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## Climate Change Adaptation and Mitigations: Students' Knowledge and Experiences in Jimma University, Ethiopia

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### Abstract

Climate change adaptation and mitigation are essential to minimize the potential impacts of climate particularly for the Sub-Saharan Africa like Ethiopia due to high vulnerability to the effects of climate change. Afforestation, re-afforestation, forest conservation, using water in efficient way, water harvesting and storage techniques, livelihood diversifications and green economy are some of the potential climate change adaptation and mitigation options. The study was conducted in Jimma University College of Agriculture and Veterinary Medicine to assess the student knowledge and experiences on climate change adaptation and mitigation strategies and the way forward to minimize the future impacts of climate change. A total of 95 respondents were purposively selected from the Department of Natural Resources Management and Agricultural Economics and Extensions. Open and close ended questionnaire were distributed to the students in the classroom at the end of the semester for data collection. The collected data were analyzed by using Microsoft office excel and Statistical Package for Social Science version 20. Descriptive Statistics such as frequency and percentage were employed to examine the student knowledge and experiences on adaptation and mitigation options.

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The results of the study show that majority of the students (87.4%) perceived that climate change is occurring in Ethiopia. Based on their knowledge and experiences on climate change and its impacts the students prioritized afforestation, forest conservation, re-afforestation, wise use of water and diversifying community livelihoods as the top five ranked adaption and mitigation options in Ethiopia.

The study suggests that capacity building at different levels in the form of training and workshop on climate change adaptation and mitigation is crucial; the wise use of natural resources in general and specifically the conservation of forest should be encouraged in all regions of Ethiopia and the Ethiopian Ministry of Education should incorporate the issue of climate change and its adaptation and mitigation options in all discipline as much as possible.

**Keywords:** adaptation; afforestation, climate change; Jimma University; mitigations

## **1. Introduction**

Climate change is one of the burning global concerns due to its considerable impacts on ecosystem services and food security [1, 2]. It has become a major agenda of discussions and debate at all levels and throughout the world [3]. Climate change impacts are so pervasive, affecting almost all sectors and regions in time and space [4]. International leaders give high concern on the issue of climate change. For instance, the US Secretary of State (John F. Kerry) declared that “Today people all over the world are demanding action on climate change, and those of us in positions of authority globally have responsibility to lead the way toward progress [5].

Different researchers have tried to identify the major causes of climate change in order to adapt or mitigate the possible impacts of the change. For instance [6] pointed out that deforestation, forest degradation, land use and land use change, fossil fuel burning and various industrial processes changes our climate at an alarming and accelerating rate. Increasing the concentration of carbon dioxide from volcanic activities and other natural events and processes are the causes of climate changes [4]. [7] pointed out in his studies on “Impact of Climate Change: Views and Perceptions of Policy Makers on Smallholder Agriculture in Ghana” the policy makers respondents results reveals that about 94% of the cause of climate change is related to fossil burning, deforestation, indiscriminate small-scale mining, water pollution, urbanization and other human activities and the remaining 6% attributed to ozone layer depletion. [8] also conclude that deforestation, rapid population growth, agricultural expansions, industrialization and road constructions are the main causes of climate change in Ethiopia.

Education has the potential to impact student’s knowledge on their understanding of the variables that affect the climate system and their understanding of adaptive responses to climate change [9]. Understanding perception and knowledge on climate change is crucial to promote successful adaptation strategies [10]. The most vulnerable are those who have only a low level of education and who strongly depend on Agriculture [11]. Sub-Saharan Africa (SSA) countries are the most susceptible to the effects of climate change and variability [2, 12, 13, 14]. Studies indicate that the Least Developed Countries (LDCs) have contributed least to the emissions of greenhouse gasses (GHGs) but they are most vulnerable to the effects of climate change [15, 16]. The

vulnerability of the LDCs is only due to low level of development that makes less resilient to negative external events and have lower capacity to adapt than other developing countries [17].

Societies can reduce risks of damage from climate change through climate change adaptation and mitigation [18]. Climate change impacts do not affect each community in the same way as other, thus; the wealth nations are more resilient than poorer countries since they have the least capacity to adapt to climate change, as they lack the resources and money [19, 15]. Adaptation and mitigation practices are occurring in both the developed and developing worlds, however, the capacity for adaptation and mitigations of climate change vary greatly within or across the regions, countries, sectors and communities [20].

Adaptation and mitigations are designed to minimize the potential impacts of climate change. The two terms tend to differ fundamentally in the timing of their effects. While adaptation benefits may be realized more quickly and are more likely to be localized, mitigation benefits lag in time and are global in scale [18]. Mitigation aims at reducing GHGs emissions while adaptation aims at reducing current and future impacts of climate change [21]. Adaptation is actual adjustment, or changes in decision environments, which might ultimately enhance or reduce vulnerability to observed or expected changes in climate [20]. Adaptation can enhance the capacity of people and governments to reduce climate change impacts [22].

Crop and livelihood diversification, seasonal climate forecasting, community-based disaster risk reduction, water storage, emergency response and disaster recovery are the major climate change mitigation practices [20, 23]. Using different crop varieties, planting trees, soil conservation, and irrigation are the most common adaptation strategies in Ethiopia and South Africa [10].

Carbon trading is another alternative option for climate change mitigations. Carbon trading could contribute to mitigation of climate change and thus relieve exposure, finance adaptation and development, and conserve the resource base of food security [2]. According to [24] there are three main types of forest based climate mitigation strategies (1), Afforestation: increasing the size of carbon store and the annual carbon sequestration rate by expanding the area of forests and plantations, (2), Conservation: maintaining the size of the carbon store by protecting the existing forest from deforestation and timber exploitation, and (3), Sustainable management: increasing the sustainability of the existing forest Management in order to stabilize the size of forest carbon stores. Carbon conservation, carbon-substitution, and carbon sequestration and storage are the three methods used to sequester carbon through forestry [25].

The forestry sectors is important in climate change mitigation because of its potential as a source as well as sink for carbon emissions and can stabilize the concentration of CO<sub>2</sub> at global scale [16]. Forests play a role both as adaptation (provide local ecosystem services) and mitigation through global ecosystem services of carbon sequestration [26]. Forests can make a very significant contribution to low-cost global mitigation portfolio that provides synergies with adaptation and sustainable development [27].

REDD+ refers to Reducing Emissions from Deforestation and Forest Degradation in Developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in

developing countries [28, 29]. According to [29], REDD+ was established by multi-stakeholders such as transnational organizations, states, and non-governmental organizations (NGOs) to assist developing countries to build capacity to reduce emissions and to participate in the future REDD+ mechanism. REDD+ is forming as a regime to mitigate and adapt to climate change in the global society [28].

Rainwater harvesting is one of the strategies for reducing the impacts of unpredictable climatic conditions on water supplies and an important tools for human well-being [29]. People may resort to modify dwelling environments by adapting new strategies to optimize the utility of available water by harvesting rain rather than migrating to newer areas [30]. Similar to water harvesting, water storage techniques is also played a role in climate change adaptation. For instance, water storage techniques can enhance the community resilient to climate change related problems like precipitation and water scarcity [31]. Therefore, this research was aimed to assess student's knowledge and experiences on climate change adaptation and mitigation strategies.

The limitation of this study was that, it did not involve students from all programs in the university. We conducted the study on students from college of agriculture and veterinary medicine. Because of shortage of fund from the side of the researchers, we limited our survey to undergraduate students from the Departments of Natural Resources Management and Rural Development.

## **2. Materials and Methods**

### **2.1 The Study Area**

We conducted our study at Jimma University College of Agriculture and Veterinary Medicine which is found in southwestern Ethiopia. The university accommodate a total of 42,672 students in 2014/2015 academic calendars.

### **2.2 Methods**

The respondents were purposively sampled from the Departments of Natural Resources Management and Agricultural Economics and Extension (Rural Development) program. The two Departments were selected due to the following factors (1) The Department of Natural Resources Management have take Introduction to Climatology and Meteorology, Introduction to Environmental Sciences, Forest Development, Agroforestry System and Practices, Participatory Forest Conservation and Management and Climate Change adaptation and mitigation courses. (2) Rural Development Program also have taken courses like Agroforestry, Environment and Development and other courses that address the issues of climate change. A total of 95 final year BSc students were sampled from which 53 (56%) of them belongs to Natural Resources Management and the remaining 42 (44%) were Rural Development (Figure 2).

### **2.3 Data collection and analysis**

Data for the study were collected through close and open ended questionnaire in the class room from 4 to 28 May 2015. We purposively selected the final year students in order to understand their knowledge and

experiences on the issues of climate change adaptation and mitigation. The quantitative data were analyzed by using SPSS version 20 and Microsoft Excel 2007. In the data analysis we employed, descriptive statistics such as frequency and percentage to know the student's knowledge and experiences on climate change adaptation and mitigation strategies and the findings were then presented using tables and figures.

### 3. Results and Discussion

#### 3.1 Demographic and Regional Distribution of the respondents

The demographic data of the respondents indicated that 53% males and the remaining 47% represents female (Figure 1) and 56% and 44% of the respondents were from Natural Resources Management and Rural Development respectively (Figure 2). The age of the respondents varies from 19 to 27 with an average age of 21.61 years and about 55.8% were between 21 and 22 years old (Table 1).

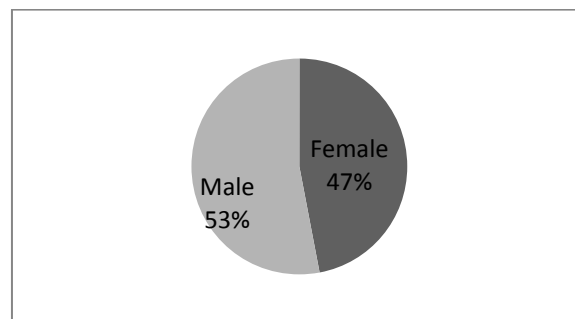


Figure 1: Sex of the respondents

Table 1: Age of the Respondents

Age	19	20	21	22	23	24	25	26	27	Total
Frequency	3	19	27	26	10	5	4	0	1	95
Percent	3.2	20	28.4	27.4	10.5	5.3	4.2	0	1.1	100

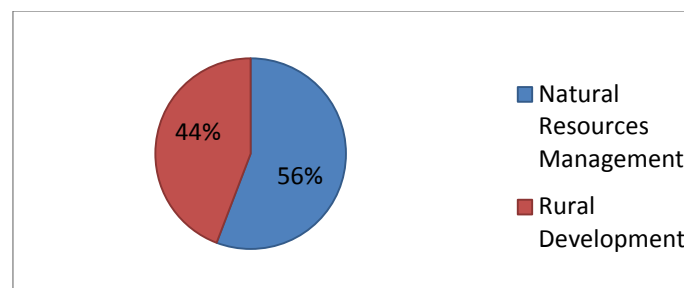
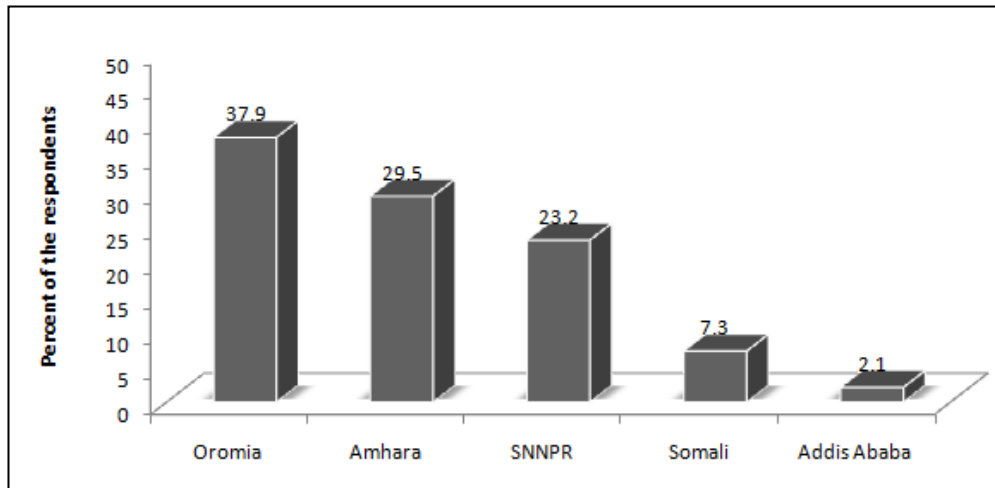


Figure 2: Department of the Respondents

Concerning the regional distribution of the student respondents, they joined Jimma University from four national regional states, (Oromia, Amhara, Southern Nation Nationalities and Peoples Regional States (SNNPR) and Somali) and one city administration, Addis Ababa. About 37.9% came from Oromia, 29.5% from Amhara, 23.2% from SNNPR, 7.3% from Somali and 2.1% from Addis Ababa (Figure 3). The distribution of the respondents across different regional states provides an opportunity to explore the experiences of students on climate change adaptation and mitigation options from the point of view of regional distribution in Ethiopia.



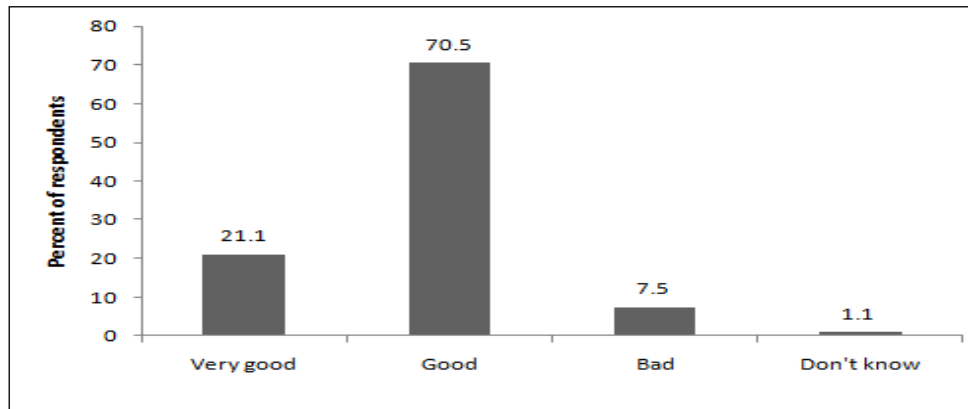
**Figure 3:** Regional Distributions of the respondents (Birth place)

The current climatic condition of Ethiopia is expressed by the respondents in ranks like very good, good, bad and don't know. Accordingly, 70.5% perceived that the present climatic condition of Ethiopia is 'good' while 21.1%, 7.3% and 1.1% declared that the climatic condition of the country is 'very good', bad and 'don't know' respectively (Figure 4). This great variation of student's perceptions on the climatic condition of the country is due to the fact that the respondents joined Jimma University from various regional states of the country which has great variations in climatic conditions. Although 21.1% of the respondents perceived the climatic conditions of Ethiopia is very good, the problem of climate change exists in the country, for instance, 62.1% of the respondents agreed that climate change is a real problem of Ethiopia and 30.5% of the respondents strongly agreed to this statement (Figure 5). Similarly, [8] on his research entitled as the perceptions of Climate Change among Natural Resources Management students at Jimma University, Ethiopia reported that climate change is occurring in Ethiopia.

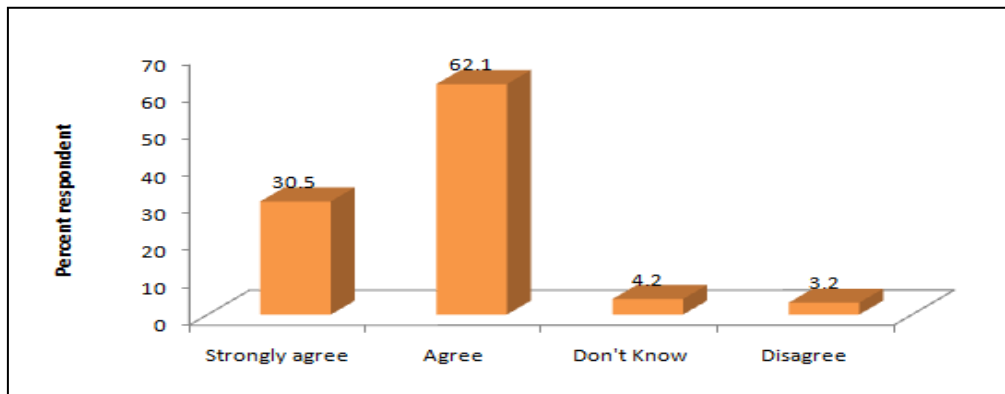
Global warming is one of the major evidencies of climate change. The respondents have enough knowledge on the causes of global warming. For instance, majority of the respondents have good knowledge (61.4%) and about 28.4% of the respondents reported that their knowledge on the causes of global warming is very good (Figure 6).

The analysis of the students perceptions on climate change indicates that most of the students are aware the fact that the world temperature is increasing (75.8%). Moreover (87.4%) of the respondents perceived climate change is happening in Ethiopia. To get information on the concept of GHGs, students were asked about the role

of GHGs on climate change and majority (89.5%) of them understand that GHGs can change the climate system (Table 2).



**Figure 4:** The present climatic conditions of Ethiopia



**Figure 5:** Climate change is a real problem of Ethiopia



**Figure 6:** Students knowledge on the causes of global warming

### 3.2 Knowledge of climate change adaptation and mitigation

To make clear on the difference between climate change adaptation and mitigations, students were also asked, whether they understand the difference between the two terms or not. The response of the students indicate that about 95.8% differentiate the difference between adaptation and mitigations. Adaptation and mitigation tend to differ fundamentally in scale; adaptation is more likely localized while mitigation are global both in scale and space [18]. The response from the students are in line with the report by [9], which described the role of education on students knowledge and understanding of adaptive response to climate change.

**Table 2:** Students perceptions towards climate change

Do you think that world temperature is increasing?	Frequency	Percent
Yes	72	75.8
No	23	24.2
Total	95	100.0
Did you perceive climate change is happening in your region?		
Yes	83	87.4
No	12	12.6
Total	95	100.0
Did you differentiate the difference between adaptation & mitigations?		
Yes	91	95.8
No	4	4.2
Total	95	100.0
Do you know about the role of greenhouse gasses in climate change?		
Yes	85	89.5
No	10	10.5
Total	95	100.0

The analysis of climate change adaptation and mitigation options indicate that diversifying livelihoods and carbon trading are some of the major climate change mitigation practices. Accordingly, 73.7% of the respondents understand the role of livelihood diversification to compact the impact of climate changes (Table 3). In the same way, [10] suggest that using different crop varieties are one of the most climate change adaptation strategies in Ethiopia and South Africa. Other researchers like [20, 23] also reported that crop and livelihood diversification is among the major climate change mitigation practices.

### 3.3 Knowledge on carbon trading

In order to assess the understanding and knowledge of students on carbon trading two questions were developed: (1), do you have information about carbon trading? (2), do you know the role of carbon trading in



climate change mitigation? For the first questions 68.4% of the respondents said ‘Yes’ while 31.6% said ‘No’. Concerning the role of carbon trading 58.9% of the respondents have knowledge on the role of carbon trading in climate change mitigation and about 41.1% of the respondents did not understand the role of carbon trading as climate change mitigation strategies (Table 3). The contribution of carbon trading is described by [2]; carbon trading could contribute to climate change mitigation and thus minimize exposure, finance adaptation and development, and conservation of resources for food security.

**Table 3: Student Knowledge on climate change adaptation and mitigation options**

Do you think diversifying livelihoods minimizes the impact of climate change?	Frequency	Percent
Yes	70	73.7
No	25	26.3
Total	95	100.0
Do you have information about carbon trading?		
Yes	65	68.4
No	30	31.6
Total	95	100.0
Do you know the role of carbon trading in climate change mitigation?		
Yes	56	58.9
No	39	41.1
Total	95	100.0

In addition to the above climate change adaptation and mitigation options (Table 3), the respondents were also asked to rank their level of agreement on seasonal migration of people and the role of various sectors to minimize the negative impacts of climate change with four alternative responses (Strongly agree, agree, don’t know and disagree). With reference to seasonal migration options, 63% of the respondents agreed and 20% strongly agreed that the seasonal migration of people as alternative options of climate change adaptations particularly for transhumance people in southeastern part of the country. The respondents were also asked about the involvement of different sectors on climate change adaptation and mitigations in Ethiopia and the results of the study reveals that about 66.3% of the respondents agreed that various sectors are working on adaptation and mitigation practices in Ethiopia (Table, 4). From this analysis we learnt that the issue of climate change is not the concern of one sectors. According to [3], climate change is a major agenda of discussions and debate at all levels and throughout the world.

Students were asked to rank their knowledge and experiences on adaptation and mitigation related information for 7 statements demonstrated in Table 5 along 4 alternative responses (Very high, high, low and very low). The analysis of the survey reveals that more than 60% of the respondents have knowledge on climate change adaptation and mitigations. Concerning the REDD+ knowledge and experiences, about 49.5% and 18.9% of the respondents have ‘high’ and ‘very high’ knowledge respectively. REDD+ is important to mitigate and adapt to

climate change in global society (Park et al., 2013). As indicated in (Table 5), about 60% of the respondents declared that the role of forest is very high in climate change mitigation. This findings is in line with the report of [6, 26, 27], all authors give high concern for forest both as an adaptation and mitigation of climate change. More than 50% of the respondents have knowledge on the role of crop diversification, rainwater harvesting and carbon sequestration as climate change adaptation and mitigation options. The role of rainwater harvesting to minimize the negative impacts of climate change was supported by [30, 31].

**Table 4:** Other adaptation and mitigation options

Seasonal migration of people is one means of climate change adaptation strategies		
Strongly agree	19	20.0
Agree	63	66.3
Don't know	7	7.4
Disagree	6	6.3
Total	95	100.0
Various sectors are working on climate change adaptation and mitigations in Ethiopia		
Strongly agree	13	13.7
Agree	63	66.3
Don't know	14	14.7
Disagree	5	5.3
Total	95	100.0

**Table 5:** Students knowledge and experiences on climate change adaptation and mitigations

	Very high	High	Low	Very Low	Total
Your knowledge on climate change adaptation is	22.1%	60%	15.8%	2.1%	100%
Your knowledge on climate change mitigation is	16.8%	64.2%	16.8%	2.2%	100%
Your knowledge and experiences on REDD is	18.9%	49.5%	25.3%	6.3%	100%
The role of forest in climate change mitigation is	60%	29.5%	7.3%	3.2%	100%
Role of crop diversification in adaptation and mitigation is	33.7%	50.5%	12.6%	3.2%	100%
The use of rainwater harvesting as adaptation option is	21.1%	50.5%	23.2%	5.2%	100%
The role of carbon sequestration in climate change mitigation is	17.9%	49.5%	26.3%	6.3%	100%

### 3.4 Skills on climate change adaptation and mitigation options

The respondents asked to prioritize the ten possible climate change adaptation and mitigation options (Table 6) based on their experiences and knowledge. Analysis of their prioritization shows that of the ten adaptation and

mitigations options, afforestation 90 (94.7%), forest conservation 89 (93.7%) and re-afforestation 76 (80%) were ranked in order of importance (Table 6). All top three ranks are associated with forests. Similarly, the capacity and the potential of forest for adaptation and mitigation has been studied by [6, 26, 10, 24, 27]. Afforestation and re-afforestation program is also suggested by [8] to compact the problem of climate change in Ethiopia. The wise use of water 63 (66.3%), livelihood diversification 55 (57.9%), enhancing the use of tree shade 55 (53.7%), and increased green economy 44 (46.3%) stood 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> ranks respectively as climate change adaptation and mitigation options. The respondents were least concerned on people displacement 38 (40%), heating and cooling system 36 (37.9%) and adjusting wearing style 29 (30.5%). Study conducted by [32] also recommended the use of rain water harvesting rather than migrating to new areas because of water scarcity.

**Table 6:** Climate change adaptation and mitigation in order of priority

Mitigation and adaptation options	Score frequency	Percent	Ranking
Afforestation	90	94.7	1 <sup>st</sup>
Forest conservation	89	93.7	2 <sup>nd</sup>
Re-afforestation	76	80.0	3 <sup>rd</sup>
Using water in efficient way	63	66.3	4 <sup>th</sup>
Diversifying livelihoods	55	57.9	5 <sup>th</sup>
Increasing use of tree shade	51	53.7	6 <sup>th</sup>
Enhancing green economy (Hydro, solar and wind power)	44	46.3	7 <sup>th</sup>
People displacement	38	40.0	8 <sup>th</sup>
Using cooling and heating systems in house	36	37.9	9 <sup>th</sup>
Adjusting wearing style	29	30.5	10 <sup>th</sup>

#### 4. Conclusions

Human beings can reduce the negative impacts of climate change through adaptation and mitigation strategies. The student’s knowledge and experiences on climate change adaptation and mitigation options show that majority (95.8%) understand the two terms because of their education. Education has power to enhance student’s knowledge and understanding on climate change adaptation and mitigation. Besides, education from school, the students enhances their knowledge through environmental observation. The students experiences on the role of forest, crop diversification, use of rainwater harvesting and carbon sequestration as climate change adaptation and mitigation options are also high (above 70%). Based on their knowledge and experiences, the respondents’ prioritized afforestation, forest conservation and re-afforestation as the top three ranks in climate change adaptation and mitigation options. Using water in efficient ways, diversification of livelihoods, increasing use of tree shade and enhancing green economy were the 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> ranked as adaptation and mitigation strategies in Ethiopia. Less emphasis was given for migration, cooling and heating system and adjusting wearing styles were least concerned as climate change adaptation and mitigation options.

## **5. Recommendations**

- The role of education, training in awakening citizens on the issue of climate change adaptation and mitigation options will be encouraged at all levels;
- It is also important to teach our society the negative impact of climate change on the environment like frequent occurrence of drought, flooding and other extreme events;
- It is crucial to incorporate the issue of climate change adaptation and mitigation issues in all field of study as much as possible;
- The role forest conservation and re-forestation should be promoted by governmental and NGOs to strengthen intervention the issues of climate change;
- Community and stakeholders awareness on the issues of climate change adaptation and mitigation options will be encouraged.

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