



The Greenhouse Effect Conception of the Pre-service Teachers of Kotobe Teacher Training University (KTTU)

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The main purpose of this study is to appraise the greenhouse effect preconceptions and misconceptions of pre-service teachers. Descriptive survey method was used for the study. The participants of this study were 59 student teachers from Teacher Training University who are in the first year of their study. In the survey, 36 statements which were divided into three subsections regarding the greenhouse effect and ozone depletion with Likert scale choice were administered to 29 geography and 30 biology teacher candidates. Results show that in survey-based conception test geography majors scored slightly higher than biology (mean score of 55.3 to 51.3 and standard deviation 10.8 to 9.4 respectively). Analyses of gender effect reveals that female students scored higher ($P < 0.01$) than male on the conceptual knowledge statements. Results further indicate that both majors grip a lot of misconceptions about the causes and consequences of greenhouse effects. They confuse ozone depletion with greenhouse effect as well as the ways through which they happen. Although many existing studies have produced similar findings, this project is the first of its kind in Ethiopia that generated information which can be used to develop teacher education materials. These findings call for further survey to scrutinize the curriculum and the teaching practices at high schools, universities and teacher education programs.

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1. INTRODUCTION

One of the most imperative environmental problems that our world faces is global warming, especially that aspect known as the "greenhouse effect". Global warming is not remote premise but a reality of our lives. A question then is raised: is this important concept being taught adequately, if at all, and are students, our future citizens, acquiring an understanding of the phenomenon?

In view of the fact that community, individually or collectively, are responsible for the aggravation of this phenomenon, such a radical change requires a systematic and lasting effort in which education seems to be the safest way to achieve it. In such cases the basic way of overcoming climate change and other environmental degradation necessitate a cognizant and well thought-out environment education.

However, most of the studies conducted in the most developed parts of the world on three environmental issues (climate change, global warming and ozone depletion) revealed the fact that, students at various educational levels have misconceptions regarding these environmental phenomenon. These studies have been reported in the literature about elementary school students', high school students' and pre-service teachers' perceptions, ideas and comprehension of climate change and the greenhouse effect, either exclusively or in conjunction or comparison with other environmental issues.

As affirmed above, analogous findings were reported by Boyes and Stanisstreet, [1]; Francis, Boyes, Qualter, and Stanisstreet [2] the presence of misconceptions among the elementary students that ozone depletion and greenhouse effect had casual association. Similar misconceptions and misunderstandings were disclosed by Boyes and Stanisstreet [3]; Boyes, Chuckran, and Stanisstreet [4]; Boyes and Stanisstreet [5]; Boyes and Stanisstreet [6]; Boyes and Stanisstreet [7]; Daniel, Stanisstreet, and Boyes [8]; Pål J. Kirkeby Hansen [9]; Rye, Rubba and Wiesenmajer [10] with secondary school students and Fatih [11]; Jeffries, Stanisstreet and Boyes [12] college and university students respectively. In addition, studies on pre-service teachers' perception about climate change, greenhouse effect and ozone depletion by Dove [13]; Grove and Pugh [14];

Khalid [15] and Papadimitriou [16] revealed that they held preconceptions and misconceptions regarding these environmental issues. Furthermore, not surprisingly Ralya & Ralya, Blanchett and Wandersee et al. (as cited in Abell [17]) found that prospective elementary teachers, practicing teachers and teachers detained a number of alternative conceptions and misconceptions as students about science and science- associated issues. Here, more likely the role of teachers as the most powerful influences in learning as stated by Hattie [18] in his model entitled as " A model of Visible teaching – Visible learning" ruthlessly desecrated.

From these studies a universal misleading notion has emerged, which is that there is a cause-effect relationship between the greenhouse effect and depletion of the ozone layer. Moreover, these results indicate that array of misunderstandings and alternative conceptions are in pre-service teachers' minds who are likely to teach students in the secondary schools. In spite of how these students develop their misconceptions regarding these environmental issues, it is quite likely that they will perpetuate them in their classrooms. In order to overcome these challenges and come up with solutions, first of all one should establish such misconceptions kept in their mind. More likely, chief reasons for the existence of misconceptions among the students and pre-service teachers are the theoretical nature of the concepts, ineffective classroom teaching, and the way the textbooks were prepared. This is why; these students and pre-service teachers had common misconceptions and keep unchanged up to University level [2]. Bearing in mind this fact, the themes that contribute to the development of environmental awareness should be integrated into the schools, Universities and teacher education programs curricula in realistic problem-oriented structure and discussed in depth in classroom. Moreover, lack of systematic approach to higher education programs at the universities, university colleges, colleges and teacher training programs in Ethiopia make challenges more complicated. This is because; many of the present higher institutions have extraordinarily analogous programs of study, offer much the identical mix of qualifications, and carry out limited and non specialized research. This study therefore, was designed to fill this gap, since education is the most powerful

instrument to send correct message concerning the complex feature of greenhouse effect and the way to ease its impact. Moreover, no similar studies were found in Ethiopia that dealt with aforementioned environmental conceptions at any level, let alone with pre-service teachers.

To conduct the present survey and achieve the intended objectives, the study sought to provide answers to the following leading research questions.

- What is the level of pre-service teachers' knowledge about greenhouse effect and ozone layer depletion?
- What is the conception of pre-service teachers' about greenhouse effect and ozone layer depletion?
- Are there any misconceptions among pre-service teachers' regarding climate change and greenhouse effect? If so, how do such misconceptions arise?
- Is there any difference on greenhouse effect perception among pre-service teachers' in terms of gender and academic stream regarding causes, consequences and cures of greenhouse effect?

The main objective of this study was assess the level of first year pre-service teachers' environmental conception and misconceptions regarding the causes, consequences and ways to alleviate the greenhouse effect. Specifically the study was conducted to determine the degree of pre-service teachers' attained knowledge about greenhouse effect, its causes, consequences and cures, to identify the pre-service teachers' conceptions about greenhouse effect, and to compare the similarities and difference in pre-service teachers' conceptions about greenhouse effect based on gender and academic stream.

1.1 Significance of the Study

For policy makers and curricula designers, the study can contribute to illustrate the literacy level of pre-service teachers regarding consequences and causes of the greenhouse effect, that may help to fill the gap, if any, in the policy in general and curricula materials in particular. In addition it gives information that may initiate other researchers to investigate deeply on the problem. Furthermore, this study is significant in that it can contribute a valuable source of information that may be considered by any environmental protection organizations which aim to have an interest in making learning institutions more productive to address such environmental problems.

2. MATERIALS AND METHODS

2.1 Population, Sample and Sampling Technique

This study was aimed to include the entire population considering their total number, thus no sampling method was employed. The participants' age range from 20 to 22 and all of come straight from high school many of them without work experiences. The subjects were 59 students, 20 females and 39 males majoring biology and geography at Kotobe Teacher Training University (KTTU). They were targeted for the study for three reasons. Firstly, the newly revised geography and biology syllabi and the textbooks comprise relatively sufficient opportunities to address climate change issues in general and issues related to greenhouse effect and ozone layer depletion in particular. Secondly, to examine the effect of attained high school environmental education lessons on their conceptual knowledge. Thirdly, they are the only teacher candidates who are assigned to teach environmental subject in secondary schools.

2.2 Data Collection and Analysis

The survey questionnaires adopted from Groves and Pugh [14] and Boyes et al. [4] and slightly modified by researcher. The questionnaire consisted of 36 statements; the first 12 statements deal with causes of the greenhouse effect; the second set of 12 deal with consequences of the greenhouse effect; while the last 12 focuses on ways to mitigate greenhouse effect. The Likert scale employed through three steps from "Agree, Disagree and No Idea". After compiling the questionnaire a series of pilot tests were carried out in order to gauge the efficiency of the questions. Two pilot surveys were conducted, from these results; perfections were made so that the final questionnaire supplied only relevant and informed data. Using the Cronbach Alpha value, the calculated coefficient alpha was equivalent to 0.796 which shows that the test had high reliability. The validity of questionnaires insured through the expert opinion of 2 environmental education professors of Addis Ababa University. Content analysis of newly adopted geography and biology textbook also has been conducted to triangulate the result of the study. In particular, it was carried out to determine how much statements of objectives and contents related to climate change, global warming and ozone depletion are elaborated in the incumbent biology

and geography textbooks together with respective teachers as panels of experts. The data collected from respondents were analyzed using inferential statistics like independent sample t-test and descriptive statistics such as percentages, frequency distributions, mean scores, and standard deviations.

3. RESULTS AND DISCUSSION

3.1 Analysis of Gender Effect on the Conceptual Knowledge

An analysis of gender effect was not a principal center of this study. This variable was included in intention to enrich the findings of the study. As shown in Table 1, female geography and biology students scored significantly higher ($M=59.20$, $SD=10.08$) than their male counterparts ($M=50.18$, $SD=8.98$) on environmental conceptual knowledge; $MD=9.02$, $t(57) 3.50$, $P=0.001$, $\alpha=0.05$. These results suggest that, sex has an effect on the level of students' environmental conceptual knowledge. This finding is supported by findings of Fatih and Osman [11] who came up with result that shows female students are keener to environmental issues than male students. The probable reason for this result is female students' active participation in school environmental clubs. However, this finding contradicts with the conclusions of Groves and Pugh [14] who reported that male science majors scored significantly higher than female students. Similarly, in a study conducted by Pål J. Kirkeby Hansen [9] in Norway the boys performed better than the girls.

3.2 Analysis of Academic Stream Effect on the Conceptual Knowledge

Analysis of academic stream found that the variability in the geography and biology students score is not significantly different, as was anticipated from their relatively better exposure and factual knowledge about environmental issues. Table 2, depicts that geography students scored slightly higher ($M=55.28$, $SD=10.77$) than biology students ($M=51.27$, $SD=9.94$) on conceptual environmental knowledge; $MD=4.00$, $t(57) 1.52$, $P=0.13$, $\alpha=0.05$. This insignificant mean difference between two streams might be because of the fact in which the climate change, global warming and ozone depletion issues more or less better treated in geography curriculum than in biology curriculum (see Table 3).

Regardless, the exhibited result by geography major students, the content analysis of newly revised geography and biology students' textbooks makes clear that the method the textbooks were prepared and the way these specific contents are selected and presented is far away from increasing the level of awareness about climate change and greenhouse effect. For these cases the national schools curricula have, generally, been harshly denounced of being inappropriate by most educators in the country. Similarly, Aklilu [19] explained that inadequate information has been integrated into students' textbook regarding issues under consideration above; and wherever included discussions on matters suffered most. For example, in study conducted by Hattie [18] explained that more significant value in each curriculum development is the balance of surface and deep understanding, which directs to conceptual clarity. One can hence understand why a number of misconceptions pertaining to this observable fact are prevailing in the mind of trainees.

3.3 Analysis of Individual Items

Under this sub-section sample statements with the high percentage of correct and incorrect responses were selected from three categories (causes, consequences and cures) of the greenhouse effect for analysis.

3.3.1 Causes of the greenhouse effect

Preconceptions and misconceptions about causal factors was manifested by incorrect responses regarding hole in ozone layer (1), deforestation and/or slash-burn (2), acid rain (4), origins of greenhouse effect (6), association between increased incoming solar radiation and greenhouse effect (10), and statement 12, about linkage between ozone layer hole and carbon dioxide (CO_2) concentration in the atmosphere (Table 3). For statement 1, disappointingly only very few pre-service geography (7%) and biology (10%) teachers could give correct responses. The result showed that the students appear to have misconceptions of the nature of the ozone and its depletion. This finding is supported by conclusion of Groves and Pugh [14] who came up with result that reveals incorrect conceptions of college students regarding causal relations between holes in the ozone and increased greenhouse effect. Boyes et al. [4] suggested that a reason for this common misconception is learning in this area cannot be experimental. Similarly, very less percentage of geography

(21%, 31%, and 28%) and biology (17%, 20% and 10%) answered correctly for statement 4, 10 and 12. The findings reveal that pre-service students displayed misconceptions while responding to statements, because they draw a parallel among all three environmental issues (greenhouse effect, acid rain and CO_2) and realize they are causative of each other. Many misconceptions are existing in the mind of pre-service teachers that the greenhouse effect is a phenomenon entirely anthropogenic (geography 69% and biology 87%). The result of present study revealed that both geography and biology trainees believe that greenhouse effect is entirely because of human caused activities. Many students were not knowledgeable of the natural greenhouse effect produced by atmospheric gases that maintains a habitable temperature on earth. Here, more likely the role of the media in causing confusion than clarification cannot be ruled out. Dove [13] and Boyes et al. [3] reported similar observations while studying understanding level of student teachers and secondary school children on greenhouse effect and ozone layer damage respectively. Similarly, in a study carried out by Koulaidis and Christidou [20] not a few students responded that increased greenhouse gases will cause air pollution.

Regarding correct responses, about more than three quarter of geography (76%) and biology (80%) student teachers were sure that littering in the streets, dumping rubbish in water bodies and decaying wastes made worse greenhouse effect. In addition, majority of geography (69%) and biology (90%) students knew that CO_2 that increases progressively in the atmosphere because of hydrocarbon combustion aggravating the greenhouse effect. Similarly, high percentage of geography (69%) and biology (70%) pre-service teachers recognized that gas from artificial fertilizers /Nitrous Oxide (N_2O)/ enhances greenhouse effect. Furthermore, about 76% of geography and 77% of biology student teachers were aware of the fact that methane (CH_4) resulting from agriculture, landfills, transportation and use of fossil fuels enhances the greenhouse effect. Similar observations were reported by Jeffries et al. [12] and Reye et al. [10] while studying knowledge level of students on greenhouse effect and global warming respectively.

3.3.2 Consequences of greenhouse effect

The data pertaining to pre-service teachers' perceptions about possible consequences of

greenhouse effect are presented in Table 4. The results of the study revealed substantial misconceptions over the association of the greenhouse effect to skin cancer (16), acid rain (17) and food poisoning (18). Disappointingly, only 17% of geography and biology student teachers responded correctly, hence revealing a strong conviction that the increased greenhouse effect might cause holes in the ozone that will let more ultraviolet rays (UV) which augments the incidence of skin cancer among people. Similarly, both academic streams erroneously interrelated greenhouse effect with acid rain (geography 90% and biology 93%). They also thought that there would be food poisoning if greenhouse effect rises (geography 79% and biology 83%). More than half of the geography (52%) student teachers rejected while three fifth (60%) affirmed that greenhouse effect causes earthquake. The result of this study and the studies conducted by Groves and Pugh [14], Dove [13], Boyes et al. [4] and Hills [21] are discouraging and clearly show that a number of misconception are at work. However, the results of the study reflected that both geography and biology student teachers were possessing a bit better knowledge about some of possible consequences than causes of the greenhouse effect like an increase in emission of greenhouse gases would cause the earth's average surface temperature to rise (geography 79% and biology 93%), greenhouse effect would cause the amount and pattern of rainfall (geography 76% and biology 80%), greenhouse effect will cause melting of glacial ice (geography 72% and biology 83%), greenhouse effect would lead to an increase in pests, insects, crop diseases and weeds in warmer areas (geography 79% and biology 53%), greenhouse effect could cause more respiratory diseases (geography 90% and biology 77%), an increase in greenhouse effect could cause more environmental refugees (geography 90% and biology 73%). They also rightly recognized that increase in the effect of greenhouse results in much more deserts and less fishes in the rivers (geography 72% and biology 73%). The knowledge these pre-service teachers have tended, however, to be not only very general but also uncritical. For example, in a similar study conducted by Boyes and Stanisstreet [6] many students accidentally mistook infrared radiation for ultraviolet rays and thought that the greenhouse effect causes skin cancer. As stated by Boyes and Stanisstreet [3] if people do not know the exact causes of the problem, they cannot come up with proper cures to alleviate it.

Table 1. An independent samples t-test analyses of gender effect on the conceptual knowledge of greenhouse effect

Gender	N	Mean	Std. deviation	df	t	Sig (2-tailed)	Mean difference
Male	39	50.18	8.98	57	3.50	.001	9.02
Female	20	59.20	10.08				

Table 2. An independent samples t-test analyses of academic stream effect on the conceptual knowledge of greenhouse effect

Department	N	Mean	Std. deviation	df	t	Sig (2-tailed)	Mean differences
Geography	29	55.28	10.77	57	1.52	0.13	4.00
Biology	30	51.27	9.94				

Table 3. Climate change, global warming and ozone depletion issues in the biology and geography curriculum guides

Grades	Periods allotted per year for geography	No. of topics/ subtopics in geography %	Topics/subtopics related to CC, GW & OD in geography		Periods allotted per year for biology	No. of topics/ subtopics in biology	Topics/subtopics related to CC, GW & OD in biology	
			N	%			N	%
9	68	154	2	2.94	102	104	3	2.9
10	56	194	15	7.7	102	99	4	4.0
11	132	188	9	4.78	136	63	0	0
12	128	192	5	3.9	135	112	2	1.8
Average	96	182	7.75	4.83	118.75	94.5	2.25	2.18

**Note: CC, GW & OD, climate change, global warming and ozone depletion*

3.3.3 Cures of the greenhouse effect

The responses of biology and geography pre-service teachers to the possible remedial actions of greenhouse effect displayed in Table 5. The data of the present study revealed several misconceptions of the student teachers about how greenhouse effect can be alleviated, however, overall, they achieved better score than on the prior two categories. This result is similar to the finding of Groves and Pugh [14] who came up with result that reveals appraised students scored better on cures of the greenhouse effect than on causes and consequences statements. A majority of the geography and biology pre-service teachers were aware of the universal remedial actions for alleviating greenhouse effect such as generating electricity from renewable energy source (geography 69% and biology 67%), conserving and preserving threatened plant and animal species (geography 86% and biology 80%), recycling and reusing practices (geography 83% and biology 77%), promoting the production and use of biofuel (geography 69% and biology 73%), reducing poverty and starvation (geography 59% and biology 67%), efficient use of electricity (geography 79% and

biology 73%), and developing a green economy (geography 79% and biology 80%). Similarly, majority of the geography and biology students rightly rejected that planting more trees across the globe can made the greenhouse effect greater (geography 66 % and biology 53%). On the other hand, this study did not convincingly show if these students have critical knowledge of why these measures are considered useful. Studies of Jeffries et al. [12] revealed similar results while studying the knowledge level of college students pertaining to greenhouse effect. Similarly, in a study carried out by Boyes et al. [3] argued analogous observations while studying understanding level of student teachers and secondary school children on greenhouse effect. However, they were unaware of many commonly adopted techniques and ideas which could help to mitigate the causative driving forces of greenhouse effect such as using nuclear power stations instead of coal (geography 24% and biology 30%), reducing the use of private vehicles (geography 38% and biology 17%), and making nuclear weapons' free planet (geography 38% and biology 30%). As stated by Aklilu [22] reason for these misconceptions may be alternative energy technologies installed

Table 4. The frequency (f) and percentage (%) distribution of pre-service geography (N=29) and biology (N=30) teachers responses about the causes of the greenhouse effect

Statements	Department	Correct		Incorrect	
		f	%	f	%
1. Holes in the ozone layer contribute significantly to the greenhouse effect	Geography	2	7.0	27	93.0
	Biology	3	10.0	27	90.0
2. Deforestation and/or slash-burn system of farming increase carbon sequestration	Geography	7	24.0	22	76.0
	Biology	2	7.0	28	93.0
3. Littering in the streets, dumping rubbish in water bodies and decaying wastes made worse greenhouse effect	Geography	22	76.0	7	24.0
	Biology	24	80.0	6	20.0
4. Acid rain contribute significantly to the greenhouse effect	Geography	6	21.0	23	79.0
	Biology	5	17.0	25	83.0
5. Carbon dioxide that increases progressively in the atmosphere because of hydrocarbon combustion aggravating the greenhouse effect	Geography	20	69.0	9	31.0
	Biology	27	90.0	3	10.0
6. The greenhouse effect is a phenomenon entirely anthropogenic (Human-caused)	Geography	9	31.0	20	69.0
	Biology	4	13.0	26	87.0
7. CFC (Chlorofluorocarbon) gases given out from spray cans enhance greenhouse effect much more	Geography	25	86.0	4	14.0
	Biology	19	63.0	11	37.0
8. Methane (CH ₄) resulting from agriculture, landfills, transportation and use of fossil fuels enhances the greenhouse effect	Geography	22	76.0	7	24.0
	Biology	23	77.0	7	23.0
9. Ground-level ozone contributes considerably to the greenhouse effect	Geography	14	48.0	15	52.0
	Biology	17	57.0	13	43.0
10. Increased incoming solar radiation to earth over past years made worth the greenhouse effect	Geography	9	31.0	20	69.0
	Biology	6	20.0	24	80.0
11. Gas from artificial fertilizers /Nitrous Oxide (N ₂ O)/ enhances greenhouse effect	Geography	20	69.0	9	31.0
	Biology	21	70.0	9	30.0
12. Ozone layer holes' will get bigger if more carbon dioxide (CO ₂) gets into the atmosphere	Geography	8	28.0	21	72.0
	Biology	3	10.0	27	90.0

Table 5. The frequency (f) and percentage (%) distribution of pre-service geography (N=29) and biology (N=30) teachers responses about the effects of the greenhouse effect

Statements	Department	Correct		Incorrect	
		f	%	f	%
13. Continued emission of greenhouse gases will cause the earth's average surface temperature to rise more	Geography	23	79.0	6	21.0
	Biology	28	93.0	2	7.0
14. Greenhouse effect causes earthquake	Geography	15	52.0	14	48.0
	Biology	12	40.0	18	60.0
15. Greenhouse effect causes changes in rainfall patterns (frequent droughts and fires in some areas, flooding in other areas)	Geography	22	76.0	7	24.0
	Biology	24	80.0	6	20.0
16. Greenhouse effect causes skin cancer	Geography	5	17.0	24	83.0
	Biology	5	17.0	25	83.0
17. Greenhouse effect causes acid rain	Geography	3	10.0	26	90.0
	Biology	2	7.0	28	93.0
18. If greenhouse effect rises, people will be poisoned from foods	Geography	6	21.0	23	79.0
	Biology	5	17.0	25	83.0
19. Greenhouse effect causes accelerated melting of glacial ice	Geography	21	72.0	8	28.0
	Biology	25	83.0	5	17.0
20. Greenhouse effect increases pests on crops, crop diseases, and weeds in warmer areas	Geography	23	79.0	6	21.0
	Biology	16	53.0	14	47.0
21. If the greenhouse effect increases, more people will die of respiratory disease	Geography	26	90.0	3	10.0
	Biology	23	77.0	7	23.0
22. Greenhouse effect causes the sea level to rise	Geography	14	48.0	15	52.0
	Biology	20	67.0	10	33.0
23. If the greenhouse effect increases, there will be more environmental refugees	Geography	26	90.0	3	10.0
	Biology	22	73.0	8	27.0
24. Increase in the effect of greenhouse results in much more deserts on the earth and less fishes in the rivers	Geography	21	72.0	8	28.0
	Biology	22	73.0	8	27.0

Table 6. The frequency (f) and percentage (%) distribution of pre-service geography (N=29) and biology (N=30) teachers responses about the solutions to alleviate the greenhouse effect

Statements	Department	Correct		Incorrect	
		f	%	f	%
25. Planting more trees across the globe can made the greenhouse effect greater	Geography	19	66.0	10	34.0
	Biology	16	53.0	14	47.0
26. Using nuclear power stations instead of coal will aggravate the greenhouse effect	Geography	7	24.0	22	76.0
	Biology	9	30.0	21	70.0
27. Generating electricity from renewable energy source (solar, wind, flowing water, waves, tides etc...) can made lesser greenhouse effect	Geography	20	69.0	9	31.0
	Biology	20	67.0	10	33.0
28. Conserving and preserving threatened plant and animal species will reduce greenhouse effect	Geography	25	86.0	4	14.0
	Biology	24	80.0	6	20.0
29. Recycling and reuse practices can diminish the greenhouse effect	Geography	24	83.0	5	17.0
	Biology	23	77.0	7	23.0
30. Promoting the production and use of biofuel will reduce the greenhouse effect	Geography	20	69.0	9	31.0
	Biology	22	73.0	8	27.0
31. Reducing the use of private vehicles can made the greenhouse effect greater	Geography	11	38.0	18	62.0
	Biology	5	17.0	25	83.0
32. Making nuclear weapons' free planet will increase the greenhouse effect	Geography	11	38.0	18	62.0
	Biology	9	30.0	21	70.0
33. Reducing poverty and starvation on the planet can made the greenhouse effect lesser	Geography	17	59.0	12	41.0
	Biology	20	67.0	10	33.0
34. Efficient use of electricity can made the greenhouse effect smaller	Geography	23	79.0	6	21.0
	Biology	22	73.0	8	27.0
35. Producing and using more fuel-efficient vehicles/machines exacerbate the greenhouse effect	Geography	8	28.0	21	72.0
	Biology	3	10.0	27	90.0
36. Developing a green economy can make the greenhouse effect much more lesser	Geography	23	79.0	6	21.0
	Biology	24	80.0	6	20.0

in the school compounds and community based organizations such as churches. Moreover, most students were unaware of the important contribution nuclear energy makes in cleanly

providing a significant proportion of the world's electricity. In addition, a reason might be that Ethiopia generates most of its electricity from cleaner renewable energy (hydropower,

geothermal power, and wind power) and a poor country to use nuclear power for electricity generation. Furthermore, majority of the pre-service teachers have made amply clear that neither using of private vehicles nor more fuel efficient vehicles has significant impact on greenhouse effect. This is most probably because, Ethiopia ranks least by vehicles per capita in the world.

Finally, from the outcome of this study and similar international studies' findings one can hence, observe the consistency of results across time and across different settings which confirm the reliability of the study. Moreover, it is needless to say that cause-effect relationship identified in the study is really there and the results obtained from participants are true of general people.

4. CONCLUSION

The evidence from this survey exhibits that many concepts regarding the nature, cases, consequences and cures of the greenhouse effect are not well understood by pre-service geography and biology teachers. Moreover, some misconceptions were universal. For example, the incorrect association of the greenhouse effect to skin cancer, acid rain and food poisoning. According to Hills [21], these misconceptions can appear from "untutored beliefs" and insufficient understanding, rather than from scientific interpretation. As pointed out by Soyibo [23] the textbooks utilized in schools contain insufficient or sometimes distorted information regarding these complex and abstract environmental issues as well. Furthermore, a content analysis of geography curricula for Ethiopian secondary and preparatory schools conducted by Aklilu [19] demonstrated that the impact of human actions is, for instance, not clearly expressed while discussing factors contributing to global climate change. Hence, meager curriculum, feeble textbooks, most teachers without deeper knowledge and low priority to this topic, are basic sources of misconceptions concerning environmental issues in various countries including Ethiopia. The findings presented in this study and aforementioned international conducted similar studies are either not encouraging or totally disappointing. For the most part, these common misconceptions can be alleviated, if not entirely solved, by integrating problem-oriented greenhouse effect and global warming issues to courses at all levels adequately without water downing. For these

reasons, environmental education programs should be revised in detail and the contents of the courses and classroom instructional approach should be revisited at high schools, Universities and teacher education programs. In particular, since pre-service teachers are shapers and educators of future generation, designed and implemented curricula must foster a coherent understanding of the many features of the environmental issues. It might be also useful to link the conceptual problems to hands-on experiences when possible that could easily be illustrated through students experiment or teacher demonstrations. Moreover, teacher candidates who graduated from teachers training Universities and Colleges of Ethiopia should be granted with in-service training to dispel these misconceptions in their minds. Future study requires to assess appropriate teaching methods which best promote firm comprehension of these complex environmental issues.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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