Article

Perceptions of Congolese Students about Climate Change and their Recommended Actions for Raising Climate Change Awareness in the Community

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Abstract: Students are often portrayed as future leaders. Their participation in climate change mitigation would improve when they access climate information and gain a high level of climate change awareness. This study was initiated to assess the Congolese students' awareness of climate change by focusing on their sources of information on climate change, knowledge about the causes and impacts of climate change and activities that can raise awareness on climate change. Using a convenience sampling technique, we collected data through individual interviews conducted among 1,278 students from 13 universities across the Democratic Republic of Congo (DRC). The interview results showed that all students irrespective of their disciplines were concerned about climate change, a phenomenon strongly driven by human activities, such as deforestation (78%), urbanisation (30%), agriculture activities (30%) and transport services (26%). The students' perceptions of climate change impacts included increase in temperature (82%), decrease in the number of rainy days (66%), proliferation of pests (60%) and increase in the number of malaria patients (39%). The primary sources of information that significantly affected students' awareness of climate change included environment-related university courses and television broadcasts. The awareness-raising and mitigation actions related to climate change recommended by the students included educating people about good waste management (56%), planting trees (65%) and using the taxes paid by mining companies for the restoration of degraded ecosystems. The students believed that in DRC, all layers of the society (educational institutions, civil society organisations, community members and businesses) are important in building resilience to climate change. This study can guide teachers to focus their educational efforts on shaping pro-environmental behaviour in students.

Keywords: students' awareness; climate change; climate information; mitigation activities; Democratic Republic of Congo

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1. Introduction

Climate change has become one of the most devastating environmental threats. Its cost and repercussions are high and can be felt in various ways within the natural, human and economic systems [1, 2]. Recent evidence indicates that monthly economic activity in the African region could contract by 1% when the average temperature in the region increases by 0.5°C [2]. A study conducted by [3] in the Congo Basin explains how climate variability has already resulted in community conflicts over access to resources, including water and pastures, and migratory movements over the past two decades.

Although in Central Africa, the Democratic Republic of Congo (DRC) has been historically portrayed as a prosperous country in terms of natural resources, such as minerals and extensive forests, which arouse conflicts [4], these potential resources have diverted the attention of many local leaders, policymakers and economic actors from the severe threats and losses that climate change and variability pose to communities. For example, in South Kivu in eastern DRC, heavy rains and subsequent flooding had recently destroyed homes and agricultural fields, adversely affecting at least 90,500 people [5]. This situation has been exacerbated by poor urban planning and waste management. Regular floods that occur in urban areas affect transport services, job accessibility and economic activities, inducing substantial economic costs to the local commuters and in Kinshasa this cost is estimated at $1.2 million per day [6].

In the Katanga Copperbelt, for example, the pressure on natural resources due to intensified mining activities and rapid demographic growth and subsequent landscape transformation have resulted in the modification/perturbation of the local environment, including the climate [7,8]. The farmers have been reporting about long dry seasons, reduction in the number of rainy days, changes in the rain distribution patterns and new pests that adversely affect agricultural production. Although long-term meteorological data is not available [9], existing information suggest that the annual temperatures in DRC would increase by 1.7°C–4.5°C by the end of the century [10]. The impacts of climate change are expected to be severe owing to high levels of poverty and weak socioeconomic systems [4]. Most of the surveys on the impacts of climate change conducted in DRC have targeted smallholder farmers [9, 11, 12]; the perceptions of Congolese students toward climate change have remained unexamined. Yet, university students, considered future leaders and professionals, are expected to play an essential role in climate change mitigation and adaptation in DRC.

To help prepare students to be the type of climate leaders we need, understanding their perceptions of climate change drivers, impacts and risks as well as identifying the sources of information that shape their awareness of environmental challenges are important. This insight into students' perception will allow the DRC to address knowledge gaps via national and regional climate change policies, including educational curriculum revisions.

This study was designed to assess students' awareness and perceptions of climate change by addressing four research questions. 1) What are the drivers and impacts of climate change perceived by the students? 2) Which sources of information significantly shape the students' perceptions of climate change? 3) Do students' perceptions of climate change depend on their schools/disciplines? 4) What are the actions suggested by the students to tackle climate change challenges? We hypothesised that owing to the recent introduction of environment courses to university curricula and students' exposure to media, students would have a high awareness of climate change and that they would be able to provide strategic solutions to the adverse impacts of climate change.

2. Materials and Methods

2.1. Study area

This study was conducted in the DRC, Central Africa's largest country with a surface area of 2,344,860 km^2. In 2006, DRC adopted a new constitution, which divided the country into 26 provinces (Fig. 1). Although the last population census of DRC was conducted

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more than three decades ago, the population of the country is projected to reach 120 million by 2030 [13].

The majority of the DRC's population is young. Between the academic years 2019 and 2020, DRC had 971 universities/higher education colleges. Approximately 54% of these institutions were private institutions, while 46% were public institutions; the total student enrolment was 564,421. Most universities are located in North Kivu (17%), Kinshasa (11%) and Upper Katanga province (8%) [14]. In DRC, agriculture is the primary livelihood of more than 70% of the people living in its rural and peri-urban areas. The country is facing security challenges and political instability. Credible reports indicate that competition for access to and control over resources (minerals and forests) has led to the creation of militias, which have fuelled the on-going conflicts, particularly in eastern DRC [4].

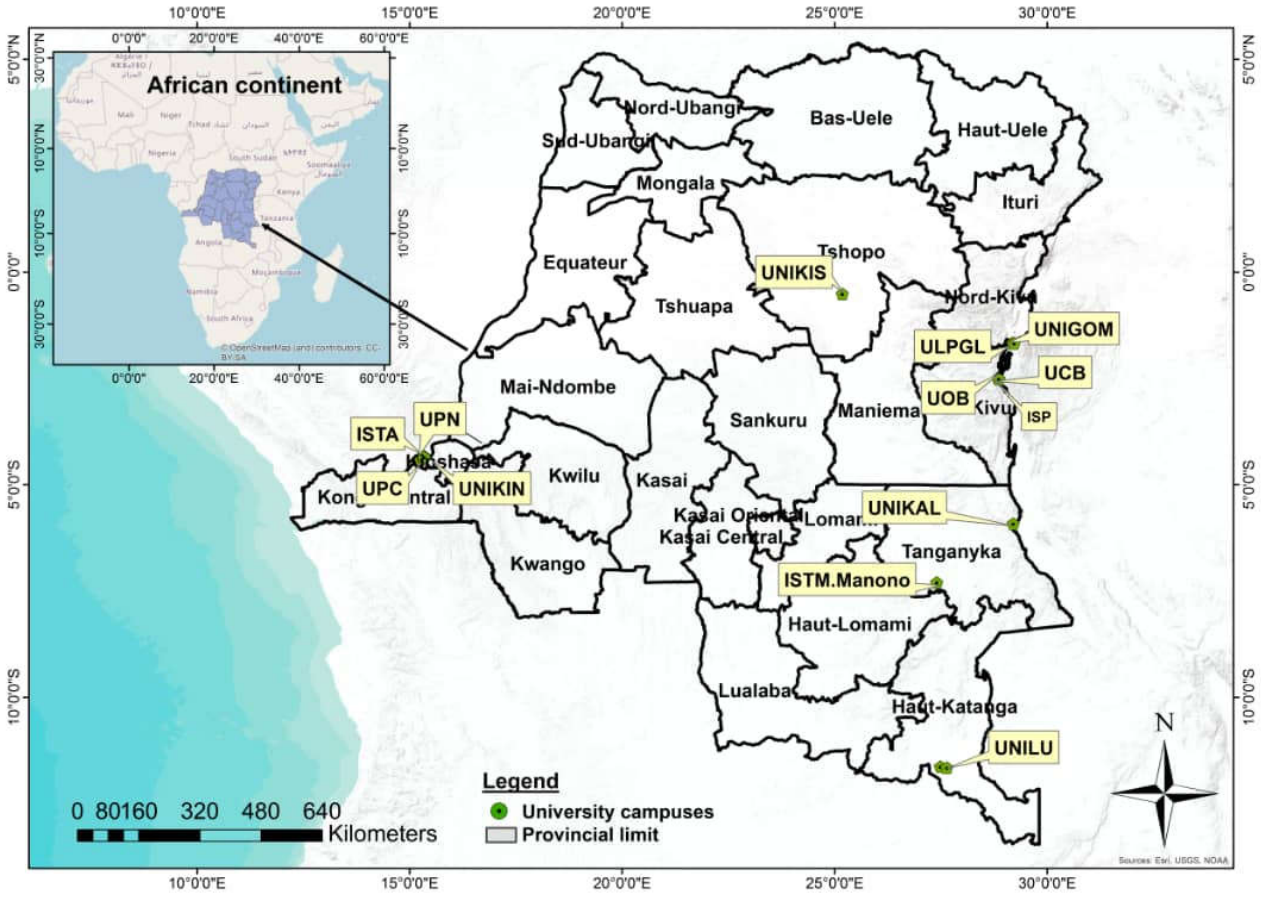

Figure 1. Map of the Democratic Republic of Congo showing six provinces and the location of the 13 campuses within them.

2.2. Data collection

This study was primarily based on surveys and interviews conducted among a convenience sample of 1278 students from 13 universities across the DRC between 5 February 2021 and 18 October 2021. (Fig. 1 and Table 1).

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Table 1. Number of students selected from 13 different universities in DRC.

Universities	Number of students	Provinces. Cities
Institut supérieur pédagogique de Bukavu	100	South Kivu. Bukavu
Institut Supérieur des techniques appliquées de Kinshasa	29	Kinshasa. Kinshasa
Catholic University of Bukavu	102	South Kivu. Bukavu
Université Libre de pays de grands Lacs	119	North Kivu. Goma
University of Goma	90	North Kivu. Goma
University of Kalemie	90	Tanganyika. Kalemie
University of Kinshasa	127	Kinshasa. Kinshasa
University of Kisangani	100	Tshopo. Kisangani
University of Lubumbashi	265	Upper Katanga. Lubumbashi
ISTM Manono	100	Tanganyika. Manono
Official University of Bukavu	72	South Kivu. Bukavu
Université Protestante du Congo	33	Kinshasa. Kinshasa
Université Pédagogique Nationale	51	Kinshasa. Kinshasa

To minimize the bias inherent in the convenience sampling method, we interviewed only students who were regularly enrolled in the universities surveyed and enrolled as undergraduate and postgraduate students). The convenience sampling method allowed collecting data from very large samples at a relatively low cost because students were found at the campuses where most of the investigators worked as well. To clear the ethical dilemma, students interviewed provided oral consent confirming their willingness to participate in the survey.

Data were collected using a questionnaire that requested information about the profiles of the respondents, their sources of climate information and knowledge of the causes and impacts of climate change. The last part of the questionnaire explored the students' recommendations on the actions that would mitigate climate change and increase climate change awareness in the community. We also used the Likert scale to identify the perceptions of the students about climate change, their knowledge of the causes of climate change and potential climate change mitigation actions. We adopted the Likert scale because it allowed the respondents to indicate their positive-to-negative strength of agreement and helped us assess their attitudes, knowledge and beliefs about a particular topic, which was climate change perceptions in this case [15]. The Likert scale had been used in many other countries also to measure the students' and lecturers' perceptions of climate change [16].

We studied university students because higher education is vital in educating citizens about climate change and promoting pro-environmental behaviour [17]. Many of the selected universities are public universities and host a large number of students. For example, the University of Kinshasa, University of Kisangani and University of Lubumbashi host many students attending different faculties [14]. These universities being located in different cities, their students can have contextual experience of the climate of the cities concerned. The students who participated in the questionnaire survey were from the departments of agronomy, Arts, economics, health sciences, law, polytechnics, applied sciences and social sciences. The students were chosen randomly during their lunch break (12–2 pm) or after their classes were over (4–5 pm).

2.3. Data analysis

Data analysis was performed using descriptive statistics (frequencies and percentages). A chi-square test (χ^2) was used to investigate whether significant differences existed between the students' disciplines and climate change awareness. A multiple

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correspondence analysis (MCA) was performed to analyse the relationship between each university and its level of concern about climate change. Additionally, binary logistic regression was used to identify the sources of information that significantly affected students' awareness and sensibility to climate change. The study considered α <0.05 (p-value) as a criterion to determine statistical significance.

3. Results

3.1. Students' social characteristics and perceived impacts of climate change

The majority of the students who were selected to participate in the questionnaire survey were male students (61%) between 18 and 25 years. A large proportion of the students (60%) was enrolled as undergraduates and attended different schools (Table 2).

Table 2. Profiles of the students (n=1278) surveyed and their level of awareness about climate change.

Variables	Category	Frequency	Percentage
Gender	Female	495	39
	Male	783	61
Age (years)	18-25	1021	80
	26-33	195	15
	34-41	38	3
	>42	24	2
School (faculties)	Agronomy	169	14
	Arts	30	2
	Economics and management	418	32
	Medicine and nursing	104	8
	Law	104	8
	Polytechnics	84	7
	Applied sciences	203	17
	Social sciences	162	13
Level of education	Undergraduate	767	60
	Graduate (licence)	511	40

When presented with five yes/no questions on the perceived climate change impacts, 82% of the students agreed that there had been an increase in the temperature—the highest affirmative answer (Fig. 2). Many students mentioned a decrease in the number of rainy days (66%), an increase in agricultural pests (60%), and an abundance of rains (39%). Moreover, the students also mentioned about the increase in malaria and other diseases, unknown within the communities (39%).

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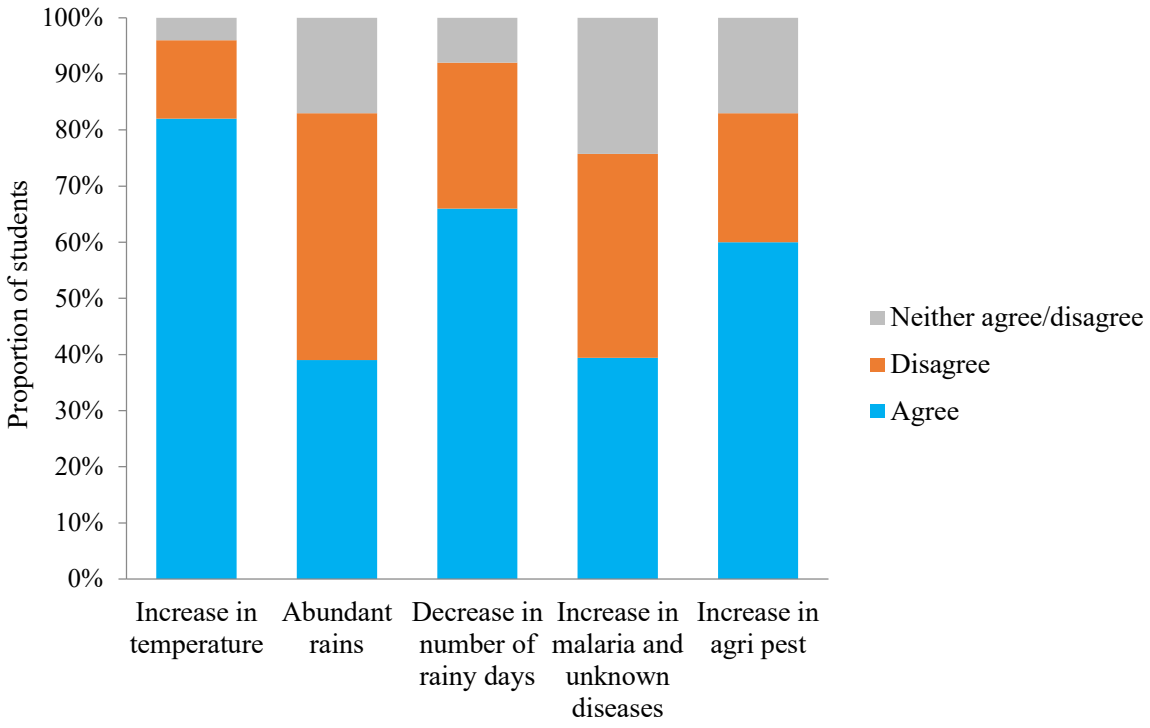

Figure 2. University students' perceptions of climate change trends in DRC.

3.2. Sources of information that affect students' awareness about climate change

Five sources of information about climate change were identified. Among those sources, binary logit results (Table 3) showed that university courses (environment-related), television, environmental radio broadcasts and friends' clubs positively and considerably influenced the students' perceptions and awareness of climate change.

Table 3. Sources of information affecting students' awareness of climate change.

Sources	Estimate	Std. Error	z value	Pr (>|z|)
(Intercept)	0.875143	0.256004	3.418	0.000 ***
Univsity courses	1.212441	0.250297	4.844	0.000 ***
Radio	0.616330	0.245125	2.514	0.011 *
Television	0.953941	0.242605	3.932	0.000 ***
Social media	-0.005804	0.253490	-0.023	0.981
Friends' clubs	0.706353	0.338839	2.085	0.037 *

Number of observations: 1278, -2log- likelihood =640.6, Nagelkerke R^2 =0.76, ***= significant at 1%; *= significant at 10%.

3.3. Students' awareness of climate change across universities and faculties

The results of the multiple correspondence analysis that grouped universities according to students' awareness of climate change are presented in Fig. 3 of the supplementary materials.

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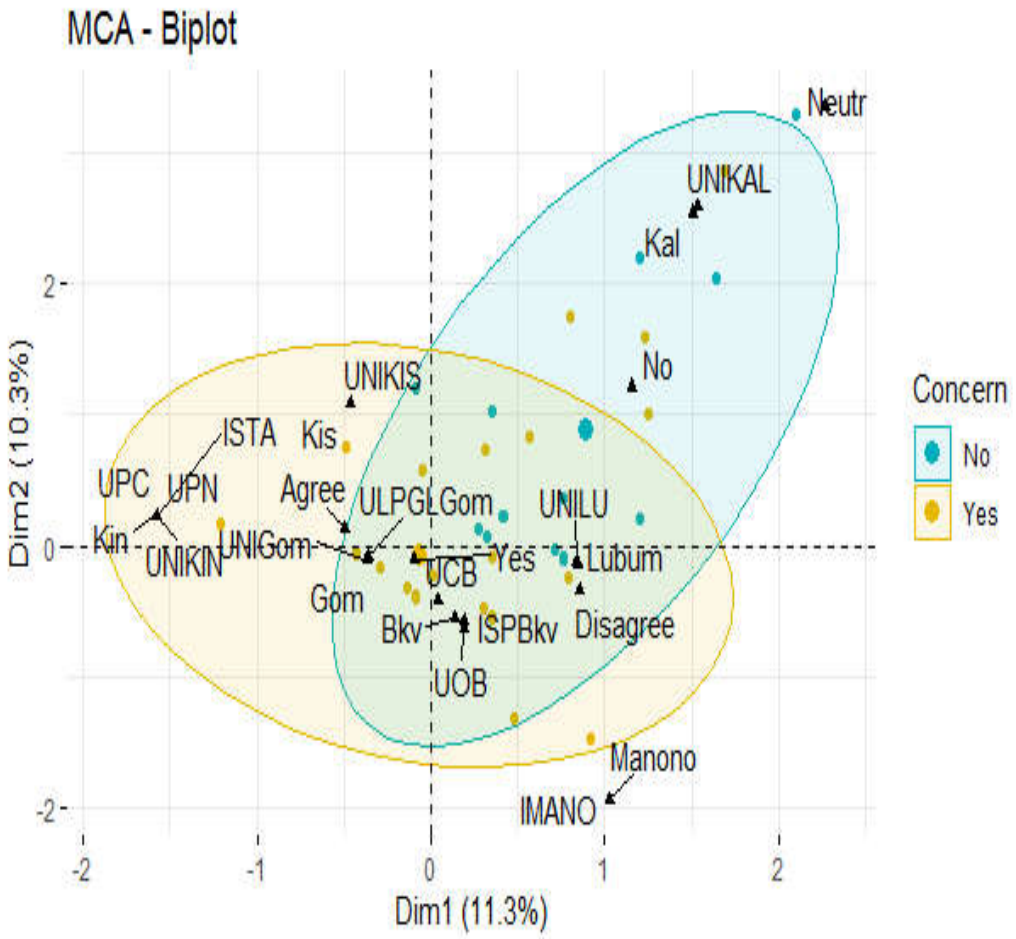

Figure 3. Results of the multiple correspondence analysis showing the trend of the concerns of the students of universities located in six provinces, on climate change.

Legend: UNILU: University of Lubumbashi, ISPBKv : Institut supérieur pédagogique de Bukavu, UNIKIS : University of Kisangani, UNIKIN : University of Kinshasa ,ULPGL Gom: Université Libre de pays de grands Lacs Goma , ISTA : Institut Supérieur des techniques appliquées de Kinshasa, UPC :Université Protestante du Congo, UPN :Université Pédagogique Nationale, UCB : Catholic University of Bukuvu , UOB : Official University of Bukavu, IMANO : ISTM Manono, UNIKAL : University of Kalemie, UNIGOM : University of Goma, Kis :Kisangani , Kin : Kinshasa , Kal : Kalemie, Bkv: Bukavu, Lubum: Lubumbashi.

We observed that most of the students who were only little concerned about climate change were mainly from the University of Kalemie in Kalemie, University of Lubumbashi in Lubumbashi and the Catholic University of Bukavu in Bukavu. Notably, we found a high degree of awareness toward climate change among the students of the University of Kinshasa in the city of Kinshasa and University of Kisangani in Kisangani.

Fig. 4 displays the students' awareness of climate change by faculty/school measured using the Likert scale data obtained from the questionnaire survey. While 54% of the survey respondents indicated their concern about the climate, 38% indicated that they were strongly concerned about the climate. The results of the chi-square test conducted revealed significant differences between students' disciplines and their degree of concern about climate change (χ^2=26.682, $p<0.05$). Most of the students who were strongly concerned about climate change were from the faculties of economics (61%) and social sciences (52%). However, 21% and 10% of the students from Law and Art Schools, respectively, indicated that they were not at all concerned about climate change.

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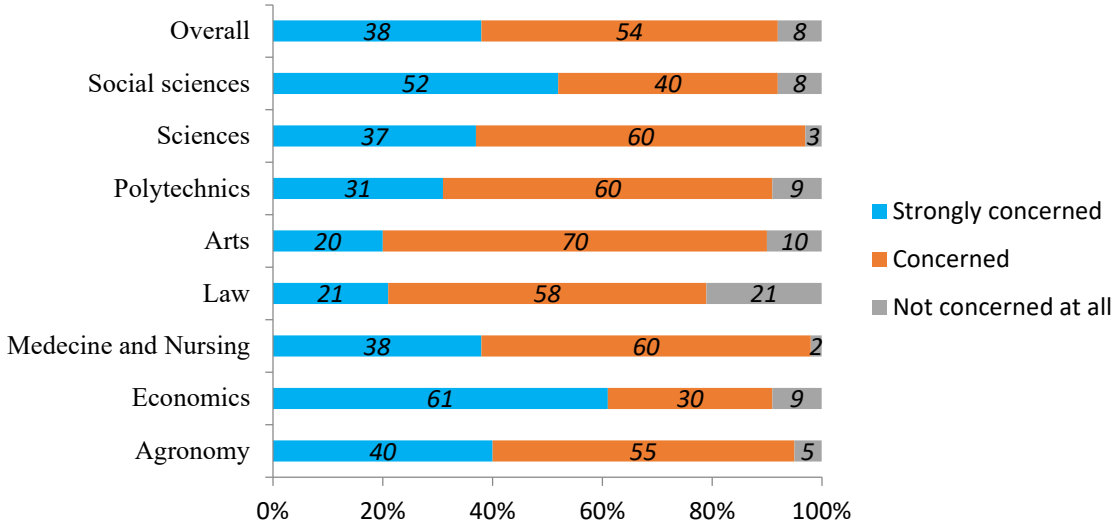

Figure 4. Relationship between the schools of the students and their climate change awareness.

3.4. Assessment of students' knowledge of the causes of climate change

The causes of climate change reported by the students are presented in Table 4. A majority of the students (78%) strongly agreed that deforestation was the leading cause of climate change, while 30% and 26% of the students believed that rapid urbanisation and farming activities and transport and trade, respectively, were the significant causes of climate change. While 19% of the students agreed that all human activities can lead to climate change, a considerable percentage (23%) of the students firmly believed that climate change is a natural phenomenon that humans cannot control. However, 45% of the students strongly disagreed that all human activities can cause climate change.

Table 4. Students' knowledge of the causes of climate change in DRC percentages.

Drivers of climate change	Strongly agree	Agree	Neutral	Disagree
Urbanisation	373 (30)	346 (27)	132 (10)	414 (33)
Deforestation	985 (78)	109 (9)	45 (3)	122 (10)
Agriculture activities	373 (30)	263 (21)	153 (12)	464 (37)
All human activities	218 (17)	239 (19)	239 (19)	569 (45)
Trade and transport	331 (26)	172 (14)	220 (17)	535 (43)
Natural phenomenon	289 (23)	255 (20)	199 (16)	517 (41)

3.5. Awareness-raising and mitigation actions recommended for tackling climate change

The actions recommended by the students for mitigating climate change and increasing climate change awareness are presented in Fig. 5. These actions include educating people about good waste management practices (56%), prohibiting and criminalising bushfires (57%), planting of trees (65%) and getting civil society organisations and business companies to participate in pro-environmental activities, such as tree planting. The respondents strongly recommended that mining companies should pay taxes at high rates (77%) to help government and local communities to restore landscapes degraded by pollution and mining activities. In our discussions with them, many students consistently mentioned, '*Climate change is a global issue and the actions of everybody matters*'. Additionally, 59% of the students suggested getting rural communities to participate in the management of natural resources, such as forests.

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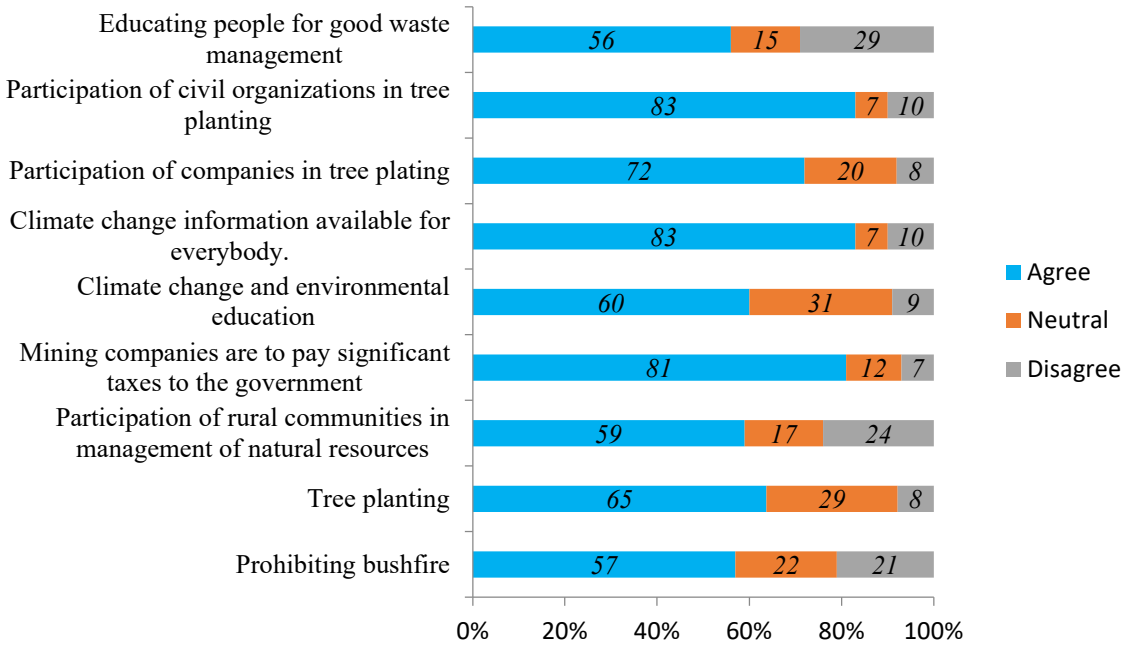

Figure 5. Actions recommended for mitigating climate change and raising awareness about climate change within the community.

4. Discussion

4.1. Students' awareness of climate change

The assessment of students' perceptions of climate change is important to understand how young people experience, feel and care about climate change issues and their preparedness to respond to sudden, on-going and forthcoming changes in their communities [17-18]. The students involved in this study were largely aware about climate change and the perceived changes in rainfall patterns, temperature trends and pest proliferation.

The findings of our study are in line with the findings of [17, 19, 20] who stated that most university students across the world express concern about climate change issues. Young people's awareness about climate change has resulted in the Greta Thunberg's *Fridays for Future Students* movement, which urges governments to take radical action on climate change [21]. Results of a survey by [22] reveal that students are even more concerned about climate change than about COVID-19. Students' awareness of climate change is reportedly increasing across the world owing to their exposure to various sources of information and experiences of climate events (heat waves, storms, floods and desertification).

4.2. Sources of information affecting students' awareness of climate change

Our study findings revealed that university and media (TV and radio) significantly affected the students' awareness of climate change. To fall in line with the long-term vision of the DRC government, environment-related courses were recently introduced to university curricula with the objective of developing pro-environmental behaviour in university students. The introduction of environmental courses is crucial because Coleman and co-workers [23] strongly recommend that universities, regardless of students' disciplines, should integrate courses related to climate change into education curricula with ecological challenges becoming increasingly salient to the global population. Environmental courses will equip and reinforce students' understanding of the threats to global sustainability and awaken a sense of personal responsibility in them toward the environment. As climate change education is at crossroad of many disciplines, professors/climate change or environment educators need to use multiple

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teaching tools to make students understand and achieve their teaching goals. Coleman and co-workers [23] and [24] argue that movies (watched in class), documentaries, artworks, community service projects and class dialogues can increase the students' understanding and awareness of climate change issues. In short, education systems are expected to play a determinant role in climate change mitigation despite the dismal reports on climate education and its criticism within universities and colleges [17, 25, 26].

This study also revealed that three-quarters of the students acquired climate information from media, mainly from social media and television. The study findings are in agreement with those of [17,25] showing that social media, television and radio were considered the primary source of information about climate change by the students of the University of the South Pacific in Fiji and South African university, respectively. This same observation was made at Oyo State University in Nigeria, where 88.9% of its students agreed that they received information on climate change and sustainable development from broadcasts and awareness programmes on radio and television [27]. The determinant role played by media in creating awareness about climate change among public is acknowledged [27, 28, 29]. Mavrodieva and collaborators [28] noticed visible links between social media and changing public perceptions and the possibility of public opinion influencing political decision-making. In DRC, for decades, social media networks have been most often used by Congolese students/youth to exchange photos and short videos on hot news, particularly about sociopolitical mouvements and climate and natural hazard occurance (e.g. recent vacano erruption in Goma).

4.3. Deforestation as a main driver of climate change

People's understanding of the causes and consequences of climate change can have important implications for their behaviour and support for policies that promote climate change mitigation and adaptation [19]. Although [18] stated that students hold misconceptions about the primary causes and consequences of climate change, students interviewed in this study appeared to be different. In fact, a large majority of the students strongly agreed that climate change was mainly caused by deforestation. Their views corroborated the findings of many studies that have highlighted the impact of anthropogenic activities on forest land and degradation of landscapes [30, 31]. Students' concerns about deforestation are shared by many specialists, such as [30], who explain how deforestation can lead to changes in temperature, evapotranspiration, runoff and local climate modification. When deforestation occurs in large continuous areas, the rainfall may decrease [30]. The students stated that they have already observed the changes in the rainfall patterns in their respective communities, a situation also reported by the existing studies on climate change across the country [8, 9, 10]. The causes of deforestation in DRC are many. First, 70% of the people in the country depend on agriculture for their livelihood and slash-and-burn is a common practice used by smallholder farmers to open crop fields in forests and savannahs [33]. This practice is at the root of tropical forest degradation [31, 33]. In fact, deprived of state support, the population in rural areas with the slight possibility of economic diversification considers forest resources the primary means to sustain their livelihood [31]. Moreover, forest soils in developing countries have been pervasively overrun by agricultural households because their limited financial resources do not allow them to purchase agricultural inputs, such as chemical fertilisers [31]. Recently, specialists have argued that in some parts of DRC, the pressure exerted on forests by armed groups, logging and mining companies—controlled and uncontrolled—is higher than that exerted by smallholder farmers [3,34]. Additionally, the pressure exerted on the forests to obtain energy sources, such as charcoal and firewood, is increasing at a worrying scale. In DRC, charcoal is mainly used to meet domestic energy demands because only 19% of the population has access to electricity [35].

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4.4. Increasing climate change awareness and taking sustainable actions for climate change mitigation

An increased awareness of climate change and engagement in sustainable actions will help communities to face climate change challenges [23]. A large proportion of the students strongly recommended the prohibition and criminalisation of slash-and-burn agriculture, which can cause bushfires. While this recommendation of the students seems to favour the protection and preservation of biodiversity and maximisation of forest ecosystem services, a case study conducted in Madagascar explains how the criminalising of bush burning can lead to protests by the rural populations as that practice help farmers to extend their crop fields [36].

To restore and maintain degraded ecosystems in mining areas, such as the Katanga copperbelt, mining companies are expected to plant trees and pay high taxes to the government. These actions expected from mining companies are fair, because mining activities lead to complex environmental issues, affecting the health and the livelihoods of the people of the area [37]. The students further mentioned that climate change being a global problem, the involvement of all layers of the society in climate change mitigation is important. Involvement in and commitment to climate change mitigation should specifically start with actions such as the intensification of climate and environmental education in schools and universities, that will raise awareness about climate change [20, 26].

The awareness-raining activities can be extended to civil society organisations, including religious bodies, as many respondents thought that churches can be used to reach out to a broad group of the population and convey to them a message on climate change because they have the ability to organise large gatherings. The students' thinking was in line with the findings of many studies that have acknowledged the roles of religions and civil society organisations for addressing climate issues [38]. The pivotal roles of religion in matters of climate change and environmental justice are based on their teachings, influence and ability to inspire adherents and disseminate worldviews that empower environmental attitudes and actions [38].

4.5. Research originality, limitations and practical implications of the study

This study is one of the few studies conducted in DRC to address the students' perceptions of climate change, using a large sample size from universities across the country.

This study is considerably different from previous studies, which targeted only smallholder farmers [9, 11, 12]. Using statistical tools, we identified the universities and faculties where teachings on climate change or courses related to the environment require intensification. This intensification is important because the Congolese higher education system is undergoing reforms at the moment (adoption of the licence, master and doctorate system). While these reforms are expected to make students competitive, innovative and skilled to tackle community challenges, such as climate change, the results of our study can guide teachers and researchers to improve and target their educational efforts at those students most in need.

However, the survey was conducted at universities located within large urban entities and thus, it would not help determine the knowledge and attitude of students living in rural and small cities with regard to climate change. Yet the perceptions of the students living in rural and small cities will depend on the predominant socioeconomic activities of their respective areas (e.g. agriculture in rural areas) and will be different from those of students living in large cities where services and infrastructure facilities are developed. This difference between the perceptions of students coming from large cities and those of students coming from other areas agrees with the findings of [39] who observed differences in attitudes toward climate change between rural and urban communities in the United States. Given that teachings on climate change are at the crossroads of several disciplines, in a future survey, the students could be requested to indicate how and what they would like to learn or how to deepen their knowledge about climate change. The information obtained can help higher education institutions to expand their educational

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efforts to ensure that students of all faculties understand the scientific consensus on climate change and that the students are actively engaged in climate change mitigation in their public and private roles [18].

5. Conclusion

This study assessed the university students' perceptions of climate change by focusing on their sources of information, drivers, impacts and mitigation actions. Television broadcasts and university environment-related courses play significant roles in shaping students' awareness of climate change. Study results indicate that Congolese university students are aware about global climate change despite the considerable differences observed among their universities and faculties. Students argued that climate change is a phenomenon strongly induced by human activities, such as deforestation, urbanisation and transport services. The perceived impacts of climate change included an increase in temperature, an abundance of rains that leads to floods and the proliferation of pests and diseases.

Moreover, students requested all society layers (civil society organisations, schools, business companies and community members) to participate and take actions in favour of the climate. These actions range from awareness-raising on climate change—intensification of climate and environmental education within schools and civil society organisations—to the implementation of resilience and mitigation initiatives, such as tree planting and proper waste management. In close collaboration with Congolese authorities, mining companies should develop a post-mining plan, preferably geared toward reforestation of sites degraded by mining activities. The students also insisted on using the increased taxes paid by mining operators to restore destroyed ecosystems and build resilient communities. Students finally recommended the participation of rural communities in natural resource management because these communities can play a leading role in climate change mitigation and in the sustainable use of limited resources already overexploited by various actors.

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References

1. O. Serdeczny, S. Adams, F. Baarsch, C. Dim, A. Robinson, W. Hare , S. Michiel, P. Mahé, J. Reinhardt, Climate Change Impacts in Sub-Saharan Africa: From Physical Changes to Their Social Repercussions. Reg. Env. Change 17(6) (2017) 1585–1600. doi: 10.1007/s10113-015-0910-2.
2. G. Zeufack, C. Calderon, K. Ntumba, K. Megumi, K. Vijdan. C. Cantu, Climate change adaptation and economic transformation in sub-Saharan Africa. Africa's Pulse 24 (23) (2021) 102p.
3. M. Tshimanga, K. Spirou, K. Nana, C. Kabujenda, E. Sondi, J. Mihaha, L. Ngandu, J. Sankania, A. Beya , L. Kombayi, A. Bonso, N. Likenge, P. Nsambi, Y. Sumbu, M. Yuma, M. Lututala, An Integrated Information System of Climate-Water migrations-Conflicts Nexus in the Congo Basin. Sustainability 13(16) (2021) 1-27, doi: 10.3390/su13169323.
4. World Bank. Democratic Republic of Congo Urbanization Review: Productive and Inclusive Cities for an Emerging Democratic Republic of Congo (2018) 68p. DOI: 10.1596/978-1-4648-1203.
5. USAID, Democratic Republic of the Congo - complex emergency fact sheet #3, fiscal year(2020) https://reliefweb.int/report/democratic-republic-congo/democratic-republic-congo-complex- emergency-fact-sheet-3-fiscal-7

6. Y. He, S. Thies, A. Paolo, J. Rentschler, Flood Impacts on Urban Transit and Accessibility -A Case Study of Kinshasa. Transportation Research Part D 96 (2021) 102889 Contents. https://doi.org/10.1016/j.trd.2021.102889.
7. M. Khoji, D. Nghonda, F. Malaisse, W. Salomon, R. Kouagou, K. Cabala, K. Munyemba, J. Bastin, J. Bogaert, S. Useni, Quantification and Simulation of Landscape Anthropization around the Mining Agglomerations of Southeastern Katanga (DR Congo) between 1979 and 2090. Land (11) (2022) 850. https://doi.org/10.3390/land11060850.
8. K. Kalombo, Evaluation des Éléments du Climat en R.D.C.; Editions Universitaires Européennes: Saarbrücken (Allemagne), Germany (2016) 220p.
9. R.K. Amani, B. Riera, G. Imani, R. Batumike, N. Zafra-Calvo, A. Cuni-SanchezClimate Change Perceptions and Adaptations among Smallholder Farmers in the Mountains of Eastern Democratic Republic of Congo. Land 628 (11) (2022) https://doi.org/10.3390/ land11050628
10. World Bank. Climate Risk Profile: Congo, Democratic Republic (2021) https://climateknowledgeportal.worldbank.org/DRC.
11. N. Kasongo, N. Mosombo, Perception paysanne des impacts de la variabilité climatique autour de la station de l'INERA/Kipopo dans la province du Katanga en République Démocratique Congo. Vertigo (2017) http://journals.openedition.org/vertigo/18873.
12. M. Balasha, K. Kitsali, B. Murhula, M. Hwali, B. Ndele, V. Cirhuza, B. Assumani, I. Akili, C. Nicanor, B. Benoît, Perception et stratégies d'adaptation aux incertitudes Climatiques par les exploitants agricoles des zones marécageuses au Sud-Kivu.VertigO (2021) https://doi.org/10.4000/vertigo.31673.
13. USAID. Democratic Republic of the Congo's (DRC's) 2020-2025 Country Development Cooperation Strategy (CDCS). (2021) https://www.usaid.gov/sites/default/files/documents/Public_CDCS-DRC-12-2025.pdf
14. Ministère de l'enseignement supérieur et universitaire, Annuaire statistique de l'enseignement supérieur et universitaire année académique 2019-2020. Kinshasa (2021) 534p.
15. J. Losby, A. Wetmore, Using a Likert scales in evaluation survey work (2012) https://www.cdc.gov/dhdsp/pubs/docs/cb_february_14_2012.pdf.
16. N. Moswete, M. Haretsebe, H. Purkitt, Perceptions of College Students towards Climate Change, Environmental, and Tourism Issues: A Comparative Study in Botswana and the US. Int. J. of Env. and Sc. Educ. 12(5) (2017) 1175-93.
17. R. Prasad, L. Mkumbachi, University Students' Perceptions of Climate Change: The Case Study of the University of the South Pacific-Fiji Islands." International Journal of Climate Change Strategies and Management (13) (2021) 416-34. doi: 10.1108/IJCCSM-12-2020-0126.
18. S. Wachholz, N. Artz, D. Chene, Warming to the idea: university students' knowledge and attitudes about climate change. Int. J. Sust. H Educ. 15(2) (2014) 128-141. https://doi.org/10.1108/IJSHE-03-2012-0025.
19. A. Valkengoed, L. Steg, G. Perlaviciute, Development and Validation of a Climate Change Perceptions Scale. J. of Envi. Psych.76 (4) (2021) 101652. doi: 10.1016/j.jenvp.2021.101652.
20. M. Akrofi, H. Antwi, R. Gumbo, Students in Climate Action : A Study of Some Influential Factors and Implications of Knowledge Gaps in Africa. Environnement 6 (12) (2019) 2-15. doi: 10.3390/environments6020012.
21. J. Marquardt, Fridays for Future's Disruptive Potential: An Inconvenient Youth between Moderate and Radical Ideas. *Frontiers in Communication (5*) (2020) 1-18. https://doi.org/10.3389/fcomm.2020.0004.
22. United students. Students call for stronger action on climate change (2021) 5p. .
23. Coleman, K., Murdoch, J., Shelly, R., Seidl, A. Wallin K. Students' Understanding of Sustainability and Climate Change across Linked Service-Learning Courses. *J.Geo.Edic.* 65(2) (2017) 158-67. doi: 10.5408/16-168.1.
24. K. McNeal, J. Spry, M. Ritayan, L. Tipton, Measuring Student Engagement, Knowledge, and Perceptions of Climate Change in an Introductory Environmental Geology Course." Journal of Geosc. Educ. 62 (4) (2014) 655-67. doi: 10.5408/13-111.1
25. S.Mugambiwa, D. Obey, Climate Change and Vulnerability Discourse by Students at a South African University. Jamba: Journal of Disaster Risk Studies 10(1) (2018) 1-6. doi: 10.4102/jamba.v10i1.476.
26. K. Hiser, K. Lynch, Worry and Hope: What College Students Know, Think, Feel, and Do about Climate Change. J. com. Eng. and Sch. 3 (13) (2021) 96-107.
27. A. Sola, E. Michael, Awareness of Climate Change and Sustainable Development among Undergraduates from Two Selected Universities in Oyo State, Nigeria.World J. Educ. 6(3) (2016) 70-81. doi: 10.5430/wje.v6n3p70.
28. A. Mavrodieva, K. Okky, B. Vito, R. Shaw. Role of Social Media as a Soft Power Tool in Raising Public Awareness and Engagement in Addressing Climate Change. Climate 7(10) (2019) doi: 10.3390/cli7100122.
29. L. Tuitjer, P. Dirksmeier, Social Media and Perceived Climate Change Efficacy: A European Comparison. Dig. Geo. and Society (2) (2021) 100018. doi: 10.1016/j.diggeo.2021.100018.
30. P. Tinker, J. Ingram, S. Struwe, Effects of slash-and-burn agriculture and deforestation on climate change. Agriculture, Ecosystems and Environment 58 (1) (1996) 13-22. https://doi.org/10.1016/0167-8809(95)00651-6
31. W. Salomon, S. Useni, T. Akoua , S. Sadaiou , J. Theodat, J. Bogaert, Monitoring of Anthropogenic Effects on Forest Ecosystems within the Municipality of Vallières in the Republic of Haiti from 1984 to 2019.Trees, Forests and People 6(8) (2021) 100135. doi: 10.1016/j.tfp.2021.100135.
32. T. Kabongo , K. Pongi, M. Muliele, V. Kizungu, L. Kiasala, K. Mbuya, Influence of Climate Variability on Seasonal Rainfall Patterns in South-Western DR Congo. OALib 3(09) (2016) 1-9. doi: 10.4236/oalib.1102952.
33. S. Hauser, L. Norgrove, Slash-and-Burn Agriculture, Effects of, In : Levin S.A. (ed.) Encyclopedia of Biodiversity, second edition, Waltham, MA .Academic Press (2013) 551-562.
34. C. Shapiro, P. Katie. Z. Stefano, D. Müller , A. Naikoa, D. Rémi, Proximate Causes of Forest degradation in the Democratic Republic of the Congo Vary in Space and Time. Frontiers in Conservation Science (2) (2021) 1-19. doi: 10.3389/fcosc.2021.690562.

35. M. Matumona, Y. Chen, Analysis of the Factors Affecting Electricity Consumption in DR Congo Using Fully Modified Ordinary Least Square (FMOLS)," in Dynamic Ordinary Least Square (DOLS) and Canonical Cointegrating Regression (CCR) Estimation Approach. .Energy (2021) 232. 121025. https://doi.org/10.1016/j.energy.2021.121025.
36. C. Kull, Madagascar aflame: landscape burning as peasant protest, resistance, or a resource management tool?. Political Geography 21 (7) (2002) 927-53.
37. M. Ambayeba, L. Banza, F.Mwitwa , M. Misery, V. Haufroid, S. Erik, B. Nemery Contamination of Water and Food Crops by Trace Elements in the African Copperbelt: A Collaborative Cross-Border Study in Zambia and the Democratic Republic of Congo. Environmental Advances (6) (2021) doi: 10.1016/j.envadv.2021.100103.
38. J. Ostheimer, J. Blanc, Challenging the Levels: The Catholic Church as a Multi-Level Actor in the Transition to a Climate-Compatible Society. Sustainability 13(7) (2021) 1-19. doi: 10.3390/su13073770.
39. P. Diamond, R. Bonnie, E. Rowe, Rural Attitudes on Climate Change Lessons from National and Midwest Polling and Focus Groups. Nicholas Institute for Environmental Policy Solutions (2020) 19p.