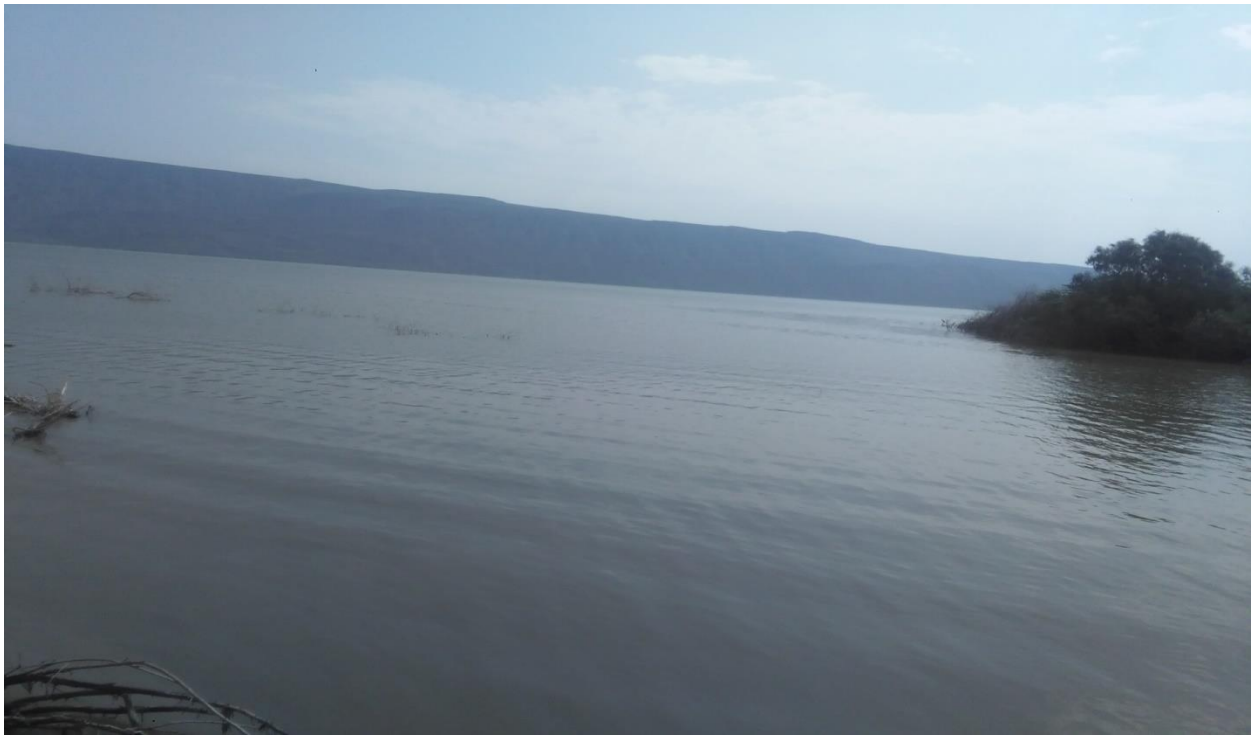
THE FEDERAL DEMOCRATIC REPUBLIC of ETHIOPIA ENVIRONMENT, FOREST and CLIMATE CHANGE COMMISSION



FACT-SHEET OF GUMMARE LAKE ECOSYSTEM

ADDIS ABABA,

2020

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Acronyms and Abbreviations

AFW: Artuma Furci Woreda

CRGE: Climate Resilient Green Economy

CSA: Central Statistical Agency

DCW: Dawa chefa Woreda

DEM: Digital Elevation Model

EDRI: Ethiopian development research institute

ENRCBD; Ethiopia's Fifth National Report to the Convention on Biological Diversity

FGD: Focus Group Discussion

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IPCC: Intergovernmental Panel on Climate Change

IUCN: International Union for Conservation Nature

KI: key informants

LULC: Land Use Land Cover Change

Max.Temp: Maximum Temperature

MinTemp: Minimum Temperature

NBSAP: National Biodiversity Strategy and Action Plan

UNFCCC: United Nations Framework Convention on Climate Change

WMO: World Meteorological Organization.

1. General Back ground

1.1. Environment for Green Economy Development

Human being highly interacting with the environment so, they full their basic need from the environment like food, shelter, fuel energy, clean air , water etc… generally natural resource. Human being disrupt their interaction with the environment through over exploitation of natural resource and produce un wanted waste substance to the environment so, this condition alter the environment on the contrary environment also affect human lives. Human impact on the environment increased through expansion of industrialization (http://www.open.edu/).

According to, Human Development Report 2016 Progress in human development has been impressive over the past 25 years. The Millennium Declaration and the Millennium Development Goals Global commitments at the turn of the century to end basic human deprivations within 15 years added to the momentum. Yet human development has been uneven, and human deprivations persist. Some groups, communities, societies and people have achieved only the basics of human development, and some not even that. And new development challenges have emerged, ranging from inequalities to climate change, from epidemics to desperate migration, from conflicts to violent extremism. To solve the challenges of development needs use environmental friendly means improve sustainable use of environment resource especially development of green economy is very necessary to improving human wellbeing and social equity by reducing environmental risks and ecological scarcities.

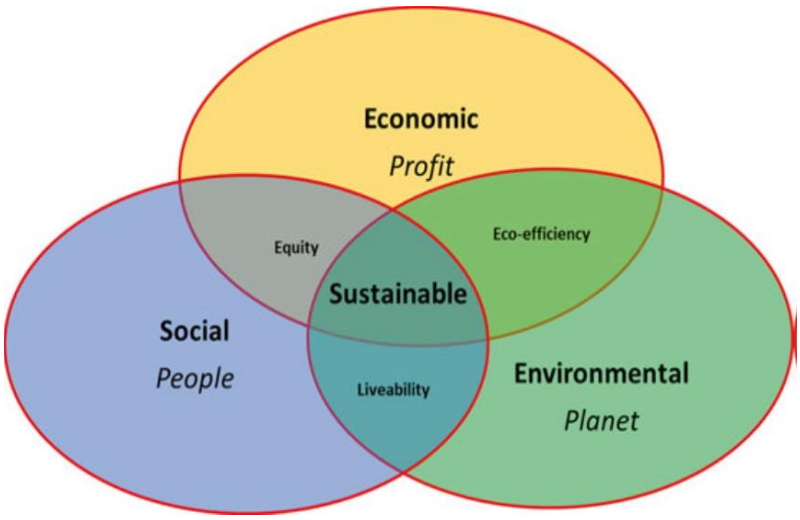


Figure 1: The Three Dimensions of Sustainability

Source: (G.Sonnemann 2015)

Nevertheless, the record of development at the global level is found to be unsatisfactory and criticized for two reasons. First, the benefits of development have been distributed unevenly, i.e. income inequalities remain persistent and sometimes increasing over time; and the global numbers of extremely poor and malnourished people have either remained high or in some areas have increased. Secondly, development-related endeavors have resulted in major negative impacts on the environment (such as depletion of biological resources and pollution) and on the existing social structures. Growing awareness on the failure of the traditional development thinking to satisfy the needs of the expanding global population, in turn, led to emergence of the idea of sustainable development.

Sustainable development is development which meets the needs of the present generation without compromising the ability of future generations to meet their own needs. The concept of sustainable development takes into account the interlinking of the environment, economic and social issues.

The idea of development, in this sense, is not based on a straight-line progression from traditional to modern mass-consumption society which results in social inequalities and negative environmental impacts. Instead, the kind of development aspired here is that remedies social inequities and environmental damage while maintaining a sound economic base. The kind of economy developed in this case is green economy that results in improved human-wellbeing and social equity wile significantly reducing environmental risks and ecological scarcities.

According to Clouth (2012) categorized key words definitions according to the three dimensions of sustainable development as follow.

Social green economy Human well-being; social equity; socially inclusive; reduced inequalities; better quality of life; social development; equitable access; addressing needs of women and youth.

Social green growth Well-being, socially inclusive, access to basic commodities for the impoverished; meeting demands for food production, transport, construction, housing and energy, Economic green economy Growth in income and employment; public and private investments; resilient economy; economic growth; new economic activity.

Economic green growth Economic growth and development; technology and innovation; environmentally sustainable economic progress; more resilient; sustained economic growth; driver for economic growth; new growth engines; green technology; new job opportunities; qualitative growth rather than simply increasing GDP; job creation or GDP growth

Environmental green economy Reducing environmental risks and ecological scarcities; low carbon; resource efficient; reduce carbon emissions and pollution; enhance energy and resource efficiency; prevent loss of biodiversity and ecosystem services; within ecological limits of the planet; environmental responsibility; finite carrying capacity.

Environmental green growth Protection and maintenance of natural assets and environmental services; provision of resources and services; low carbon; using fewer resources and generating fewer emissions; resource efficient; cleaner; climatic and environmental sustainability; energy and resource efficient; minimizes pollution and environmental impacts; resilient to hazards; harmony between the economy and the environment; environmental protection; reduce GHG.

Most of Africa countries their economy activity and their livelihood based on natural capital assets in order to raised their economy growth rates they over exploits the natural resource and degraded the environment, change the climate, increases desertification, and increase environmental risks and resource scarcities due to these most of African countries are face to persistent poverty(UNECA 2012).

The Government of the Federal Democratic Republic of Ethiopia and the Regional State governments are striving to fulfill their responsibilities to their citizens. They strive to provide social services and security, ensure adequate functioning of infrastructure, provide a climate conductive employment and pay their debts. They are promoting development, and achieve their national aspirations using the resources available at their disposal. To be able to achieve the desired social and economic development, the government has already started to pursue its development endeavors following the green growth path.

Accordingly, the country's 5 years Growth and Transformation Plan (GTP) that aims at improving the livelihoods of its people is being implemented. The GTP, which aims at sustaining the rapid and broad-based growth of the country, hinges on seven pillars and four of these (i.e.

sustaining faster and equitable economic growth, maintaining agriculture as a major source of economic growth, creating favorable conditions for the industry to play key role in the economy, and enhancing expansion and quality of infrastructure development). Furthermore the environmental sector plan is one of the GTP of the country.

The green economy, growth is mostly based on the reduction of carbon emissions and pollution and enhances energy and resource efficiency prevents the loss of biodiversity and ecosystem services. Ethiopia aims to be a middle-income country by 2025 through developing a climate-resilient green economy. The country has developed Climate Resilient Green Economy (CRGE) strategy and mainstreamed it into the second Growth and Transformation Plan (GTPII) NAP-ETH (2017).

GTP-II argues that reaching its goals require significant investments to boost agricultural productivity, strengthen the industrial base and foster export-oriented growth NAP-ETH (2017). NAP-ETH aims to strengthen holistic integration of climate change adaptation in Ethiopia's long-term development path way; its vision is to create climate change impact resilient development for Ethiopia and its people NAP-ETH (2017).

One of the activities outlined within the environment sector plan of the GTP is the preparation of the State of the Environment Report of the country through undertaking fast assessment and study. To this end, the federal Democratic Republic of Ethiopia Commission of Environment, Forest and Climate change has conducted assessment on the Gummare Lake ecosystem. The study was conducted through a team of multidisciplinary professionals in an integrated approach.

1.2. Frame works/Approaches

1.2.1 The Driver-pressure-state-impact-response framework

The current study tried to use DPSIR approaches.The DPSIR frame work is a variant of the Pressure – State – Response (PSR) framework originally developed by Rapport and Friend (1979) for Statistics Canada and also adopted by other bodies such as UNEP in the GEO and AEO processes.

The "DPSIR" framework is multi-scalable and indicates generic cause and effect relations within and among the following:

• DRIVERS: The drivers are sometimes referred to as indirect or underlying drivers or driving forces and refer to fundamental processes in society, which drives activities having a direct impact on the environment;

• PRESSURES: The pressure is sometimes referred to as direct drivers as in the Millennium Assessment (MA) framework. It includes in this case the social and economic sectors of society (also sometimes considered as Drivers). Human interventions may be directed towards causing a desired environmental change and may be subject to feed backs in terms of environmental change, or could be an intentional or un-intentional by-products of other human activities (i.e., pollution);

• STATE: Environmental state also includes trends, often referred to as environmental change, which could be both naturally and human induced. One form of change, such as climate change, (referred to as a direct driver in the MA framework) may lead to other forms of change such as biodiversity loss (a secondary effect of climate gas emissions);

• IMPACTS: Environmental change may positively or negatively influence human wellbeing (as reflected in international goals and targets) through changes in environmental services and environmental stress. Vulnerability to change varies between groups of people depending on their geographic, economic and social location, exposure to change and capacity to mitigate or adapt to change Human well-being, vulnerability and coping capacity is dependent on access to social and economic goods and services and exposure to social and economic stress;

• RESPONSES: Responses consist of elements among the drivers, pressures and impacts which may be used for managing society in order to alter the human – environment interactions. Drivers, pressures and impacts that can be altered by a decision-maker at a given scale are referred to as endogenous factors, while those that can't are referred to as exogenous factors

2. Socio-Economic Environment

2.1. Social Environment

2.1.1 State and trend of social environment

The social environment, social context, socio cultural context, or milieu, refers to the immediate physical and social setting in which people live or in which something happens or develops.

It includes the culture that the individual was educated or lives in, and the people and institutions with whom they interact. The interaction may be in person or through communication media, even anonymous or one-way, and may not imply equality of social status. Therefore the social environment is a broader concept than that of social class or social circle (http://www.definitions.net/definition/social environment).

Lake Gummare is found Afambo Woreda at the eastern end of Afar Regional of Ethiopia; at 11°32′N 41°40′Ecoordinates. Afambo is situated in the eastern part of the region the Altitude ranges from 270 – 300 meters above sea level sharing international boundaries with Djibouti in the East and regional boundaries with Dubti Woreda in the West, Asaita Woreda in the North, and Ethiopian Somali region in the South (MAPDRSLP, 2014). **Lake Gummare** is one of a chain of lakes into which the Awash River empties its waters and it lies on a roughly north-south axis, 15 kilometers long by five wide, having about 6,000 hectares of open water.-Gummare receives its inflow from the Awash on its northwestern shore, and its outflow is on its southern shores where a channel joins the lake with Lake Afambo.

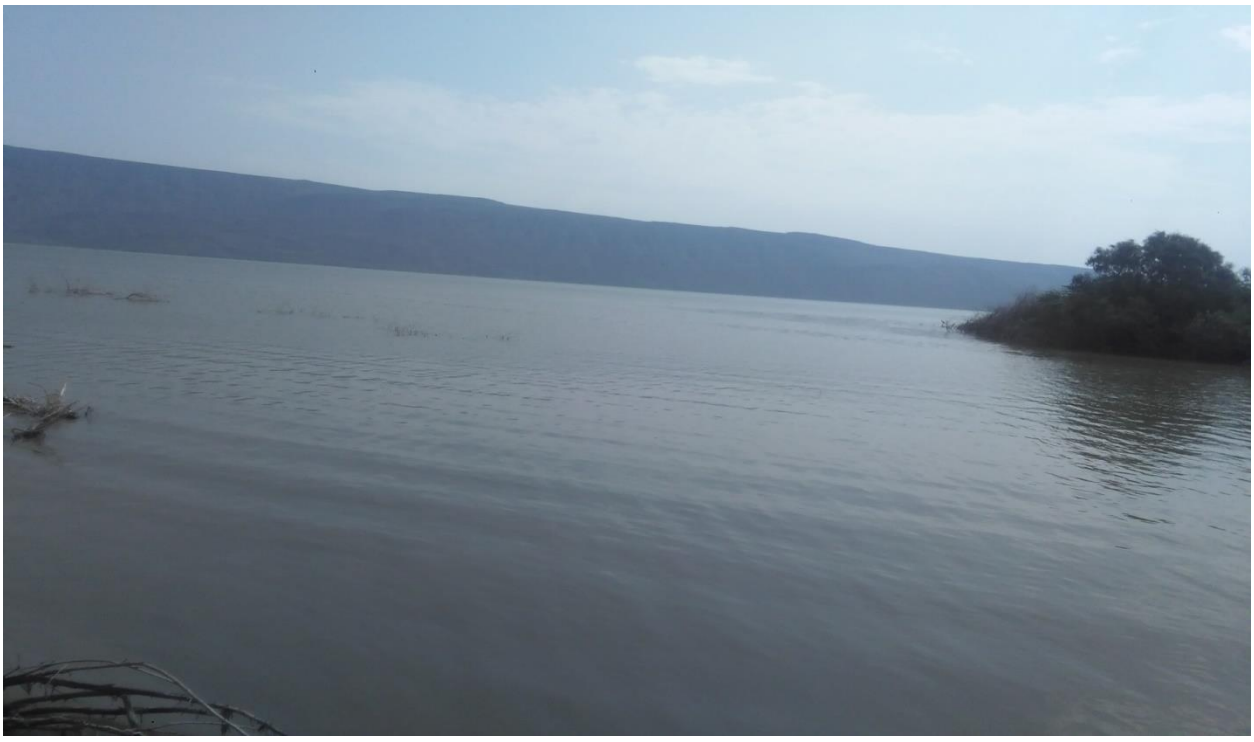


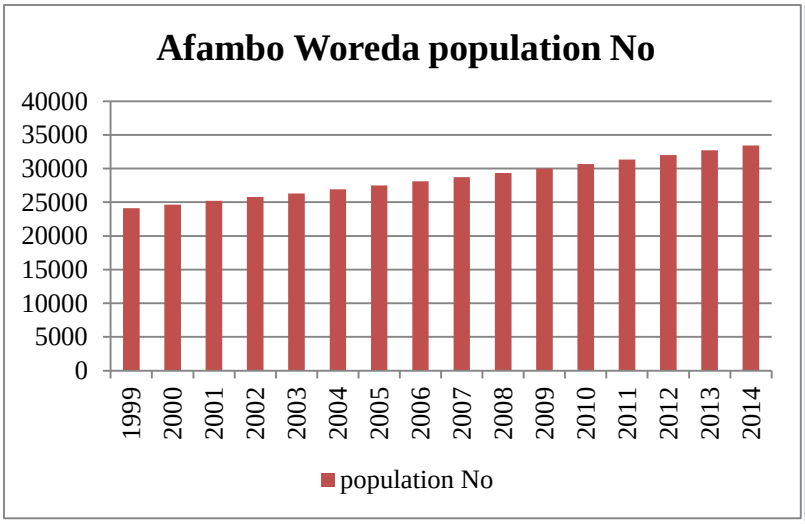
Figure 2: Gummare Lake during field observation

Population

The distribution of Ethiopia's population is influenced greatly by altitude, climate, and availability of good soil. These physical factors explain the high concentration of the population in the highlands. About 14 percent of the population lives in areas with an altitude of 2,400 meters above sea level (m.a.s.l) or higher, in climates similar to the temperate zone outside the tropics. About 75 percent people live between 1,500 and 2,400 masl where temperature is moderate and the rest live below 1,500 masl where temperatures are high. The hot zone encompasses more than half of Ethiopia's territory but contains only 11 percent of the population (Adugna, 1989)

Based on the 2007 Census conducted by the central statistical Agency of Ethiopia (CSA), Afambo Woreda has a total population of 24,153, of whom 13,312 are men and 10,841 women; with an area of 1,258.97 square kilometers, Afambo has a population density of 19.18. While 822 or 3.40% are urban inhabitants, a further 6,529 or 27.03% are pastoralists. A total of 4,251 households were counted in this Woreda, which results in an average of 5.7 persons to a household, and 4,322 housing units. 99.96% of the population said they were Muslim (https://en.wikipedia.org).

According to Afambo Woreda population data the trend of population was increased for instance in 1999 the no. of population was 24,129 while in 2014 the no. of population was become 33,443 within 15 years the population number was increased by 9314 this shows there is high population increase in the areas and the population growth rate 2.2 percent, the population of the *Woreda* is projected to be 38,107 in year 2020.



year	populatio
1999	24129
2000	24660
2001	25202
2002	25757
2003	26323
2004	26903
2005	27494
2006	28099
2007	28717
2008	29349
2009	29995
2010	30655
2011	31329
2012	32018
2013	32723
2014	33443

Figure 3: Population Trend of Afambo Woreda 1999-2014.

As the population increases, their economic interest, the demand on infrastructure, food security, energy source, health facilities and basic necessities as a whole is increased. This is also true for Gummare Lake forest resource become decline due to the population use forest for energy, for house construction and to farm land and grazing land

Education

Education is the most important factor that plays a leading role in human development. It promotes a productive and informed citizenry and creates opportunities for the socially and economically under privileged section of the society. One of the primary goals of FDRE Ministry of Education is promoting primary education in every corner of the country, based on the motto "education for all".

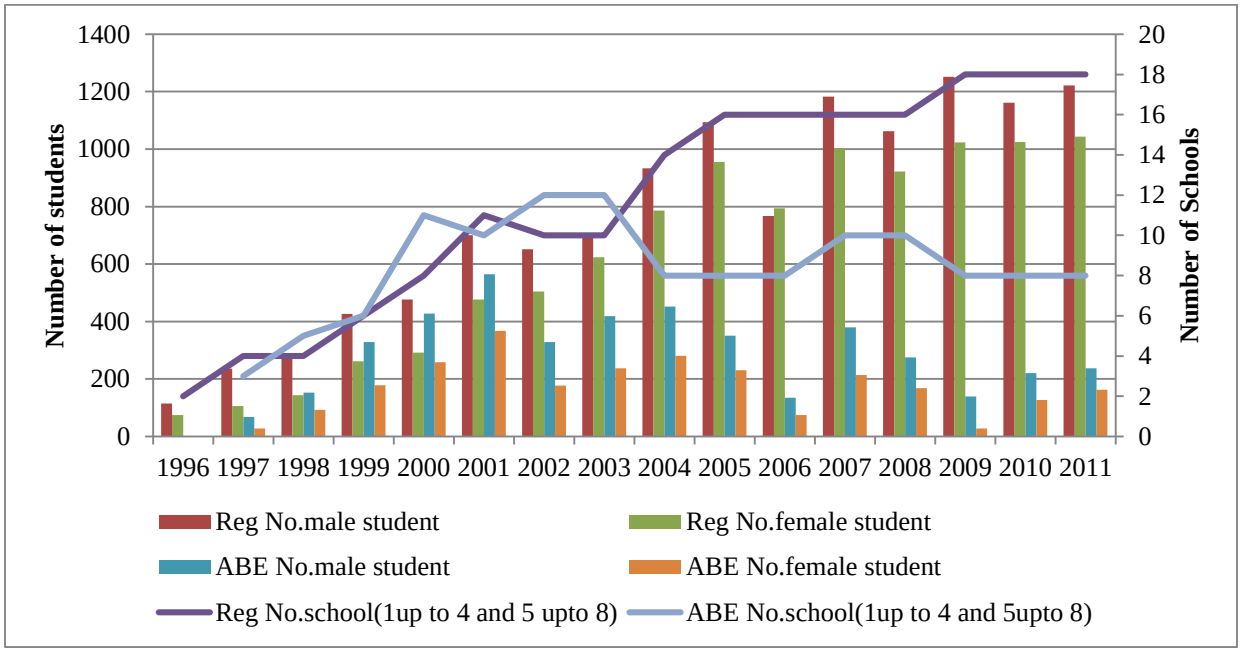


Figure 4: Number of students and Schools in Afambo woreda

From 1996 up to 2011 the number of regular students, both female and male from grade 1 up to 4 and 1up to 8 were increased, while number of ABE female and male students were relatively decreased (Figure 4). Regular numbers of school were increase while ABE numbers of school were decreased.

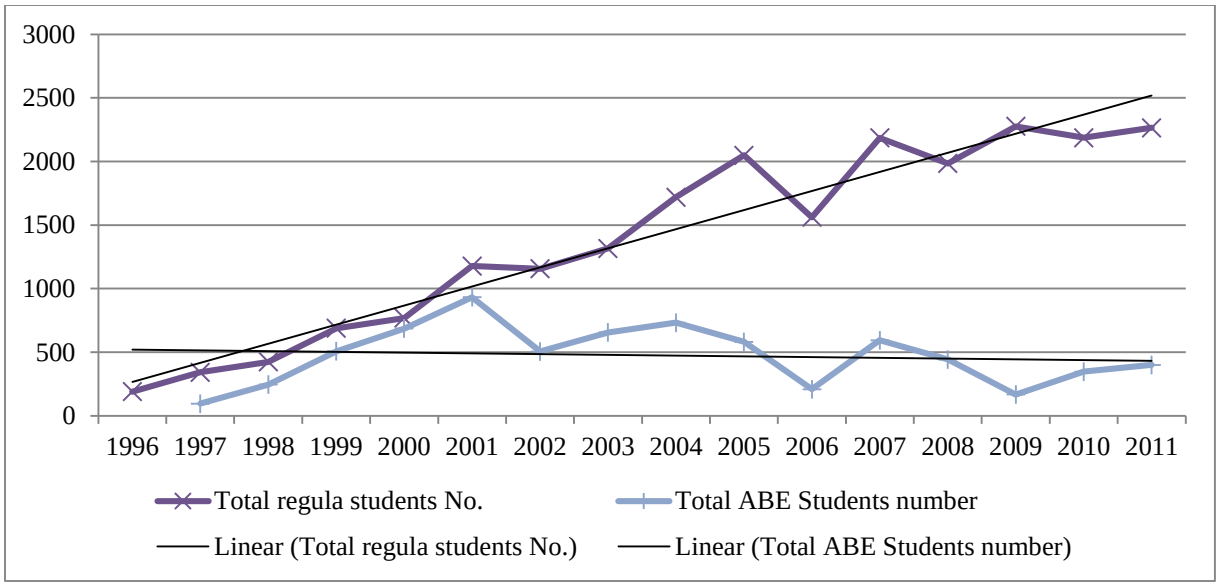


Figure 5 : Total Regular and ABE Students numbers

When considering the enrolment of regular female students in, in 2017 it was 47.4% and 46% in 2011 whereas, for male students it was 70% (1997) and 54% (2011). The above figure also show as the number of regular students were become increase while, ABE students become decrease.

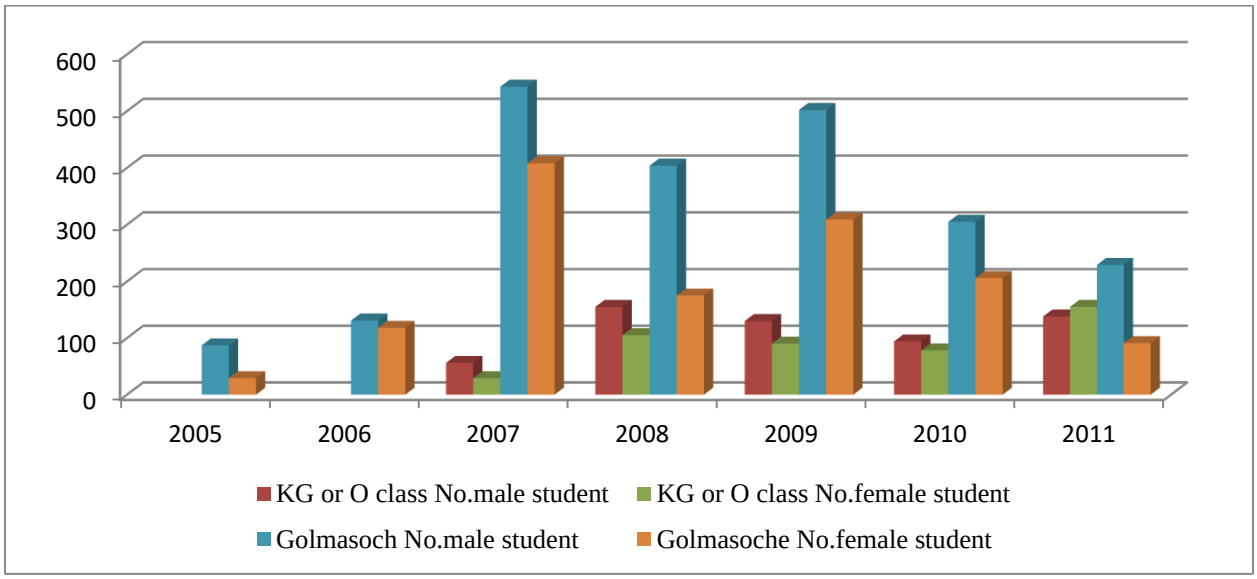


Figure 6: Number of Male and Female Student for KG and Golmasoch

KG or O-class was started in 2007 and Golmasoch enrolment started in 2007 when we see the trend female and male students of Golmasoch were become decreased and the number of KG or O-class number of students were become increase. The enrolment of KG class female students in

2007, 34% and male 66% and in 2011 female 53% and male 47%. The ratio of teacher per students for KG or O-Class was 1: 19, for ABE 1:38 and for regular 1:28

School infrastructures

Education is the most important factor that plays a leading role in Human development to educate the peoples it needs school infrastructures, according to Afambo educational office data report, in Afambo Woreda have 12 school from grade 1 up to 4, 6 school from grade 5 up to 8, 13 school for KG or O-class and 8 school for ABE from 1 up to 3 grade totally in Afambo Woreda have 26 schools. Until 2011 there was no grade 9 and 10 class but in 2012 grade 9 was starting.

Health

The Health service sector is one of the key sectors of the economy and for human development. Adequate health service is one aspect of social service that communities aspire to get from the government. To this end, the Government of Ethiopia is putting the maximum possible effort to set targets towards societal development such as GTP goals and targets, and other policies and strategies. This is exhibited by increasing number of health institutions being established in different regions and city administrations including the rural clinics.

Health Institution & Health Coverage

The health institutions based on the information gathered in Afambo health office in Afambo Woreda have 2 health center and 11healthcare. The Afambo community if they need refer to hospital they were go to up to Assayita Hospital so, in Afambo Woreda they have no governmental hospital. Based on gathered information from Afambo health office they were describing measles and diarrheal diseases are top diseases in Afambo Woreda.

Despite this there are growing challenges to the effective delivery of the health services. In the study area, it was observed that major health problems are uneven distribution of health services, shortage of health trained manpower, low coverage of clean water, inadequate sewage disposal facilities and sanitation services, lack of self-hygiene and environmental sanitation, which result into high prevalence of communicable diseases. According to the profile, diarrheal diseases are

almost caused by the environmental factors of poor sanitation, hygiene and access to clean water and food.

Road and Transport

Road is an essential infrastructure for a given area for economic and social development. The level of development of transport Facilities and services including the road are determining factor for other development activities. Thus transport sector play a key role in the socio-economic development of a *Woreda*. Afambo has 79 kilometers of all-weather gravel road (https://en.wikipedia.org).

The population who has access to Road infrastructure is around 3Kebeles and builds with pista road. According to focal groups and key informant discussion there was a great problem of road infrastructure.

We can observe that due to poor road network system from Afambo up to Lake Gummare the area become not tourists attract area even though, Lake Gummare is one of tourist potential area. Deterioration of road has been hindering the *Woreda's* development activates and even affects the day-to-day life of the community.

Water Resource and Supply

Awash River water is one of the main water sources for Afambo Woreda community. Based on the information of Afambo water office, in Afambo Woreda totally have 25 hand pump water. During FGD the community were described that there was scarcity of drinking water and pure water due to this they were easily affected by water born disease.

Figure 7: Hand pump water in Afambo Woreda

Communication Services

Even though communication services in urban area has an old age, its expansion yet is poor in terms of the stage of development and service per capital. The communication infrastructure that have been rendering service are telecommunication; telephone, fax, and postal services. Based on the Afambo Woreda office data around 3 or 7% of the people were accessible to telephone service and also use wireless communication services.

Electricity

Electricity is an essential infrastructure for a given area of economic and social development. Based on Afambo Woreda office data 30% of the community have accesses of electric services. The other residents used fuel wood, charcoal as the source of energy

2.1.2 Drivers and pressure of social environment

Due to human and natural driver the Gummare Lake is decreasing. Farm expansion, overpopulation, urbanization, intensive overgrazing practice, and deforestation, climate variability, waste dumping and sedimentation were factors that contributed to the depletion of the Lake. There for increasing of population growth is one of the main driver and pressure for social environment of Lake Gummare ecosystem.

- Basically due to a number of driver among them the following are the important ones,
  - Low educational background that lead the society to use natural resources like forest in unsustainable manner.
  - Even though, currently much attention is given to the provision of primary health care in the households, the provision of family planning services are still low. As a result, there will be much more delivery and an increase to the existing population.
  - The most significant drivers of environmental degradation are land use and land cover changes, resulting from agricultural farmland, grazing land and settlement expansion.

Increasing of population number that pressure on natural resource like forest through deforestation therefore deforestation is one of the pressures for social environment. The need of farm land, expansion of urbanization, infrastructure development, settlement expansion that pressure on natural resource like forest, water etc….

2.1.3 Impacts due to social environment change

Two hundred years ago, the power of population is indefinitely greater than the power of the earth to produce subsistence for man (Malthus, 1798). In a latter period (Ester, 1981) forwarded contrasting views to the Malthusian theory and emphasized innovation and land use intensification as a response to population growth or resource scarcity. They focus on "population density" as a driving factor for innovation and the expansion of carrying capacity. With current high population growth rate of 2.2 percent, there is a very high demand over the available natural resources to satisfy the increasing demand by cultivating and overgrazing which exacerbated the condition of environmental degradation. Population pressure cause over grazing, over cultivation, increased the demand of fuel wood and constructional materials, which ultimately resulted in soil nutrient depletion and deteriorating proximate environmental resources and increasing the exposer affected by climate change impact and, there by resulted in declined food security. This is also happened for the society living around Gummare Lake ecosystem, because of extreme soil degradation in crop area and climatic irregularity in all Kebeles this leads the society was under assistance of Safety Net Program. As FGD participants explained that in Mego and Genet Kebelle around 150 and 200 people's lives under poverty.

Due to deforestation different habitat, fruits, animals and medicinal plant disappear, Due to this the society their life depend on forest ecosystem highly affected, disrupted and the getting of

ecosystem service is decreasing like fruits, medicinal plant, decrease water quality and quantity, decrease production and productivity, facilitate animal and crop pastes, etc.

- As a result of Scarcity of Drinking water and impurely, women and children were more suffer than man.
- Climate variability change make for the society more vulnerable for drought and flood because of this the society become food insecure due to this the FGD participant explained that their poverty level was increased year to year.
- Over grazing due to increasing animal population around Gummare lake ecosystem one problem for ecosystem degradation.

2.1.4 Responses to social Environment Change

Population pressures have impact on the natural resource and degraded the environment. Even though there are many potential policy responses to the environmental implications of local population pressure but the policy was not well implemented in Afambo Woreda such as, The population policy of Ethiopia aims at

(i) Closing the gap between high population growth and low economic productivity through planned reduction of population growth;

(iii) Improving the carrying capacity of the environment by taking appropriate environmental protection measures; and

(iv) Improving the social and economic status of vulnerable groups (women, children and elderly). In line with the policy document, Ethiopia set out a national population program me in accordance with national priorities as stated below

(i) Expansion of population information, education and communication;

(ii) Provision of expanded family planning services;

(iii) Strengthening of training in population;

- Promotion of the status of women.

Both government and non-government organizations are closely working together to lessen the implication of population pressure by expanding network of family planning and contraceptive

service delivery, providing in-service training for health professionals and introduce gender specific career counseling, etc.

2.1.5 Outlook for Socio Environment of Lake Gummare

If everything continues as it is practiced as present, population growth rate within the study area is nearly increase in 2.2 will continue. In year 2025, the population number will increase by 42,488. And also the demand of fuel energy and farm land, grazing land, settlement, urbanization and infrastructure expansion will increase, these will lead to increase forest and wet land degradation, destruction of Gummare Lake ecosystem and the carrying capacity of the environment also will decrease as well as the whole social and economic activities of the community will become endanger and soil erosion, land degradation, injured people and livestock natural and human induced caused would aggravate, leading to increase loss of soil fertility and highly affecting agricultural productivity and livestock production in Gummare Lake ecosystem.

2.1.6 Recommendation

Obviously the interaction human and environment continue. If the interaction is in unsustainable manner it will become difficult to continue the positive interaction. But when we see the interaction of the human and environment in the Gummare Lake ecosystem is negative because the society use natural resource in unsustainable manner as a result the environment highly degraded. These condition increase the vulnerability of the society to live under poverty level so to decrease the impact it needs gives public awareness to the society about sustainable use of natural resources, it needs increase alternative energy instead deforest trees, and increase access of clean water, infrastructure and hospital to use man power effectively and Closing the gap between high population growth and low economic productivity through planned reduction of population growth.

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2.2. Economic Environment

2.2.1 State and trend of the economic Environment

Economically, Ethiopia is one of the world's fastest-growing countries. Building on its positive recent development, it intends to reach middle-income status before 2025. It aims to do so by building a green economy. Boosting agricultural productivity and strengthening the industrial base will be essential to reach this goal.

Animal husbandry and Agriculture is the most important determinant specially, animal husbandry play the leading role for the economy development of Gummare Lake ecosystem living community and for overall economy development of the region. The livelihood of the people is primarily depend on animal husbandry and secondly on the agriculture, however, agricultural system in the region is at subsistence level and food insecurity problem is increasing at alarming rate.

According to the data gathered from Afambo office the contribution of animal husbandry and agriculture on GDP was 60% and 40% respectively and animal husbandry is also the main source of income for the society.

Livestock sector is a source of livelihoods and income, mainly for the rural and per-urban communities. The *Woreda* has an animal resource with an estimate of about **94,909 cattle**, **106,430 sheep**, **154,416 goats**, 42,591 **camels**, 8, 914 **donkey, and 271 chickens**. Livestock production management is poor; almost all farmers in the area follow traditional production system. They were focus only on the increasing of animal's number not done on the quality of the product.

As key informant and group discussion the main food crops utilized was maize. They mainly consume cereal based foods together with vegetables and livestock product. Maize, millet, Sesame and Masho (oil seed) are the major crops grown in the area from vegetable Tomato, Onion, Mango, Papaya, palm seed and peppercorn are available in the area. Most of the community lives in Afambo Woreda they follow mixed farming system livestock and agriculture production except Genetye Kebele, follow the livestock production.

Their agriculture activity is based on rainfall and Awash River water this cause low production on agriculture sector because FGD participants explained that Awash River that cause flash flood

and destroy their farming land and makes the community vulnerable for food insecurity and also due to rainfall variability and luck of rainfall that cause drought and flood as result farming land and livestock's was lost.

Flash flood come from Awash River that damaged road and low access of telephone service in Afambo, thus makes difficult to create market linkage and market information. Also they produce low standard quality due to lack of awareness, lack of market competition and accessibility. So, a farmer does not return as their potential producer from the livestock.

2.2.2 Drivers and pressures of the economy

The macro-economic objectives should be environmentally and socially sustainable. Obviously, the macro-economic objectives are: economic growth measured in terms of the percentage change in the Gross Domestic Product (GDP), employment, price stability, and equity. The very concept of studying population dynamics and economic environment is that its interlinked nature. In Afambo Woreda the industry have no contribution on GDP of Afambo while livestock production that contribute 60% and agriculture 40%. Even thought, animal husbandry have great role for the GDP but have negative impact on the environment.

So increasing the number of livestock, unimproved technology use, lack of accessibility of infrastructure, high rates of population growth by 2.2 in the study area, the demand to satisfy the increasing new comers increases in over exploitation of the available natural resources and impact of climate change are the main driver and pressure of economy development for Gummare Lake ecosystem society.

2.2.3 Impacts due to the Economic Condition

The nature of economic growth can be analyzed according to economic sectors. Three indicators of environmental pressure, namely sectorial composition, sectorial rate of growth and a change in sect oral production methods and techniques can be considered to understand the economic growth. The Climate-Resilient Green Economy (CRGE) help the country achieve its development goals while limiting 2030 GHG emissions to around today's 150 Mt CO2e – around 250 Mt CO2e less than estimated under a conventional development path. The green economy plan is based on four pillars:

1. Improving crop and livestock production practices for higher food security and farmer income while reducing emissions

2. Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks

3. Expanding electricity generation from renewable sources of energy for domestic and regional markets

4. Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

Due to Gummare Lake ecosystem society practice un improving crop and livestock production practices that affect the environment by increasing GHG emissions and the income of the society become decrease.

Due to lack of accessibility of infrastructure like road, telephone service and electricity that makes difficult to increase market linkage and current market information with in in different Kebeles this affect the income of the society and decrease market competition and lack of electricity that influence on forest resources.

Climate change impact also that affects the economy of the society flash flood come from Awash River that affect their farm and drought also kills their animals this makes the society become food insecure and increase poverty. As FGD participant explained that the poverty rate was increased year to year and affect the society. As the participant of Maygo and Genetye Kebelles explained that the around 150 and 200 households were live under poverty respectively. According to Afambo Woreda office data due to poverty around 5392 peoples were aided by Safety Net Program. In Afambo Woreda Forest coverage is very low, due to intensive destruction of forests for charcoal, for construction and firewood production. Livestock's per capita production is very low and decreasing due to limited modern technique application and yield enhancing inputs. Therefore, the current livelihood practice is a challenging task to promote sustainable development by protecting the environment and as well as it will become difficult to increase the income of the society.

2.2.4. Response Measures

In the Afambo Woreda to increase their economy development in sustainable manner they were not done anything while there are many potential policy responses to the environmental implications of local population pressure even though they were not implemented in Afambo Woreda such as, the population policy of Ethiopia aims at

i. Closing the gap between high population growth and low economic productivity through Planned reduction of population growth;
ii. improving the carrying capacity of the environment by taking appropriate environmental protection measures; and
iii. Improving the social and economic status of vulnerable groups (women, children and elderly).

To alleviate the problem and attain the Millennium Development Goals both the government and society are working together to achieve sustainable natural resource conservation.

Apart from the above major responses by the Government of Ethiopia, a new plan has been coined and put into practice by different components of the government in this fiscal year Growth and Transformation Plan (GTP II). The planning year is between 2015/16 and 2019/20. GTP's vision in the economic sector is "to build an economy which has a modern and productive agricultural sector with enhanced technology and an industrial sector that plays a leading role in the economy; to sustain economic development and Secure social justice; and, increase per capita income of citizens so that it reaches at the level of those in middle-income countries."

The major objectives of GTP are to:-

- Maintain at least an average real GDP growth rate of 11% and meet the Millennium development goals,

- Expand and ensure the qualities of education and health services there by achieving the MDGs in the social sectors,

- Establish favorable conditions for sustainable state building through the creation of stable democratic and developmental state.

- Ensure growth sustainability by realizing all the above objectives within stable macro-economic framework.

  - This broad social, economic, and political aspect of the GTP are managed on the following major pillars

- Sustaining faster and equitable economic growth

- Maintaining agriculture as a major source of economic growth

- Creating favorable conditions for the industry to play key role in the economy

- Enhancing expansion and quality of infrastructure development

- Enhancing expansion and quality of social development

- Building capacity and deepen good governance`

- Promote women and youth empowerment and equitable benefit

Ethiopian climate-resilient green economy strategy is also one of the responses. Ethiopia aims to achieve middle-income status by 2025 through developing a green economy and build green economy through decreasing, GHG emissions and unsustainable use of natural resources.

2.2.5 Outlook for Economy

If everything continues as business as usual, if the population in the study area continues by 2.2 % in 2025 the population of Afambo Woreda will be 42,888 And the subsistence mode of economic situation that based on animal husbandry and farming and they were practice un improved production system and use natural resource unsustainable manner this will lead the natural environment could not be able to provide the environment service and the economy development will become decrease and will increase the poverty rate of the society.

2.2.6 Recommendation

The current policies, programs, strategies that are issued by the government are strong instruments for the management of natural resources however they need to be strengthened to cope with the changing situation such climate change and natural resources degradation and depletion. Implementations these policies and strategies should be ensured.

Expansion of irrigated agriculture, Introduction of drought tolerant crops environmentally friendly resettlement action plan should be in place, Income diversification such as engaged in off-farm activities, livestock fattening. Change the cropping pattern to cope up with the rain fall pattern variability due to shifting of seasons. Integrated and diversified agriculture need to be practiced for instance growing both subsistence and perennial cash crops by using additional technology to increase production and productivity. To achieve middle-income status by 2025 the Afambo Woreda must be done not only increasing livestock number but also done on the quality of production in order to decreasing GHG emission emitted by livestock's.

- To improve Livestock production management of all farmers in the area follow intensive and semi-intensive system management practices to increase Production performance of the animals
- Awareness creation should be given on the links of climate change, overpopulation natural resource degradation to the overall environment.

3. Physical Environment for Gummare Lake Ecosystem

3.1. Land Use Land Cover Change for Gummare Lake Ecosystem

3.1.1 State and Trend of Land Use Land Cover Change for Gummare Lake Ecosystem

Land is the major natural resource on which economic, social, infrastructure and other human activities are undertaken. Changes in land use have occurred at all times in the past, present, and are likely to continue in the future (Lambin et al., 2003). Land cover and land use change (LUCC) is a phenomenon starting from ancient time. However, the last three centuries witnessed rapid and extensive LUCC as part of global environmental changes (Gutman et al., 2004). Dramatic changes on the natural landscape and the Earth Summit in Rio de Janeiro in 1992, brought concern to scientists as well as policy makers.

Land use land cover change is one of those major challenges that affect the natural landscape. It is one of the main driving forces of global environmental change, and central to the sustainable development debate (Lambin et al, 2000)

Land use/land cover changes in a lake drainage basin reflect changes in the magnitude of the water balance components and rate of sediment deposition in a lake as a reflection of the fundamental linkage between what happens in a lake considered against what is happening in the drainage basin of the lake.

Land use land cover change is an endlessly changing process taking place on the surface of the earth (Mas, et al., 2004; Reid et al., 2000). LUC is mainly caused by the processes of expansion of agricultural, settlement and grazing lands and the removal of vegetation. In the light of this, the modern world has faced massive changes in its land-use patterns in the past few centuries (Muttitanon, 2005). Forest lands, wetlands, grasslands and shrub land have been modified and transformed both in space and time. The size of human settlement, agricultural land and other related land-use systems have increased enormously.

In its wider sense, the term land use denotes the human employment of the land, which includes settlements, cultivation, grazing, recreational areas, or industrial zones. Whereas, land cover represents the biophysical cover of the land (Duadze, 2004). In line with this, LUCC is a term used for human modification or alteration of Earth's terrestrial surface from one to the other; for example, from forest to cultivation or grazing to degrade land (Lambin et al., 2003).

Ethiopia is endowed with a variety of agro-ecological conditions (World Bank, 2007). Its complex topography and wide altitudinal variations contribute to the presence of various types of land use land cover change class. However, the LULCC system is a very dynamic process in Ethiopia and various practices control the rate of this change. As a result, environmental degradation processes in the form of soil, vegetation, and biodiversity and water /Lake/ degradation are the major environmental problems facing Ethiopia today.

The Lake Gemeri is endowed with a large potential of natural resources. In the buffer area a series of LULCC dynamics has largely occurred over the past few decades. These dynamics and associated factors have resulted in the degradation of resources of the area; amongst others, Lake Gemeri and its related consequences particularly in 1995.

For understanding of such LULCC dynamics and their environmental implications, information is needed on where and when changes occur; the rates at which they occur as well as their implications for the environment. This can be achieved through change-detection analysis approaches. Change-detection analysis of LULCC is best done by interpreting images that show features using remotely sensed datasets or images. In such types of analysis, the geo-informatics technologies (Remote Sensing and GIS tools and Google earth professional software) have been used in the recent decades in diverse areas of applications. Remote sensing and GIS techniques provide vital information on the spatial distribution of various LULCC classes over the years. Such type of information is important in environmental planning, monitoring and management strategies.

Therefore, the aim of the present study is to provide information on long-term LULCC dynamics (over a period of 13 years), and their implications concerning environmental degradation in Lake Gemeri, by examining the available spatial-temporal datasets by means of an integrated approach of remote sensing and GIS technologies. The output of the analysis will give baseline information in devising an appropriate strategy for resource management, aimed at reversing or reducing the problems of environmental resource degradation.

Location of the study area

The Gemeri Lake is located in Afambo woreda, Afar region of Ethiopia. Geographically, the Afambo woreda is located between 41°37’44"-41°48’22"E and 11°7’39"-11°40’39" N and Lake Gemeri is situated at 41°32’5"-41°45’48"E and 11°27’36"-11°42’15"N the area.

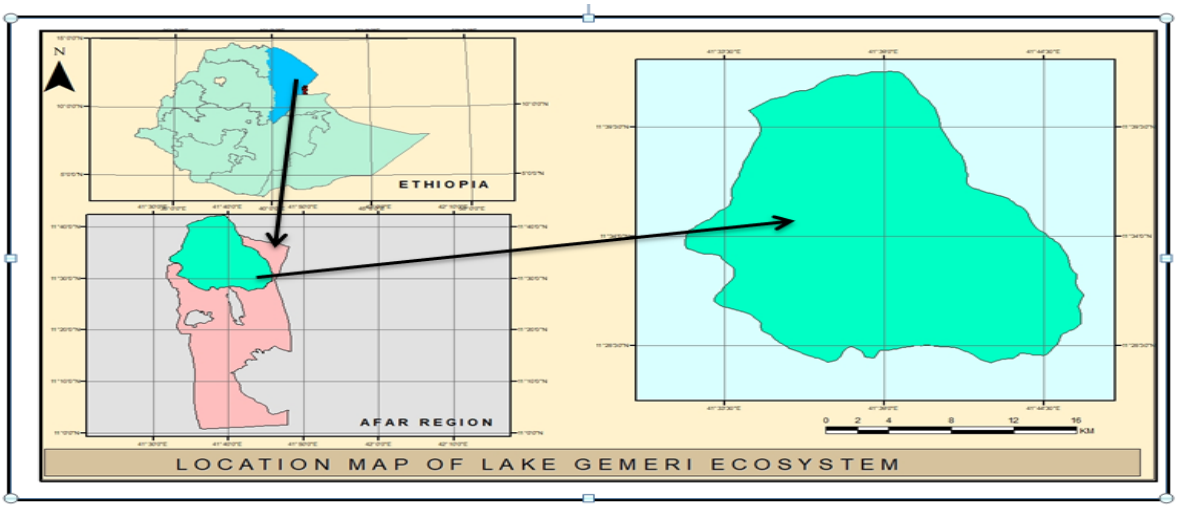

Figure 8: Location map of Gemeri Lake Ecosystem

Figure 9 : Partial view of Lake Gemeri

Table 3: Land Use/Cover Type and their Respective Definition Land use/cover type Description

No	**Land use types**	**Descriptions**
1	Forest land	Represents both the natural and enhanced plantation forest areas that are stocked with trees capable of producing timber or other woody products
2	Cultivated land	Land covered with annual or perennial agricultural crops
3	Shrub land	Includes bushes open stands of short trees and shrubs
4	Lake /open water/	Land completely covered with water and include mainly in the lake water
5	Settlement land	Land which contains scattered rural settlement land
6	Degraded land	Areas that have little or no vegetation cover, mainly with gullies and exposed rocks

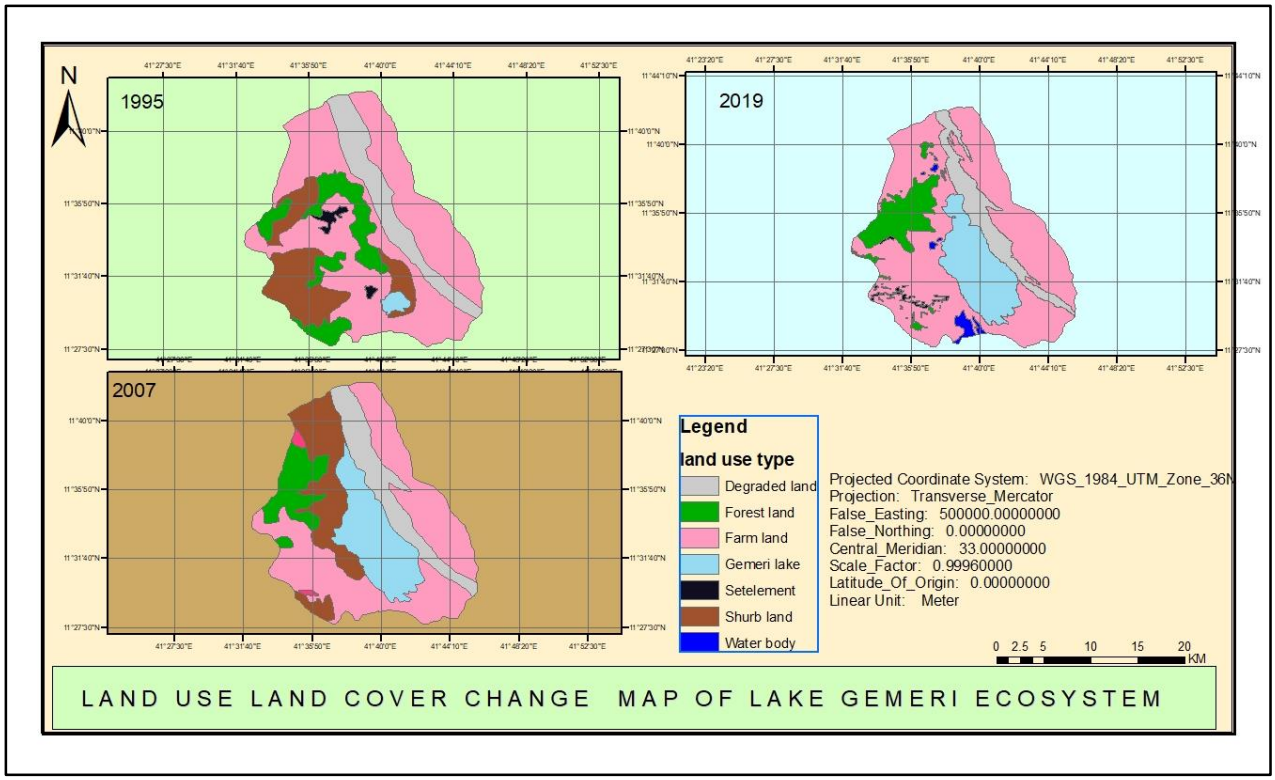

Figure 10: Land use land cover change map of Gemeri lake ecosystem

Table 4: land use land cover change proportion for year 1995, 2007 and 2019.

No	**land use type**	**year**		**year**		**Year**	
		1995(ha)	**%**	**2007(ha)**	**%**	**2019(ha)**	**%**
1	Degraded land	5970.03	13.510	5715.01	12.93	4571.26	10.34
2	Forest land	5062.23	11.456	3836.42	8.68	4141.68	9.37
3	Farm land	26358.79	59.650	19632.5	44.43	27575.2	62.40
4	lake	519.63	1.176	7812.61	17.68	6774.58	15.33
5	Settlement	286.41	0.648	411.89	0.93	487.63	1.10
6	Shrub land	5992.29	13.560	6781	15.35	223.23	0.51
7	water body	0	0	0	0	415.76	0.94
	Total	**44189.38**	**100**	**44189.4**	**100**	**44189.4**	**100**

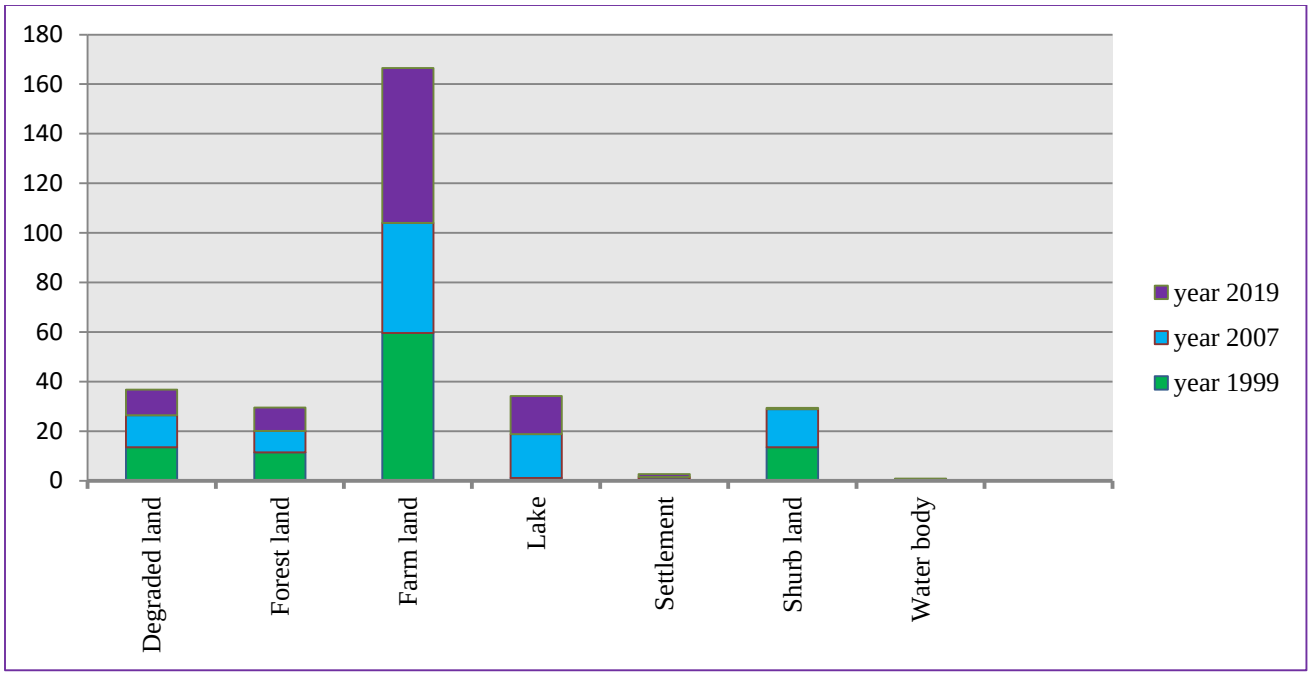

Figure 11 : Brief description of land use land cover change by per cent

States of Land Use/Land Cover

A total of Seven LULC types were extracted in the study landscape with different reference years, viz. 1995, 2007, 2019, in 1995, intensive cultivation was the dominant LULC type, and making up 69.6.5% of the study landscape followed by shrub land (13.56%) and degraded land (13.51%).

Degraded land

This LULCC class covered 5970.03 ha (13.51%) in 1995, 5715.01 ha (12.93%) in 2007 and 4571.26 ha (10.34%) in 2019. This reveals that degraded land reduced by 0.58% between 1995 and 2007, 2.59% between 2007 and 2019 and 3.17% over the whole analysis period. In 1995 the size and depth of the lake was highly diminished and the rate of degradation was higher, but in 2007 and 2019 the rate of land degradation reduced because, the lake accounted the highest change and it more than doubled over 13 years period.

Forest land

This LULCC class covered 5062.23ha (11.456%) in 1995, 3836.42 ha (8.68%) in 2007 and 4141.68 ha (9.37%) in 2019. This shows that, the coverage of forest land from 1995 -2007 it

reduced by 2.776%, thus between these years a significant proportion of forest land was, transformed into shrub land. However, from 2007 -2019 it expanded by 0.69% because currently the buffer area highly covered by invasive species (prospers species) which locally known as woyanie tree

Figure 12: Woyanie tree spread to the lake side

Farm land

The cultivated LULCC class covered the major part of the area during the study period. It accounted for 26358.79ha (59.65%) in 1995, 19632.5ha (44.43%) in 2007 and 27575.2ha (62.40%) in 2019. In the year 1995-2007 the farm land was reduced by 15.22% this suggests that, during this time the demand for crop production of the local community turning less land in to production than other years.

Lake

The coverage of lake Gemeri was declined over the analysis period of 1995 It covered 519.63 ha (1.176%) however in 2007, it was extremely expanded 7812.61 ha (17.68%) and in 2019 6774.58ha (15.33%) respectively. The continuous increasing was only observed in farm land and settlement among all study period (1999, 2007 &2019). On the contrary forest land, shrub land

and lake are showing in increasing or decreasing throughout the study period. The continuing LULC changes in Lake Gemeri have different implications.

As shown in the result, expansions of cultivated land were due to the reduction in the forest and shrub lands. The lake was increased as result of forest land reduced and shrub land was increased in the year 2007 and 2019.

Table 5: land use land cover change detection for 1999, 2007 &2019.

No	land use type	d/c 2007-1995		d/c 2019-2007		d/c 2019-1995	
		Ha	Change (%)	Ha	Change (%)	Ha	Change (%)
1	Degraded land	-255.02	-4.27	-1143.75	-20.01	-1398.77	-23.43
2	Forest land	-1225.81	-24.21	305.26	+7.96	-920.55	-18.18
3	Farm land	-6726.34	-25.52	7942.79	+40.46	1216.45	+4.61
4	lake	7292.98	1403.49	-1038.03	-13.29	6254.95	+1203.73
5	Settlement	125.48	43.81	75.74	+18.39	201.22	+70.26
6	Shrub land	788.71	13.16	-6557.77	-96.71	-5769.06	-96.27
7	water body	0	0.00	415.76		415.76	

Land use/land cover change analysis:

Change analysis was conducted using post-classification image comparison technique (Singh, 1989). Images of different reference years were first independently classified. The classified images were compared in three periods, i.e., 2007-1995 and 2019-2007 and 2019-1995. Change statistics were computed by comparing image values of one data set with the corresponding value of the second data set in each period. This results in a summary table of the overall changes per class. The values were presented in terms of hectares and percentages. The percentage LULC changes were calculated using the following equation:

Percentage LULC change = Area final year − Area initial year x 100 /Area initial year Where Area is extent of each LULC type. Positive values suggest an increase whereas negative values imply a decrease in extent. LULC comparison between 1995 and 2007, 2007 and 2019 and lastly, 1995 and 2019 was generated and the values were presented in terms of hectares and

percentages. Land Use/Land Cover Changes, the change results revealed a considerable reduction of, natural forests and lake over the periods (1995, 2007 and 2019).

Generally, from 1995-2019 the land degradation status in terms of vegetation coverage reduced by 23.43%, forest land also reduced in extent by 18.18% but from 1999-2007 it was increased by 7.96%, shrub land was reduced by 96.27% while the farm land increased by 4.61%, lake by 1203.73% and settlement increased by 70.26% respectively. From this we can understand that, the area is highly vulnerable to climate change and drought. As the local community confirm that, this lake is the main destination for Awash River if the magnitude of the river is reduced from upper catchment by expansion of irrigation land and other hydro power generation then the size of the lake is reduced /diminished/.

3.1.2 Driver and pressure for Land use Land Cover Change for Gummare Lake Ecosystem

Understanding the complexity of land-use and land-cover (LULC) changes and their driving forces and impacts on human and environmental security is important for the planning of natural resource management and associated decision-making. Accordingly, in the framework, (DPSIR) the “driving force” includes the increase in population growth, high demand for Natural resource (fuel wood, charcoal, timber etc), inadequate resource management strategy and policy gaps. The “pressure” includes unregulated harvest of the natural resource such as forest resources (for construction, fuel or energy), conversion of forest lands to agricultural land, encroachments.

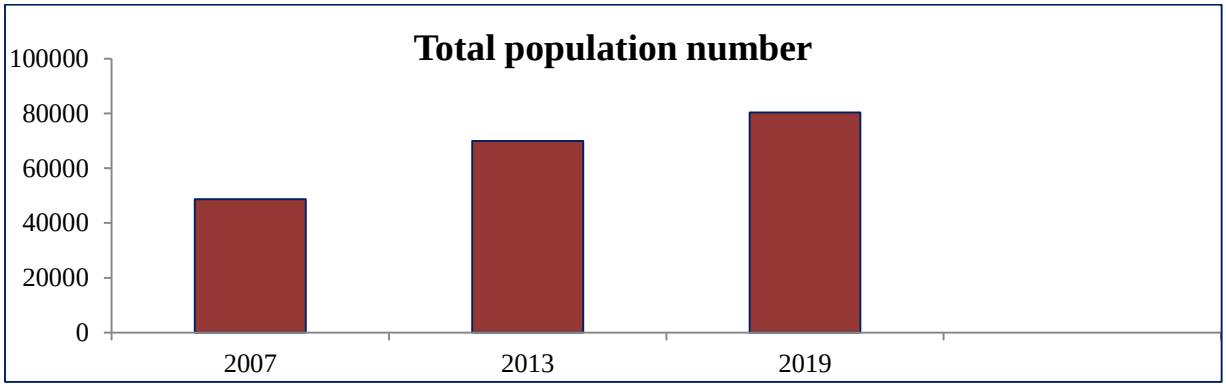

Figure 13: population numbers in Afambo woreda

As we have seen, from the above figure the population growth was increased by 9314 from 1999-2014.

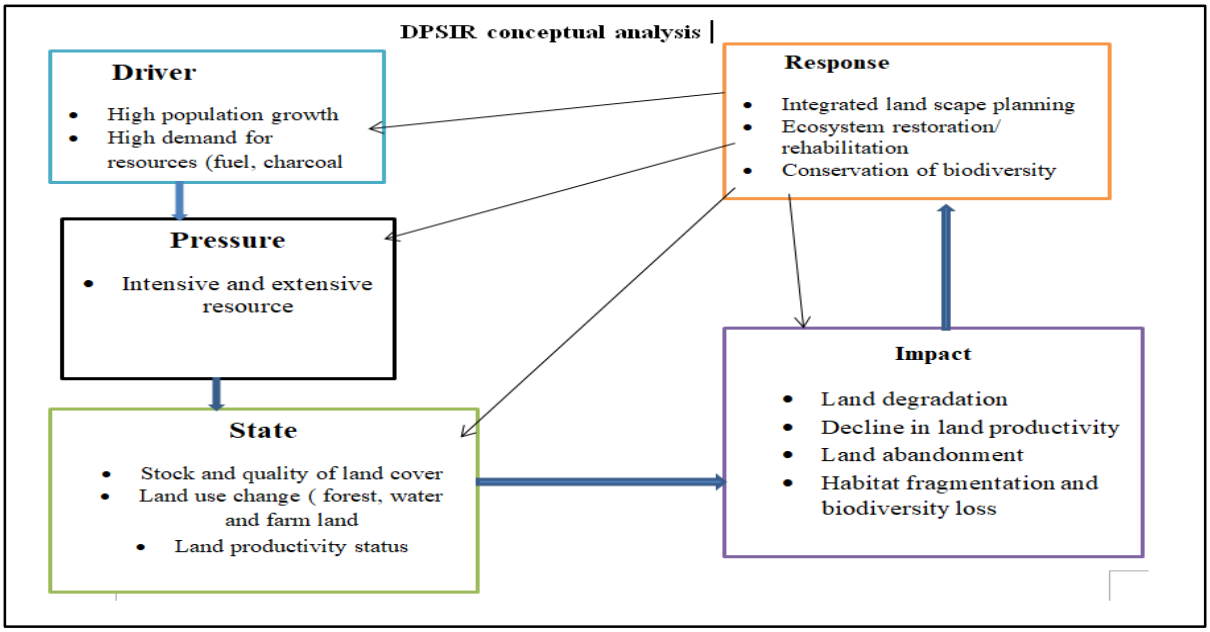

Figure 14: Short summery of DPSIR approach

3.1.3 Impacts of Land Use Land Cover Change of Gummare lake Ecosystem

The "impact" refers to the influence of the change caused as the result of the pressure exerted on the state. Mankind's presence on the surface of the earth results in the modifications of landscape (Daniel & Steven, 2000). This modification largely occurs through land-use/cover (LUC henceforth) changes (Dwivedi, Sreenivas & Ramana, 2005) and can have adverse impacts and implications on the local, regional and global environments.

Freshwater shortage: as a result of modification of stream flow, pollution of existing supplies, changes in the water table, the lake is facing critical threat. Catchment areas of these lakes are highly degraded and siltation of Lakes has been increasing.

Pollution Microbiological: Eutrophication, chemical, suspended solids, solid wastes, etc are the second serious concern to the survival of the aquatic biodiversity in this lakes

Habitat and community Biodiversity loss: Loss of ecosystems, modification of ecosystems or Eco tones, including community structure and/or species composition is another key factor that

may have progressing impact on the water resources. As a result of LULC changes that has been taking place in the area; much has been modified with resultant effect on the water resources.

Unsustainable exploitation of fisheries and other living resources: Over-exploitation, excessive by-catch and discards, destructive fishing practices, have been witnessed in the Lake Gemeri with a negative impact on the viability of stock and the biological and genetic diversity. It is likely that some species of fishes may have already been exterminated.

Climate change: Changes in hydrological cycle, sea level change, increased radiation Elnino-Lanina effect etc, will have an impact on local ecosystems' structure, function and resilience. The capacity to respond to these unpredictable climate changes may be further deteriorated as a result of unabated degradation and poor management of the natural resource in the area.

Sedimentation problem all rivers contain sediments: a river, in effect, can be considered a body of flowing sediments as much as one of flowing water, Awash river carry sediments which contains sink to the bottom of the reservoir(lake). The amount of sediment carried into a reservoir is at its highest during floods.

3.1.4 Response measures to improve the status of Lake Gummare

The "response" refers to the effort made or to be made in order to abet the challenges, which may include institutional and policy reforms. Since this study has been conducted, no response has taken by the local and the regional government to reverse the degradation or the reduction of Lake Gemeri.

3.1.5 Outlook

According to (land detection analysis, from 1995-2019), the cultivated land expanded by 4.61%, settlement increased by 70.26%. But in the study especially in year 2007-1995 the lake was highly declined by 13.29%, however from 2007-2019 it has been increased by double in extent. So that the overall land use land cover change and the land degradation becomes hazardous situation this makes the lake will be overcome to the land surface and could damage the community property.

3.1.6 Recommendation

Based on the DPSIR framework of analysis, an integrated land use and development planning and policy reform were suggested to encourage the on-going and planned ecosystem restoration, degraded land rehabilitation, and biodiversity conservation intervention in the area. These include the following options:

- **An effective water management plan** and practice should be employed at the landscape level breaking down major river basin into sub-watersheds and prioritizing the sub-watershed for conservation and management based on degradation level so as to conserve and minimize the human induced impacts faced by it,
- **Well-planned tree planting should be promoted** to complement the area closures intervention in the degraded lands. The local community, the Government and collaborating non-governmental organizations should be engaged in the process with a clear role and contribution, Restoration, target investments and policy incentives must look to the most valuable parts of the landscape with the greatest restoration potential, To protect and restore the forest an incentive –based approach should be deployed to encourage the local people for guarding the new plantations.
- **Government** should take appropriate steps to restore the degraded lands specially degraded soil, water and forest lands and their further degradation must be prevented, Integrated land use and development planning should be done for the watershed prior to any developmental project being conducted in the area and must be preceded by a proper Environmental Impact Assessment, Considering their impact on water resources focus should be more on improving the environmental and economic performance of current systems than the further development of these systems
- **Restoration/Rehabilitation is** need to be prioritized, Protecting and conserving critically endangered ecosystems, habitats and species. In addition NGO is needed to investigate the possibilities to improve the performance of rain-fed agriculture and other livelihood strategies.
- **Watershed management**" – including afforestation and the promotion of farming practices which reduce soil erosion – is frequently advocated as the best way of cutting sediment deposition in reservoirs.

3.2. Biodiversity for Gummare Lake Ecosystem

3.2.1 State and Trend of Biodiversity for Gummare Lake Ecosystem

Afambo is one of the woredas in the Afar Regional state of Ethiopia. It is located near Asayita, the international border with Djibouti. Part of the Administrative Zone 1, Afambo is bordered on the south by the Somali Region, on the west by Dubti, on the north by Asayita, and on the east by Djibouti. Afamboo woreda people economically depend up on raising animals and agriculture. Lake Abbe is the ultimate destination of the waters of the Awash River. It lies at the Afar Triple Junction, the central meeting place for the three pieces of the Earth's crust, a defining feature of the Afar Depression. Lake gumare water containing mineral salts flows in but there is no out flow, and pure water evaporates from the surface. It is also known as an "amplifier lake", the water level fluctuating dramatically in response to quite small changes in climate. Afar people have established a settlement near the lake's shore. Lake Gemarie is known for its limestone chimneys. These carbonate chimneys are formed by the mixing of lake water and a deeper geothermal fluid.

The only perennial river is the Awash, which passes through Lake Afambo, and a chain of lakes south and east of it: Laitali, Gummare, Bario, and Lake Abbe.

The Total wet land coverage is 2000 hectar of land, and the dominant species like ሸዉሸዋ /Shewushewa/, ከሰንቱ/kesentu/, and ከሰልቱ/kseltu/. The Afambo people grows different verities of crop species along with the awash river, but when the amount of river water increases the cultivated crops slated with sand and soil.

Starting from 2000 e.c.the agricultural irrigation land is increased by 1500 hectares of land to grow crops and sorghum. They grows different crops like maize, corn, pea etc. and vegetables, like tomatoes, onion mango, papaya banana, Chile, tamer, etc. but the dominant species grown in the area is corn, the wet land of the river and the lake is needed for different purposes for agriculture to grow maize and corns, and for human and animal drinking, but the water is highly polluted that are brings by Awash river and causes different diseases, not only this biodiversity of the lake is decreased. Due to the diminishing of the fish, the region brings different varieties of fishes from Lake Chamo and Abaya and inoculating to the Gemarie lakes, yet they can't survive and grow it. The invasive species of *proficcia/ commonly known as/*የወያኔዛፍ/ is highly grows and dominate the ecosystem around its lake. This invasive species comes to the area

through animal dung /by camels and cattle's / in which it is Tran's boundary species that are the main causes of the biodiversity loss.

Overgrazing, bush encroachment and invasive species such as *Prosopis juliflora* and *Acacia drepanolobium* in Affambo are among the factors threatening the Ecosystem. Expansion of small scale and commercial agriculture such as corn is major activities taking place in this ecosystem. Furthermore, wide spread collection of firewood and charcoal making has contributed to the deterioration of this ecosystem.

A sample enumeration performed by the CSA in 2001 interviewed 894 farmers in this woreda, who held an average of 4.61 hectares of land. Of the 4.125 square kilometers of private land surveyed, 58.71% was under cultivation, 4.44% pasture, 33.92% fallow, and 6.42% was devoted to all other uses. For the land under cultivation in this woreda, 43.95% was planted in cereals like maize and sorghum; the amount of land planted in pulses/oily plant/ and vegetables is missing, but 40 hectares was planted in fruit trees, 0.09 hectares in bananas and 0.51 in guavas. The CSA reports that 19.46% of the farmers only grow crops and 81.54% only raise livestock; the returns for those who raise both are missing. Land tenure in this woreda is distributed between 84.78% own their land, 1.13% rent, and the remaining 13.75% are held under other forms.

Plant species

Ethiopia's Fifth National Report to the Convention on Biological Diversity/ENRCBD/Desert and Semi-desert Scrub land Ecosystem hosts drought tolerant species including woody species such as *Acacia bricchettiana, A. stuhlmanii, A. walwalensis, Boswellia Commiphora longipedicellata, C. staphyleifolia, Hyphaenethebaica*, and other species of *Boscia, Cadaba, Maerua, Grewia, Balanites,* and *Ziziphus*.

Grasses like *Dactylo ctenium aegyptium* and *Panicumtur gidum* species as well as succulents of such species as *Euphorbiaceae* and *Aloaceae* families are found in this ecosystem.

Table 6: **Plant species around**

LOCAL NAME	*SCINTIFIC NAME*
Adiquento	*Acacia seyal*
Dadaho	*Salvadorapersica*
Dehbey	*Acacia tortilis*
Eibeto	*Acacia asak*
Fo	*Grewiaferruginea*
Garas	*Doberaglabra*
Gishita	*Annonasenegalensis*
Kat	*Catha edulis*
Keselto	*Acacia abyssinica*
Sanu	*Cassia alexandrina*
Segentu	*Tamarixaphylla*

Source from FGD 2019 local name and scientific name of some plants

The extinct spices

Medicinal plants are their used by the people, but they are now extinct like ከሰንቱ፣ it was very important to treat abdominal pain, according to FGD.

Animal species

Wild mammals that are found in this ecosystem include Soemmerring's Gazelle, Oryx, Grant's Gazelle, Gerenuk, Lion, Leopard and Cheetah, Hyena, hippopotamus, fox, tiger, monkey, ape, wiled goat, python, Segar, crocodile, fish etc. There are no any known spices that extinct, on the opposite side the number of lion increase, time to time/source from biodiversity /.

Characteristic bird species include Kori Bustard, Arabian Bustard, Black-headed Plover, Temminck's Courser, Two-banded Courser, Tawny Pipit, Chestnut-bellied Sand Grouse, Lichstenstien's Sand grouse, Singing Bush Lark and Masked Lark. There is no evidence about the migratory bird spices, and that inhabited to the ecosystem.

Invasive spices

All the land of Affambo wereda is covered with alien Invasive spices of *proficcia prosopis julifloras*is the dominant invasive spices. This is comes by animals dung, sometimes the children consider as mice rice /yeayte mesere/. It comes before 20 years ago**.**

Table 7: Coverage of Invasive spices and land type

Land types	**In hectare**
Pouching	80,448.37 ha
Cultivated land	4165ha
Grazing	36,872.17 ha
Bushy	20,112.09 ha
Swampy &Stony	30,168.14 ha
Total area in Ha	167,600.78 ha

Based on= Source- LUPRD = 1982 E.c.

Figure 15: Invasive species

Source: Filed survey of 2012

The dominant land Cover types in percentage of the Worda is Rain feed Cultivation 0% Irrigation 4 %, Grass land 6%, Scarab land 18%, Wood land 10%, Natural forest 1%, Riparian forest 0%, Water body16% , Wet land 1%, Exposed soil/sand 21%, Exposed Rock 23% / Source- LUPRD;1982 E.c/

3.2.2 Driver and Pressure of Biodiversity for Gummare Lake Ecosystem

The driver of Lake Gemarie is alien invasive species, anthropogenic factors, human population growth, and wastes from Awash River. Main direct threats to Lake Gemarie biodiversity are habitat conversion, unsustainable utilization of biodiversity resources, invasive species, replacement of local varieties and breeds, climate change and pollution. Indirect causes of

biodiversity loss in the district are demographic Change, poverty, and lack of awareness and coordination.

Figure 16: lacks are poluted by Livestock

1. **Habitat conversion**

Conversion of natural forests, grazing lands, woodlands, and wetlands to agriculture and settlement are some of the threats to ecosystems and biodiversity in Afambo. In agriculture sector alone, the growth of crope productivty yield increment and agricultural land expansion (MoFED, 2011).

2. **Unsustainable utilization**

Unsustainable utilization (over grazing/browsing, harvesting and hunting) of biological resources is one of the major threats to biodiversity and ecosystems in afambo district. Fish species and medicinal plant species such as *Taverniera abyssinica* are notable examples that have been threatened due to over-utilization. Overgrazing/browsing by livestock in many ecosystems has also contributed to the degradation of range lands and forest ecosystems. The consequences of these impacts include ecological disturbance, loss of species and ecosystem services there by affecting livelihoods of local communities.

Farmers found with in the lake watershed were pumping water unsustainably to irrigate chat(*Catha edulis*), the main commercial crop in the area.

3. Invasive species

Invasive species cause biodiversity loss by competing native species for feed and habitat and altering the physical environment in a way that excludes native species. So far, close to 35 invasive weed species are identified in Ethiopia, and they are posing negative impacts on native biodiversity, agricultural and range lands, national parks, water ways, lakes, rivers, power dams, road sides and urban green spaces with huge economical as well as social consequences. Some of these species include: mesquites (*Prosopis juliflora*), parthenium weed (*Partheniumhysterophorus*), water hyacinth (*Eichhornia crassipes*), lantana weed (*Lantana camara*), *Acacia*species, and other weeds such as Orobanche and Cuscuta species that are identified as majorplant invaders.

Prosopis juliflora is aggressively invading pastoral areas in the Middle and Upper Awash Valleys,Afar and Somali national regional states; driving out more nutritive browse and grazing plant species by forming a thick mono specific scrub, there by increasing incidence of crop pests and damage to eyes and hooves of both domestic and wild animals eventually leading to death of the affected animals and reduction in the over all biodiversity of the areas. *Parthenium hysterophorus* is spreading rapidly in many range land areas and farm lands of Afar, national regional states,causing enormous reduction in crop and forage production. Its impact in natural habitats posesa major threat to the biodiversity in these areas. Yield losses due to *Parthenium* weed in sorghum production reached 46-97% depending on location and year.

4. Pollution

Major causes of pollution to aquatic and wetland ecosystems in afambo and lake gummare are large and small scale factories such as brewery, textile, chemical, tobacco, thread and garment, and paint factories releases their wast to awash river. Most of these factories do not have proper waste disposal systems and are dumping and/or draining their wastes into nearby aquatic and wetland ecosystems. This results incausing major damages to the biodiversity of the ecosystems through deposition of heavy metals.

Figure 17: Lake Gumere Poluted By Animals And People

5. Population growth

Table 8: Afambo district population growth from 1999 up to 2008(CSA)

year	Alasabolo	Humodayita	Horogubi	Mego	total
1999	4,881	4,881	3,923	3,747	16,647
2000	4,989	4,989	4,010	3,830	17,013
2003	5,325	5,325	4,280	4,000	18,161
2006	5,684	5,684	4,569	4,364	19,386
2008	5,937	5,937	4,772	4,558	20,248
2010	6,201	5,202	4,984	4,761	21,149
2012	6,477	5,434	5,206	4,972	22,090
2014	6,765	5,675	5,438	5,194	23,072
2016	7,066	5,928	5,680	5,425	24,099
2018	7,381	6,191	5,932	5,666	25,171

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this woreda has a total population of 24,153, of whom 13,312 are men and 10,841 women; with an area of 1,258.97 square kilometers, Afambo has a population density of 19.18. While 822 or

3.40% are urban inhabitants, a further 6,529 or 27.03% are pastoralists. A total of 4,251 households were counted in this woreda, which results in an average of 5.7 persons to a household, and 4,322 housing units. 99.96% of the population said they were Muslim.

3.2.3 Impact on Gummare Lake Biodiversity

Due to the absence of plants there is no enough water ,and quality water; as aresult most of the animals are leads to shortage of water and affected by different diseases

Especially females are more vulenerable to get water in relation to water quality there are different disease occurs in animals and humans.

Deasert occurs many times in the areas ,due to this factor animal raising people gose into other place like zone five to greaze the animals. In the area there is no forest land they utilize.

The amuont of fish is highly diminsh by the water pollution, but the community do not use the resorce for food and income.

3.2.4 Response on Gummare Lake Biodiversity

The government trie as to recover the reduced and extinct plant specie.There is not any mechanism to protect the species. There is no in-situ and ex-situ conservation method to Control of invasive species: awareness rising on and clearance of invasive species have been conducted to control the spread of these species. In Afar national regional state, for example, about 10,000ha of land has been cleared from *Prosopis juliflora*. /National Biodiversity Strategy and Action Plan/2005/

Rehabilitation and restoration: about seven million hectares of degraded area has been rehabilitee using area closure. Moreover, forest management plans have been prepared for 1.4million hectares of natural forests and about 2.9 million hectares of land has been afforested with different tree species. In years 2011 through 2013, a total of 16.8 million seedlings of different indigenous and exotic tree species have been planted in different parts of the country**.**

3.2.5 Outlook

Unless the Federal government and afar regional state government, concerned bodies and stakeholders deal and work together to protect and save the Afamboo biodiversity ecosystem in common understanding, the Afamboo biodiversity ecosystem is in great risk and it's difficult to control the future risk. Because, the biodiversity of the forest ecosystem is destroyed severly from time to time as the forest is destruct by fire for, settlement and other purposes; this will lead to the total loss of biodiversity species of the forest ecosystem.

3.2.6 Recommendation

In general Research should be conducted on Lake Gumerie ecosystem, acts up on minimum interventions on the forest. Repair rather than replace by other species like eucalyptus tree.

The forests play a vital role in tackling global warming. And so, the surrounding communities need to thoroughly work towards the conservation and sustainable use of forests. They have to pay attention to the maintenance of the carbon stocks that these forests hold. At the same time, the government must respect the rights of the local communities and indigenous peoples that depend on the woodlands. The community and the government have to greatly help in minimizing the impact of forest degradation and lake pollution. The community and the government have the responsibility to take care of the habitat they have – the planet Earth. The communities have also to coordinate with the local Forestry, Environment and/or Natural Resources office in their area and find out what their forests and immediate environment needs. Conducts ecological principles of conservation methods, such as Biodiversity are supported by protection of any species and varieties, Habitat maintenance is fundamental to species conservation, Habitat disturbances reshape an ecosystem. We can start planting trees at an individual community level to restore our degraded environments.

3.3. Climate change/ Variability of Gummare Lake Ecosystem

3.3.1 State and Trend of Climate Change/Variability for Gummare Lake Ecosystem

Climate

Climate is generally defined as the average state of the atmosphere for a given time scale and for a specified geographical region Ocean, land surface, ice and snow surface and biosphere (both terrestrial and marine) which are directly interact with the atmosphere and determine the climate of the atmosphere (Houghton, 2002).

According to (IPCC, 2014) Annex II, Climate defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the WMO.

Climate Change and variability

Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.

This fact sheet was done by using Afambo meteorological data and analyzed the data using excel. Gridded data of Max and Min temperature and rainfall data For Afambo, Meteorological data collected for 27 years (1989-2016) from NMA.

Based on the available data state and trend of rainfall, maximum and minimum Temperature was analyzed. FGD were carried out across four Kebelles such as, Maygo, Genetay, Daka and Orgobit Keble's are found in Gummare Lake ecosystem Afambo Woreda

Gummare Lake is one of a chain of lakes into which the Awash River empties its waters and it lies on a roughly north-south axis, 15 kilometers long by five km wide, having about 6,000 hectares of open water. Gummare receives its inflow from the Awash on its northwestern shore, and its outflow is on its southern shores where a channel joins the lake with Lake Afambo (https://en.wikipedia.org/wiki/Lake_Gummare).

3.3.1.1. State and trend of Rainfall for Gummare Lake Ecosystem

The rainy seasons in Ethiopia are influenced by different global and regional rain-bearing factors. The main features that affect the *Kiremt* rain include the ITCZ, Tropical Easterly Jet (TEJ), South Atlantic Ocean and South West Indian Ocean anticyclone, East African Low Level Jet (EALLJ) or Somali Jet and ENSO. Particularly ITCZ, Subtropical Westerly Jet (SWJ) stream, Arabian High, the frequency of tropical cyclones over the Southwest Indian Ocean and ENSO affect the global and regional weather features that affect the Belg rain (Dawit, 2010).

Ethiopia has different rainy seasons influenced by topographic variation and rain-bearing system

As a result of the topographic variation and geographical location, rainfall in Ethiopia characterized by high spatial and temporal variability. Central, eastern and northern parts of Ethiopia experience a bimodal rainfall pattern. (www.nationalparks-worldwide.info/eaf/ethiopia/ethiopia-weather.html. Accordingly, Gummare Lake ecosystem has bimodal rainfall pattern which is influenced by the above mentioned rain baring factors and topographic variation.

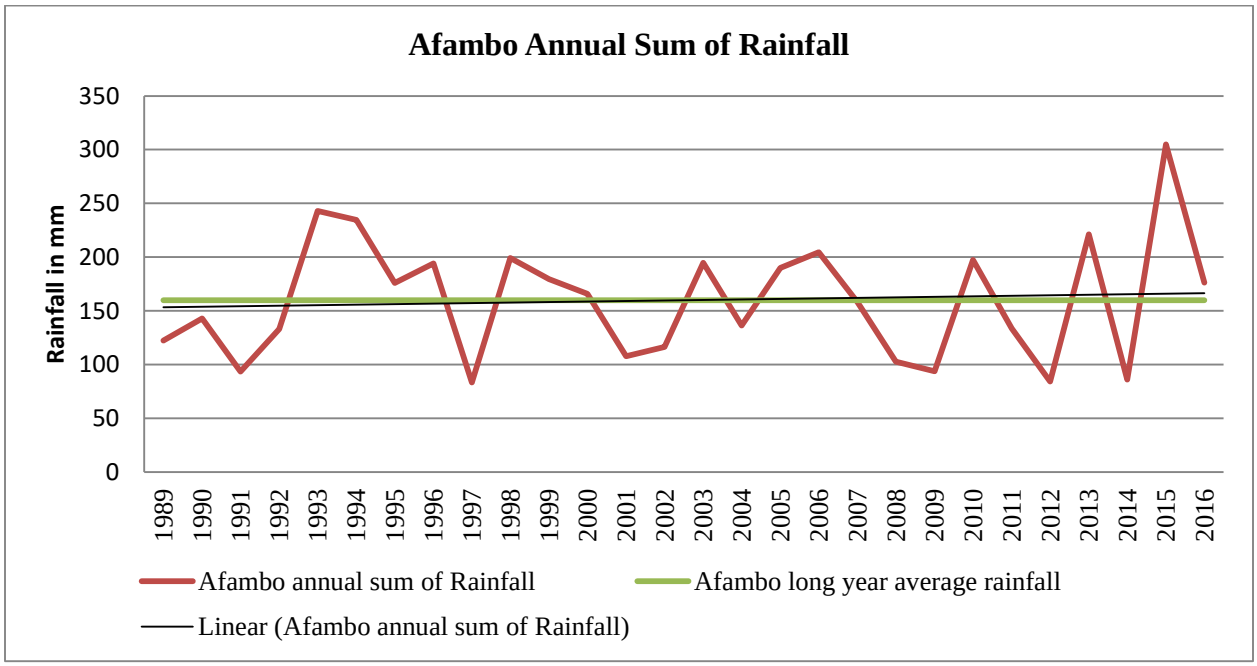

Figure 18: Afambo Annual Sum of Rainfall from 1989-2016

Figure1show that in Afambo the highest and the lowest annual sum of rainfall was recorded in 2015 and in 1997 it was reached 304.8mm and 83.56mm respectively. Based on the available data the average annual sum of rainfall for 27 years was 159.8mm. Rainfall variability was high year to year and in the figure 1 the line that indicates the rainfall trained of Afambo which is

increasing trend. In1993,1994,1995, 1996,1998,1999, 2003,2005,2006,2010,2013,2015 and 2016 rainfall was recorded above long year average rainfall. Similarly FGD participants explained that there was rain fall variability, shifting of rainfall seasons, changing of cessation and onset of rainfall period.

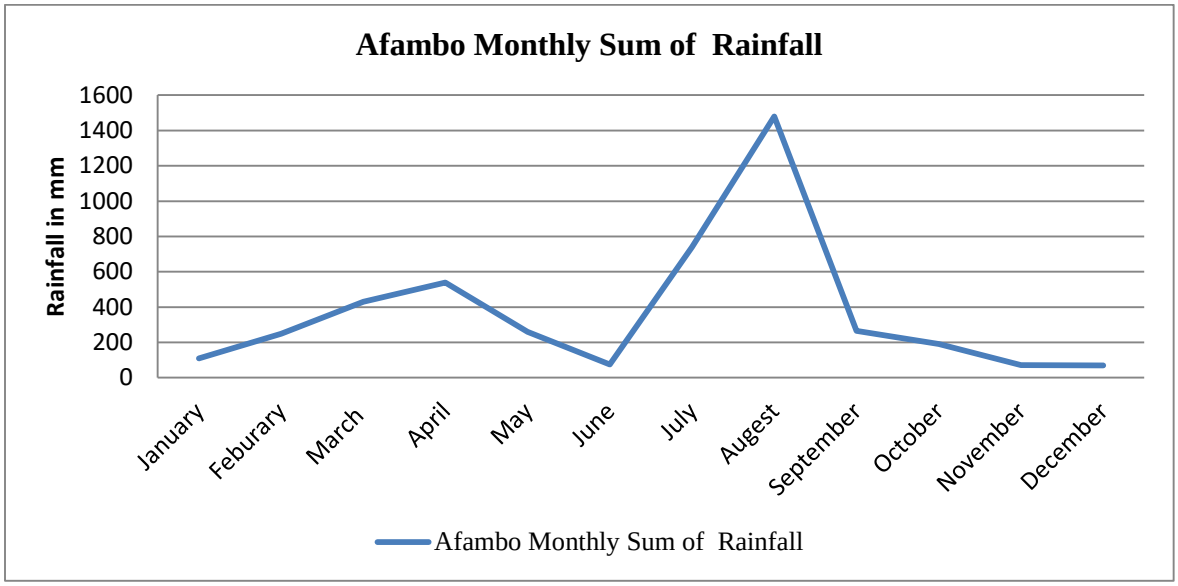

Figure 19: AfamboMonthly Average Rainfall for the last 14 years.

Ethiopia, broadly speaking has three seasons such as, the short rains season, known as the Belg, runs from February to May, the long rains season, known as the Kiremt, which is between June and mid-September and Bega, typically occurs between October and January, and is characterized by generally dry weather over most part of the country (MetOffice, 2016).Hence, figure 2shows as in Afambo there was better coverage of rainfall during Kiremt season and the peak rainfall was recorded during August. Relatively short rainfall was occurred in Belg season, the peak Belg rainfall was recorded in April. The Gummare Lake has bimodal rainfall type have got rainfall during Kiremt and Belg seasons.

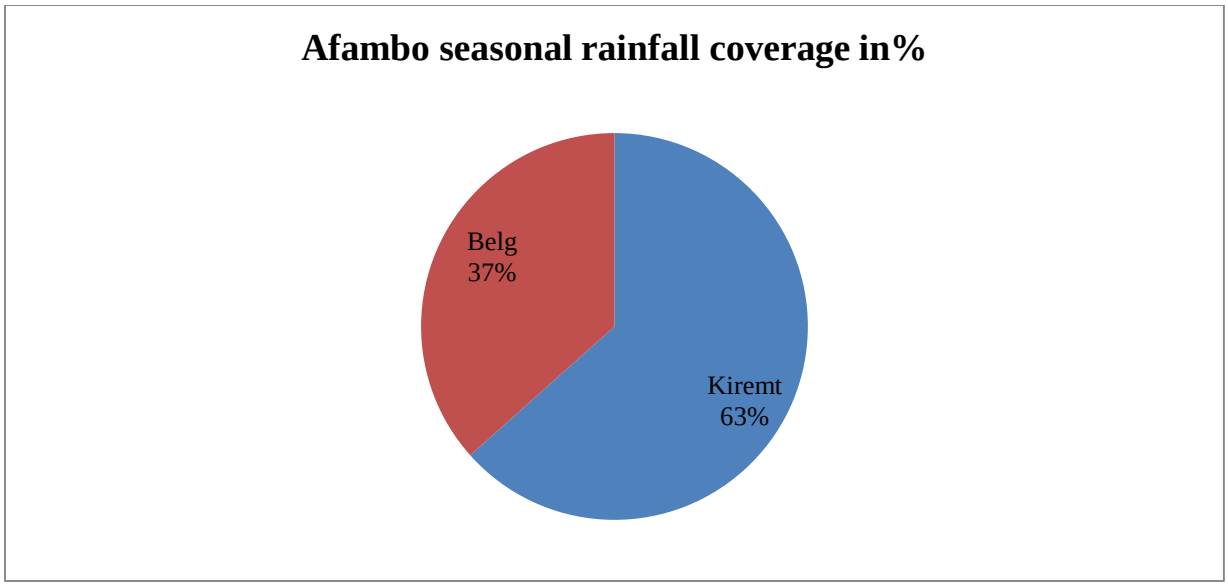

Figure 20: Afambo seasonal rainfall coverage from 2003-2018

Around 63% of the rainfall occurs in between June and September (Kiremt season).In Kiremt seasons there is an increase in the probability of above-average rainfall that bring the most rainfall to Gummare Lake. From the available meteorological data of Afambo the average rainfall of Kiremt and Belg season was recorded around 639.7mm and 369.3mm respectively. The Belg rainfall is important for crop production while, the participants mentioned that due to reduction of the Belg rain it was become difficult to use the Belg rain as the previous years. It became lesser and lesser.

3.3.1.2 State and Trend of Temperature for Gummare Lake Ecosystem

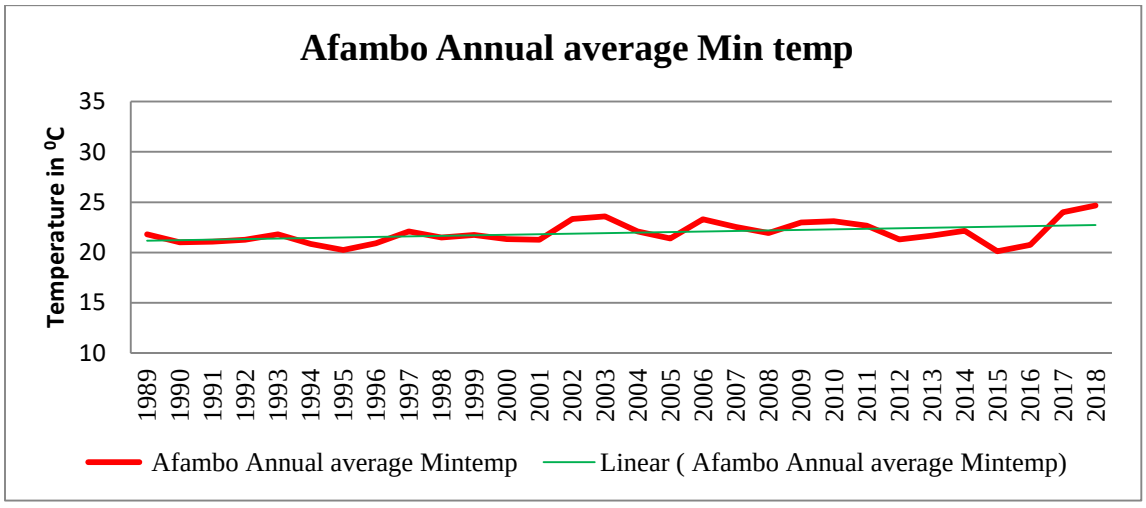

Figure 21: Afambo Annual Average Min Temp

Figure 4 show that the lowest Monthly Average annual minimum Temperature was 20.1^{o}C recorded in 2015 and peak value was 24.6^{o}C recorded in 2018 and monthly minimum temperature trend increased year to year.

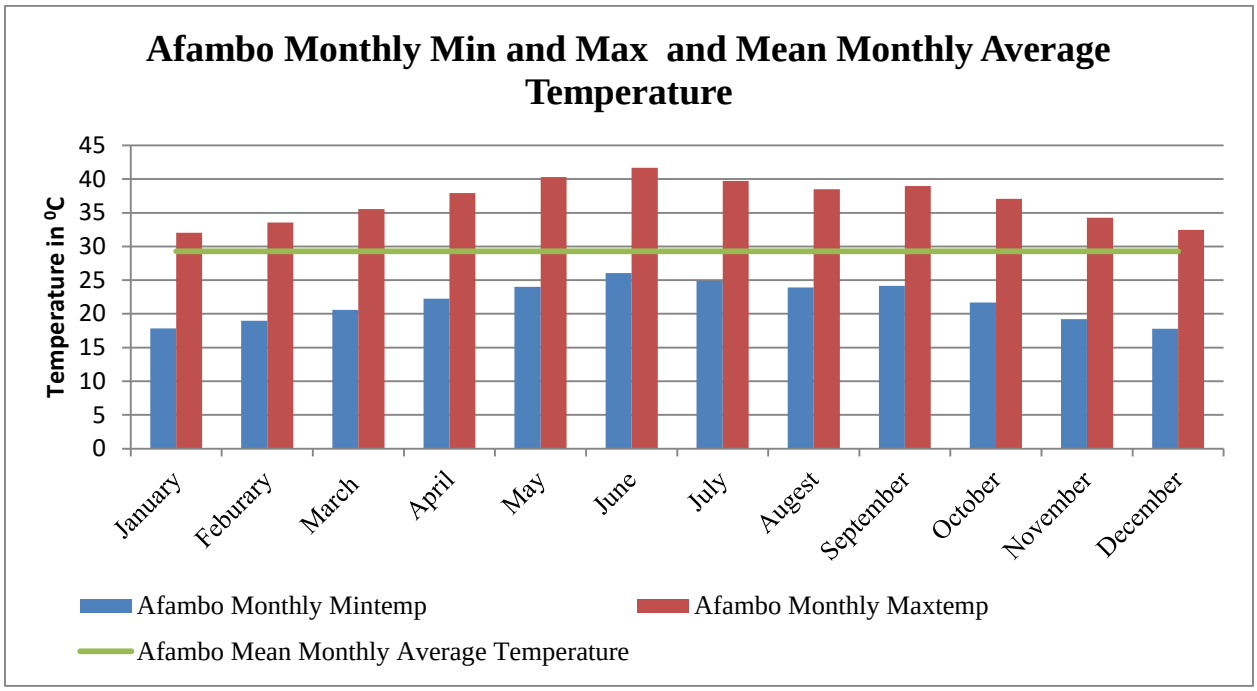

Figure 22 : Afambo Monthly Average Minimum, Maximum and Mean Monthly Average Temperature from 2004-2018

From figure 5 the range of monthly minimum temperature was in between 17.7^{o}C up to 26.1^{o}C, the range of monthly average maximum temperature was in between 32.0^{o}C up to 41.6^{o}C and the mean monthly average temperature was 29.3^{o}C.

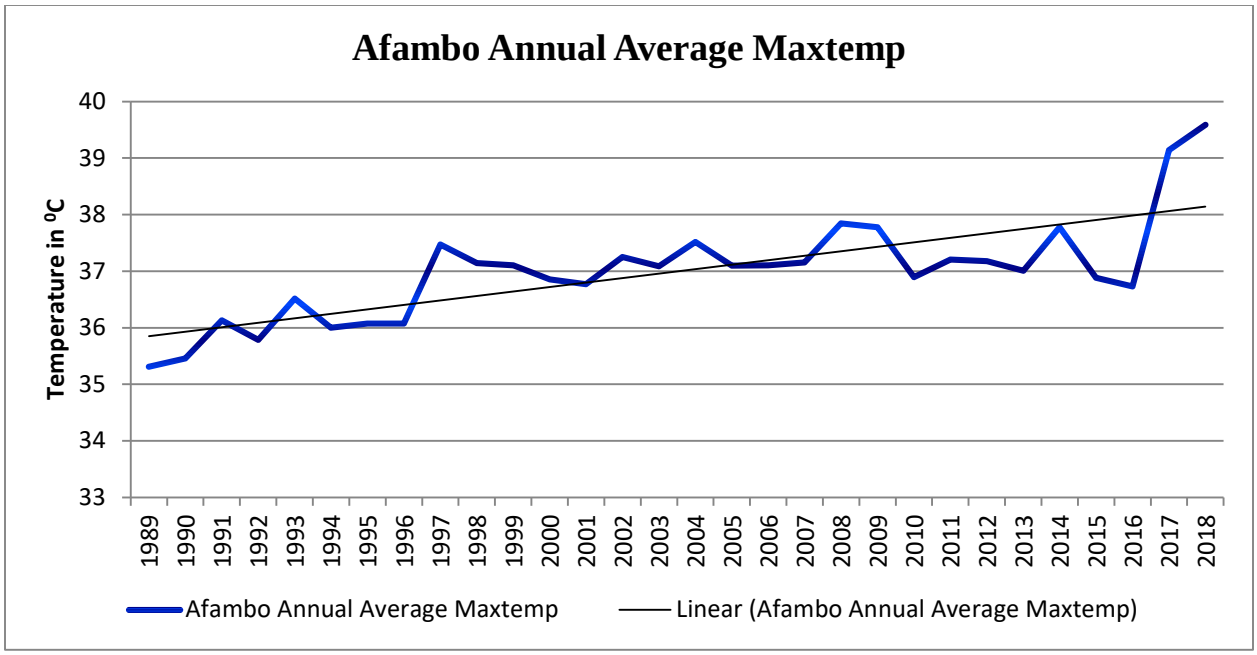

Figure 23: Afambo Annual Average Maximum Temperature

From figure 6 we can see that the annual average maximum temperature trend is increase. In 1989 and 2018 the lowest and the peak average annual maximum temperature value was 35.5°C and 39.6°C respectively.

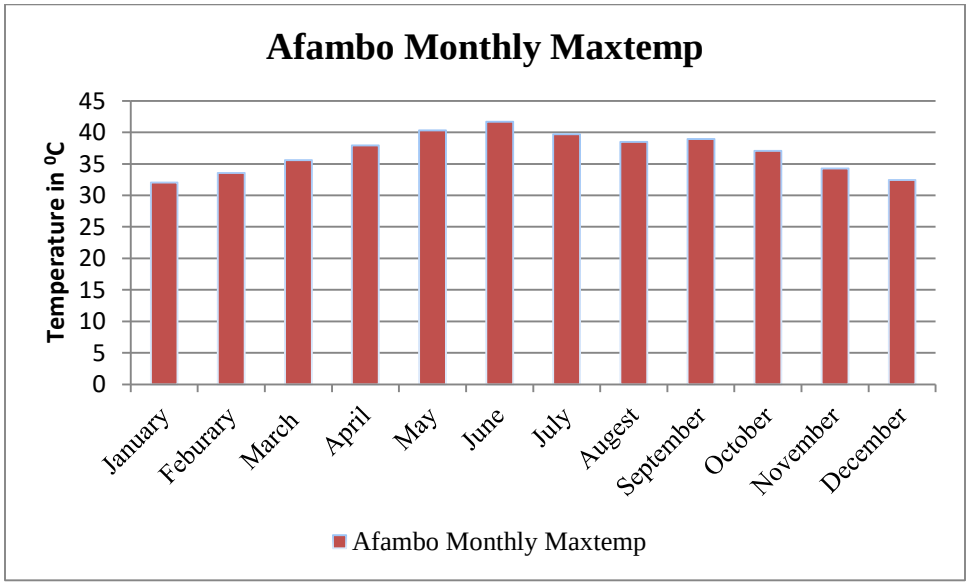

Figure 24: Afambo Monthly Average Max Temperature

Figure 7 shows that during May and June maximum monthly temperature was reached more than 40°C and the peak and lowest maximum monthly temperature was recorded in June and January month which was 41.6°C and 32.0°C respectively.

3.3.2 Driver and Pressure for Climate change/Variability of Gummare Lake Ecosystem

Due to human and natural factors the Gummare Lake is decreasing. As FGD participants explained that natural factors like the flow of Awash River to Gummare Lake during rainfall season which affect the Lake by increasing sedimentation which decrease the level of the lake. Overpopulation, intensive overgrazing practice, and deforestation, climate variability, waste dumping and sedimentation were factors that contributed to the depletion of Lake Gummare. Therefore, the main drivers for climate variably for Gummare Lake are over population and Agricultural expansions, huge number of animal population and globally increasing of GHG in the atmosphere.

Over population; on the FGD the participants explained that the number of population continuously grow, as a result the need to provide housing, agricultural land expansion and fuel wood consumption also increases these exert pressure on natural resource like on forest.

- **An agricultural expansion is**: the community surrounding the Gummare Lake their economic activity is based on agro-pastoralist. Agricultural is one sector to contribute global greenhouse gases. Agricultural processes comprise 54% of methane emissions, roughly 80% of nitrous oxide emissions, and virtually all carbon dioxide emissions tied to land use (EPA, CRGE of Ethiopia, 2011).

- **Huge number of animal population** the community surrounding the Gummare Lake mostly they were breeding large number of goat. Farming livestock-cattle, sheep goat, pigs and chickens contributes around 6 billion tons of greenhouse gases (carbon dioxide, methane and nitrous oxide to the atmosphere each year while estimates vary, this could represent up to 18%of global emissions. Around 1.6-2.7 billion tons of greenhouse gases each year, mostly methane, are produced from livestock digestion. Another 1.3-2 billion tons of nitrous oxide come from producing feed for livestock and the final 1.6 billion tones come from land use change, such as clearing for animal pasture (Marrio H. C., 2016)

The most important greenhouse gases from animal agriculture are methane and nitrous oxide. Methane, mainly produced by enteric fermentation and manure storage, is a gas which has an effect on global warming 28 times higher than carbon dioxide. Accordingly in Afambo Woreda it was estimated that 6.3Gg of Methane which is 157.4Gg Carbon dioxide equivalent amount produced from animal enteric fermentation. Nitrous oxide, arising from manure storage and Use of Organic/inorganic fertilizers, is a molecule with a global warming potential 265 times higher than carbon dioxide (Giampiro.G, 2019).

The main pressures for climate variability for Gummare Lake ecosystem are

- **Deforestation**

  Forests are a stabilizing force for the climate, regulate ecosystems, play an integral part in the carbon cycle, support livelihoods, and supply goods and services that can drive sustainable growth (IUCN, 2015)while, in Gummare lake ecosystem deforestation is one of the Pressures for regional climate change and increasing greenhouse gas emissions to the atmosphere. As FGD participants mentioned that they were deforest forest for agriculture, for fuel and for house construction.

- **Over grazing**

  Livestock are also the principal source of GHG emissions in the country and a significant contributor to emissions globally. Livestock generates greenhouse gases mainly in the form of methane emissions arising from digestion processes (mostly attributable to ruminant animals like goat) and nitrous oxide emissions arising from excretions. Livestock emissions are estimated to amount to 65 MtCO2e-35% of Ethiopia's total emissions today (Ethiopian CRGE, 2011). Due to large number of goat found in the area the range land vegetation cover will be depreciate. Research found that decrease in vegetation cover reduces Evapotranspiration thereby allowing an increase in local temperature levels (Mingyuan, 2012).

- **Globally increasing of GHG:-** The WMO Greenhouse Gas Bulletin showed that globally averaged concentrations of carbon dioxide (CO_2) reached 407.8 parts per million

in 2018, up from 405.5 parts per million (ppm) in 2017. Globally increasing of GHG that cause global warming.

- **Flash Flood**

  Extreme weather events like bushfires, cyclones, droughts and floods are becoming more frequent and more intense due to increasing of global warming. In Gummare Lake due to the occurrence of flash flood that affect the lake by increasing sedimentation. As FGD participants explained that flash flood come from Awash River that greatly affects the Lake.

3.3.3 Impact of climate change and variability on Gummare Lake Ecosystem

Climate change will have wide-ranging effects on the environment, and on socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity. Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding (UNFCCC, 2007). Accordingly, in Gummare Lake ecosystem flood and drought occurred in different year and affect the community and the environment. Deterioration of the Gummare Lake ecosystem that affected different biodiversity that live in the Lake and the surrounding area, resulting in the loss of fishes, crocodiles, herbs, grasses and tree species.

On the FGD the participants were clarified that yield production decreased due to shortage of rainfall and increasing of climate variability and also they supposed that due to deforestation, drought was occurred frequently as a result the community become vulnerable to food insecurity and increasing expansion of desertification.

The participate of Orgobit Kebelle they were explained that due to flood around 500hactar land become damaged, around 3Tabiyas peoples were displaced and large coverage of range land was submerged. Due to climate change the rainfall not fallen throughout the year and unseasonal rainfall also occurred. Even though in some year the rainfall amount was better but the distribution was not good. Harvesting seasons also changed due to changing of rainfall seasons for instance in the previous years they harvest during July and August month but now changed to September and October month.

The participant of Daka kebele they were described that in the previous years there were seasonal rainfall but now the rainfall was fall only for two months in a year and also the amount was decreased when compare with the previous years. Since starting from 1986 the Daka Kebele is drought vulnerable area and due to climate change the drought condition become harsh drought was the main problem for them, as a result it was become difficult to feed their livestock so they travel to Assaita with their livestock in order to find animal forage. Due to drought and flood more than 300 goat, more than 100 camel, different livestock and peoples of the community were died.

Global temperature were increasing due to increasing greenhouse gases in the atmosphere this conditions largely affect developing countries like Ethiopia(Gebeyehu, 2016). On the FGD the participants of Daka Kebele were explained that Due to climate change the temperature were increased while on the Orgobit Kebelle the temperature condition were decreased.

Climate change/variability affects the livelihood system of the people and those habitats living on the land and in the water. According to EDRI (2015), report increases in temperature that cause may change the ecosystem, were some species is forced out their habitat, some may be extinct while other species will introduce.

Maygo Kebele participants were explained that around 150 heactar of land was damaged by flood.

3.3.4 Response to Climate Change and Variability for Gummare Lake Ecosystem

The current response measures or practices

To protect the state of the climate and to reduce the impact of climate change and variability the community, different sectors, the government and NGO were not done anything. There are national and international climate change policies are available to reduce the impact of climate change even though on Afambo Woreda are not implemented such as:-

International level climate change response

UNFCCC

The UNFCCC with its successions (Kyoto Protocol with its Doha amendments and the Paris Agreement) has been ratified and the national government is acting in accordance with the basic principles of the Convention, Common but Differentiated Responsibilities and Respective Capacities. Currently Ethiopia prepared and implementing its INDC (Intended Nationally Determined Contributions). The focal point to the Convention, Ministry of Environment, Forest and Climate Change (MEFCC) was institutionally rearranged to consider and mainstream climate change in Ethiopia's development activities on some selected sectors and all regions as well as city administration of Dire Dawa and Addis Ababa.

Ethiopia currently not only participated in annual COPs nationally and as member of African Group, LDC and G77 and China but also leads climate negotiation groups such as LDCs. Ethiopia is also a president for Climate Vulnerable Forum (CVF) which consists of a group of countries that are highly affected by adverse impacts of climate change

Sustainable Development Goals:-

Goal 11.Make cities and human settlements inclusive, safe, resilient and sustainable

Goal 13.Take urgent action to combat climate change and its impacts. Much emphasis should be given to these two goals. (Many targets are there to be implemented by 2030 ready those targets)

National Responses to climate change

Environmental policy of Ethiopia:-

From the perspective of the multi-sectorial impacts of climate change, the environmental policy of Ethiopia is worth considering. The policy was formulated in 1997 and **considers climate change as a cross-cutting issue (EPA, 1997).** The policy underlines the importance of incorporating rural-urban migration, human settlement and environmental health concerns into regional, district and local level planning and development activities and improved environmental sanitation to the federal and regional agendas for achieving sustainable urban development. The policy gives due attention to industrial water pollution. personal or communal appliances or any other external sources and establish clear linkages

between the control of pollution and other policy areas including water resources, agriculture, human settlements, health and disaster prevention and preparedness.

The national Adaptation Program of Action (NAPA, 2007): identified urgent adaptation needs and priority projects.

CRGE (2011):-. Ethiopia is committed to building a Climate-Resilient Green Economy (CRGE) that aims to ensure economic development that pursues a low emissions path while building resilience to adapt to climate change. The green economy strategy focuses primarily on emission intensive sectors. The climate resilience strategy, on the other hand, tries to address risk reduction by focusing on two aspects – integrated disaster risk reduction and management and sectorial as well as regional climate adaptation strategy and action plans.To avoid the negative impact due to increasing of GHG emissions and unsustainable use of natural resource the Federal government of Ethiopia has developed a strategy to enhancing the adaptive capacity and reducing climate variability and change thus, the country's Climate-Resilient Green Economy (CRGE). It is now starting to transform the strategy into action. This CRGE must be practiced in Gummare Lake ecosystem areas.

The green economy plan is based on four pillars:

1. Improving crop and livestock production practices for higher food security and farmer income while reducing emissions
2. Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks
3. Expanding electricity generation from renewable sources of energy for domestic and regional markets
4. Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

As part of the strategy, the government has selected four initiatives

For fast-track implementation: exploiting the vast hydropower potential; large-scale promotion of advanced rural cooking technologies; efficiency improvements to the livestock value chain; and Reducing Emissions from Deforestation and Forest Degradation (REDD)

The Climate-Resilient Green Economy (CRGE) initiative was started in 2011, giving the initiative three complementary objectives:

1 Fostering economic development and growth

2 Ensuring abatement and avoidance of future emissions, i.e., transition to green economy

3 Improving resilience to climate change.

According to UNDP (2011), UNDP Ethiopia is supporting Ethiopia's transition to a climate resilient green economy in three thematic areas:

i. Cross-cutting Support for Formulation and Piloting of Low-Emission Climate-Resilient Development Strategies
ii. Pursuing a low emission economic growth
iii. Building Resilience through (a) Adaptation and (b) Disaster Risk Management

The Ethiopian Program of Adaptation to Climate Change (EPACC, 2013):- The main objective of EPACC is to create the foundation for a carbon-neutral and climate-resilient path towards sustainable development in the country.

National Adaptation Plan (NAP, 2017): document that enable Ethiopia to approve climate fund support to respond drought. It is comprehensive document comprises of 18 initiatives integrating many of the sectors to implement the national plan.

A Brief on the National Disaster Prevention and Preparedness Strategy for Ethiopia (1989):-the strategy intended to concentrate on how long-term environmentally sustainable approach to greater agricultural productivity, soil and conservation and alternative means of income generation can relate to the short – term means of disaster preparedness.

National Policy and Strategy on Disaster Risk Management (2013):- The main objective of the Policy is to reduce disaster risks and potential damage caused by a disaster through establishing a comprehensive and coordinated disaster risk management system in the context of sustainable development. To reduce and eventually prevent disaster risk and vulnerability that pose challenges to development through enhancing the culture of integrating disaster risk reduction into development plans and programs as well as by focusing on and implementing activities to be carried out before, during, and after the disaster period to address underlying factors of recurrent disasters. Specifically, In times of disasters, to save lives, protect livelihoods, and ensure all disaster affected population are provided with recovery and rehabilitation assistances, to reduce dependency on and expectations for relief aid by bringing attitudinal change and building resilience of vulnerable people.

3.3.5 Outlook

Deforestation, forest degradation and land use now account for around 24% of total global emissions, more than the entire global transportation sector (IUCN, 2015). If deforestation and forest degradation continue regional climate change/variability will increases this disrepute hydrological cycle as a result, unexpected hazards like flood, drought, pests and diseases etc. will become accelerated so this condition will affect community livelihood and the environment at all and reduce the capacity of Gummare Lake ecosystem to store a significant amount of carbon.

At the global level warming is currently increasing at 0.3-0.7 ^{o}C per 30 years (Follandetal, 2018). Accordingly based on the available meteorological data in Afambo average temperature was increased by 0.6^{o}C. If this condition continuous without any strong adaptation option it will lead increase evapotranspiration and this cause decrease the water level of Gummare Lake.

3.3.6 Recommendation

- The main cause climate changes for Gummare Lakes area are
- ✓ Agriculture ,
- ✓ Deforestation,
- ✓ Overgrazing,
- ✓ Sedimentation from Awash River during flash flood , if the problem continued without any solution, the benefit get from Gummare Lake like environmental and economic benefit will be diminish so, to reduce the impact different adaptation options are needed.

To increase the quality of Gummare Lake Integrated Water conservation work and watershed management must be done together with the community, governments, NGO and interested bodies.

Instead of using trees for energy purposes it needs develop and using renewable energy unless this makes difficult to improve living standards without keeping the environment and the climate.

Even though we have different global and regional climate responses none of them are not implemented on the Afambo Woreda so, the different bodies should focus and done on the implementation in order to reduce the different impact of climate change. Soil conservation

measures should be done in order to reduce soil erosion & siltation on Gummare Lake ecosystem.

The concerned bodies should give emphasis for climate change impacts and for the Awshe river flash flood that bring different pollutants and siltation to Gummare Lake in order to manage and tackle droughts and flood.

Environmental education and Farmers have been encouraged to adopt climate-smart agriculture with a focus on dealing with water scarcity and drought.

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