

Schoolchildren's Perceptions and Motivations of Climate Change towards Climate Change Education: A Comparative Study among Boys and Girls in Koulikoro, Mali

Adama Boua Doumbia^{1,2*}, Marcelinus Dery³, Abou Abdoulaye Sow¹, Halidou Kafando¹, Elh Maman Garba Ibrahim¹, Abdoulie F. R. Jadama⁴, Walter Leal Filho⁵

¹Graduate Study Programme on Climate Change and Education, West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL), School of Agriculture and Environmental Sciences, University of The Gambia, Banjul, The Gambia

²Graduate Study Programme on Climate Change and Agriculture, West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL), Institut Polytechnique Rural de Formation et de Recherche Appliquée (IPR/IFRA) de Katibougou, Koulikoro, Mali

³Department of Communication Studies, Faculty of Arts, University of Cape Coast, Cape Coast, Ghana

⁴School of Education, University of The Gambia (UTG), Banjul, The Gambia

⁵Research and Transfer Centre "Sustainable Development and Climate Change Management (FTZ NK)", Hamburg University of Applied Sciences, Hamburg, Germany

Email: *ada.bouadoubia@gmail.com, hondery@gmail.com, diambor@hotmail.fr, kafandohalid@gmail.com, garbaelhadj84@gmail.com, afrjadama@utg.edu.gm, walter.leal2@haw-hamburg.de

How to cite this paper: Doumbia, A. B., Dery, M., Sow, A. A., Kafando, H., Ibrahim, E. M. G., Jadama, A. F. R., & Leal Filho, W. (2026). Schoolchildren's Perceptions and Motivations of Climate Change towards Climate Change Education: A Comparative Study among Boys and Girls in Koulikoro, Mali. *Open Journal of Social Sciences*, 14, 571-589.

<https://doi.org/10.4236/jss.2026.149035>

Received: July 31, 2026

Accepted: September 19, 2026

Published: September 22, 2026

Abstract

The effects of climate change (CC) differ considerably among groups, with gender having an important role in defining how people think about and respond to climate hazards. This study aims to explore the differences and similarities between boys' and girls' perceptions and motivations regarding CC and assess their views of the status of CC in the curriculum. The study employed a multi-stage sampling procedure. The two primary schools were selected using stratified convenience sampling by the Pedagogical Animation Centre (CAP) of Koulikoro. The selection of these schools involved their engagement in the research activities at the CAP. The research employed a descriptive research design with a survey questionnaire. Simple random sampling was used to select 114 fifth- and sixth-grade pupils among a population of 160, utilising the Raosoft (2004) sample size calculator. The findings revealed that both boys and girls have similar concerns about CC. However, girls demonstrated statistically significant differences in attitudes towards climate change compared to their counterparts, boys. In addition, girls' awareness of CC was slightly higher than



boys'. The data indicated that boys have a greater understanding of the causes and impacts of CC, and a greater motivation to act on climate than schoolgirls. Girls showed a higher understanding of mitigation and adaptation actions and desire to learn about CC, with no statistically significant differences compared to boys.

Keywords

Boys and Girls, Climate Change, Climate Change Education, Comparison

1. Introduction

Climate change (CC) is a worldwide issue, yet its impacts are unevenly distributed. Extreme weather phenomena such as droughts, floods, storms, and heavy rainfall are becoming more frequent and severe, with serious social and economic impacts. Between 1970 and 2019, developing nations had the highest number of recorded deaths from weather, climate, and water extremes (WMO, 2021). Mali is a country exposed to both short-term climate variability and long-term CC due to its high vulnerability to CC's negative effects, as well as high population growth, limited resilience, and multiple violent conflicts (Cedric De & Florian, 2021).

Among the greatest worrying consequences is the disproportionate burden it throws on women, particularly those in marginalised communities. These women, who commonly live in low- and middle-income countries (LMICs), indigenous communities, and underserved sections of more affluent countries, are particularly vulnerable due to social, cultural, and environmental issues (IPCC, 1998; Anjum & Aziz, 2025; Verner et al., 2026).

The importance of understanding CC from people's social perspectives has increased due to the inadequate transmission of climate science findings to communities (Segnon et al., 2024). Despite limited scientific data on CC awareness, communities continue to experience its impact on their livelihoods, wellness, and natural resources (World Health Organization, 2012; WMO, 2021; Gbode et al., 2025). While most individuals acknowledge the reality of CC, there are differing understandings of its causes and impact on adaptation (Asongu et al., 2021; Fruttero et al., 2023; Segnon et al., 2024; Anjum & Aziz, 2025).

Several studies have looked into schoolchildren's concerns, perceptions, and awareness of CC (García et al., 2022; Jurek et al., 2022; Modu & Deba, 2024; Doumbia et al., 2025a; Doumbia et al., 2025b; Doumbia et al., 2026b). Additionally, studies explore students' knowledge of CC causes, impacts, mitigation and adaptation strategies (Kundariati et al., 2024; Doumbia et al., 2025a; Doumbia et al., 2025b; Doumbia et al., 2026b). Another study assesses Malian primary schoolchildren's knowledge of environmental education and behaviour towards health and environment (Doumbia et al., 2026a). Evidence revealed that gender differences in CC perception and awareness, motivations and pro-environmental be-

haviour have been documented (Mohammed et al., 2021; Khan et al., 2022; Ross et al., 2025). However, studies about differences in the perspectives of CC between females and males are limited in Mali. These are the gaps in the current research to determine the differences and similarities of CC perceptions and motivations among schoolchildren, boys and girls in Koulikoro, Mali.

The views of individuals on the reality, causes, and impacts of CC can have a significant impact on their conduct and support for mitigation and adaptation strategies (Chaudhary & Bawa, 2011; Segnon et al., 2024). As a result, people's awareness and understanding of the changing climate are critical for improving coping techniques and better adapting to its effects (Mehta et al., 2010; Segnon et al., 2024). Men and women hold different perspectives on CC and its consequences. Individuals who have been personally influenced by various climatic events tend to report that the likelihood of such an event occurring again is very high, which can alter or shift their opinion of CC (Carlos et al., 2018; Anjum & Aziz, 2025; Knight, 2019; Verner et al., 2026). Women and men react separately to changes in the climate because of their socially established gender roles, obligations, rank, and personalities, as well as their differing positions in society (Lambrou & Nelson, 2010; Segnon et al., 2024; Anjum & Aziz, 2025; Verner et al., 2026). Women's and men's ability to behave in a changing climate is also influenced by their social and cultural identities, as well as gender roles (Dankelman, 2012; Segnon et al., 2024; Anjum & Aziz, 2025; Verner et al., 2026). However, a limited understanding of gendered perceptions and awareness in various environmental and social management strategies becomes difficult to identify gendered needs and awareness in sustainability management. Failure to acknowledge female needs can increase their vulnerability and result in inadequate CC response measures. Therefore, it is relevant to investigate boys' and girls' perspectives on CC in CC education (CCE). This research aims to determine the differences and similarities of schoolchildren's perceptions and motivations of CC in Koulikoro, Mali.

Theoretical Frameworks and Hypotheses

Research from different regions has documented differences in CC concerns and attitudes between men and women (Shields & Zeng, 2012; Lewis et al., 2018; Knight, 2019; Mohammed et al., 2021; Khan et al., 2022). Scholars studied the differences between men's and women's perceptions of CC (Chaudhary & Bawa, 2011; Pagiaslis & Krontalis, 2014; Mohammed et al., 2021; Khan et al., 2022), knowledge of CC mitigation and adaptation strategies (Mehta et al., 2010; Jamal et al., 2017; Knight & Givens, 2021; Mohammed et al., 2021; Verner et al., 2026). Evidence indicated the disparities between men and women in vulnerability to CC (Asongu et al., 2021; Fruttero et al., 2023; Segnon et al., 2024; Anjum & Aziz, 2025).

Gender differences in the perceptions of CC have been restricted (Lewis et al., 2018; Khan et al., 2022). Lewis et al. (2018) conducted a global survey on concerns about CC. Khan et al. (2022) analysed gender disparities in CC perception and

awareness using descriptive statistics. Mohammed et al. (2021) used a mixed-methods approach that included focus groups and household questionnaires to determine how male and female farmers perceived climatic variability. Verner et al. (2026) highlighted a crucial knowledge gap: women in less democratic and economically developed cultures are less likely than men to believe that human activity is the cause of CC. Knight & Givens (2021) used multilevel models with cross-level interactions to examine how three macro-level contextual factors: national affluence, climate risk, and gender equality affect the individual-level impacts of gender on CC concern and perceived seriousness. Ross et al. (2025) employed quota and snowball sampling strategies to select UK-based participants from a big engineering/construction company to investigate perceived worry, importance, and action about CC. Oliver & Adkins (2020) employed a stratified design and a multilevel model to assess 15-year-olds' scientific literacy, perceptions, and awareness of CC across 54 countries. Several other studies compare awareness, perceptions and knowledge of CC between male and female students (Ezeudu et al., 2016; Gazzaz & Aldeseet, 2021; Jurek et al., 2022; García et al., 2022; Ramos et al., 2023; Odekeye et al., 2024).

Therefore, it is important to know the basic understanding of CC among schoolchildren, boys and girls. In this research, we specifically highlight schoolchildren's concerns, attitudes, and awareness of CC. The study included schoolchildren's perceptions of the causes, impacts, mitigation, and adaptation of CC. Moreover, we are interested in schoolchildren's motivation for CC in this study. The status of CC in the curriculum is also included in the study. Considering the above components, we hypothesised that:

H01: There is no statistically significant difference between attitudes towards CC among schoolchildren, boys and girls in Koulikoro.

H02: There is no statistically significant difference between perceptions of CC among schoolchildren, boys and girls in Koulikoro.

H03: There is no statistically significant difference between motivations regarding CC among schoolchildren, boys and girls in Koulikoro.

H04: There is no statistically significant difference between the status of CC in the curriculum among schoolchildren, boys and girls in Koulikoro.

Purpose

This current study aims to explore the differences and similarities between schoolchildren boys' and girls' perceptions and motivations of CC in Koulikoro.

To address these aims, the study specifically seeks to:

- (1) Compare perceptions of climate change between schoolchildren boys and girls in Koulikoro.
- (2) Assess the differences in motivations for climate change between schoolchildren boys and girls in Koulikoro.
- (3) Compare schoolchildren boys' and girls' views of the status of climate change in the curriculum.

2. Materials and Methods

2.1. Sample Size and Sampling Determination

This study was conducted among primary school children in Koulikoro (Doumbia et al., 2025b). Koulikoro is located in the East of Bamako, about 65 kilometres away. The study population comprises pupils in Grades 5 and 6 from two schools anonymously named School A and School B.

The study used a multistage sampling technique including simple random sampling and stratified convenience sampling. The schools of this study were conveniently selected by the Pedagogic Animation Centre (CAP) of Koulikoro. The staff of the selected schools are active, and they are able to collaborate in the activities of the research. Moreover, the Raosoft (2004) sample size calculator was used to determine 114 pupils among a population of 160 pupils from two Grade 5 and two Grade 6 classes, with a 95% confidence level and a 5% margin of error. Simple random sampling was used to select the participants. Pupil participants were selected in accordance with Article 34 of the Malian educational law, which states that a child can start school as young as 6 years old. In this view, pupils of Grade 5 are supposed to be 11 years old, and those of Grade 6 are supposed to be 12 years old. To proceed with the selection, we drew the list for each class. Therefore, we randomly selected the pupils in accordance with the criteria stipulated in Article 34 of the educational law. Finally, the sample size comprised 54 pupils, made up of 30 fifth-grade pupils—15 boys and 15 girls and 24 sixth grade, including 11 boys and 13 girls from School “A”. On the other hand, 60 pupils were selected from School “B”. From each grade, 15 boys and 15 girls, totalling 30 pupils, were selected. The sample size of 114 pupils consists of 58 girls (50.9%) and 56 boys (49.1%). The Raosoft (2004) sample determination formula used for the sampling is presented below:

$$X = Z \left(\frac{C}{100} \right)^2 r(100 - r) \quad (1)$$

$$n = Nx / ((N - 1)E^2 + x) \quad (2)$$

$$E = \text{Sqrt}[(n - p)x / n(N - 1)] \quad (3)$$

where: N = Population size, r = responses, X = variability of responses, $Z(C/100)$ = critical value, n = sample size, C = confidence level and E = margin of error.

2.2. Research Design

This study employed descriptive and inferential statistics to examine differences and similarities in fifth and sixth-grade boys' and girls' perceptions and motivations of CC. Many researchers applied this research design in their studies. Gazzaz & Aldeseet (2021) employed this research design to assess the level of CC knowledge among female and male undergraduate students in Jordan. Also, Ramos et al. (2023) employed a descriptive research design in their study in Portugal. This study was conducted among children aged 9 to 13 years old. Therefore, they

used the Mann-Whitney test to examine differences in CC perceptions among boys and girls. The success of this design in previous studies makes it relevant for our study.

2.3. Questionnaire

We used a quantitative approach to examine the differences and similarities in perceptions and motivation of CC between boys and girls of fifth and sixth grade. The questionnaire was developed from Doumbia et al. (2025b) and Doumbia et al. (2026b). Beyond the personal information in section A, the questionnaire was structured as follows: awareness and perceptions (section B), motivations (section C), and the status of CC in the curriculum (section D).

A Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), is used to measure fifth and sixth-grade pupils' awareness, perception, motivation to act on CC, and the status of CC in the curriculum. A Likert scale that ranges from 1 (not important) to 4 (very important) is used to measure the desire to learn about CC in the section "motivation for CC". The absolute limit of the measurement scale (1) was set at 1.00 - 1.49.00.49 = strongly disagree, 1.50 - 2.49 = disagree, 2.50 - 3.49 = neutral, 3.50 - 4.49 = agree, and 4.50 - 5.00.50.00 = strongly agree. The limit measurement of scale (2) was set at 1.00 - 1.49.00.49 = not important, 1.50 - 2.49 = moderately important, 2.50 - 3.49 = important, 3.50 - 4.49 = very important.

The questionnaire was administered using the Kobo Collect mobile application. Taking the respondents' level of education into account, the survey was administered three times. We investigated fifth and sixth-grade pupils' perceptions of CC concerns, attitudes, awareness and causes of CC. This was followed by testing their perceptions of CC impacts, mitigation and their adaptation strategies. In the third part, we explored the motivation regarding CC and gathered views on CC in the syllabi. The sections and subsections of the questionnaire and summary of the items are presented in Table 1.

Table 1. Summary of the survey questions.

Section	Subsection	Topics Investigated	Number of Items
Awareness Perceptions	Concerns	Believe in CC and hope for actions against it.	4
	Attitudes	Asking questions and participating by taking action.	4
	Awareness	Effects of daily actions, and news from television, radio, social media, and the newspaper.	4
	Causes	Burning fossil fuels, crops and livestock production, cutting down trees, bushfires, and waste. Water vapour and chlorofluorocarbons.	7
	Impacts	Floods, droughts, rising temperatures, erosion, evapotranspiration, migration, agricultural losses, financial problems, and health problems.	7
	Mitigation	Biking or walking, renewable energy sources, improved stoves, solar ovens, agroforestry, pesticides, forest protection, planting trees, and waste management.	8
	Adaptation	Crop rotation, intercropping, zai, half-moon, stone barriers, windbreaks, dune fixation, and raising awareness in the community.	6

Continued

Motivations	Motivation to act	Planting trees, using renewable energy, walking or biking, helping people affected by CC, and utilising early warning systems.	5
	Desire to learn	Greenhouse gases, CC causes, impacts, and adaptation and mitigation measures.	4
Status	Curriculum	Natural sciences, physics and chemistry, history and geography, civic and moral education, and French.	5

2.4. Validity and Reliability of Research Instruments

A well-structured questionnaire was developed and examined by professionals to guarantee the reliability and consistency of the research tool. A meticulously designed questionnaire that was developed and reviewed by four experts (Doumbia et al., 2025b) was used to evaluate these parameters. The final edition of this report included several recommendations. After obtaining approval, the questionnaire was pilot-tested on 10% of the sample size, resulting in 11 pupils from two primary schools from the pedagogical animation centre of Sogoniko, Bamako, following the reliability testing selection criteria using the Kobo Collect Tool. Internal consistency was achieved using the Cronbach alpha scale coefficient reliability test, which resulted in a value of 0.81 %. This value exceeded the acceptable threshold of 50% cited by previous investigations Cronbach (1951); Bagozzi & Yi (1988); Cronbach & Shavelson (2004).

2.5. Data Analysis

Data analysis was conducted using the IBM Statistical Package for the Social Sciences (SPSS) software. We computed the variables according to the variables of the subsections of each section in Table 1. Therefore, awareness, attitudes, and concerns, as well as perception of CC causes, impacts, mitigation and adaptation, comprised the factors in the perception analysis. The motivation for CC comprises variables such as the desire to learn about CC and the motivation to take action. Moreover, this study determines the status of CC in the curriculum.

To start the data analysis, we administered the Shapiro-Wilk normality test to analyse the sample and verify whether the independent variables of perceptions and motivations regarding CC and CC status in the curriculum followed a normal probability distribution. The p -value for the variables examined was $p < 0.05$. In this view, we applied descriptive and inferential statistics, including the non-parametric Mann-Whitney U test. Non-parametric data do not presume any particular population characteristics, typically due to the uncertain nature of their numerical variables (Upton & Cook, 2008). Inferential statistics aim to draw conclusions and formulate predictions based on the collected data.

The Mann-Whitney U test was used with a 95% confidence interval to explore the differences and similarities between boys and girls who participated in the study. Therefore, we computed seven variables for awareness and perception: (consisting of CC concerns, attitudes, awareness, causes, impacts, mitigation and adaptation). Two variables constituted the CC motivations, including motivation to act on CC and desire to learn about it. The level of CC in the curriculum was

considered a variable. The mean rank and p -value were used to determine differences and similarities in perceptions, motivations, and views of CC in the curriculum between boys and girls. This test was performed at a significance level (α) of 0.05 for comparison. The mathematical formula of the Mann-Whitney U test is given as follows:

$$U = n_1 n_2 + \frac{n_2(n_2 + 1)}{2} - \sum_{i=n_1+1}^{n_1+n_2} R_i \quad (4)$$

U = Mann-Whitney U test; N_1 : Sample size one; N_2 : sample size two; and R_i rank of the sample size.

2.6. Ethics Statement

The Pedagogical Animation Centre (CAP) ethics committee of Koulikoro provided the ethical clearance for this study (CK: 217). This ensured that the study complied with the national and international ethical standards applicable in the country where the research was conducted. The Pedagogical Animation Centre of Koulikoro provided the researcher with ethical approval. This guaranteed that the study complied with national and international ethical standards in Mali. Because of their education and life experiences, the study participants (grades 5 and 6) were well-suited to provide data, enabling them to respond to our questionnaire at the primary school level. Their parents were given consent letters in the field, allowing them to take part in the research. Before the survey, pupils were given a verbal explanation of the letter's contents. The option to withdraw from the study and refuse to answer any questions was made clear to the participants. Additionally, they were informed that the data they submitted would be utilised for research. Before they started to answer the survey questions, pupils were given a verbal explanation of the letter's contents. The option to withdraw from the study and refuse to answer any questions was made clear to the participants. Additionally, they were informed that the data they submitted would be utilised for research. The quality of the research was ensured by a survey conducted in the field. Both French and Bamanankan, Mali's most common language, were used to clarify the study's questions.

3. Results

3.1. Comparison of Schoolchildren, Boys' and Girls' Climate Change Attitudes, Concerns and Awareness

This study revealed that girls' attitudes towards CC were statistically significantly different from those of boys, as girls showed a higher mean score in CC attitudes than boys (mean rank of 64.80 vs 49.94; $p = 0.00$). The analysis of perceptions revealed that boys and girls were equally concerned about CC (57.57 vs 57.43; $p > 0.05$). Therefore, there were no statistically significant differences between boys and girls in this study. Boys and girls all believed that CC is real. In **Table 2**, the results indicated that there was no statistically significant difference in CC awareness between boys and girls, despite females having a higher mean value of CC

awareness than males (mean rank of 59.85 vs. 55.06; $p > 0.05$). Boys and girls are at the same status to ask questions about CC and listen to radio and TV for the news of CC.

These findings supported our research hypothesis (H01), showing statistically significant differences in attitudes towards CC. The data rejected our research hypothesis (H02), showing no statistically significant differences in concerns and awareness of the perceptions of CC.

Table 2. Comparison of schoolchildren's climate change, attitudes, concerns and awareness between boys and girls.

Variable	Boys	Girls	Z_score	P_value
Attitudes	49.94	64.80	2.40	0.0092*
Concerns	57.57	57.43	0.02	0.9829
Awareness	55.06	59.85	0.77	0.4089

Note: This analysis of the comparison of schoolchildren's boys and girls related to perceptions of CC. In the Mann-Whitney U Test employed, the correlation coefficient is significant if $*p < 0.05$. The absolute limit of the measurement scale: "1.00 - 1.49.00.49 = strongly disagree, 1.50 - 2.49 = disagree, 2.50 - 3.49 = neutral, 3.50 - 4.49 = agree, and 4.50 - 5.00.50.00 = strongly agree".

3.2. Comparison of Schoolchildren, Boys' and Girls' Perceptions of Climate Change Causes, Impacts, Mitigation and Adaptation

The results in **Table 3** showed that the boys had slightly higher mean values of understanding of CC causes than the girls, but the values were not statistically significantly different (mean values 58.91 vs. 56.14; $p > 0.05$). Therefore, the boys and girls reported similar perceptions that CC is caused by burning fossil fuels, crop and livestock production, cutting down trees, bushfires, and waste. In addition, boys' and girls' responses revealed proportionate knowledge regarding CC causes. Boys and girls reported similar perceptions that an increase in water vapour and chlorofluorocarbons in the atmosphere leads to CC.

Table 3. Comparison of schoolchildren's perceptions of climate change causes, impacts, mitigation and adaptation between boys and girls.

Variable	Boys	Girls	Z_score	P_value
Causes	58.91	56.14	0.45	0.6539
Impacts	58.68	56.36	0.37	0.7046
Mitigation	53.22	61.63	-1.36	0.1705
Adaptation	53.79	61.09	-1.18	0.2275

Note: The analysis of the comparison of boys' and girls' perceptions of causes, impacts, mitigation and adaptation. In the *Mann-Whitney U Test* employed, the correlation coefficient is significant if $*p < 0.05$. The absolute limit of the measurement *Scale*: "1.00 - 1.49.00.49 = strongly disagree, 1.50 - 2.49 = disagree, 2.50 - 3.49 = neutral, 3.50 - 4.49 = agree, and 4.50 - 5.00.50.00 = strongly agree".

Regarding perceptions of the impacts of CC, the data showed no statistically significant differences between the boys and the girls. Therefore, the boys demonstrated higher scores compared to the girls, with the mean values 58.68 vs. 56.36; $p > 0.05$. The pupil participants showed a similar understanding that CC could cause floods, droughts and rising temperatures. Results of the boys and the girls did not differ significantly regarding the impacts of CC, such as migration, agricultural losses, financial problems, and health problems.

In comparison, the girls posed a higher mean value of CC mitigation and adaptation than the boys, which values did not also show any statistically significant difference (61.63 vs. 53.22; $p > 0.05$) and (61.09 vs. 53.79; $p > 0.05$), respectively. The boys and the girls indicated similar agreement towards mitigation strategies of CC included in the survey, such as biking or walking, solar, wind, hydrologic energy production, improved stoves, solar ovens, agroforestry, pesticides, forest protection, planting trees, and waste management.

The girls reported slightly higher levels compared to the boys regarding adaptation to CC, including crop rotation, intercropping, zai, half-moon, stone barriers, windbreaks, dune fixation, and raising awareness in the community.

These findings rejected our study hypothesis (H02), showing no statistically significant differences regarding the boys' and the girls' perceptions of CC causes, impacts, mitigation and adaptation.

3.3. Comparison of Schoolchildren, Boys' and Girls' Climate Change Motivation to Act, the Status in the Curriculum and Desire to Learn

The result displayed in **Table 4** revealed no statistically significant difference in motivation to act on CC between the boys and the girls ($p > 0.05$) in mean rank 58.40 vs. 56.63. Therefore, the boys were not more motivated to take actions such as planting trees, using renewable energy, walking or biking than the girls. Data also showed that the boys indicated agreement to help people affected by CC and utilise early warning systems compared to the girls.

Table 4. Comparison of schoolchildren's climate change motivation to act, desire to learn and the status in the curriculum between boys and girls.

Variable	Boys	Girls	Z_score	p_value
Motivation to act	58.40	56.63	0.29	0.7722
*Desire to learn	55.63	59.31	-0.60	0.5505
Status of climate change	59.86	55.22	0.75	0.4438

Note: This analysis compares the motivation of schoolchildren, boys and girls, the motivation of CC and the status of CC. In the *Mann-Whitney U Test* employed, the correlation coefficient is significant if $*p < 0.05$. The absolute limit of the measurement **Scale 1:** 1.00 - 1.49.00.49 = strongly disagree, 1.50 - 2.49 = disagree, 2.50 - 3.49 = neutral, 3.50 - 4.49 = agree, and 4.50 - 5.00.50.00 = strongly agree; ***Scale 2:** 1.00 - 1.49.00.49 = not important, 1.50 - 2.49 = moderately important, 2.50 - 3.49 = important, 3.50 - 4.49 = very important.

The result also showed no statistically significant difference in the desire to learn about CC between the girls and the boys (59.31 vs. 55.63; $p > 0.05$). The findings demonstrate that both boys and girls are interested in learning about greenhouse gases and their effects. The pupils are willing to learn about the causes and impacts of CC. According to the data, the participants desire to learn about adaptation and mitigation measures for CC.

The boys agreed more with the state of climate-related topics in the syllabi than the girls, but the mean values revealing agreement were not statistically significant (59.86 vs. 55.22; $p > 0.05$). Therefore, the boys and the girls reported similar views of the status of CC in their subjects, including natural sciences, physics and chemistry, history and geography, civic and moral education, and French in the curriculum of fifth- and sixth-grade pupils.

The research hypothesis H03 was rejected, since the findings showed no statistically significant differences in motivation to act on CC and desire to learn about CC between the boys' and the girls' participants. Furthermore, the hypothesis H04 of the study was also rejected by the findings, showing that no statistically significant differences in the status of CC in the curriculum among the boys' and the girls' respondents were found.

4. Discussion

The statistical analysis carried out included the concerns, attitudes and awareness of boys and girls in Koulikoro regarding CC, which revealed very interesting results. The findings demonstrated that attitudes of the pupils towards CC; the results depicted a dissimilarity between the number of boys' attitudes towards CC and those of the girls. Less than half of the boys demonstrated a positive attitude towards CC, as indicated in their mean results (49.94), as compared to their female counterparts, who indicated an appreciative attitude towards CC (64.80). This vast difference in mean attitude culminated in a statistically significant difference in the attitudes of males and females towards CC ($p = 0.009$). This result is in conformity with that of the [World Health Organization "WHO" \(2014\)](#). In their publication on gender, CC and health, the organisation posits that there is a difference regarding the attitudes of men and women towards CC. "Women and men differ in their roles, behaviours and attitudes regarding actions that could help to mitigate CC" ([World Health Organization, 2014: p. 3](#)), the document added.

Examining these results from the gender perspective, it emerged that even though more than half of both boy and girl pupils had concerns about CC (57.57/57.43, respectively), there was no statistically significant difference between them in terms of their concerns about CC ($p = 0.982$). This finding resonates with that of [Knight & Givens \(2021\)](#). In their study on gender and CC views in context, they stated that globally, women express statistically significantly greater CC concern than men in a number of countries but added that this gender gap is not universal. They observed that this statistically significant difference in gender concerns is only prevalent in affluent countries, as in some countries in Asia, more

males even express concern about CC than females. Mali is not an affluent country; therefore, statistically significant gender concerns towards CC are not expected to be found in it. Therefore, the results synchronise with earlier studies, especially that of [Knight and Givens \(2021\)](#).

Even though there is no statistically significant difference in gender awareness of CC among the pupils ($p = 0.4089$), there is an indication that girls have a higher level of awareness than their boy counterparts among the study population (59.85 vs 55.06, respectively). This finding aligns with those of [Oliver & Adkins \(2020\)](#). In their study conducted in 54 countries worldwide among school children, females were found to be more likely to understand greenhouse gases than their male counterparts in several countries. This result is, however, at variance with that of [Khan et al. \(2022\)](#). In their study about CC awareness in the Suru valley of the Ladakh region in the Indian western Himalayas, it was discovered that “CC awareness was higher for the men respondents due to their better education and access to mass communication than the women respondents” ([Khan et al., 2022: p. 1](#)). Our findings are consistent with [Odekeye et al. \(2024\)](#) reporting no statistically significant differences between males’ and females’ awareness of CC. However, males demonstrate slightly more awareness of CC than males (mean 3.97 vs 3.62 respectively).

The study also sought to investigate a gender perspective regarding the cognitive abilities of respondents on causes, impacts, mitigation and adaptation to CC. Generally speaking, many of the respondents have more than average knowledge of the causes of CC, as the mean scores of both boys and girls were 58.91 and 56.36 respectively. This almost parity in the mean knowledge on the causes of CC between the two genders has resulted in a statistically non-significant difference in their knowledge disparities on the causes of CC ($p = 0.6539$). This aligns with the study of [García et al. \(2022\)](#) on students’ knowledge and perception of CC in Mozambique. They reported no statistically significant differences in level of knowledge between eleventh-grade females and males regarding CC. Our findings corroborate [Jurek et al. \(2022\)](#) who found that Czech boys’ and girls’ demonstrate no statistically significant difference in the causes of CC.

Results on the knowledge of respondents on the impacts of CC show a similar pattern according to both genders. While an average of 58.68 of the boy respondents displayed adequate knowledge on the impacts of CC in their communities, the figure for their girl counterparts was 56.36. Similarly, there was no statistically significant difference in knowledge between the two genders. This observation is very similar to what was discovered by [Bessah et al. \(2021\)](#). In their study about gender-based variations in the perception of CC impact, vulnerability and adaptation strategies in the Pra River basin of Ghana, they observed that 99.2% of males were able to mention and describe the CC impacts in their localities as compared to 96.1% of their female counterparts. Similar findings were recorded by [Jurek et al. \(2022\)](#) who found no significant differences between boys and girls in primary schools. This result is not isolated as it feeds into the global narrative involving

gender perspectives of knowledge on CC impacts in societies.

On the issue of CC mitigation, there was a slight reduction in the mean number of boys with adequate knowledge on that aspect of the phenomenon, as 53.22 boys demonstrated adequate knowledge in it. The mean number of girls demonstrating knowledge in CC mitigation showed an improvement, as a mean figure of 61.09 is reported involving girls. These two different figures notwithstanding, there was no statistical difference in knowledge of CC mitigation between the two genders (0.1705). This result aligns with that of [Ratinen & Uusiautti \(2020\)](#). In their study about examining the knowledge of Finnish school children on CC mitigation and adaptation, they observed that girls were better in many aspects of CC mitigation than boys. “They knew more about mitigation I ($t(948) = 7.001, p < 0.000, d = 0.45$ and mitigation II ($t(947.3) = 7.524, p < 0.000, d = 0.45$). However, boys’ knowledge of mitigation III was better than that of girls, ($t(948) = -3.171, p < 0.00, d = 0.24$ ” ([Ratinen & Uusiautti, 2020: p. 9](#)), he stated.

Results on CC adaptation showed very little difference regarding the two genders, as the mean score for boys demonstrating knowledge in CC adaptation issues was 53.79, while that for girls was 61.09. There was also no significant statistical difference in the difference in knowledge between the two genders (0.2275). [Ratinen & Uusiautti \(2020\)](#) again recorded a similar finding in their study. They mentioned that “the girls’ CC adaptation knowledge was better than that of the boys: for adaptation I ($t(948) = 2.685, p < 0.007, d = 0.17$ and adaptation II ($t(948) = 5.551, p < 0.000, d = 0.36$ ”.

Our study also examined the gendered dimension of motivation to act on CC issues. The results showed that more boys are motivated to act on CC than girls, as the mean scores for both genders were 58.40 and 56.63, respectively. There was, however, no statistically significant difference in the responses of pupils regarding the motivation to act on CC issues between these genders ($p = 0.7722$). However, the mean score indicating that more boys are motivated to act on CC than girls, contradicts the work of [Ross et al. \(2025\)](#). In their study on how gender influences motivation and action on CC in the United Kingdom, they discovered that females were 6% more likely to consider CC as a real issue than men and “if people perceive something to be a real issue worth tackling, then this often translates into action” ([Ross et al., 2025: p. 2](#)).

The results also showed that more girls are more desirous of learning about CC than boys (59.31 and 55.63, respectively). Again, there was no statistically significant difference in the desire to learn about CC between these two genders ($p = 0.5505$). In the same line of our study, ([Ramos et al., 2023](#)) found statistically significant differences in desire to learn about CC between males and females. Therefore, females were more desirous of learning about CC in comparison to males ($p = 0.014$). The susceptibility and vulnerability of females in general make them more desirous of learning about CC so that they can take action on it ([Anjum & Aziz, 2025](#)). This is because the experiences of the impacts of CC are gendered, as females are affected more than males ([Ross et al., 2025](#)). More female pupils in

Mali demonstrating their desire to learn about CC is therefore in tandem with similar studies conducted across the globe.

Regarding the status of CC in the curriculum, boys and girls demonstrated similar views of the status of CC in their subjects. This finding suggests that CC-related themes are not widely covered in the fifth- and sixth-grade curricula. This result corroborates with [Jurek et al. \(2022\)](#), who found that subjects on CC and its mitigation are not clearly defined in the official Czech educational standards for the secondary school curriculum.

5. Conclusion

Overall, this study explored differences and similarities in fifth and sixth-grade pupils' perceptions and motivations of CC. The findings revealed similarities in concerns about CC between fifth and sixth-grade boys and girls. Whereas girls demonstrated statistically significant differences in attitudes towards CC compared to their counterparts, boys did not. CC awareness and perceptions of CC causes, impacts, mitigation, and adaptation revealed no statistically significant differences between the boys and the girls. According to the findings, boys and girls showed similar motivation to act on CC and a desire to learn about it. There were no statistically significant differences in the views of boys and girls regarding the status of CC in their syllabus.

The findings of this study on the differences and similarities among genders are reported in the literature ([Oliver & Adkins, 2020](#); [Jurek et al., 2022](#); [García et al., 2022](#); [Odekeye et al., 2024](#)). Fifth and sixth grade pupils' views of CCE in the curriculum align with the educational policies of Mali ([Sanogo et al., 2020](#)). Environmental education activities are carried out in primary schools in Mali; however, most of the time, and ironically, they occur outside of the formal curriculum, on the teacher's own initiative. This is insufficient to ensure that learners understand and internalise the need for better environmental preservation.

Limitations, Implications and Recommendations

First, it is not possible to measure attitudes, views or intentions in an absolute sense ([Reid, 2007](#)). Therefore, there are certain methodological issues inherent to this study, particularly that it employed a system of multiple-choice questions and statements that require agreement or disagreement, examining perceptions and motivations of CC. Previous studies have employed open-ended and closed-ended questions ([Jurek et al., 2022](#); [García et al., 2022](#)). The relatively small sample size, comprising fifth- and sixth-grade boys and girls from two primary schools in Koulikoro, cannot fully represent the broader gender balance in primary schools in Mali. This study did not consider information access, media literacy or risk perceptions in gender differences among fifth and sixth-grade learners.

A previous study demonstrated that primary school children remained mostly neutral in CC perceptions, knowledge and motivations ([Doumbia et al., 2025b](#)) and limited environmental knowledge and unhealthy environmental behaviours

(Doumbia et al., 2026a). The current study compares fifth and sixth-grade pupils' perceptions and motivation of CC between boys and girls. To provide both genders with the knowledge, abilities, and drive to effectively execute CCE, there is an urgent need for teacher training, curriculum reform, and the inclusion of global warming subjects in formal education. The practical implications are equally essential for Mali's educators, policymakers, and non-governmental organisations (NGOs). Despite pupils' inadequate climate knowledge (Doumbia et al., 2025b), girls have considerably different attitudes toward CC than boys.

Future research could expand the sample size and include schools from various regions of Mali to obtain a more comprehensive and effective gender inclusion in order to foster a deeper understanding of differences and similarities between them towards climate actions. A longitudinal study with qualitative data may also better comprehend boys' and girls' perceptions, knowledge and motivation for CC. While there might not be any statistical difference in many of the gendered perspectives on CC in this study, it is evident from the mean scores that boys and girls have different intensity of observation, attention, interest and motivation towards the phenomenon. It is therefore important that duty bearers and stakeholders in CCE, communication, mitigation and adaptation interventions and campaigns consider the issue of gender seriously. Such a consideration will ensure that communication and education campaigns contain messages that are tailored to meet the gender gap existing in CC awareness among any community members. Also, just as there is a gender gap in CC knowledge, motivation and concerns, so is there a gender gap in the CC mitigation and adaptation needs in society. Therefore, every CC intervention must consider the issue of gender before it is rolled out.

Acknowledgements

This document was produced with the financial support of the Prince Albert II of Monaco Foundation. The contents of this document are solely the liability of Adama Boua Doumbia and under no circumstances may be considered as a reflection of the position of the Prince Albert II of Monaco Foundation and/or the IPCC. The authors acknowledge the West African Science Service Centre on Climate Change and Adapted Land-Use (WASCAL) with its fully funded doctoral programme of Climate Change and Education at the University of the Gambia. The authors of this study would like to express their sincere thanks to the authorities, staff, and directors of the Pedagogic Animation Centre of Koulikoro for giving them access to conduct the study.

Author Contributions

Conceptualization, Adama Boua Doumbia; methodology, Adama Boua Doumbia; software, Adama Boua Doumbia; validation, Walter Leal Filho; formal analysis, Adama Boua Doumbia, Marcelinus Dery and Abou Abdoulaye Sow; investigation, Adama Boua Doumbia; resources, Adama Boua Doumbia; data curation, Adama Boua Doumbia and Elh Maman Garba Ibrahim; writing—original draft prepara-

tion, Adama Boua Doumbia, Marcelinus Dery, Abou Abdoulaye Sow and Abdoulie FR Jadama; writing—review and editing, Walter Leal Filho, Marcelinus Dery, Abou Abdoulaye Sow, Halidou Kafando, Elh Maman Garba Ibrahim and Abdoulie FR Jadama; visualization, Adama Boua Doumbia; supervision, Walter Leal Filho; project administration, Adama Boua Doumbia; funding acquisition, Adama Boua Doumbia. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- Anjum, G., & Aziz, M. (2025). Climate Change and Gendered Vulnerability: A Systematic Review of Women's Health. *Women's Health*, 21, 1-22. <https://doi.org/10.1177/17455057251323645>
- Asongu, S. A., Messono, O. O., & Guttemberg, K. T. J. (2021). *Women Political Empowerment and Vulnerability to Climate Change: Evidence from Developing Countries*. AGDI Working Paper, No. WP/21/010, African Governance and Development Institute (AGDI).
- Bagozzi, R. P., & Yi, Y. (1988). On the Evaluation of Structural Equation Models. *Journal of the Academy of Marketing Science*, 16, 74-94. <https://doi.org/10.1007/bf02723327>
- Bessah, E., Raji, A. O., Taiwo, O. J., Agodzo, S. K., Oloade, O. O., Strapasson, A. et al. (2021). Gender-Based Variations in the Perception of Climate Change Impact, Vulnerability and Adaptation Strategies in the Pra River Basin of Ghana. *International Journal of Climate Change Strategies and Management*, 13, 435-462. <https://doi.org/10.1108/ijccsm-02-2020-0018>
- Carlos, S. D. M., Cunha, D. A. da, Pires, M. V., & Santos, F. R. C. (2018). *Understanding Farmers' Perceptions/Beliefs and Adaptation to Climate Change: The Case of Rio das Contas Basin, Brazil* (pp. 1-24). Agricultural & Applied Economics Digital. <https://ageconsearch.umn.edu/record/275925/files/2442.pdf>
- Cedric de, C., & Florian, K. (2021). *Climate, Peace and Security Fact Sheet Mali*. <https://www.sipri.org/publications/2021/partner-publications/climate-peace-and-security-fact-sheet-sahel-2021>
- Chaudhary, P., & Bawa, K. S. (2011). Local Perceptions of Climate Change Validated by Scientific Evidence in the Himalayas. *Biology Letters*, 7, 767-770. <https://doi.org/10.1098/rsbl.2011.0269>
- Cronbach, L. J. (1951). Coefficient Alpha and the Internal Structure of Tests. *Psychometrika*, 16, 297-334. <https://doi.org/10.1007/bf02310555>
- Cronbach, L. J., & Shavelson, R. J. (2004). My Current Thoughts on Coefficient Alpha and Successor Procedures. *Educational and Psychological Measurement*, 64, 391-418. <https://doi.org/10.1177/0013164404266386>
- Dankelman, I. (2012). Gender and Climate Change: An Introduction. *Global Environmental Politics*, 12, 128-129.
- Doumbia, A. B., Anthony-Krueger, C., Coulibaly, A., & Ojeh, V. N. (2026a). Towards Consolidating Environmental Education in Public Primary Schools of Mali: A Critical Analysis. *International Journal of Research and Innovation in Social Science*, X, 1919-1930. <https://doi.org/10.47772/ijriss.2026.100700139>

- Doumbia, A. B., Coulibaly, A., Ojeh, V. N., Filho, W. L., & Antony-Krueger, C. (2025a). *Examination of Climate Change Education Among Fifth and Sixth-Grade Pupils in Koulikoro, Mali* (pp. 1-20, Preprint).
- Doumbia, A. B., Dery, M., Wolf, F., & Filho, W. L. (2026b). Assessment of Climate Change Perception and Motivation in Climate Change Education among Lower Secondary School Students in Koulikoro, Mali. *Environmental Processes*, 13, 1-21. <https://doi.org/10.1007/s40710-026-00823-4>
- Doumbia, A. B., Filho, W. L., Alhassan, I., & Pires, J. P. (2025b). Primary School Pupils' Perceptions and Motivations of Climate Change in Koulikoro, Mali. *African Research Reports*, 1, 423-436. <https://doi.org/10.65221/0060>
- Ezeudu, S. A., Ezeudu, F. O., & Sampson, M. (2016). Climate Change Awareness and Attitude of Senior Secondary Students in Umuahia Education Zone of Abia State. *International Journal of Research in Humanities and Social Studies*, 3, 7-17.
- Fruttero, A., Halim, D., Broccolini, C., Coelho, B., Gninafon, H., & Muller, N. (2023). *Gendered Impacts of Climate Change: Evidence from Weather Shocks* (Policy Research Working Paper) World Bank.
- García, V. A., Rui Mucova, S. A., Azeiteiro, U. M., Meira Cartea, P. Á., & Pereira, M. (2022). Mozambican Students' Knowledge and Perceptions about Climate Change: An Exploratory Study in Pemba City. *International Research in Geographical and Environmental Education*, 31, 5-21. <https://doi.org/10.1080/10382046.2020.1863671>
- Gazzaz, N. M., & Aldeseet, B. A. (2021). Assessment of the Level of Knowledge of Climate Change of Undergraduate Science and Agriculture Students. *World Journal of Education*, 11, Article 41. <https://doi.org/10.5430/wje.v11n5p41>
- Gbode, I. E., Ajayi, V. O., Coulibaly, A., Abel, D., Ziegler, K., Weber, T. et al. (2025). Analysis of Crop Suitability Index for Current and Future Climates Using Statistically Downscaled cmip6 Outputs over Africa. *Meteorological Applications*, 32, 1-31. <https://doi.org/10.1002/met.70022>
- IPCC (1998). The Regional Impacts of Climate Change: An Assessment of Vulnerability. In R. T. Watson, M. C. Zinyowera, & R. H. Moss (Eds.), *Special Report of IPCC Working Group II, Intergovernmental Panel on Climate Change* (p. 517) Cambridge University Press.
- Jamal, A. M., Antwi-Agyei, P., Baffour-Ata, F., Nkiaka, E., Antwi, K., & Gbordzor, A. (2021). Gendered Perceptions and Adaptation Practices of Smallholder Cocoa Farmers to Climate Variability in the Central Region of Ghana. *Environmental Challenges*, 5, Article 100293. <https://doi.org/10.1016/j.envc.2021.100293>
- Jamal, A. M., Antwi-Agyei, P., Baffour-Ata, F., Nkiaka, E., Antwi, K., & Gbordzor, A. (2017). Gender Differences in Climate Change Adaptation Strategies and Participation in Group-Based Approaches: An Intra-Household Analysis from Rural Kenya. *Ecological Economics*, 138, 99-108. <https://doi.org/10.1016/j.ecolecon.2017.03.019>
- Jurek, M., Frajer, J., Fiedor, D., Brhelová, J., Hercik, J., Jách, M. et al. (2022). Knowledge of Global Climate Change among Czech Students and Its Influence on Their Beliefs in the Efficacy of Mitigation Action. *Environmental Education Research*, 28, 1126-1143. <https://doi.org/10.1080/13504622.2022.2086687>
- Khan, K. A., Chattopadhyay, A., & Ali, I. (2022). Gender Differences in Perception and Awareness of Climate Change in the Suru Valley of Western Himalayas, India. *Current World Environment*, 17, 88-98. <https://doi.org/10.12944/cwe.17.1.8>
- Knight, K. W. (2019). Explaining Cross-National Variation in The Climate Change Concern Gender Gap: A Research Note. *The Social Science Journal*, 56, 627-632.

- Knight, K. W., & Givens, J. E. (2021). Gender and Climate Change Views in Context: A Cross-National Multilevel Analysis. *The Social Science Journal*, 63, 11-28.
<https://doi.org/10.1080/03623319.2021.1913041>
- Kundariati, M., Ibrohim, I., Rohman, F., Nida, S., Hayuana, W., & Putra, Z. A. Z. (2024). Exploring Students' Climate Change Perception: The Key Factor of Climate Change Mitigation and Adaptation. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 10, 185-194.
<https://doi.org/10.22219/jpbi.v10i1.32655>
- Lambrou, Y., & Nelson, S. (2010). *Farmers in a Changing Climate. Does Gender Matter?* Food and Agriculture Organisation of the United Nations.
- Lewis, G. B., Palm, R., & Feng, B. (2018). Cross-National Variation in Determinants of Climate Change Concern. *Environmental Politics*, 28, 793-821.
<https://doi.org/10.1080/09644016.2018.1512261>
- Mehta, P. S., Sharma, A. K., & Negi, K. S. (2010). Indigenous Knowledge System and Sustainable Development with Particular Reference to Folklores of Kumaon Himalaya, Uttarakhand. *Indian Journal of Traditional Knowledge*, 9, 547-550.
- Modu, M. A., & Deba, A. A. (2024). Assessment of Students' Knowledge and Attitude Toward Climate Change: A Review. In *Hybrid Conference International Conference of School of Science and Technology Education (SSTE)* (pp. 261-269).
- Odekeye, O. T., Fakokunde, J. B., OyebolabIwintolu, R., Alaba, A. O., & Adewusi, M. A. (2024). Assessment of Climate Change Awareness among Secondary School Students in Osun State, Nigeria. *Journal of Teaching and Learning (UJTL)*, 4, 131-139.
- Oliver, M. C., & Adkins, M. J. (2020). "Hot-Headed" Students? Scientific Literacy, Perceptions and Awareness of Climate Change in 15-Year Olds across 54 Countries. *Energy Research & Social Science*, 70, Article 101641.
<https://doi.org/10.1016/j.erss.2020.101641>
- Pagiaslis, A., & Krontalis, A. K. (2014). Green Consumption Behavior Antecedents: Environmental Concern, Knowledge, and Beliefs. *Psychology & Marketing*, 31, 335-348.
<https://doi.org/10.1002/mar.20698>
- Ramos, R., Rodrigues, M. J., & Rodrigues, I. (2023). Children's Perception of Climate Change in North-Eastern Portugal. *Societies*, 13, 1-12.
<https://doi.org/10.3390/soc13010006>
- Raosoft. (2004). *Raosoft Sample Size Calculator*.
<https://www.calculator.net/sample-size-calculator.html>
- Ratinen, I., & Uusiautti, S. (2020). Finnish Students' Knowledge of Climate Change Mitigation and Its Connection to Hope. *Sustainability*, 12, Article 2181.
<https://doi.org/10.3390/su12062181>
- Reid, N. (2007). Thoughts on Attitude Measurement. *Research in Science & Technological Education*, 24, 3-27. <https://doi.org/10.1080/02635140500485332>
- Ross, F., Middleton, C., & Remes, O. (2025). How Gender Influences the Motivation and Action Towards Climate Change: A Qualitative Study of Participants from a UK Construction Company. *Challenges*, 16, 1-14. <https://doi.org/10.3390/challe16010003>
- Sanogo, K., Antoine, K., Ademola, D., & Gilberte, K. (2020). *Boosting Environmental Education in Primary Schools in Mali*. Policy Brief No 49, World Agroforestry.
- Segnon, A. C., Magassa, M., Obossou, E. A. R., Partey, S. T., Houessionon, P., & Zougmore, R. B. (2024). Gender Vulnerability Assessment to Inform Gender-Sensitive Adaptation Action: A Case Study in Semi-Arid Areas of Mali. *Frontiers in Climate*, 6, 1418015.
- Shields, T., & Zeng, K. (2012). The Reverse Environmental Gender Gap in China: Evidence from "the China Survey". *Social Science Quarterly*, 93, 1-20.

<https://doi.org/10.1111/j.1540-6237.2011.00802.x>

- Upton, G., & Cook, I. (2008). *A Dictionary of Statistics. A Dictionary of Statistics* (2nd ed). Oxford University Press.
- Verner, M., Vu, H. T., Marlon, J., Lee, S., Carman, J., Rosenthal, S. A. et al. (2026). Gender, Development, and Recognition of Anthropogenic Climate Change. *World Development*, 197, Article 107169. <https://doi.org/10.1016/j.worlddev.2025.107169>
- WMO (2021). *WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes* (WMO-No 1267). World Meteorological Organization.
- World Health Organization (2012). *Mainstreaming Gender in Health Adaptation to Climate Change Programmes*. WHO Press.
- World Health Organization (2014). *Climate Change and Health*. WHO Press.