

# Secondary School Teachers' Knowledge Level of the Concepts of Environmental Education in Morogoro, Tanzania

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**Abstract:** *The main focus of the study was to determine the knowledge level of the certificate of secondary education geography teachers when teaching the concepts of meteorology, environmental education and climate change. The study involved observing and interviewing 24 classroom teachers who were randomly selected from both rural and urban Morogoro. Teachers could demonstrate ability to present the causes, extent and effects of pollution and wastes including most of the concepts of the elements of weather and the use of power. But there was a disparity between the intended curriculum and the implemented one because of the observed teachers' misconceptions, inability to link various environmental concepts or to contextualize examples and questions they ask. Therefore there should be well planned environmental education for both pre-service and in-service teachers specifically synchronized with the secondary school curriculum. This should go together with more comprehensive geography syllabus and teachers guide.*

**Key words:** *Teaching, teachers knowledge, meteorology, environmental education, climate change*

## INTRODUCTION

### Background

According to the National Academy of Sciences, the Earth's temperature has risen about approximately 0.5 degrees Celsius in the past century, with accelerated warming during the past two decades (Baird, 2005). This unnatural warming has become a potential threat to our biosphere with huge social, environmental and economic consequences (Papadimitriou, 2004). This condition has raised interest in educating pupils, the future citizens, about global warming, especially the greenhouse effect, all over the world (Koulaidis and Christidou, 1999; UNESCO, 2014).

In Tanzania, certificate of secondary school curriculum, meteorology and environmental education issues appear to be given more emphasis in geography subject than the rest of the subjects. For example, concepts related to meteorological issues and environmental education such as elements of weather, climate, natural regions, importance of weather, human activities water sources, power use and environmental issues and management are suggested in the geography syllabus (MOEVT, 2005; TIE, 2011). However, although climate change is mentioned in the syllabus it is not linked with the sections of meteorology or environmental education. This means for effective teaching of environmental education concepts by focusing on the contemporary problems teachers need to have sound knowledge on meteorological concepts and environmental education.

Research shows that the enhanced teachers' capacities help learners to address environmental problems through active learning, critical thinking and active involvement seems to occupy the focal point (Roux and Ferreira, 2005). However, studies conducted on students' ideas about greenhouse effect in different parts of the world revealed that students almost every level have misunderstandings about the greenhouse effect (Andersson and Wallin, 2000; Bozkurt and Cansüngü-Koray, 2002; Darçin *et al.*, 2006). Study done in Tanzanian secondary schools observed that students could relate some aspects of environmental degradation with climate change but they had some misconceptions on the causes of climate change and in relating the same concepts with conservation techniques and power consumption (Kira, 2014).

Groves and Pugh (1999) state that students' misunderstandings might arise from incorrect understandings passed along by their teachers. In Tanzanian colleges of teacher education, environmental issues are addressed as a topic of 'environmental problems and issues' according to the geography syllabus for college teachers (MOEVT, 2009). Though various environmental issues are addressed in the syllabus for teacher education, evolving issues of climate change are not incorporated though integrated with secondary school geography syllabus. Therefore the purpose of this study is to carry out a study to determine secondary school teachers' knowledge level for teaching the concepts of environmental education.

## **THEORETICAL FRAMEWORK**

In formal school-based environmental education, teachers have an important role in providing students an adequate knowledge base and clear understanding of environmental problems (Khalid, 2001). Such a role of teachers is supported by the observation that; teachers generally want to incorporate environmental education and teaching about socio-scientific issues into science instruction (Forbes and Davis, 2008; Kim and Fortner, 2006; Sadler *et al.*, 2006; Plevyak *et al.*, 2001). In addition, teachers recognize that engaging in teaching and learning about the environment requires that they assume many roles similar to those described by highly effective science teachers in inquiry-oriented, project-based classrooms (Dresner, 2002). It should be considered that teachers with particularly strong subject-matter knowledge for particular environmental topics and concepts will emphasize them in teaching and learning about the environment (Fortner and Meyer, 2000). Conversely, pre-service teachers with more limited subject-matter knowledge, especially pre-service elementary teachers, may not apply conceptual understanding of science concepts to environmental issues in practice (Forbes and Davis, 2008; Ekborg, 2003). This is the reason why teacher educators generally like to incorporate environmental education into their teacher education courses and programmes (Heimlich *et al.*, 2004; Powers, 2004). They also show awareness of the relationship between environmental education and environmental literacy and the importance of the latter as a learning goal for students.

The two most often utilized integration points for environmental education are methods courses, particularly science methods courses, and associated content courses that pre-service teachers take (Heimlich *et al.*, 2004). One particularly important dimension of science teacher education is a focus on learning to teach science as inquiry. As such, teacher education programmes often focus on various inquiry practices, such as asking questions, making predictions, using evidence, and, most importantly, constructing explanations. This implies that the approach goes beyond single subject approach and helps children to use the contents and methods of science and social sciences and environment to solve environmental problems/issues in future (Ravindranath, 2011).

These enquiry techniques ensure that students are centered on developing curiosity and awareness about their surroundings, knowledge and understanding of their environment and their relationships or connections. Applying multiple associations during teaching involves also the use of a range of assessment techniques for measuring the learning outcomes (Ravindranath, 2012). However, even when teachers ground science instruction in environmental issues that are of importance to the community, they often rely on examples which are less familiar to students when discussing controversial phenomena (Christenson, 2004; Zint and Peyton, 2001). Probably this is the reason why some researches in environmental education have observed that teachers have poor understanding of the actual environmental problems, especially the greenhouse effect (Michail *et al.*, 2007; Summers *et al.*, 2000). Despite these limitations, teachers can come to view the benefits of exploring multiple viewpoints on environmental issues as outweighing possible drawbacks contextualizing controversies (Forbes and Davis, 2008; Sadler *et al.*, 2006).

## **METHODOLOGY**

Survey was a research design chosen for this study whereas the research approach used was qualitative. Qualitative approach was used because the researchers sought to gain an in-

depth understanding of the teachers' knowledge on accuracy of concepts, depth/coverage of issues, ability to link related concepts with one another and with students' immediate environment using appropriate examples and ability to ask questions that cover the stated objectives and also widen students' understanding of these concepts. The approach considers the observation that qualitative approach is an empirical inquiry that investigates a contemporary phenomenon within its real life context (Miner-Romanoff, 2012).

The researcher needed to involve both rural and urban Morogoro. Rural Morogoro and Morogoro urban are administratively subdivided into 24 and 26 wards respectively with running secondary schools. Since each ward in Morogoro urban has 1 to 7 secondary schools whereas each ward in Morogoro rural has 1 to 2 secondary schools, the researcher selected 6 wards from each of the two districts using stratified random procedure. Then the researcher sampled one school from each of the selected ward in both urban and rural Morogoro. For the wards having more than one school, simple random procedure was used to select one school from that ward. Thus, it made a total of 12 schools that were sampled from both urban and rural Morogoro. For each school, 2 teachers who taught geography in the certificate of secondary education were sampled randomly. Therefore a total of 24 teachers were sampled from the selected 12 schools.

The data collection process involved non-participant classroom observations and unstructured interviews with teachers and students. The researchers also had mobile phones with voice recorder devices; hence the researchers could retrieve both students and teachers' voices after classroom observation whenever required. The two researchers agreed upon the entire procedure for observing and recording the responses before starting the observation including also the focus of the unstructured interview with teachers and students.

Since classroom observation was performed by two different researchers, validity and inter-rater reliability of the observation items was determined by doing a pilot study in a school different from the sampled ones. Then, based on the pilot data; intra-class correlation coefficient (ICC) was determined and it was found to be 0.81. Since this value was above the minimum acceptable value of 0.80, it means the researchers (raters) considerably shared understanding of the performance and the rating scale (Gwet, 2010). However, the researchers still refined the instrument, discussed and further agreed on the other details of the rating pattern such that ICC value calculated after the study increased to 0.83.

## **FINDINGS**

In each of the following sections both numbers and percentages were used to show proportion of teachers knowledgeable with the observed aspects by focusing at accuracy of concepts, depth/coverage of issues, ability to link related concepts with one another and with students immediate environment using appropriate examples and ability to ask questions that cover the stated objectives and also widen students' understanding of the concepts of meteorology and environmental education. The sections considered were waste management, minimizing power use, preventing environmental degradation, elements of weather and climate change.

### **Waste management**

All 24 (100%) teachers observed carried out their classroom presentations on the causes, extent, and effects of pollution and improper means of wastes disposal as specified in the objectives of the geography syllabus (MOEVT, 2005). For example, they were able to differentiate different types of solid, liquid and gaseous pollutants and their effect on various natural environments. They also prepared notes with accurate concepts for the sections mentioned for their students except 4 (16.7%) of the teachers whose most common mistakes were mainly grammatical errors. However, there was one of the teachers who could not elaborate on the specific wastes which was the cause of the over growth of the aquatic plants. This was revealed from a question which was asked by students.

The researchers' investigation on coverage revealed that, all teachers except 3 (12.5%) of them covered only the specified objectives on pollution and wastes management without any extra information such as asking students to propose solutions for environmental pollution. When the researcher asked the teachers about adding such an objective, the answers were divided such that 12 (50%) of them suggested that it is a good idea if that objective is added but the other 9 (37.5) teachers objected the idea of adding any more objectives where one of them stressed that:

“The syllabus is already much overloaded; why do we have to add other stuff while we are not sure of finishing the specified content! After all we are always told to focus on the specified objectives as they are stipulated by curriculum experts” (Field Data, 2012).

Other responses from this category of teachers added that probably the curricular experts thought that even if such an objective will not be specified it will be covered in a section of conservation. But when the same teachers were teaching that section of conservation, issues of controlling pollution were not discussed.

Regarding teachers' ability to relate various concepts with one another, it was observed that all teachers could relate concepts of pollution and waste mismanagement with various sections/topics in the geography syllabus though at varying levels. For example, 4 (16.7%) of the observed teachers could relate this section with various concepts on human activities and population while 15 (62.5%) of them could relate with human activities, population and settlements whereas 5 (20.8%) of them could relate with human activities, population, human settlements and poverty. For instance one of the students in one of the urban schools asked: “How does it happen that some places are cleaner than others in the same country governed by the same laws?” The teachers' response was:

“Take a scenario of an illiterate peasant from disorganized settlements without any patterns of waste disposal, carrying her crops to the market and on the way he/she manages to sell his/her luggage where will he/she cast any remains of his/her crops?” (Field Data, 2012).

After more elaboration, most of the students were convinced that the market place or anywhere along the way may eventually be full of wastes if the population of such peasants with the same habit is large, provided that nobody else cares.

Though in some cases teachers 13 (54.2%) could show that good policies can control environmental pollution and ensure conservation strategies, none of them was able to explain about the role of the existing environmental policy in environmental management.

Majority of the teachers 16 (67.7%) were giving examples based on their text books they were using. Only some of them 8 (33.3%) included a couple of other questions based on students' surroundings when dealing with various sections such as causes, extent and effects of pollution and waste mismanagement. These teachers succeeded so because they were able to ask their students to give examples of wastes they produced from their homes, schools, surrounding industries, farms and mines. However, one of the teachers could not explain the way fertilizers pollute the soil when she was urged so by students as she replayed:

“All fertilizers I have mentioned pollute the soil because once applied the soil gets used to it in such a way that one needs to re-apply the same fertilize every time new crops are to be grown in order to be assured with the same productivity” (Field Data, 2012).

Some students were not satisfied with such an answer because they wanted to know the chemistry behind how such fertilizers may be destructive to the soil. When the teacher discovered this, she said any further explanation on this can be explained better by your chemistry teacher.

Concerning the teachers' questioning skills, 9 (37.5%) of them asked varieties of low and higher levels' questions that covered the specified objectives although most of such questions were taken directly from their books; for example, they asked questions like: classify different types of wastes, explain the effects of various types of wastes in the environment etc. Hence they could not make students get focused to their surrounding environment. However, 2 (8.3%) of such teachers could set their own questions that included students' environment of rivers, industries and settlements. The rest of the teachers 13 (54.2%) could not ask enough questions to cover all concepts. The researchers could associate this with lack of competencies especially for guiding discussions through questioning as it was also revealed by previous studies in Tanzania (Jokolo, 2004; Kira *et al.*, 2013).

### **Minimizing power use**

Each of the 24 teachers observed could accurately present the concepts of the topic 'sustainable use of power and energy sources'. But one of the teachers could not respond satisfactorily towards a question from students that demanded extra explanation regarding the way natural gas is converted to electric power that is consumed for various purposes in homes and in industries. The teachers' response was: “The important thing for you to note is to identify various sources of power and not much on the mechanism of producing electricity from such sources”.

However, the geography syllabus specifies that the teacher should guide students to discuss on the various methods used to extract power and energy. Further interview with such a teacher after the class identified that, the teacher was not informed of the details on the mechanism involved in converting natural gas into electricity as it is mostly physics. It

seemed that the same applied for the rest of the teachers because such details did not feature their classroom discussions or their lesson notes.

Coverage of the objectives on this topic was not uniform among teachers. While all teachers were able to identify oil, solar, coal, water, natural gas, and wind as the major sources of power; 8 (33.3%) of them added also organic wastes and nuclear power whereas 4 (16.7%) of them further added geothermal and nuclear power. It was surprising that only 1 of the observed teachers could site wood and charcoal as sources of power. Probably this heterogeneity is contributed by the objective that, “students should identify the types of energy and power sources” which does not limit teachers to specific power sources. The teachers training manual identifies all these sources of power except power from tidal waves (TIE, 2011).

It was also observed that the objective, “students should be able to explain the uses and importance of different types of power and energy sources and discuss the problems facing the process of power harnessing” in the geography syllabus, directed these teachers to identifying appliances which use these sources of power and the problems facing energy harnessing. None of these teachers focused much on weighing the advantages of using one source of power from another although they were specified as activities in the geography teacher’s manual.

Most teachers 22 (91.7%) could relate power production and other topics for example, environmental pollution, conservation, management of water resources, transportation and manufacturing industries. But none of these teachers could relate power production and utilization of wastes. For instance, they did not show that manufacturing of goods from recycled wastes is one of the effective ways of reducing power use that would be spent to produce the same item from its original raw material (Green Party of the United States, 2012). Also, teachers’ discussions did base much on the problems facing power production and solutions proposed mainly were based on what should the government or society at large do so as to overcome the problems of power harnessing. Only few teachers 3 (12.5%) could show the students that they also have a stake in controlling power consumption by minimizing power use in their homes and at school.

However, even these few teachers could not spend enough time to allow students reveal various ways by which they can minimize power utilization such as reducing consumption of industrially manufactured goods such as plastic bags, papers, bottles etc. or reusing them for other purposes after their original use. Likewise the teachers could not use any convincing efforts to change students mind set by showing them the way they can reduce the use of fossil fuel if they may opt to walk or take a bicycle for short distances. The researcher’s interview with these teachers discovered that half of the teachers were well aware with these individually based means of reducing power consumption but they did not include them in their discussions because the syllabus only directs them to guide students to: “discuss problems facing power and energy harnessing and explain the methods on how these problems are addressed in focal countries”.

Most teachers 19 (79%) did not ask enough number of questions to cover all objectives as specified in the geography syllabus. For example, except for two teachers only, there was

neither oral nor written question for the section on the mechanism of producing electricity from the power and energy sources. Also, most of these teachers 20 (83.3%) asked general questions even when there were referring to power sources in Tanzania. Only few of them 4 (17%) could for instance ask a question which needed the students to identify various sources of power in Tanzania.

### **Preventing environmental degradation**

The 24 observed teachers tried to substantiate accurately various ways of preventing environmental degradation by controlling soil erosion, carrying out various types of human activities sustainably by preventing environmental pollution and doing conservation measures. However, one of the teachers could not respond satisfactorily towards one of the students' question that: "As population increases more wastes are produced; is it possible to utilize such wastes to generate electricity while at the same time cleaning the environment"? The teacher's response was that: "not all wastes can be decomposed readily for power production; wastes will easily decompose if made up of organic matter". While this answer may partly be true but students may develop an idea that if all wastes were of organic matter they could readily get electricity from their decomposition without knowing the cost involved in establishing the waste digester and in collecting the wastes; but more importantly constant supply of such wastes.

Though teachers could carry out their presentation to cover most of the objectives stipulated in the geography syllabus, only 16 (66.7%) of the teachers could identify specific wastes associated with agricultural and industrial productions, the rest were only generalizing such wastes.

Also, only 3 (12.5%) of the teachers who could show that tourism in the conserved areas or along the coast can contribute to environmental degradation and hence discuss with students on the measures which can be taken. However, none of the teachers could show students that tourism is also associated with extraction of biological products which may lead to loss of biodiversity (Rangarajan and Shahabuddin, 2006). Also none of the teachers discussed with the students on the role of biotechnology in environmental conservation (Singh, 2012). Hence, measures discussed in the classroom did not address specifically conservation of the most vulnerable plant and animal species under the prevailing conditions of liberal economies. The teachers were trying to relate various methods of preventing environmental degradation with human activities such as diluting the industrial effluents to make them harmless to the environment, sustainable mining and practicing sustainable agriculture. Half of the teachers could also link environmental degradation with increasing population, disorganized settlements and poverty. Also, while 3 (12.5%) of the teachers could associate environmental pollution with formation of acid rain and its effect to the plant growth, none of them could relate it with mass wasting or weathering of rocks.

Since classroom assignments can be one of the means of contextualizing issues (Perin, 2011); researchers' observation further traced the teachers' questions and found out that most of the observed teachers 22 (92%) asked general questions on environmental degradation; the questions were mostly set based on the syllabus objectives like, "Explain the causes of air pollution on the environment or what are the effects of wastes mismanagement on the environment?".

### **Weather, climate and climate change**

The observed teachers' information on the elements of weather and climate was accurately presented in the classroom and in the students' notes. But most of the teachers 21 (87.5%) observed demonstrated one or more misconceptions when presenting the causes, effects or steps to be taken against climate change either in their classrooms or in their notes.

The interview with teachers revealed that even the remaining 3 (12.5%) teachers had the same misconceptions only that they could not be discovered in the classroom because rarely did they allow discussions in the classroom and they normally advised their students to prepare their own notes. These misconceptions were mainly identified when trying to relate issues of climate change with the other environmental problems or human activities.

Firstly, when presenting the causes of climate change they could not show the students that, climate change is mainly due to human activities. Thus, students concentrated much on discussing natural causes raised by their teachers such as: "volcanic eruption, continental drifting, the impact of asteroids and cosmic radiation from exploding stars and change in periodic patterns in weather cycle". These created questions from students for instance: "why are these natural events happening now and they had not been there before?" Such questions could not be answered satisfactorily by the teachers. For example, one of the teachers answered: "although these events have been there before, nowadays they are catalyzed by human activities which are unfriendly to the environment". Such a response created a notion to some students that, there is no direct influence of human activities on climate change rather indirectly by intensifying the occurrence of the natural events. But research shows that climate change is mainly due to human activities (Petit, 2010).

Secondly, when presenting the effects of climate change they used to indicate that: "since climate change is characterized by increase in temperature some cold areas have become warmer such that tropical crops are grown successfully". A statement like this gave an impression to some students that while some crops fail to survive due to increased temperatures others replace them where the environment allows without any net negative effect due to climate change.

Thirdly, the teachers were proposing that since climate change is caused by green house gases, and methane gas being one of the green house gases produced from rice cultivation; large scale cultivation of rice should be avoided in order to cut off methane production. But these teachers could not justify with evidence that methane gas relative to other green house gases contributes so significantly to global warming and if most of this gas is produced from rice compared to other sources.

Fourthly, most of the teachers i.e. 18 (75%) were not distinguishing depletion of ozone layer from global warming in their discussions. Through interview with the teachers the researcher discovered that, the teachers thought that global warming is mainly due to the depleted ozone layer by greenhouse gases; a condition which allows most of the ultraviolet rays into the earth leading to global warming and hence climate change. Although 12 (50%) of these teachers knew that carbon dioxide contributes significantly to global warming, they thought that it is through destroying the ozone layer.

Although all 24 teachers addressed the concept of weather and elements of weather but 6 (25%) of the teachers did not include the objective, “explain how to establish a weather station” in the geography syllabus either in their presentation or in their notes or assignments. Those who included this objective in their lessons could mention all the instruments for measuring the elements of weather but only 17 (70.8%) of them included descriptions on how the instruments are used to measure the elements of weather. The rest of the teachers 7 (29.2%) included only diagrams of such instruments without any description. Also, none of the teachers covered the objective, “Students should describe the meaning of weather forecasting and how it is done”. When the researchers wanted to know why they didn’t include such objective in their lessons, the reason was because the syllabus recommends the section to be taught by a meteorologist who could not be invited because of several circumstances beyond their control. In the geography teacher’s manual the topic of weather and climate was missing.

All teachers could show the application of weather in various human activities and also the relationship between climate and human activities. But the same activities were not related with climate change except for agriculture. The number of teachers who could relate climate change with the other topics varied depending on whether the concept being presented was a cause, effect or measure against climate change as summarized in Table 1.

**Table 1: Number of Teachers who could relate Issues of Climate Change with Other Topics**

<i>Topics</i>	<i>Causes</i>	<i>Effects</i>	<i>Measures against climate change</i>
Agriculture	5	24	4
Water management for economic development	none	21	none
Sustainable use of forest resources	24	20	24
Sustainable mining	4	None	none
Tourism	none	1	none
Manufacturing industry	24	None	3
Transport	18	None	17
Soil	2	3	4
Sustainable use of power and energy resources	4	6	7
Human population	12	10	4
Settlement	none	1	2

Table 1 shows that all teachers, i.e. 24 (100%) could relate effects of climate change with agriculture, sustainable use of forest resources with causes of climate change, measures against climate change with sustainable use of forest resources and also causes of climate change with manufacturing industries. While very few teachers i.e. 4 (16.7%) could relate sustainable mining with causes of climate change, none could relate the same with either effects or measures against climate change. Comparable observation is for the case of tourism where only 1 (4%) of the observed teachers could relate tourism with the effects of climate change whereas none of the teachers could relate climate change with either causes or measures against climate change. Some teachers i.e. 2 (8%), 3 (12.5%) and 4 (16.7%) respectively could show the relationship between soil and causes, effects and measures against climate change.

Table 1 further shows that though nearly half of the observed teachers could relate human population with causes and effects of climate change; the proportion of teachers decreases slightly for the case of sustainable use of power and energy sources. Also, the number of teachers decreased further for the case of determining teachers' ability to relate climate change with causes, effects or measures against climate change.

Although teachers were indicating activities involved in agriculture that produce green house gases as one of the causes for climate change; they were paying less attention on the deforestation due to large scale agriculture. This is the reason why measures they were suggesting against climate change focused on decreasing agricultural activities which add green house gases in the atmosphere. This marginalized the way climate change is contributed by unplanned agricultural activities that cause deforestation in the sensitive areas (FAO, 2010). For instance, they did not mention that limiting agricultural activities along the water sources as a measure against climate change because they did not identify how agricultural activities in the water catchment areas will lead to deforestation

downstream hence causing climate change. But they could identify that while climate change may suppress agricultural productivity in some areas it may lead to increased productivity of some crops in others.

The teachers were confidently describing that industries and automobiles contribute significantly to the effects of climate change. Hence, easily to suggest for decreasing industrial and automobile activities which produce green house gases as a means of mitigating climate change. However, they could not show that climate change may also limit availability of industrial raw materials and power supply or disrupting transportation infrastructure due to floods, mass wasting and storms (American Society of Civil Engineers) (ASCE). 2009). But some of them i.e. 4 (16.7%) could show that soil erosion decreases vegetation which may contribute to the causes of climate change and that climate change on the other hand may reinforce soil erosion in areas with increased rainfall. Hence, they could suggest prevention of soil erosion as mitigation means for climate change.

The teachers who could show that climate change may be accelerated by the unplanned increase in population in both rural and urban areas which continuously polluted the environment and destroyed biodiversity, could also point out that climate change will lead to eruption of diseases and likely to kill massively especially in densely populated areas with unplanned settlements. Thus, they sometimes proposed family planning and planned settlements as adaptation means against climate change.

None of the teachers used aspects of weather and climate or any data from climate change projections as examples in the topics of statistics or research when describing terms like statistic, variable, parameter, research problem, hypothesis, research question etc. But some of the teachers i.e. 7 (29.2%) could at least use examples related with geography such as population, crops harvested, and settlements. Majority of these teachers i.e. 17 (70.8%) used other examples for example, rate of certain diseases, students' performance, school dropout rate or school enrolment rates.

Most of the teachers i.e. 21 (87.5%) were asking general questions which did not necessitate students to include examples from their environments for example: "explain the effects of climate change". But if the teacher could ask for instance, "explain the effects of climate change in Ngorongoro crater" students could specifically get focused in the specified area, explore the resources available and the way they are maintained by the existing ecosystem. Such an example would raise students' interest to start thinking of the mitigation means against climate change even before they are asked so because it is a scenario which is likely to affect them directly (Mork, 2012).

## **DISCUSSION**

The findings show that teachers could demonstrate ability to present the causes, extent, and effects of pollution and wastes including most of the concepts concerning with the elements of weather and the use of power. But they could not consider the current environmental policy (2004) which reinforces individual responsibilities in environmental management in the era of climate change. As a result teachers could not give contextualized examples or ask varieties of questions which would reveal several issues related with environmental degradation as propagated by growth of biotechnology or globalized liberal economies.

Nevertheless, one may argue that the geography syllabus does not stipulate clearly that students need to discuss measures against pollution although it does so on the causes and effects of pollution. But there is a section of conservation with an objective, “students should analyze various ways of conserving environment” (MOEVT, 2005). There were teachers who thought that even without mentioning in the syllabus that students need to discuss measures against environmental pollution, responsible teachers need to do so especially in a section of conservation. Such teachers may be considered that they were right because the geography teacher’s manual for the certificate of secondary education (TIE, 2011) specifies that conservation may also include ‘maintain the health of the natural world’. This means prevention of environmental pollution may be part of conservation. However, even those teachers who claimed so could not include pollution preventive measures such as controlling toxic industrial effluents as part of conservation either in their classroom discussions, students’ notes or assignments. This implies that the concept of ‘conservation’ was still confusing to some teachers because the idea of including measures against pollution in conservation was only raised by few teachers (9) (37.5%).

Also, since there were teachers who believed that they should not modify anything in the syllabus, geography teachers’ training manual could equip teachers with the necessary details for effective teaching of some concepts which may need clarification such as ‘conservation’. Unfortunately such a manual was not available to the observed teachers. However, even if the training manual were available to every teacher, there were cases where the manual could not elaborate some issues so as to help classroom teachers. For instance, interview with teachers discovered that teachers were well aware with individually based means of reducing power consumption but they did not include them in their classroom discussions because the syllabus only directs them to guide students to: “discuss problems facing power and energy harnessing and explain the methods on how these problems are addressed in selected countries”. For this case it seems some teachers were properly following the syllabus because even in the teachers training manual, it is only the problems related with power production that are specified (MOEVT, 2005). Thus, if the objectives in the syllabus would include also problems associated with power utilization, a syllabus user could consider individual’s responsibility in minimizing power use.

Also, the manual could not help teachers to contextualize their questions or examples they used to ask students based on students immediate environment. For instance, the manual directs teachers to: “assign students to search for negative and positive influences of human settlements on the environment” (MOEVT, 2005). This means when teachers ask their students such questions, students may only focus on developed countries. But if a question could for example be like: “search for negative and positive influences of human settlements in rural or urban Tanzania, would provide opportunity for students to start thinking of their surrounding environment before searching for other factors which are only written and hence difficulty for students to conceptualize.

There were cases where geography teachers demonstrated less ability to relate climate change with other sections in the syllabus as reflected where the teachers were suggesting for afforestation and reforestation as some of the measures against climate change but they limited the effect of climate change on forest resources to the migration of wild animals only

without including the loss of biodiversity. This is also one of the reasons why the teachers were only associating pollution from mining industries as one of the causes of climate change without also considering the possible threat of both unplanned mining and tourism on the existing biodiversity. Under such conditions they could not include controlled mining and tourism as measures for mitigating climate change.

## CONCLUSION AND RECOMMENDATIONS

Although teachers could demonstrate ability to present the causes, extent, and effects of pollution and wastes including most of the concepts concerning with the elements of weather and the use of power there was a disparity between the intended curriculum and the implemented one because of the observed miss conceptions, inability to link various environmental concepts or to contextualize examples and questions. These weaknesses can be linked directly with students learning of environmental education as it has been observed that students' misunderstandings might arise from incorrect understandings passed along by their teachers (Groves and Pugh, 1999). Therefore there should be well-planned environmental education for both pre-service and in-service teachers specifically synchronized with the secondary school curriculum. This should go together with more comprehensive geography syllabus and teachers guide with more elaboration as a means for directing geography teachers on how exactly they should go about teaching the concepts of meteorology, environmental education and climate change.

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