $425 million Higher Education for Economic Transformation Project - P166415, universities have developed demand-driven programs with climate change content at diploma, bachelors' and postgraduate levels, to be offered starting with the Academic Year 2025/26. Some of the academic programs that have been developed to address a range of climate change issues are highlighted here and summarized in table 4.

Bachelor's degree level

Programs with a sectoral focus include degrees in agricultural and water resource engineering, horticulture, renewable energy technology, construction management, aquatic sciences, and wetland management. For example, the Sokoine University of Agriculture (SUA) offers courses in: agricultural engineering, which could provide knowledge and skills in climate-resilient agricultural practices, renewable energy and water management systems for agriculture; irrigation and water resources engineering, which embraces skills water resource management and how to adapt irrigation systems to the everchanging climatic

conditions of a certain geography; and horticulture and aquaculture, which look at how to adapt horticultural and aquatic ecosystems to sustainable farming practices. Ardhi University (ARU) offers courses in electrical and renewable energy technology, architectural technology, environmental resource engineering, construction management, and the innovative oceanographic sciences program, which enables understanding between the complex relationship between oceans and climate change systems. The University of Dar es Salaam's (UDSM) new Aquatic Environmental Sciences and Conservation, and Limnology and Wetland Management courses are central to knowledge capital generation in the management of freshwater, wetland, and aquatic ecosystems that will build the resilience of future generations.

Master's degree level

Key programs developed by SUA include agrometeorology and climate change which directly focus on climate change and its impacts; environmental sciences and management which relate to environmental management issues; and environmental and natural resources economics which address economic aspects of climate change. ARU has developed master's programs in environmental and natural resources engineering. The UDSM has developed innovative master's programs in geotechnical engineering which impart knowledge and skills on how the stability of the built environment is affected by the dynamics in environmental conditions; natural resource assessment and management to impart knowledge and skills in sustainable management of natural resources and their preservations for future generations; together with marine resources management. Such programs equip the graduates with knowledge on how to address climate change challenges within different sectors, including agriculture, water resources, ecology and economics.

Postgraduate degree level

Programs in agroecology, soil and water management that have been developed at SUA have great relevance to climate change including the potential of the related research to generate results on both impact of climate change and sustainable solutions. UDSM's newly developed postgraduate program in marine fisheries and mariculture, empowers graduates to champion efforts to protect marine biodiversity ensuring the future of global fisheries and advancing sustainable mariculture practices. These newly developed programs will complement existing programs, which have elements of climate change. Key providers include but are not limited to: University of Dodoma (UDOM), SUA, UDSM, ARU, and Mbeya University of Science and Technology (table 4).

Table 4: Sample higher education programs with climate change content in Tanzania

UDOM (College of Earth Science and Engineering)	UDSM	ARU (School of Engineering and Environmental Studies)
BSc in Environmental Engineering	BA in Geography and Environmental Studies	BSc in Environmental Engineering
BSc in Environmental Sciences	PhD Environmental Science	BSc in Environmental Science and Management
BSc in Geoinformatics		PhD Environmental Science and Management
BSc in Renewable Energy Engineering	**Centre for Climate Change Studies**	Masters in Disaster Risk Management
BSc in Environmental Engineering	MSc in Climate Change and Sustainable Development	**Mbeya University of Science and Technology**
BSc in Environmental Sciences	PhD in Climate Change and Sustainable Development	BSc in Natural Resources Conservation
Master of Integrated Water Resources Management	**Short course**	BSc of Science Aquatic sciences and Aquaculture Technologies
Bachelor of Environmental Disaster Management	Climate Change and Sustainable Development (2-week course)	BSc of Science Environmental Health and Technology
BSc in Renewable Energy Engineering		MSc Biodiversity Conservation
SUA		
College of Forestry, Wild Life and Tourism	**College of Agriculture**	**Solomon Mahlangu College of Science and Education**
BSc in Forestry	BSc in Agriculture General	MSc in Environmental Sciences, Management and Technology
BSc in Environmental Sciences and Management	BSc in Agronomy	MSc in Management of Natural Resources for Sustainable Agriculture
MSc in Ecosystems Science and Management	MSc in Land Use Planning and Management	MSc in Irrigation Engineering and Management
MSc in Forestry	PhD in Soil and Water Management	
	BSc in Irrigation and Water Resources Engineering	

Notes: BA = Batchelor of Arts; BSc = Batchelor of Science; MSc = Master of Science; PhD = Doctor of Philosophy.

Males dominate climate change-related programs at public universities. The gender gap is widest in mining and earth sciences program with only 1 female to 3 males in the programs are needed. More effort needed to incentive female access to the programs.

Climate change education needs to go beyond equipping people with skills to understand climate change and equipping them with tradeoffs to make choices, innovate environmentally sustainable solutions and change lifestyles in ways that are responsive to the impact on climate. It should also involve school-based programs, non-formal and informal education as well as target both old and young.

5. Recommendations for the Government to Consider

Strengthening government efforts on climate change may necessitate a detailed review of the curricula for the existing programs for possible: (i) identification of missing gaps/thematic areas; (ii) dialogue with respective university college teams for possible integration of missing elements in the existing programs through curriculum updates; (iii) dialogue with the National Council for TVET on identified gaps and the need to develop requisite occupational standards.

Promote adaptation of the following by schools and education institutions at scale. Solar systems; energy saving stoves and biogas in preparation of school/institutional meals; tree planting campaigns launched and anchored on school/education institutional platforms; increasing public awareness on climate change at open days of schools and education institutions; climate resilient infrastructure designs and related technologies including their integration in the curriculum at TVET and university levels.

Continue research on the impact of climate change on education including the identification of effective climate change adaptation strategies.

Evidence-based policy and planning for guide: Restoration of school infrastructure in climate disaster related recovery programs; and how to support the resumption of schooling for the children and students in all climate disaster-related recovery programs.

WORLD BANK GROUP

World Bank Tanzania
50 Mirambo Street
P. O. Box 2054
Dar es Salaam, Tanzania
Tel : +255-22-216-3200
tanzaniaalert@worldbank.org

Read more on linkages between climate and development in Tanzania