

Impact and Factors of Human Activities on The Dissemination of Climate Change and Variabilities in Eastern Hararghe Zone, Ethiopia: Systematic Review

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Abstract

Studying climate change and variability at a local scale is crucial for devising proper strategies that enhance adaptive capacity. In view of this, this study was conducted in Eastern Hararghe Zone, to assess; impacts and factors of human activities on the dissemination of climate change and variabilities. The result of review revealed that, most of the respondents (92.7%) perceived increasing temperature, as well as 96.3% perceived that rainfall is decreasing with a great deal of variability. In the present study area, 90.1% and 88.0% were crop production and livestock productivity respectively confirmed decreasing trend of the two agricultural practices in the area. Similarly, due to the increment of human activities expand agricultural land in the study 62.8, 71.2 and 65.5% of the respondents were observed that vegetation's, forest and wildlife in the area were diminished. Almost all, (95%) of respondents agreed that climate change and variability has been impacting on shared resources.

Key words: Climate change and Variability; Human impact; Productivity and livestock

Introduction

Background of the study and justification

Climate change often interacts with anthropogenic impacts in causing runoff and sediment load changes, and defining their contributions is of significance for managing rivers. Some recent studies have come to quantify the relative effects of climate change and human activities on stream flow and sediment load. Aside from climate change, recently, human activities (such as land use/land cover change dam construction and operation of large reservoirs and soil and water conservations have played a crucial role in the changes of water discharge and sediment flux [1,2]. The study by Walling analyzed the changes of sediment yield of the Black Sea over the past 20,000 years, revealing that climate change was more important than human impact in driving changes in sediment yield in the long time scale [3]. Climate change threat has got a pronounced impact throughout the world particularly on social and natural environments, including forest cover and species bio-diversity [4]. According to different empirical studies disclose that the global change in climate is presenting major threats for developing countries, in which case the extent is being manifested and magnified by natural and human activities [5]. High risk areas like lowland, arid and semi-arid areas are highly sensitive to the impacts of climate change. Developing countries like Africa being the most vulnerable as a result of various stress causing situations and due to the fact that it's state of low adaptive horizon [6]. The continent is already affected by the current sever threat of climate change especially climate dependent activities and indirectly social system such as poverty, conflict, education and health [7]. Those households found around such types of areas are supposed to be poor and economically incapable [7]. Moreover, recurrently prone to frequent and adverse occurrence of events like drought, flood situations, increase in temperature, decrease and unreliability of precipitations and other related events which are the manifestations of climate change in Africa. The present multitude effects on natural resources, water resource, food security, human health, infrastructure and development, particularly on agriculture [8].

Statement of the problems

Ethiopia, which is one of the sub-Saharan African countries, is frequently vulnerable to climate change. Climate change indicators and manifestations in Ethiopia have already being observed in the recorded history of the country. Such as increasing and recurrent happening of drought and flood situations occurrence of climate shifts for instance in every ten years a 0.2 0C increase in annual temperature have been observed in the last 5 decades, whereas in every year to two years unreliable and insufficient rainfall, showing erratic pattern in its onset and offsets particularly presenting a livelihood challenge in the lowland part of the country [9]. Eastern hararghe zone is now being vulnerable zone in eastern Ethiopia to climate change and variability. Farmers in eastern hararghe being smallholder are highly dependent on climate sensitive agricultural activities which are rainfall dependent and largely influenced by the effect of climate change. As a result, drought, flood, failures of crop yield, animal disease, pest and insect outbreaks, forest cover destructions and land degradations and soil erosion are the major factors now clearly observed in the area. Furthermore, little even no similar research issues have been done in the area. So these brought my attention to undertake this peculiar research in the area. Thus, this study therefore attempts to impact and factors of human activities on the dissemination of climate change and variabilities in the study area.

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Received December 07, 2021; Accepted January 29, 2021; Published February 05, 2021

Citation: Bogale GA, Abdo DR, Tolossa TT (2021) Impact and Factors of Human Activities on The Dissemination of Climate Change and Variabilities in Eastern Hararghe Zone, Ethiopia: Systematic Review. Environ Pollut Climate Change. 5: 198.

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Objectives of the study

General objectives: The overall objective of this study is ‘to assess impact and factors of human activities on the dissemination of climate change and variabilities in eastern hararghe zone, Ethiopia.

Specific Objectives

The specifically, the objectives of this study are stated as follows;

- To assess the indicators of climate change noticed by local farmers in the study area
- To evaluate the local people’s perceptions human activities on climate change
- To explore the existing responses and adaptation strategies being practiced to climate change or variability risks

Significance of the study

The issue of human activities goes to deliberate climate variability and change is widely studied in the world. The impact of the climate brings serious damage especially in developing countries. Ethiopia currently faces various problems resulted from climate variation even though the degree of the climate change is not clearly identified. In light of the situation and profile of the study area, analyzing major human effects and climate change elements will have some paramount importance on account of the following reasons.

Limitation of the study

No research, paper, is complete and free from limitations. This paper is, therefore, constrained by the following.

- One of the drawbacks in this study was variation of time span coverage of basic climate data i.e. rainfall and temperature. But, it would have been better if both data has the available to get time span coverage for predict impacts and effects.
- The other serious problem was difficulty of budget required to undertake the study. In addition, inappropriate of motivation especially during data collection some challenges were examined. The problem more adverse and interpretation difficult in the lack of software training.

Literature Review

Some definitions and conceptual frame work

Eastern Ethiopia: the focus area of this study, is mainly characterized by dense population, small farm size, declining soil fertility, severe land degradation, fragile ecosystems and recurrent weather-induced shocks such as drought [10]. It is among the chronically food insecure areas of the country facing recursive drought situation [11]. Human activities, particularly the combustion of fossil fuels, are altering the climate system. Human-driven changes in land use and land cover such as deforestation, urbanization, and shifts in vegetation patterns also alter the climate, resulting in changes to the reflectivity of the Earth surface (albedo), emissions from burning forests, urban heat island effects and changes in the natural water cycle. Because the primary cause of recent global climate change is human, the solutions are also within the human domain.

Impacts of human activities on climate change

Reducing CO₂ emissions to mitigate regional and global climate change is one of the most challenging issues facing humanity [12]. Ecosystem C sequestration and associated functioning take place through the interactions among abiotic components (example, climate, soils, and fires), intrinsic properties of ecosystems, and natural and anthropogenic disturbances (Figure 1). Guided by this principle, the Strategic Priority Project of Carbon Budget addresses the following scientific questions: (i) What are the magnitude and distribution of ecosystem C storage and C sequestration and how do natural and human factors influence the C sequestration and other C-related ecosystem functions, both directly and indirectly through changes in productivity, biodiversity, and stoichiometry of plants (ii) What are the C consequences of the major ecological restoration projects and the alterations in agricultural management practices that have been implemented in China for ecological conservation and crop productivity enhancement during the past few decades. By “extremely likely”, it meant that there was between a 95% and 100% probability that more than half of modern warming was due to humans.

The most of observed recent global warming results from human activities: Humans are increasingly influencing the climate and the

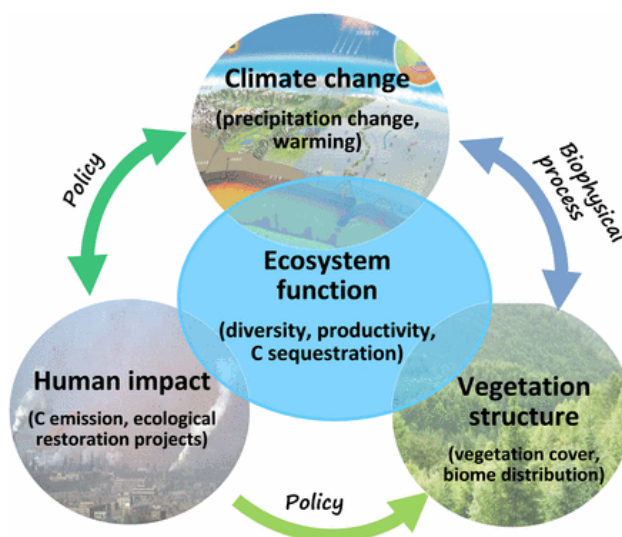


Figure 1: Conceptual diagram showing how vegetation structures, climate changes, and human activities influence ecosystem functioning.

earth's temperature by burning fossil fuels, cutting down rainforests and farming livestock. Warming of the climate system is unequivocal. According to the average global surface temperature increased by 0.85°C over the period 1880–2012 [13]. With global warming and temperature increasing, the rainfall will be affected, hence river flows. This adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming. Climatic warming or cooling arises from changes in the flows of energy through the climate system can originate from a number of possible driving factors. The main drivers that have acted over the last century are:

- increases in atmospheric CO₂ and other long-lived greenhouse gases (methane, nitrous oxide and halocarbons).
- increases in short-lived greenhouse gases (mainly ozone).
- changes to land cover (replacement of darker forests with paler croplands and grasslands).
- increases in aerosols (tiny particles in the atmosphere).
- solar fluctuations (changes in the brightness of the sun).
- volcanic eruptions.

Of these, solar fluctuations and volcanic eruptions are entirely natural, while the other four are predominantly caused by human influences. The human-induced drivers have been dominant over the past century (Figure 2). Changes in greenhouse gas concentrations, dominated by CO₂, caused a large warming contribution. Volcanic influences are highly intermittent, with major eruptions as the causing significant cooling for a year or two, but their average effects over the past century have been relatively small. There is substantial evidence that human activities, especially burning fossil fuels, are leading to increased levels of carbon dioxide and other greenhouse gases in the atmosphere, which in turn amplify the natural greenhouse effect, causing the temperature of the Earth's atmosphere, ocean and land surface to increase. "Human alteration of Earth is substantial and growing. The climate change impact on agriculture is believed to be stronger in Sub-Saharan Africa [14].

The impact of climate change on agricultural production in Ethiopia: Ethiopia is one of the Sub-Saharan countries situated at the

Horn of Africa. According to 2007 census the population of the country is around 74 million [15]. Like many other developing countries, agriculture (with the largest number of livestock in Africa) is the, agriculture is overwhelmingly dependent on the timely onset, amount, duration, and distribution of rainfall [16,17]. Over 90% of the food supply comes from rain fed subsistent agriculture and rainfall failure means loss of major livelihood source that always accentuate food deficit [18]. The use of both irrigation and water harvesting technology has a long way to go to bring the desired development. According to 2008 Farm Management Practices Survey of CSA, the total irrigated crop area was estimated to 179.8 thousand hectares (about 1.5% of the total crop land) [19]. This lag is attributed to the unsuitability of the topography for irrigation, uneven distribution of water resources and lack of technology.

Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions

Farmers and ranchers are already adapting to our changing climate by changing their selection of crops and the timing of their field operations. Scientific evidence indicates that the earth's climate is rapidly changing, owing to increases in greenhouse gas emissions. The increased concentration of greenhouse gases has raised the average temperature and altered the amount and distribution of rainfall globally [20]. For example, in Sub-Saharan Africa, warming is expected to be greater than the global average and in parts of the region; rainfall will decline [21]. Small holder farmers, for instance, can switch to more adapted crop varieties, but they may have lower productivity [22]. In developing countries, adaptation of the agricultural sector to the changing climate is important for ensuring livelihoods of the poor communities [21]. Adaptation will require the involvement of multiple stakeholders, including policymakers, extension agents, NGOs, researchers, communities, and farmers. Climate change adaptation is mostly location-specific, and its effectiveness depends on local institutions and socioeconomic setting [23]. A better understanding of how smallholder farmers perceive climate change and the adaptation strategies they practice is needed to make policies and design programs aimed at promoting successful adaptation in the agricultural sector. A combination of factors influences the farmers' perception about climate variability and the decision to use the selected adaptation strategies

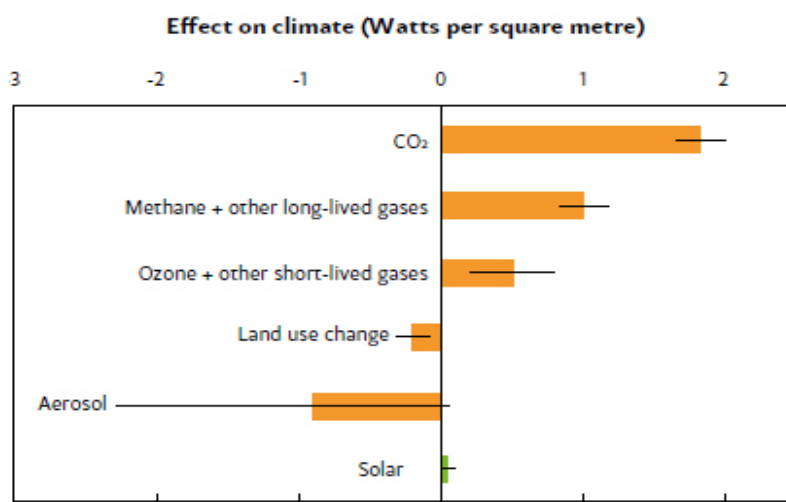


Figure 2: Human-induced drivers of climate change have been much larger than natural drivers over the last century.

[24,25]. Farmers in developing nations are developing resilience to climate change-related risks like droughts and floods through practicing diverse adaptation strategies. In the West African Sahel, for instance, pastoralists have come up with strategies to cope with the erratic rainfall [21]. In Ethiopia, diverse practices are used in both the highlands and lowlands (NMSA, 2001 and 2007). The agricultural sector in Ethiopia accounts for about 42% of national GDP, 90% of exports and 85% of employment and is mainly rained.

Indicators and causes of climate change

Climate change is defined as any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for a long period of time usually several years. The factors which could lead to climate change vary but included natural factors, such as changes in the sun's intensity, slow changes in the earth's orbit around the sun, natural processes within the climate system (such as changes in ocean circulation) and human activities that change the atmosphere's composition (such as through the burning of fossil fuels) and the land surface (such as deforestation, reforestation, urbanization and desertification) [26]. Records of geology show great evidence for large-scale climate change of earth in the past. The fossil fuel on the one hand provides the much needed energy to run machines but at the same time the machines releases CO₂ to the atmosphere. On the other hand, cutting down fossil fuel consumption implies either not operating or reduced operation of machines and the consequence is low industrial output and resultant low gross domestic product of some nations, hence the hesitation of some great industrialized countries to cut down their gas emissions.

Climate change can lead to other effects on the Earth's physical system that are also indicators of climate change. Such integrative indicators include changes in sea level (ocean warming + land ice melt), in ocean acidification (ocean uptake of CO₂) and in the amount of ice on ocean and land (temperature and hydrological changes). Climate is conventionally defined as the long-term statistics of the weather (e.g. temperature, cloudiness, precipitation). This definition emphasizes the atmospheric and physical components of the climate system. Factors that affect climate change are usefully separated into forcing and feedbacks. The conceptual diagram of (Figure 3) illustrates the connections between climate forcing, responses, and feedbacks as defined in this report. A climate forcing is an energy imbalance imposed on the climate system either externally or by human activities. Examples

include changes in solar energy output, volcanic emissions, deliberate land modification, or anthropogenic emissions of greenhouse gases, aerosols, and their precursors. Sometimes the climate system is defined more broadly by including the Sun, the lithosphere (the Earth's crust), or even humans as part of the climate system [27,28].

Agricultural adaptation strategies to climate change impacts

Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes. The Intergovernmental Panel on Climate Change (2007) defines adaptation as adjustments in natural or human systems in response to actual or expected climatic stimuli or effects, which moderates harm or exploits beneficial opportunities. It also refers to actions that people, countries, and societies take to adjust to climate change that has occurred. Adaptation has three possible objectives: to reduce exposure to the risk of damage; to develop the capacity to cope with unavoidable damages; and to take advantage of new opportunities. Planting of drought resistant varieties of crops emphasis on more drought resistant crops in drought-prone areas could help in reducing vulnerability to climate change. For example, wheat requires significantly less irrigation water compared to dry season rice. The use of drought-resistant crop varieties has been tried by smallholder farmers as adaptation methods to climate change in Nigeria, Senegal, Burkina Faso and Ghana [28].

The Crop diversification towards high value crops is feasible in the medium to long term. Crop diversity is a high priority adaptation measure in both irrigated and non-irrigated areas. In Southern Africa for example, land use is manipulated leading to land use conversion, such as the shift from livestock farming to game farming [29]. Crop diversification can serve as insurance against rainfall variability. Change in cropping pattern and calendar of planting is climate change adversely affects crop production through long-term alterations in rainfall resulting in changes in cropping pattern and calendar of operations.

Human activities are changing the climate

Rigorous analysis of all data and lines of evidence shows that most of the observed global warming over the past 50 years or so cannot be explained by natural causes and instead requires a significant role for the influence of human activities. In order to discern the human influence on climate, scientists must consider many natural variations

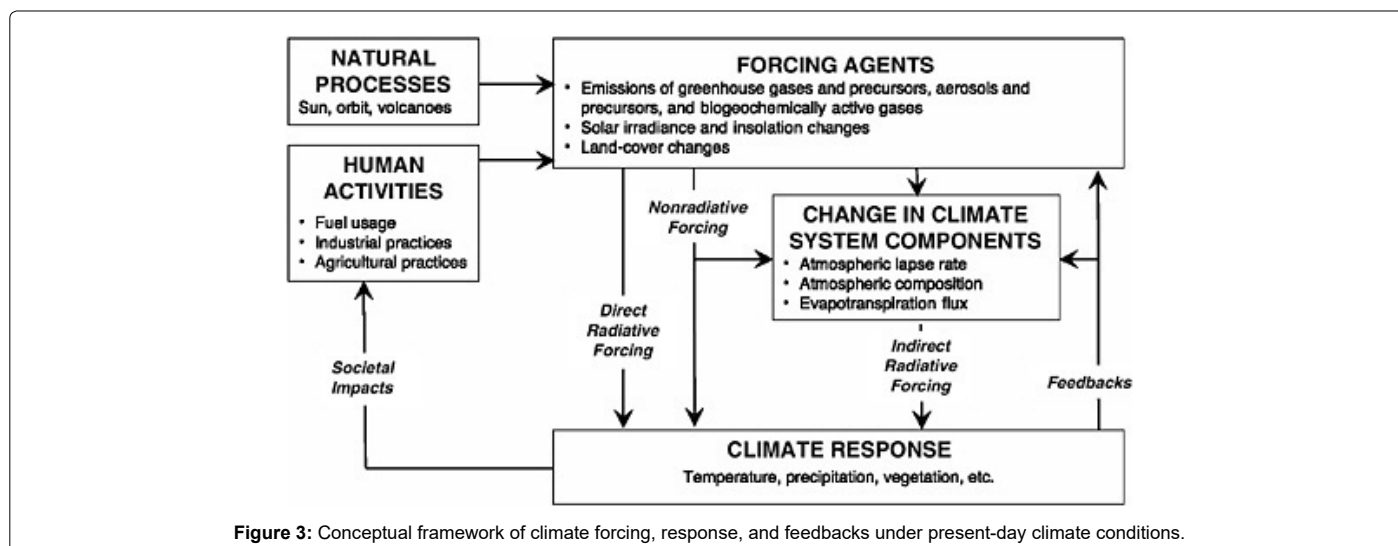


Figure 3: Conceptual framework of climate forcing, response, and feedbacks under present-day climate conditions.

that affect temperature, precipitation, and other aspects of climate from local to global scale, on timescales from days to decades and longer. One natural variation is the El Niño Southern Oscillation (ENSO), an irregular alternation between warming and cooling (lasting about two to seven years) in the equatorial Pacific Ocean that causes significant year-to-year regional and global shifts in temperature and rainfall patterns. Global climate change is unequivocal [30]. While recent climate change impacts on natural water resources and ecosystems worldwide have evidently been detected, gaps persist for many human and managed systems, and regional coverage remains unbalanced (Cramer *et al.*, 2014). Different influences on climate lead to different patterns seen in climate records (Figure 4).

Indicators and expressions of climate change and variabilities in Eastern Hararghe

Rainfall and temperature related indicators: The survey result indicated that, the majority of the respondent household perceived the existence of climate change indicators in the study area depicted in (Table 1). Most of the respondents about (92.7%) perceived increasing temperature, as well as 96.3% perceived that rainfall is decreasing with a great deal of variability at the start and end of rain season, this implies that human activities influence climate condition of the area and decreasing crop production due to shortage of rainfall amount in the study area. As the survey result showed 78.3% of respondents witnessed the rain begin later than usual and also 85.3 % said rainfall end up earlier than usual. This study is in line with [31] who has stated that the increase in temperature attributed to the dry season to be longer and the main wet season to be shorten even fail, as well as the starting and the ending of rainy season becoming more intermittent as it may happen early or late, may supposed to stop early, even complete failure of both short and main wet seasons and become part of the dry season, sometimes in short period heavy rainfall followed by high rate of runoff, erosive as result of poor vegetative cover.

The effect of human activities and physical indicators on climate variability: (Table 2) showed that, some kinds of physical environmental indicators like drought occurrence and flood situations are nowadays presenting a challenge of farmers in the study area. Farmers in the survey result have showed that drought and flood problems are increasing from time to time. As a result, 81.7% and 77.5% of the respondents respectively said as they are facing challenges from increasing incidence of the above mentioned environmental shocks. These environmental shocks being most incidence of the present day climate related natural hazards affecting the country from time to time which is actually global issue however not sever as the countries like in developing countries particularly in general Ethiopia [32]. In the present

study area with regard to crop production and livestock productivity, the descriptive result depicted that 90.1% and 88.0% respectively confirmed decreasing trend of the two agricultural practices in the area. The various climate related shocks again resulting in an alarming crop yield decline. The rise in temperature impacted the crop growing seasons leading to increased food insecurity, causing an increasing rate of livestock disease vectors transmission and distribution. At the time of prolonged drought as a result of delay in the onset of rain crop land lost its moisture and unable to tillage, range land and forage biomass deficit which act as a consequence of livestock mortality, and lack of precipitation. With regard to the biotic components the survey identified vegetation covers, forest cover and the presence or existence of wildlife as indicators and manifestations of climate change in the area (Table 3). The survey result coincides with the knowledge gathered from the key informants. According to the key informants eye witness tree species like Podocarpus (Zigba), Olea (Woyra), Hagnea (Kosso), Lol were now in the present time said to be disappeared as the result of human intervention du to expansion of agricultural land and intensify crop production. Similarly, wild animals such as Bushbuck (Agazan), Tiger (Nebir), Monkey (Zinjaroo), Calabus monk (Gureza), Warthog (Karkaro) were among wild animals now diminished from the area in the absence of forest tree and shelter. Forage species Hyperrenemia (Sembelet), Bermuda grass (Serdo), Akirma, Muja, were forage grass species now disappeared from the area. Accordingly, 62.8, 71.2 and 65.5% of the respondents were observed that vegetation's, forest and wildlife in the area were diminished and the rest of the respondents 37.2, 28.8 and 34.6% also convinced that vegetation's, forest and wildlife found in the area were decreased (Table 3) [33].

Local people's perception of climate change indicators and expressions

The characterization of drought, rainfall and temperature in the study area: Rainfall distribution logically varies from place to place from time to time and from season to season in the Ethiopian metrological agency records indicated. Variability in the rainfall amount including its start of rainy day time and end of rainy day is indicative of climate change in Ethiopia in particular in the study area. The result of sample household interview revealed that there was a decrease in rainfall in the area over the last decades (Table 4). Depending on the agro-ecological basis 83.8% of respondents in the highland and 94.5% in the midland witnessed a decrease in rainfall in the area. However, severity of rainfall fluctuation and decrease highly manifested in the lowland which as 98.5% of the respondents. The trend of temperature in the study area as the result showed was typically increasing as we go from top to down altitudinal basis. It is actually true that the low

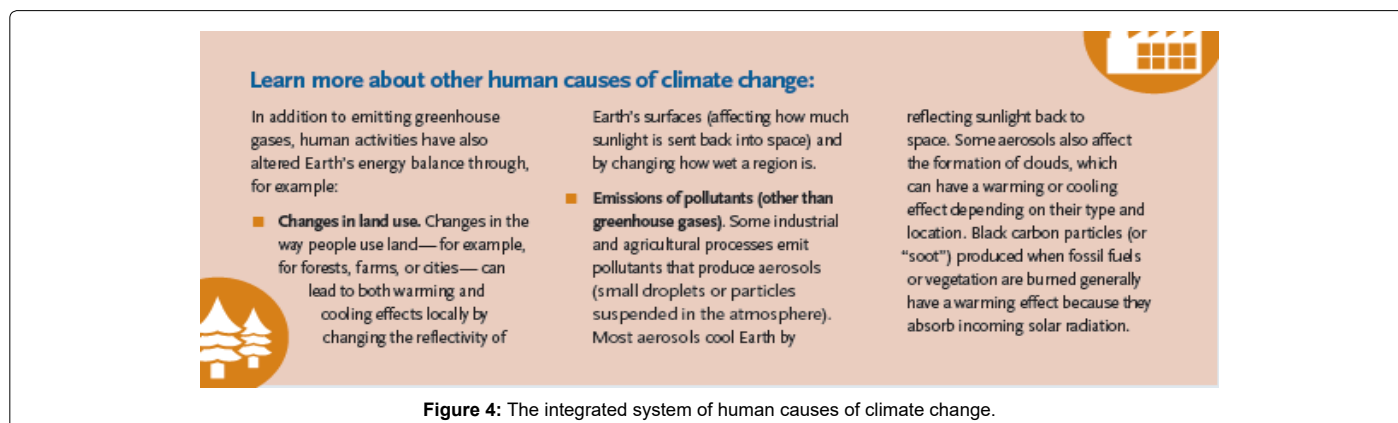


Figure 4: The integrated system of human causes of climate change.

No	Indicator	Trend	Frequency	% across sample
1	Temperature	Increase	177	92.7
2	Rainfall	Decrease	176	92.1
3	Rainfall pattern	Begin later than usual	149	78
		End up earlier	163	85.3

Table 1: Overall relative frequencies of trends in rainfall and temperature variabilities occurred in the study area.

No	Indicator	Trend	Frequency	% across sample
1	Drought situations	Increase	156	81.7
2	Flood situations	Increase	148	77.5
3	Crop yield and variety	Decrease	172	90.1
4	Livestock production	Decrease	168	88.0
5	Soil fertility	Decrease	191	100

Table 2: Overall relative frequencies of trends in the biophysical environmental factors No Indicator Trend Frequency % across sample.

No	Indicator	Trend	Frequency	% across sample
1	Vegetation cover	Decrease	71	37.2
		Diminished	120	62.8
2	Forest cover	Decrease	55	28.2
		Diminished	136	71.2
3	Wildlife	Decrease	66	34.6
		Diminished	125	35.4

Table 3: The relative frequencies of trends in the biophysical factors influence environmental condition.

land part sense more the increase in temperature. In the lowland part of the area, 98.5% of the respondents perceived that the temperature is increasing alarmingly (Table 4). Depending what is now happening and what was also before in the midland and highland, respondents in the midland and highland 90.9 percent and 88.2%, respectively, agreed that the current temperature in their local environment is completely different from the previous environmental condition, this is actually from their experience of knowing the area through comparing the past and the present.

Note: ** signifies level of significance at 5%. Further, drought problem in many parts of the African continent particularly in sub-Saharan African countries is common. For instance, Ethiopia is commonly affected by the problem of recurrent drought. Drought in the study area varies according to the agro ecology. Although the problem occurs in the area, the lowland part is strongly affected by the phenomena. Accordingly, 97.1 percent of the respondents in the lowland observed that drought has become a challenge for their livelihood (Table 5). Following the lowland, real problem of drought is also now affecting the midland and highland as such 80 and 67.6% respectively of the respondents observing the problem in their locality. In general, a higher proportion of respondents in the lowland area have perceived an increase in drought and flood occurrences whereas a substantial proportion of respondents in the highland areas reported no change for both.

*** Signifies 1% level of significance.

Forest and natural vegetation coverage of sude district: Forest availability is a problem in the world today. Respondents who are enough elderly were talk confidentially that the area lost its forest coverage completely (Table 5). The problem of agriculture intensification followed by the population increment is mentioned as a greatest challenge for the forest of the area. Majority were responding by diminished for the availability of forest cover in the area such as 63.2, 67.3 and 82.4% respondents in the highland, midland and lowland respectively which is just clear indicative of the change of environment in the area.

With respect to the wild animals in the area under study as the descriptive result from the formal survey revealed that majority of

the respondents in all the three agro ecological zones concluded as wild animals in the area are being diminished (Table 6). Availability of streams is also completely diminished in the lowland and 94.5% and 92.6% of the respondents in the midland and highland agreed that number of streams were being diminished (Table 6). Another way of describing the extent of climate change in Sude district was looking at the natural vegetation cover. According to the respondents' observation of the area, the natural vegetation's now are being converted in to crop land through deforestation because of population increase. Accordingly, 55.9% of the respondents agree that the natural vegetation cover in the highland has decreased while 44.1 % said it has totally diminished. The expression as we go from top to down is even worse. Concerning the midland agro-ecology, majority (69.1%) had observed that the natural cover has already diminished. The rest 30.9% also agree that it has decreased. The survey result showed that, the problem is manifested highly in the lowland, 76.5% of the respondents viewed that the vegetation's diminished and 23.5% said it has decreased compared to what it used to be in the past. Human activities create greater causes of climate change impacts in the eastern hararghe zone. Human activity is often directly related to the natural environmental, soil and climate plant atmosphere in the daily activities. Therefore to explain the link with climate change based on the study results in the area, for example, climate change might result in frequent crop failure and death of livestock so that people are forced to go to the forest to cope with the income crises, or, due to decrease in agricultural crop production, more and more people are getting a substantial part of the income from selling forest products which increase the pressure on the forest, or due to low productivity of agriculture local people need to cultivate larger farms to adequately supply their needs which increases the pressure on forestlands leading to higher rate of deforestation, or higher dependence on charcoal making increases the incident of forest fire in the area. More of the above explanations indicate the information from key informant in this regard which is in line with the survey result (Table 7).

Therefore, the most important human activities that are considered to be challenges to natural resources in Sude district were indicated in

Variable	Category	% within Agro climatic zone			Pearson X2_ value	P_ value
		highland	midland	lowland		
Rainfall	decrease	83.8	94.5	98.5	11.219	0.024**
	no change	10.3	3.6	0.0		
	unpredictable	5.9	1.8	1.5		
Temperature	Increase	88.2	90.9	98.5	6.908	0.41
	No change	7.4	3.6	0.0		
	Unpredictable	4.4	5.5	1.5		

Table 4: Agro ecological difference among sample households in perceiving climate change.

Variable	Category	% within Agro climatic zone			Pearson X2_ value	P_ value
		highland	midland	lowland		
Drought	Increase	67.6	80	97.1	19.901	0.001***
	No change	26.5	16.4	0.00		
	Unpredictable	5.9	3.6	2.9		
Flood	Increase	69.1	78.2	85.3	6.974	0.137
	No change	26.5	14.5	11.8		
	Unpredictable	4.4	7.3	2.9		

Table 5: Agro ecological difference in sample households in perceiving climate change.

Variable	Category	% within Agro climatic zone			Pearson X2_ value	P_ value
		highland	midland	lowland		
Forest cover	Decrease	8.8	5.5	1.5	3.712	0.156
	Diminished	91.2	94.5	98.5		
Vegetation cover	Decrease	70.5	67.3	22.1	46.919	0.000***
	No change	1.5	0.0	0.0		
	Diminished	23.5	32.7	77.9		

Table 6: Response of sample households regarding the vegetation and forest cover of the area.

(Table 8). However, the respondents in the mid land and high land practice production of timber, while the low landers do not produce timber production because some forest cover is found in the high land and mid land but not in the lowland known to do most charcoaling activities.

The local community responses and adaptation strategies to climate change and variability in the study area

The local communities have always adapted to climate variations by making preparations based on their resources and knowledge accumulated through experience of past weather pattern. Community based adaptation to climate change and variability emerged out of the growing recognition in the developing community that those most vulnerable to climate change are the poorest people in the world's poorest regions. Many are marginalized, and live in remote regions out of reach of government services. While the international community has increasingly emphasized the need for adaptation in recent years and more funding has been made available for adaptation, most efforts to help countries adapt have centered on top down approaches and policy solutions (Reid and Murray, 2010). However, given that climate change impacts, appropriate responses, and, to some extent, adaptive capacity, are location specific, adaptation at the community level is critical to the process of adaptation.

Shared resources and human activities responses to climate change and variability: According to the data obtained from HHs survey, majority of respondents replied water as their shared resource and it is followed by grazing land, is forest and the remaining is other shared resources. This implies in most parts of the Sude district there are various types of shared resources and water is the major one. As far as the adverse effects of human activities on climate change and

variability is concerned, almost all, (95%) of respondents agreed that climate change and variability has been impacting the shared resources, while only (3.1%) of the respondents did not agree. As it is indicated on the (figure 5) the negative effects of climate change and variability on major shared resources include; drying up of streams, decrease of grazing land, forest fire, and disintegration of infrastructure were 63.9%, 24.7%, 2.7%, 2.10% and 1.0% affected by adverse of climate change as the result of human activities.

The contribution focus group discussion on rainfall and climate related hazard in eastern hararghe: As presented in (Table 8) below, the focus groups have perceived that the rainfall over the past years was declined on the study area. Most of the time, climate related hazards were occurred during sowing and crop harvesting time in addition to changing agricultural and human activity. In response to climate related hazard, lack of climate information and use of improved variety were the constraints and measurement taken respectively in the past years (Table 9).

Conclusion and Recommendation

Conclusion

This study was reviewed at Eastern Hararghe Zone, Ethiopia, which has high potential for crop and livestock production among intensify by human activities. The study examined potential impacts and factors of human activities on the dissemination of climate change and variabilities over the study area with the objectives of the indicators of climate change noticed by local farmers in the study area, evaluating the local people's perceptions human activities on climate change and explore the existing responses and adaptation strategies being practiced to climate change or variability risks. Furthermore, in this paper review

Perceptible impact	% within Agro climatic zone						Pearson X2_ value Asym. Sig
	highland		midland		lowland		
Wild animals	Decrease	Diminished	Decrease	Diminished	Decrease	Diminished	0.272
	17.6	82.4	0.0	89.1	8.8	91.2	
Number of streams	7.4	92.6	5.5	94.5	0.0	100.0	0.087*

Table 7: Agro ecological difference in sample households in perceiving climate change impacts.

Anthropogenic impacts	% within Agro climatic zone		
	highland	midland	lowland
Deforestations	100.0	100.0	100.0
Agricultural expansions	100.0	100.0	98.5
Population increase	100.0	100.0	100.0
Fuel wood	100.0	100.0	100.0
Timber production	58.8	65.5	0.0
Charcoal production	22.1	36.4	98.5

Table 8: Anthropogenic climate change impact on vegetation, forest, wild animals and rangeland.

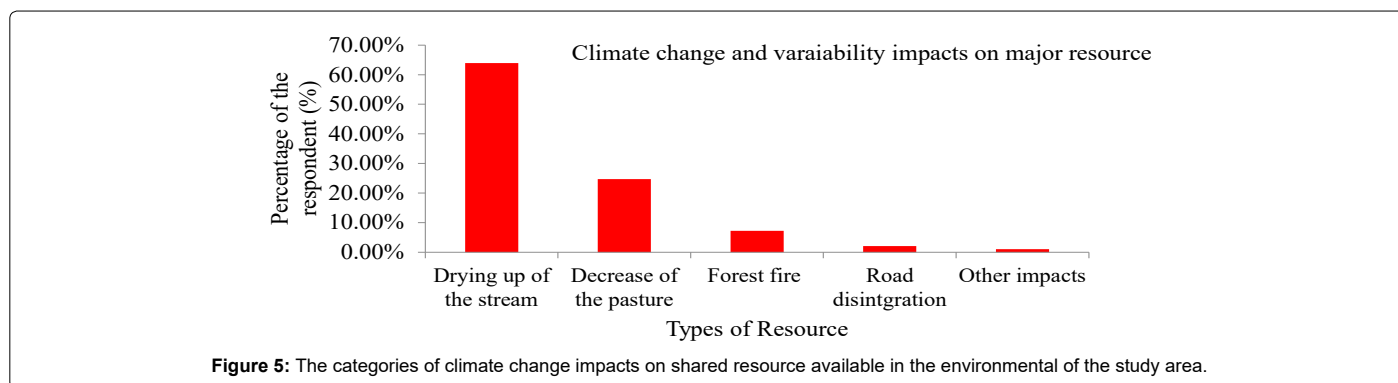


Figure 5: The categories of climate change impacts on shared resource available in the environmental of the study area.

Issues raised by respondents	Response given
➤ Direction of rainfall trend	➤ decreased
➤ Time of occurrence of climate related hazard	➤ At sowing and harvesting time
➤ Consequence of climate related hazard	➤ Agricultural activity were changed
➤ Time of climate information conveyed	➤ ahead of hazard occurred
➤ Constraints in response to climate related hazard and measurement taken	➤ Lack of climate information and use of different crop variety

Table 9: Perception gained from focus group discussion on issues of rainfall and climate related hazard.

was revealed that, the number of skill man power who attend the natural resource deliberately were small (6.45% and 1.61%) of degree and diploma hold respectively in the study area. Moreover, most of the respondents about (92.7%) perceived increasing temperature, as well as 96.3% perceived that rainfall is decreasing with a great deal of variability at the start and end of rain season, this implies that human activities influence climate condition of the area and decreasing crop production due to shortage of rainfall amount in the study area. As the survey result showed 78.3% of respondents witnessed the rain begin later than usual and also 85.3 % said rainfall end up earlier than usual. In the present study area with regard to crop production and livestock productivity, the descriptive result depicted that 90.1% and 88.0% respectively confirmed decreasing trend of the two agricultural practices in the area. The various climate related shocks again resulting in an alarming crop yield decline.

Similarly, due to the increment of human activities expand agricultural land in the study 62.8, 71.2 and 65.5% of the respondents were observed that vegetation's, forest and wildlife in the area were diminished and the rest of the respondents 37.2, 28.8 and 34.6% also convinced that vegetation's, forest and wildlife found in the area

were decreased. Depending on the agro-ecological basis 83.8% of respondents in the highland and 94.5% in the midland witnessed a decrease in rainfall in the area. However, severity of rainfall fluctuation and decrease highly manifested in the lowland which as 98.5% of the respondents. Therefore, following the lowland, real problem of drought is also now affecting the midland and highland as such 80 and 67.6% respectively of the respondents observing the problem in their locality of human factor contribution. Forest availability is a problem in the world today. Respondents who are enough elderly were talk confidentially that the area lost its forest coverage completely. With respect to the wild animals in the area under study as the descriptive result from the formal survey revealed that majority of the respondents in all the three agro ecological zones concluded as wild animals in the area are being diminished. Therefore, the most important human activities that are considered to be challenges to natural resources in Sude district were indicated. As far as the adverse effects of human activities on climate change and variability is concerned, almost all, (95%) of respondents agreed that climate change and variability has been impacting the shared resources which indicated that climate change is the major obstacle and core for locality.

Recommendation

Based on the findings and conclusions of the study, the following recommendation were forwarded to the concerning bodies of the impact and factors of human activities on the dissemination of climate change and variabilities. In Ethiopia, climate variability and change form a serious concern, because the country's economy is almost totally dependent on rain-fed agriculture which is the most vulnerable of agricultural sector. This study going to considered how human activities would affect and respond to rainfall and temperature characteristics with reliable information related to crop yield over the study area. Characterization of annual and seasonal rainfall and temperature information performance in upcoming season was well defined over the study area. Specifically, farmers encouraged to benefit from these services and apply such information for farm level decision. Climate related hazard like flooding, soil erosion, and soil acidity due to heavy rainfall were a major factor which frequently mentioned as the main cause for crop failure over the study area. Furthermore, human activities should implement properly use natural resource and replace when to use for decreasing exploitation of resource. Likewise, agricultural sectors of zone should take responsibility on the human activities versus agricultural crop production in the study area. Survey method is not enough for progressing climate change and variability for concern of anthropogenic activities through improving their life, therefore with the addition of climate modeling the future scenarios studied.

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