# Farmers' Perception and Attitude towards Changing Climate: A Case Study for Zoba Meakel, Eritrea

**Dr. SanoberNaheed**, Assistant Professor, Department of Geography, Adi-KeihCollege of Arts and Social Sciences, (Asmara University), Eritrea (North-East Africa). Email: snaheed21@rediffmail.com

## Abstract

*Eritrea is located in the semi-arid region of Sub-Saharan Horn of Africa. The harsh climatic conditions, human induced and natural calamities, the geographical location and low adaptive capacity render Eritrea vulnerable to the adverse effects of climate change. It is being frequently affected by drought and erratic pattern of rainfall. The climate is becoming more and more unpredictable and hence negatively affecting agricultural production. The central highland where the study area is located is reflected by the temporal and spatial variation of temperature and rainfall. The research was conducted by providing questionnaire to the farmers in three representative villages of AdiKontsi from sub zobaBerik, EmbaDerho from sub zobaSerejeka and Abaerdae from sub zoba Gala Nefhi to represent ZobaMaekel which is centrally located, and interestingly all are within ten kilometres from the capital city of Asmara. This paper therefore analyzes the farmer's perception of climate change, which has been classified according to their level of education. To satisfy the objective the statistical method of gamma test, a non-parametric test has been used through which it has been tried to assess if the perceptions of climate change according to educational attainment is associated significantly. The measure of association of the Gamma test indicates that the understanding and awareness of the farmers tend to increase as their level of education increases. Even though in some instances the experience of the farmers could be taken into account, but educated farmers seem more likely to understand climate change than those with informal education. There have been varied responses on the causes of climate change, and the decline in agricultural productivity.The farmershave shown readiness to change their cropping pattern and adapt to the current climatic situation, which indicates their awareness about climate change and readiness for adaptation strategies.*

**Keywords:** Eritrea, Climate-change, Gamma test, association, farmer, perception.

## Introduction:

Climate change and climate variability are already having serious impacts in Africa. Although Africa has not contributed in a significant way to the build of greenhouse gas emissions in the atmosphere, it is anticipated that a given change in climate will result in more adverse socio-economic impacts in Africa than in other parts of the world. Africa is particularly vulnerable to climate change because of it's over dependence on rain-fed agriculture, compounded by factors such as widespread poverty and weak capacity. The agricultural production of East Africa in general and Eritrea in particular has been greatly affected. This is because most of the developing countries like Eritrea depend heavily on rain-fed agriculture. Although Eritrea has a tropical climate, the eastern lowlands are extremely dry where as the western lowland is semiarid area which is being influenced by the expansion of the Sahara desert. The government's isolationist food strategy was adopted before the impact of climate change on Africa had reached its current high state of alert. Eritrea is potentially one of the most vulnerable countries in the continent, as is made clear in the National Adaptation Programme of Action (NAPA) published in 2007.

The prospect of increased variability in rainfall patterns, more frequent drought, and rising sea levels (Eritrea has many low-lying islands) acting on a primitive system of agriculture surely calls for more fundamental investment than the steps of basic good practice identified in the NAPA report.

Unusually, the science of climate modeling is unable to provide helpful projections for these changing weather patterns in Eritrea. Eritrean farmers use a variety of irrigation methods ranging from drip to pipe and sprinkler and religiously adhere to the agreed irrigation schedule in order to cope with this aridity. Even though the farmers of ZobaMaekel introduced different adaptation mechanisms they still face a food security problem. Climate change has diversified impact, however, its destructive impact is on agriculture in which farmers are targeted first. This research paper intends to discuss the attitude and awareness of farmers to climate change, and its effect on agricultural production. It also examines the policy measures and adaptation mechanism taken to cope with climate change.In spite of their low level of education most of the Eritrean farmers felt and noticed the existence of the climate change without knowing the factors that causes it. Even though farmers suffer from climatic change, they do not have ample knowledge in adapting to this problem. It is agreed that farmers' comprehensive understanding of the ongoing climatic change is crucial in tackling the problem through different mechanisms.

**Study Area and Method:**

The diversified natural features of the country have resulted in the growth of various kinds of cropping patterns pertaining to the prevailing climatic conditions. Zoba Maekel is one of the six zobas of Eritrea which is centrally located where the capital of the country is and it is bordered with Anseba, Semenawi Keihbahri, Gash-Barka and Debub zones. It has a total area of 107,907.8 hectare of which 54,448 hectare is total potential area for agriculture, from this 33,000 hectare is cultivated through rain fed cropping,3000 hectare is cultivated using irrigation system and the rest is for grazing, forest plantation etc.

Its altitude ranges from 1600 meter above sea level, which is Dirfo up to 2,610m above sea level that is Zagger. The rainy season is from June to August, but also little rain showers during spring season. Moreover frost occurs between October and February. Mean annual rain fall is 415.4 mm; maximum rain fall is 715 mm recorded in 1994 and the minimum annual rainfall is 194mm recorded in 1996. The mean annual temperature of this zone is 15ºC, with 25.5°C maximum annual temperature and 4.3 ° C minimum annual temperatures. ZobaMaekel has 89 villages administered by 59 administrative units, with 114,627 number of house hold with a total population of 518,412 of whom 27% are engaged in agriculture, 23% in trade and services 18% in manufacturing and handicraft, 7.5% in civil service and24%as casual labor. So it has its own importance in relation to trade and commerce, on the central highlands. The farmers here practice mixed farming in which growing of crops and herding of animals is the major occupation. The crops grown are cereals which go into sustaining the farmers' family and its proximity to the urban center have promoted both vegetable and dairy farming.

Eritrea like other parts of the world is under the grip of climate change. Successive drought and unreliable rainfall is prevailing in the country. This has led to decreasing agricultural production in different parts of the country as evidenced by chronic food shortage. The rainy season in Eritrea in general and in the highlands in particular is shrinking and farmers are continuously losing their long-term crops, which take a maturity period of around six months. The paper tries to deal with the aforementioned problems by making special emphasis to ZobaMaekel. The paper depends on relevant information collected from both primary and secondary sources. The primary sources encompass practical observation of the field and responses based on questionnaires. A strucured questionaire with open and closed questions was forwarded to the farmers. The questionnaire was forwarded to 55 farmers having different levels of education. This was conducted in three representative villages of ZobaMaekel. AdiKontsi from sub ZobaBerik, EmbaDerho from sub ZobaSerejeka, and Abaerdae from sub Zoba Gala Nefhi was chosen to represent the Zoba.

There were some *limitations* which hindered the successful completion of the study: *First*, there are no meteorological stations in ZobaMaekel except the one at Asmara in collecting the temperature and rainfall data record. *Second,* the data which was provided by some officials were not satisfactory, but we have analyzed it according to the existing data. Related to this some officials were not ready to give some essential data. Example could be cited the department of Limaat in the introduction of new seeds. *Third,* the sample size that has been taken from the three villages of ZobaMaekel was small, so it could not be used as a representative of the whole population. But yet it could give ample picture of this Zoba. As a pioneering work lack of literature on the topic plays its own role in limiting the study.

Eritrea being in the Sahelian region of Africa, it is frequently affected by drought and erratic pattern of rainfall. The climate is becoming more and more unpredictable and hence negatively affecting agricultural production And Zoba-Maekel is not free from such effect. The central highlands of Eritrea in which ZobaMaekel is located has an altitude of over 1500 m, receiving an average annual rainfall of 500 mm to750 mm and a growing period of crops ranging from 90 to130 days. The effect of climate change in ZobaMaekel is reflected by the temporal and spatial variation of temperature and rainfall. These climatic variations have a significant influence on the people's activities including livestock raising, crop production, forestry, horticulture etc.

It is generally accepted that the element of climate are the most important variables which play a vital role in agricultural production, even though technological advances and improvements in forecasting have made some possible adjustments in planting and harvesting schedule. The two most influential elements of climate on agriculture are rainfall and temperature.

**Rainfall:**

In general speaking rainfall is one of the major determining factors for the success or failure of agriculture. Especially this is evident in countries like Eritrea, where agriculture is mostly dependent on rainfall. Although the total amount of rainfall received each year seem to be sufficient for crop production (400 to 6000mm), most parts of Eritrea indeed suffer from chronic droughts over the years. The problem being that the rains are erratic and unpredictable. More over there are also moments when the rain fails to come in time and sometimes are late resulting in the destruction of mature crops. This was witnessed in 1997 which was the El Nino year and the rains failed to occur in time, which in turn caused a lot of destruction. Historic meteorological records reveal that the frequency of droughts has increased during the past forty years. Eritrea has faced serious recurrent droughts from1905-1915; from1939-1945; from1965-1978 and 1984&1985, 1989&1991and 2002, 2008 & 2009.Thus the availability of optimum rainfall is a necessary condition for the success of agricultural productivity. But, excess moisture in the soil can have an adverse effect on agriculture as free movement of oxygen is blocked and compounds which are toxic to the plant roots can be formed. The scarcity of moisture can also lead to plant wilting and dying.

**Table I:The Seasonal Rainfall of Asmara for Spring and Summer verses Crop Production**

| Year | Spring rainfall (mm) | Summer rainfall (mm) | Production in ton |
|---|---|---|---|
| 1992 | 10.6 | 286.5 | 21,000 |
| 1994 | 20 | 239 | 24,429 |
| 1996 | 42 | 147 | 9,559 |
| 1998 | 109.3 | 396.9 | 39,244 |
| 2000 | 100.9 | 366 | 23,090 |
| 2002 | 11.8 | 267.6 | 2,817 |
| 2004 | 61.4 | 184.2 | 6,089 |
| 2006 | 110 | 366.4 | 35,544 |
| 2008 | 86.4 | 154.7 | 3,170 |

*Source: Department of Meteorology and Ministry of Agriculture*

From (table I)a strong positive correlation can be seen between the amount of spring and summer rainfall as well as crop production. For instance the years 1998 and 2006 shows high crop production where there is high spring and summer rain fall. Whereas the years 2002 and 2008 recorded the lowest as both the spring and summer rainfall was not sufficient to support proper crop production.

Furthermore; the table shows that the occurrences of spring without summer rainfall and vice versa have negative influence on the productivity of crops. For example in the year 2008 there was abundant spring rainfall but failure of summer rainfall resulted in the decline of crop productivity. Inaddition, the distribution of rainy days and area coverage in the region has its own effect on crop production.

**Temperature:**

Temperature too plays a significant role in the productivity of agriculture. All crops have minimal, optimum and maximum temperature limitation for each of their stage of growth. Generally speaking, a high temperature is not as destructive as a low temperature, if moisture supply is sufficient to prevent wilting.

High temperature can cause *sun scaled*, an injury caused by high radiation which leads to high evapotranspiration that can lead to plant drought. The mean minimum and mean maximum temperature of Asmara has been analyzed because most of the areas in ZobaMaekel have similar altitude. The month of January and July have been used to analyze the temperature trend between 1992 and 2009. These months are selected because they show extreme temperature conditions of the year.

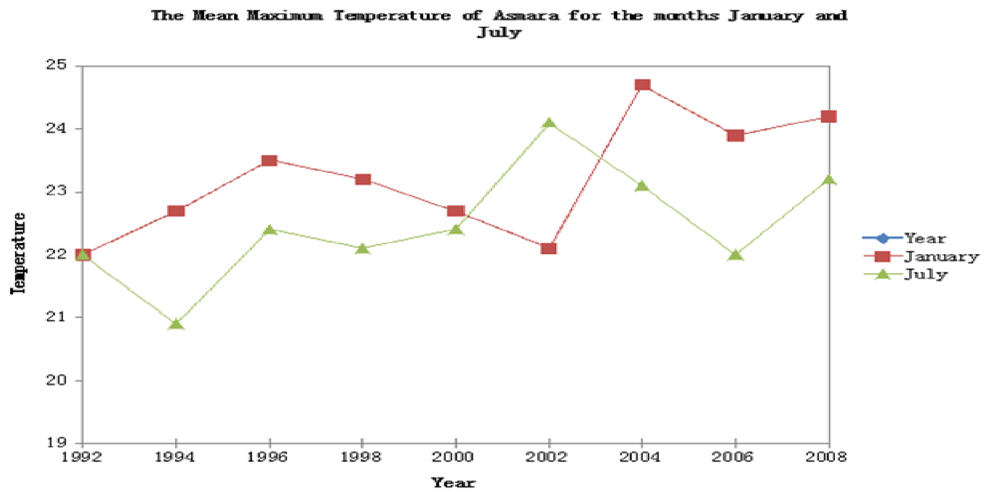


Fig:1

From the (fig:1) the month of January a general increase of temperature from 22ºC from 1992 to 24.3ºC in 2008 could be observed. Similarly, the mean maximum temperature in July escalates from 22ºC in 1992 to 23.3ºC in 2008. The mean maximum temperature of January and July show similar trend because the constant cloud cover of July reduce its maximum temperature by reflecting back most of the incoming radiation. Thus from the above graph a general increase of temperature has been observed.

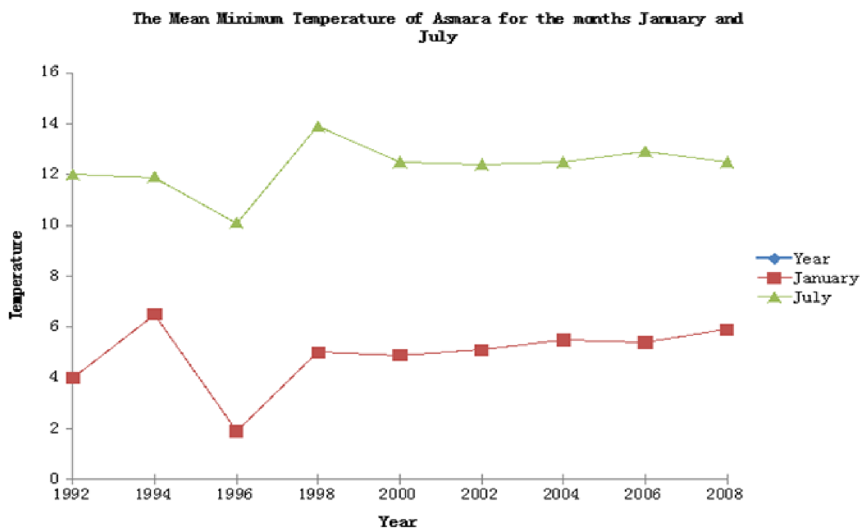


Fig:2

The occurrence of low temperature has also far reaching impact on plant growth because plant growth stops when temperature falls below 6ºC. The mean minimum temperature of

Asmara in January has risen from 4.2ºC in 1992 to 5.6ºC in 2008.Similarly, the mean minimum temperature of July shows an increase from 12.1ºC in1992 to 12.7ºC in 2008. From the (fig:2) it is evident that,the mean minimum temperature of July and January show great variation because the cloud cover in the month of July prevent heat loss through re-radiation.Thus a change in either rainfall or temperature can adversely affect the agricultural production.

**The Impact of Climate Change:**

Although global climate change is one of the most debatable issues today, the understanding people have about it varies. For some people it may mean more rains, floods and disasters. For people living in Eritrea, climate change is related to shortage of rainfall, extended rainy seasons, or late rains those results in decreased biomass production, yield loss, livestock death and therefore famine. In ZobaMaekel, as farmers' heavily depend on rain fed agriculture; they are adversely affected by climate change. Over 27 % of the total population in ZobaMaekel make their livelihood from mixed farming. These economic activities have been influenced by variation in elements of climate especially temperature and rainfall. So their changing impact on crop production is illustrated as follows.

**Crop Production:**

Climatic variations have both direct and indirect effect on both rain-fed and irrigated crops.

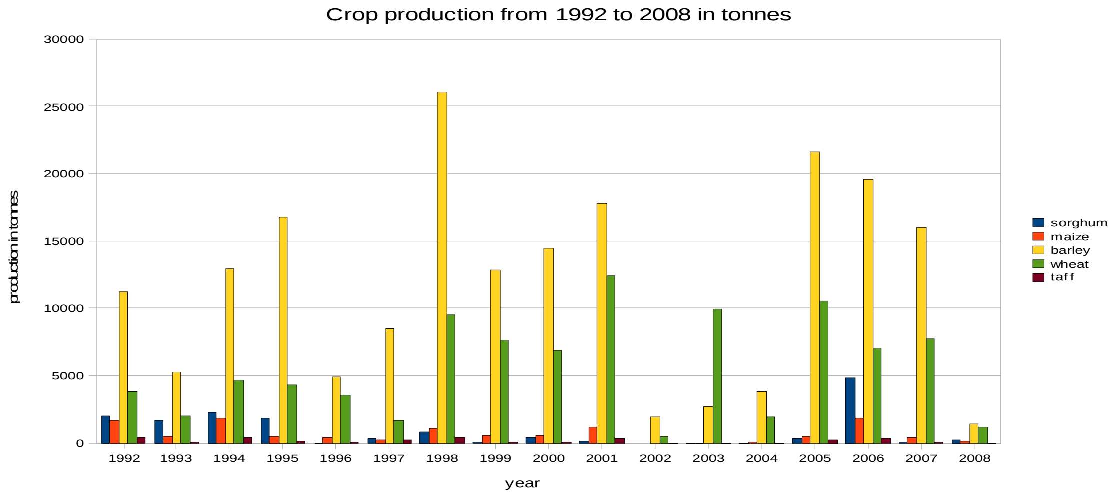


Fig:3

The common crops grown in ZobaMaekel in order of their proportion are barley, wheat, maize, sorghum, millet, taff, pea, and lentils. Most of these crops depend on rainfall since the climate change cause decline of rainfall from year to year, the production of crops also decreased (fig:3). Production of sorghum shows a decline from 2000 tonnes in 1992 to 235 tonnes in 2008. Likewise, maize production decreased from 1700 tonnes in 1992 to 120 tonnes in 2008.On the other hand, the production of barley and wheat shows a slight increase because the land which was previously used to cultivate sorghum and maize were shifted to produce barley and wheat. This shift in land cover has taken place due to the unreliability of spring rainfall, which has become very scarce in some years (tableI), and is not enough to support either sorghum or maize in the dry periods. The other years show alternative rise and fall of crop production. This means there are alternative 2 to 3 successive rise of production and 2 to 3 successive fall of production. This is because Eritrea is located in the region where drought occurs every 2 to 4 years.

Farmers' Perception to Patterns of Climate change

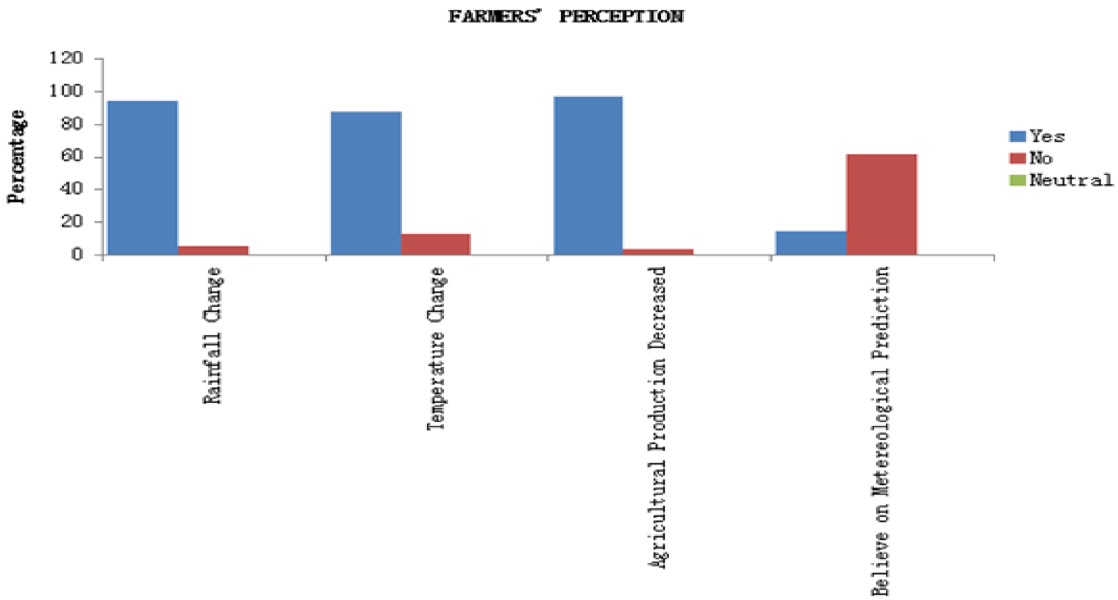


Fig:5

As the bar graph shows, overwhelmingly 94.5 % of the farmers admitted change in temperature. Similarly, 87.2 % of the respondents noticed abrupt change in rainfall over the years. Over 94 % of the respondents replied that their agricultural production showed substantial reduction. Therefore, the decreased agricultural production is directly related to the change in rainfall and temperature which are the main indicators of climate change. Thus the bar graph illustrates that the farmers have clear understanding of climate change. Even though there is controversy on the causes. That is why a small percentage (14.5 %) of the respondents believes in meteorological prediction.

**What Type of Farmers Perceive Climate Change?**

To answer the questions regarding which types of farmers perceive climate change, farmers' perceptions of climate change have been classified according to their level of education. For this level of education we distinguish four classes.

1. No formal education

2. 1-5th grade education
3. 6th -9th grade education and
4. 10th -12th grade education

Using the Gamma Test, a non parametric test, we assess if the perceptions of climate change according to educational attainment is associated significantly.

Measuring of association is a statistics that show the direction and/or magnitude of relationship between pairs of discrete variables. Gamma is a symmetric PRE (Proportionate Reduction Error) measure of association; that is, the same Gamma value is obtained whether the first variable predicts the second variable or vice versa.

Gamma measures strength of association between pairs of ordered variables such as those displayed in the following tables. Its calculation requires systematically evaluating all pairs of observation in a cross tabulation, counting the total number that are untied concordant pairs and the total number that are untied discordant pairs. A pair of observation is concordant if the subject which is higher on one variable is also higher on the other variable. A pair of observations is discordant if the subject which is higher on one variable is lower on the other. Most ordinal measures of association refer in some way to Nc-Nd. A positive difference for Nc-Nd occurs when Nc>Nd and indicates a positive association, since concordant pair are more common than the discordant pairs. A negative difference reflects a negative association. In order to avoid the influence of large sample size we calculate gamma as follows;

G = (1)

Where, G- Gamma

Nc-number of concordant pairs

Nd-number of discordant pairs

**The formula clearly shows** gamma's PRE character. When Nc=Nd, prediction is no better than chance and gamma equals zero (there is no association).

Properties of gamma;

- The value of gamma falls between -1 and +1.
- The sign ($\pm$) of gamma indicates whether the association is positive or negative.
- The magnitude of gamma indicates the strength of association.

The population parameter that gamma estimates is labeled '**γ**'. If we have a simple random sample of cases, the sampling distribution of gamma approaches normality as number of samples became large (50 or more). The test statistics is approximated by

**Z= (G-γ)**

(2) Where Z-is population estimates

γ-the population value of gamma under null hypothesis.

N-number of samples

We illustrate this with the table below. ("no" is the low end and "yes" is the high end of the scale on "y=level of understanding (perception to climate change)", and "no formal education" is the low end and "9-12th" is the high end of the scale on "x=level of education". By convention, we construct contingency tables for ordinal variables so that the low end of the row is the first row and the low end of the column variable is the first column. (There is no standard, however, and other books or software may use different convention).

**TableII:Perception to Changes in Climate by Farmers' Level of Education**

| Level of education | Response of farmers to climate change | | |
|---|---|---|---|
| | No | Yes | Total |
| No formal education | 10(29.4%) | 24(70.5%) | 34(100%) |
| 1- 5th | 1(14.2%) | 6(85.7%) | 7(100%) |
| 6- 9th | 0 | 5(100%) | 5(100%) |
| 10 -12th | 0 | 9(100%) | 9(100%) |
| Total | 11 | 44 | 55 |

The crosstab in the above table shows a 4 by 3 joint frequency distribution of two ordered variables. The sample respondent farmers from three villages of ZobaMaekel (AdiKontsi, Abardae, and EmbaDerho) were asked "whether they observed any climate change?" The given choices were "yes" and "no". The farmers where categorized by their level of education ("no formal education", "1-5th", "6-9th", "10-12th").Consider pair of subjects, one of which is classified (no formal education, no understanding to climate change) on the two variables, and the other of which is classified (1-5th level of education, yes). The first subject is one of the 10 classified in the upper left hand corner of the table, and the second subject is one of the 6 classified in the middle cell of the table. This pair of subject is concordant, since the second subject is higher than the first subject both in level of understanding (yes versus no) and in level of education (1-5th versus to no formal education); that is the subject who is higher on one variable is also higher on the other. Now, one can pair each of the 10 subjects classified (no formal education, no) with each of the 6 subjects classified (1-5th, yes). So there is 10*6=60 concordant pair of subjects from these two cells. By contrast, each of 24 subjects in the cell (no formal education, yes) forms a discordant pair when matched with each of the 1 subject in the cell (1-5th, no). The 24 subject have lower scale of education than the 1 subject, yet they have higher level of understanding to climate change. So, there is 24*1=24 discordant pair of subjects from these two cells.

**Number of concordant =Nc**

| Level of Education | Response of farmers to climate change | |
|---|---|---|
| | No | Yes |
| No formal Education | 10 | |
| 1- 5th | | 6 |
| 6- 9th | | 5 |
| 10- 12th | | 9 |

| Level of Education | Response of farmers to climate change | |
|---|---|---|
| | No | Yes |
| No formal education | | |
| 1- 5th | 1 | |
| 6- 9th | | 5 |
| 10 -12th | | 9 |

| Level of Education | Response of farmers to climate change | |
|---|---|---|
| | No | Yes |
| No formal education | | |
| 1- 5th | | |
| 6- 9th | 0 | |
| 10 -12th | | 9 |

Nc=10(6+5+9)+1(5+9)+0(9) =214

**Number of discordant= Nd**

| Level of Education | Response of farmers to climate change | |
|---|---|---|
| | No | Yes |
| No formal education | | 24 |
| 1- 5$^{th}$ | 1 | |
| 6- 9$^{th}$ | 0 | |
| 10 -12$^{th}$ | 0 | |

| Level of Education | Response of farmers to climate change | |
|---|---|---|
| | No | Yes |
| No formal education | | |
| 1- 5$^{th}$ | | 6 |
| 6- 9$^{th}$ | 0 | |
| 10 -12$^{th}$ | 0 | |

| Level of Education | Response of farmers to climate change | |
|---|---|---|
| | No | Yes |
| No formal education | | |
| 1- 5$^{th}$ | | |
| 6- 9$^{th}$ | | 5 |
| 10 -12$^{th}$ | 0 | |

Nd =24(1+0+0)+6(0+0)+5(0) =24

$$G = \frac{Nc-Nd}{Nc+Nd} = \frac{214-24}{214+24} = \frac{190}{238} = 0.79$$

In this association the null and alternative hypotheses are:

Ho: $\gamma=0$

H1: $\gamma>$ or $<0$.

To test the null hypotheses we choose $\alpha=0.05$ as a significance level. From an appendix of the z-score shows that the critical value is z = + 1.64. Now, using the sample value of G calculated above, the standard z-score (that is the test statistic) is

Z= **(G-γ)** = (0.79-0) = 0.79=2.68

Since 2.68 exceed +1.64 we reject the null hypotheses and thus the association is significant.

In a similar way the following Gamma statistics test are calculated:

**TableIII: Perceptions to Causes of Climate Change**

| Level of education | Response of farmers to causes of climate change | | | |
|---|---|---|---|---|
| | It is punishment of God | It is occurring naturally | It is man made | Total |
| No formal education | 12(52.1%) | 6(26%) | 5(21.7%) | 23(100%) |
| 1- 5$^{th}$ | 4(57.1%) | 3(42.8%) | 0 | 7(100%) |
| 6- 9$^{th}$ | 0 | 1(25%) | 3(75%) | 4(100%) |
| 10 -12$^{th}$ | 0 | 2(22%) | 7(77.7%) | 9(100%) |
| Total | 16 | 12 | 15 | 43 |

Notes: Gamma-T test Nc=341 Nd= 80 G= 0.61 Z- critical=+1.64 Z-calculated=2.40 α=0.05 Ho= rejected

**TableIV: Perceptions toChanges in Rainfall**

| Level of education | Response of farmers to change of rainfall | | |
|---|---|---|---|
| | No | Yes | Total |
| No formal education | 0 | 34(100%) | 34(100%) |
| 1 -5th | 1(14.2%) | 6(85.7%) | 7(100%) |
| 6 -9th | 1(20%) | 4(80%) | 5(100%) |
| 10- 12th | 1(11.1%) | 8(88.9%) | 9(100%) |
| Total | 3 | 52 | 55 |

Notes: Gamma-T test NC=20 Nd= 118 G= 0.71 Z- critical=-1.64 Z-calculated=-1.5 α=0.05 Ho= rejected

**Table V: Perceptions to Changes in Temperature**

| Level of education | Response of farmers to change of temperature | | |
|---|---|---|---|
| | No | Yes | Total |
| No formal education | 7(21.8%) | 25(78.2%) | 32(100%) |
| 1 -5th | 1(11.1%) | 8(88.9%) | 9(100%) |
| 6 -9th | 0 | 5(100%) | 5(100%) |
| 10- 12th | 1(11.1%) | 8(88.9%) | 9(100%) |
| Total | 9 | 46 | 55 |

Notes: Gamma-T test NC=160 Nd= 63 G= 0.43 Z- critical=+1.64 Z-calculated=0.95 α=0.05 Ho= accepted.

**Table VI: Opinions on the Prediction given by the Department of Meteorology**

| Level of education | Farmers opinion to the prediction given by the department of meteorology | | | |
|---|---|---|---|---|
| | I do not believe the Prediction | Neutral | I believe the Prediction | Total |
| No formal education | 24(70.5%) | 8(23.5%) | 2(5.8%) | 34(100%) |
| 1- 5th | 5(71.4%) | 1(14.2%) | 1(14.2%) | 7(100%) |
| 6- 9th | 1(20%) | 4(80%) | 0 | 5(100%) |
| 10 -12th | 2(22.2%) | 5(55.5%) | 2(22.2%) | 9(100%) |
| Total | 32 | 18 | 5 | 55 |

Notes: Gamma-T test Nc=408 Nd= 123 G= 0.53 Z- critical=+1.64 Z-calculated=1.96 α=0.05 Ho= rejected

The findings could be argued as:

1. Education seems to increase the probability that the farmers will perceive long term climate change. Thus non educated farmers are more likely to see that climate change does not have significant trend over the long run.
2. The educated farmers tend to associate the causes of climate change to anthropogenic and natural factors. Whereas, the non educated farmers perceive that the main cause of climate change is God's punishment.
3. With experience non educated farmers are more likely to perceive change in rainfall. Thus a strong negative association is observed between level of education and farmers' perception to pattern of rainfall change. And this association is significant.
4. Concerning the temperature change educated farmers are more likely to feel than those having no education. But, this association is weak and as a result it is not significant.
5. There is a weak positive association between level of education of farmers and their opinion on the weather forecasts given by the national meteorological department. Most of the farmers with high level of education neither completely deny the forecast nor they completely accept. This is because of the fact that the weather office is totally dependent on foreign vendors to provide them the information in the Horn, this information may be delayed which can lead to inaccurate forecasts.

**Adaptation strategies and constraints:**

Crop management strategies (change in sowing date and crop cultivar) were more adopted than soil fertility and soil water managements due to constraints attached to the latter ones. Soil fertility is restricted by fertilizer availability and cost; and soil water managements by irrigation equipment, labour or water availability.

**Conclusion:**

The increasing intensity of global warming and the erratic nature of climate change followed by land degradation have adversely affected the economies of many Sahelian countries including Eritrea. Rainfall and temperature are the most important determinant parameters of climate change. Rainfall plays a vital role in influencing the rain fed agricultural sector as in Eritrea. Therefore, there is a positive correlation between amount of rainfall and crop production. In ZobaMaekel this has been evidenced by decrease of rainfall in the past few years that has resulted in declining agricultural production.

A general increase of mean minimum and mean maximum temperature of ZobaMaekel has been observed. The measure of association of the Gamma Test indicates that the understanding and awareness of the farmers tend to increase as their level of education increases. Even though in some instances the experience of farmers could be taken into account, but educated farmers seem more likely to understand climate change. Although the rural communities have been adapting different coping strategies to the prevailing climate change induced impacts, food security and poverty alleviation were given a priority by the government of the State of Eritrea. The government has laid and implemented a number of policy measures and adaptation mechanisms to improve crop productivity and increase livestock population. In addition to this sectoral and national policies and regulating mechanisms were formulated to complement these developmental programs.

***References:***

1. ***Akponikpe I B P*** *et al 2010 Farmers' Perception of Climate Change and Adaptation strategies in Sub-Saharan West Africa presented in the 2nd International Conference: Climate,Sustainability and Development in Semi-arid Regions (www.icid18.org/files/articles/128/Peter_JOHNSTON.pdf) Accessed 2December 2012*
2. ***Apata T G 2012*** *Effects of Global Climate Change on Nigerian Agriculture: An Empirical Analysis, CBN, Journal of Applied Statistics 2(1) 31-50 (www.cenbank.org.out.2012/PUBLICATIONS/REPORTS/STD/EFFECTS%20 OF %20 GLOBAL%20CLIMATE%20CHANGE%20ON%20NIGERIAN%20AGRICULTURE.PDF) Accessed 18 February 2013*
3. ***Apata T G; Samuel D K and Adeola O A*** *2009 Analysis of Climate Change Perception and Adaptation among Arable Food Crop Farmers in South Western Nigeria presented at the International Association of Agricultural Economists' 2009 Conference, Beijing (ageconsearch.umn.edu?bitstream/51365/2/final%201AAE%20doc.pdf) Accessed 3 December 2012*
4. ***Asayehegn K*** *2012 Farmers' Perception on Climate Change Adaptation Strategies: A case study from the irrigation schemes of Central Tigray Regional State, Ethiopia Journal of Agricultural economics and Development vol:1(5) 99-105, (www.academeresearchjournals.org/download.php?id=587080934414924055.pdf&type=application/pdf&op=1=) Accessed 20 November 2012*
5. ***Ghebru B*** *et al 2012 East African Agriculture and Climate Change: A Comprehensive Analysis - Eritrea International Food Policy Research Institute (reliefweb.int/sites/reliefweb.int/file/resources/aacccs-eritrea_note.pdf) Accessed 25 December 2012*
6. ***Hartter J*** *et al 2012 Patterns and Perceptions of Climate Change in a Biodiversity Conservation Hotspot PLOS ONE 7(2):e32408 (www.plosone.org/article/info%2F10.137%2Fjournal.pone.0032408) Accessed 2 November 2012*
7. ***ICRISAT*** *2008 Climate Change in the Semi-Arid Tropics (test1.icrisat.org/gt-aes/Climate_Change_SAT Flyer.pdf), Accessed 13 December 2012*
8. ***IFAD*** *2011 Adressing Climate Change in East and Southern Africa (www.ifad.org/operations/projects.regions.pf/pub/climate.pdf), Accessed 27 September 2012*
9. ***Lehman B*** *et al 2008 Farmers perceptions and Responses to Climate Change (www.cces.ethz.ch/projects/clench/CLIMPOL/Clusters/C/C1/climpol_C1Farmers.pdf), Accessed 12 December 2012*
10. ***Mertz O*** *et al 2009 Farmers'Perceptions of Climate Change and Agricultural Adaptation Strategies in Rural Sahel Environmental Management 43 804-81 (Link.Springer.com/staticcontent/0.6134/lookinside/335/ast%253A10.1007%252Fs00267-008-9197-0/000.png), Accessed 2December 2012*
11. ***Ngigi N S*** *2009 Climate Change and Adaptation Strategies: Water Resources Management Options for Smallholder Farming Systems in Sub-Saharan Africa, A Study Supported by the Rockfeller Foundation (www. Rockfeller foundation.org/uploads/files/9eacd477-e2ef-4b72-9207-5a18135dceb3.pdf) Accessed 6 November 2012*