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FACT-SHEET OF Shengema MOUNTAINOUS FOREST

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| **Prepared by** | **Position** |
| --- | --- |
| M.r Tilahun Alemu | MA in Environment Land Resource Management (Information Management Directorate) |
| M.rs Kidist Yewalashet | Msc in climate change and Society |
| M.r Wasihun Yimer | Bsc in Natural Resource Management |
| M.rs Banchaymolu Terefe | Msc in Water Resource Management |
| M.r Endalkachew Yilkal | BA in Biology |
| M.r Fekade Melekot | BA in Geography |
| M.r Gedamu Yenesewu | BA in Geography |
| M.r Kefiyalew Gobena | Bsc Natural Resource Management |
| Facilitated by M.r Anteneh Teshome | MA in Climate Change and Adaptation (DJ, State of the Environment Reporting) |

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## Abbreviations

CSA: Central Statistics Agency

CRGE:Climate Resilient Green Economy

DLUMDR: Department of Land use Management directorate report 2011

DPSIR: Driver, Pressure, State, Impact and Response

FGD: Focus Group Discussion

GDP: Gross Domestic Product

GTP: Growth and Transformation Plan

GHG: Green House Gas

JARC: Jinka Agricultural Research Center Sep, (2016)
KI: Key informants

MAOD: Meteorology Agency office Data

OMF: Omo Micro Finance

OMFSAB: Omo Micro Finance Debub Ari Branch

SNNPs: Debub ern Nations, Nationality and

Peoples'

SAWFEDO: Debub Ari Woreda Finance and economic development office,

2010 SOZ: Debub Omo zone

SAWEO: Debub Ari Woreda Education Office

SMFE: Shngema Mountain Forest Ecosyste

SMLFE: Shangam Mountains Level forest ecosystem

SOZ: Debub Omo Zone

SOZANRDO: Debub Omo Zone Agriculture and Natural Resource Development office

CRGE: Climate Resilient Green Economy
FGD: Focus Group Discussion
D.A: Debub Ari
EDRI: Ethiopian development research institute

IPCC: Intergovernmental Panel on Climate Change

IUCN: International Union for Conservation Nature

UNFCCC: United Nations Framework Convention on Climate Change

WMO: World Meteorological Organization.

AGP—Agricultural Growth Program

CBD—Conventions on Biological Diversity

CDM- Clean Development Mechanism

FAO –Food and Agriculture Organization of the United Nations

FGD Focus Group Discussion

NGOS—Non Governmental Organization

SNNP— Debub Nation Nationality peoples

Region

UNFCCC-United Nation Frame work Convention on Climate Change

# 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 (2016). 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.

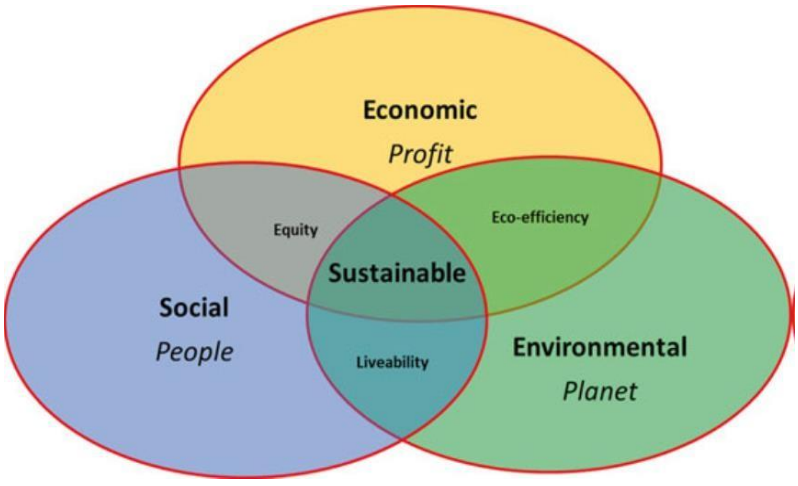



Figure 1: The Three Dimensions of Sustainability

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-well being 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 Ministry of Environment, Forest and Climate change has conducted assessment on the Shengama Mountain Forest 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 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 national 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 well being (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. Social and Economic Environment

## 2.1. 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).

Traditionally, Ethiopia and SNNPR are majorly characterized by three agro climatic or agro-ecological zones (Dejene, 2003; Mengistu 2006b; Chamberlin and Schmidt, 2012):

- *Kolla:* the tropical zone between 500 and 1,500m a.s.l., warm and semi-arid with an annual rainfall of approximately 200 to 800mm
- *Weyna dega:* the sub-tropical zone between 1,500 and 2,300m a.s.l., cool and sub-humid with an annual rainfall from 800 to 1,200mm
- *Dega:* the cool zone between 2,300m and 3,200m a.s.l., cool and humid with an annual rainfall from 900 to 1,200mm

Therefore; the three districts were characterized and the results presented based on this classification.

Debub Omo Zone is a very critical Tourism area of SNNP region located at the Debub ern part of Ethiopia. The common economic employment is depending on Agriculture. Tourism has been used as a tool for socio-economic development (Christie, et al., 2013) as well as national development (World Economic Forum, 2015).Tourism has been growing rapidly in Ethiopia. According to IMF estimates, Ethiopia averaged annual growth rates of 10.8% between 2004 and 2014, as measured by GDP per capita (SNNPTB). Debub Omo Zone is the important Tourism Area of SNNP region mostly in and Cultural Attractions and Natural Attractions.

Cultural Attractions are, Body decorations and Clothing, Traditional Dancing/ Ivangadi /, Ekuli / Bull Jumping/, and Open Market/. Natural Attractions/ Resources are Mago national parks, omo national park, Murule Control hunting Area, Walishet Sala Control Hunting Area, and Tame

Wailed Life Reserve Area. There are two national parks in Debub Omo Zone; these are omo national park and mago national parks. On the Omo River there are two dams such as gibe II and gibe III, have Omokuraz sugar factories. Debub omo is the most divers' people in SNNP of the region. There are 18 ethnic groups of people; among those seven (7) largest groups.

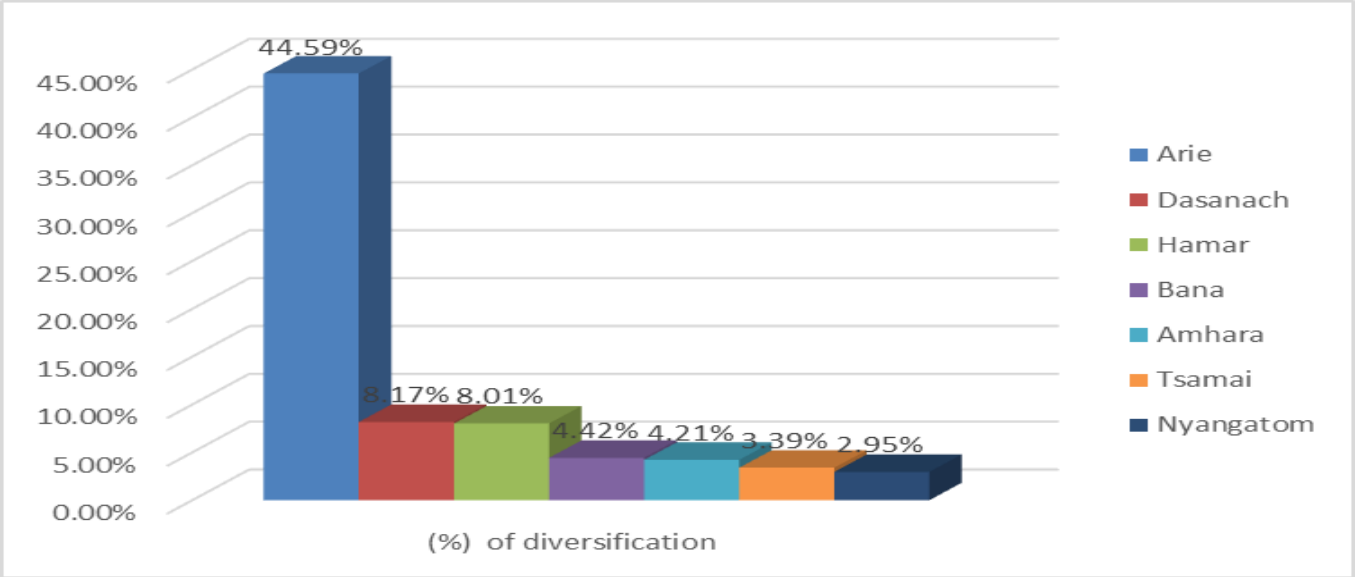



Figure 2: Ethnic groups of Debub Omo zone

Source: - SOZAO 2010

The largest ethnic groups are **Ari, Dasanach and Hamar** which accounts 44.59, 8.17, and 8.01% respectively. From figure 2 Ari people mostly found in SA *woreda* 42 km from jink. This is bordering with Semen Ari woreda in north, Mago national park in South, Salamago woreda in west, Malle woreda in east and Bena Tsemay woreda in South East. The Community in SAW mainly speaks *Aregna*, which is also considered as the first language of *Debub Omo Zone*.

Thus for the purpose of this study data was collected by discussing with development agents, key informants, and group discussion living in the four kebeles, namely (*Waset, Shengema Bili, Shengema Arki,and Dordora*). Religious institutions exist in this *woreda* mainly includes *Orthodox, Protestant and Muslim*. Debub Ari is one of nine *woreda's* in Debub Omo zone with an area of 1,520 $km^2$ (152,100 hectares ) and located b/n $5^0$.40' 22" N- & $06^0$.12'2" N Latitude to $36^0$ 18' 22" E – $36^0$ 44' 10". The lowest and highest altitude of the *woreda* ranges between 619 m a.s.l - 3282 m a. s. l and the SMFE ranges b/n 1535 m a. s. l -3282 m a. s. l.

Thus most part of the woreda has woina-dega agro ecologies (65) whereas dega and kola constitutes 30 % and 5%, respectively. The mean annual rainfall ranges between 800 - 1600 mm. The gazer Average minimum and maximum temperature ranges between 11.25 $^{0}$ c and 25.15 $^{0}$ c (MAo).

### 2.1.1. State and trend of social environment

#### 2.1.1.1. 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 (Aynalem, undated) Teller *et al* (2007).

According to the 2007 census, the population size of Debub ari *woreda was* 191,867, whereas in 2018 was 257,200 .which shows high population increase in the areas, Based on the 2018 data around 244,471, of the population live in rural areas and the remaining 12,729 lives in urban areas, where the male and female constitutes around 50.3% and male 49.7% respectively. According to the Ethiopian National Housing and Population Census of year 2015, the population of the Debub Ari *woreda* was 241,468, based on Debub Ari *woreda* population growth rate 2.9 percent, the population of the *woreda* is projected to be 264,659 in year 2019. The details of the population data of year 2015-2018 is presented in table 1(population trend of Debub Ari *woreda)Source*: - SAWFEDO (2018).

Table 1: Population Trend Debub Ari Woreda 2015-2018.

| YEAR(G.C) | rural population | | | Urban . population | | | TOTAL P0 PN. | | |
|---|---|---|---|---|---|---|---|---|---|
| | MALE | FEMALE | TOTAL | MALE | FEMALE | TOTAL | MALE | FEMALE | TOTAL |
| 2015 | 114280 | 119563 | 233843 | 3887 | 3794 | 7625 | 118114 | 123354 | 241468 |
| 2016 | 115114 | 118642 | 233756 | 3947 | 3954 | 7901 | 1118951 | 124259 | 243210 |
| 2017 | 116757 | 122232 | 238989 | 5633 | 5617 | 11250 | 122390 | 127849 | 250239 |
| 2018 | 120539 | 123932 | 224471 | 5775 | 6954 | 12729 | 126,314 | 130,886 | 257,200 |

*Source*: - DAWFEDO (2018)

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. The consequences which we saw in the nearby Shengama Mountain Forest Ecosystem proves that the forest cover has reduced and changed to farm land, grazing land and quarry to Extract row material for construction of house in the *woreda* and nearby towns. In additions the community used Bamboo forest for fencing system around the house and farming area.

**2.1.1.2. 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". Accordingly, regions and City administrations are working in line with this objective.

Thus, before 2017 and 2018 the number of students both male and female have increased (Table 2) No of students in Debub Ari *woreda for 2017and 2018).*

When considering the enrolment of female students in primary education, in 2017 it was 47.4% and in 2018 were 47.2. Whereas for male students it was 52.57% (2017) and 52.8% (2018). But for Secondary Education it was 62.17% (2017) and 59.93% (2018) for female students and 62.17% (2017) and 59.93% (2018) for male students. Due to the fact that, in primary education both male and female students were decreased, when compared to 2017 from 2018.

**Table 2: Students of Debub Ari *Woreda* in Academic year**

| NO | Level of School | Students in Debub Ari Woreda | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2017 | | | 2018 | | |
| | | Male | Female | Total | Male | Female | Total |
| 1 | Informal Education (less than 7/8 years | 3796 | 3529 | 7325 | 6620 | 6136 | 12756 |
| 2 | Primary School ( 1-8) | 33097 | 29853 | 62950 | 33093 | 29553 | 62646 |
| 3 | SS/High School ( 9-12) | 3235 | 1968 | 5203 | 3389 | 2265 | 5654 |
| | Total | 40128 | 35350 | 75478 | 43102 | 37954 | 81056 |

Source: D A w A and E O R (2017-2018)

School infrastructures

Education is the most important factor that plays a leading role in Human development.

According to Debub Ari Education office report in Debub Ari *woreda* 83 primary school, 7 Secondary school, 1 ( one ) Preparatory school, 1 (one) KG School are governmental.

Table 3: Number of Schools and Teachers of Debub Ari Woreda

| No | Level of School | Academic year | | Amount of Teachers in Debub Ari *Woreda* | | | Ratio of Teacher/ Students 2018 | Ratio of Students /class 2018 | Ratio of Books/ Students 2018 |
|---|---|---|---|---|---|---|---|---|---|
| | | 2017 | 2018 | 2018 | | | | | |
| | | | | Male | Female | Total | | | |
| 1 | Primary School ( 1-8) | 82 | 83 | 1419 | 754 | 1975 | 32 | 1/57 | 1/5 |
| 2 | SSS/High School ( 9-10) | 6 | 7 | 152 | 55 | 207 | 27 | 1/20 | 1/1 |
| 3 | Preparatory Schools ( 11-12) | 1 | 1 | | | | 20 | 1/20 | 1/1 |
| | Total | 89 | 91 | 1571 | 809 | 2180 | | | |

Source; DAWEOR (2017-2018)

According to data for the year 2017 to 2018 there were a total of **91 schools** of different types and levels. Accordingly there were (1-8) 36 Schools, (1-4) 11 schools, (9-10) 6 schools and (11- 12) (1) one schools. These institutions are located in urban and rural areas of the *Woreda*. All of them are governmental, and the Education coverage of Debub Ari *woreda* is 74.51 percent. The number of students in the case of both sexes shows increment and in the number shows significant change.

The average number of student per class room for the year 2018 was 57 for primary schools (1- 8) and 20 for senior secondary schools / see table-3. The table also illustrated that student ratio for primary school was 57, while the ratio for senior secondary school (9-12) was higher than the national standard for PE and below the national norm for SSE. The ratio of books per students for primary school is(1-8) 1/5 ratio, for SSS (9-12) 1/1 ratio which indicates higher than national

standard. In general based on table 5 in the class there is over crowding of primary schools / the existing school infrastructures' are over utilized /. These ratio indicate that there is over crowding of primary schools / the existing school infrastructures' are over utilized /. Based On the 2018 data in both different school level student teacher ratio was /32/ in Primary and /27/ for secondary schools, whereas /20/ for Preparatory Schools indicating that there was a better situation in this regard (SAWEOR 2018).

### 2.1.1.3. Health

The Health service sector is one of the key sectors of the economy. 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.

Family Planning the family size helps to protect the woman's and children's health and preserve the well being of the whole family.

Table 4: Family Planning Method and Number of Pregnancies protected, Debub Ari Woreda (2016 -2018)

| No | Methods | Number of pregnancies protected in year | | |
|---|---|---|---|---|
| | | 2016 | 2017 | 2018 |
| **1** | Family planning | 46044 | 52180 | 56965 |
| **2** | ANC-1 | 8752 | 8739 | 8739 |
| **3** | ANC-4 | 8089 | 8484 | 8484 |
| **4** | SYPHILIST TEST | 282 | 2665 | 2665 |
| **5** | PMTCT | 8270 | 6468 | 6468 |
| **6** | SKILLED DELIVERY AND PNC | 9081 | 7639 | 7639 |
| **7** | STILL BIRTH AND EARLY NEONATAL DEATH RATE | 8597 | 7639 | 7639 |
| **8** | STILL Berth RATE | 4 | 18 | 18 |
| **9** | Early Mortality Rate | 0 | 0 | 0 |

**Health Institution & Health Coverage**

The health institutions /especially hospitals/ in Jinka town give various services to the area's population as well as the neighboring population in Debub Ari *woreda* , and other *woreda's* in Debub Omo Zones.

The Health service and coverage of the *woreda* prior to the first five year development plan of the *woreda* in /2011-2015/ was to reach 100 %. In the course of this first five year plan, a number of health institutions were constructed especially in the rural part of the area and currently the health coverage of the *Woreda* was reached to 100 percent. Between 2016 and 2017 the number of health institution by around 13 % in the *woreda, detail number of* institutions are maintained in Table 5 (health institutions in *Debub Ari Woreda* for 2016and 20117) below. There were many Health personnel serving in these institutions concerning their professions. There were no medical doctors, 20 health Officer, 6 BSc Nurse, 98 Nurses, 4 pharmacy Technician, 7 laboratory technicians, 3 HIT 114 HEWs, and other 69 supportive stuff Source: - SAWHR 2016 and 2017.

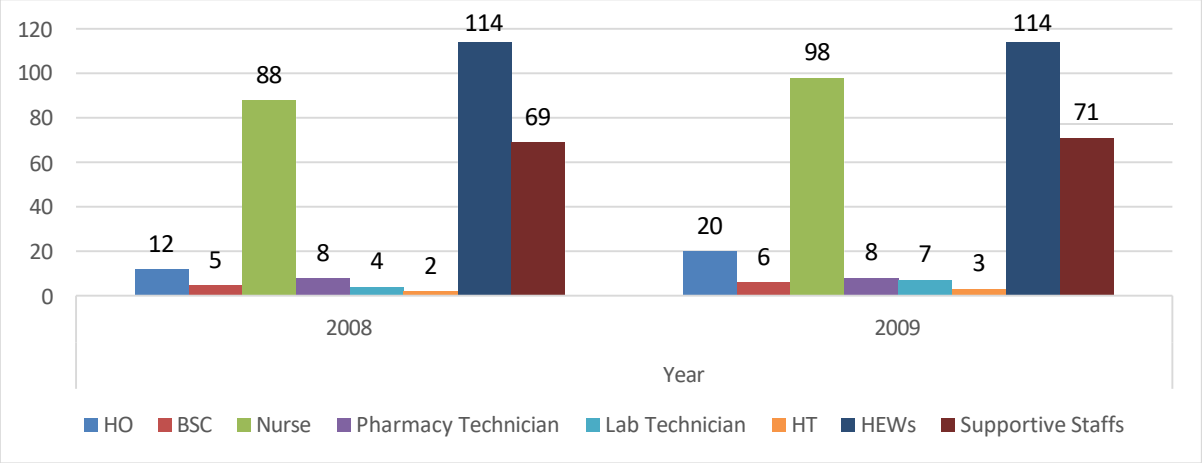



Figure 3: Health Professionals in Debub Ari Woreda of 2016 and 2017

Source: - SAWHR 2016 and 2017.

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 and sanitation services, lack of

self-hygiene and environmental sanitation, which result into high prevalence of communicable diseases. According to the profile, Ameba, diarrhea diseases are almost entirely caused by the environmental factors of poor sanitation, hygiene and access to clean water and food.

Table 5: Health Institutions in Debub Ari Woreda of 2016 and 2017

| No | Types of Health Institutions | Year | | Remark |
|---|---|---|---|---|
| | | 2016 | 2017 | |
| 1 | Governmental Health Center | | | |
| 1.1 | Primary Hospital | 0 | 1 | |
| 1.2 | Health center | 9 | 9 | |
| 1.3 | Health post | 50 | 50 | |
| 2 | Private Health Centers | | | |
| 2.1 | Primary Health clinics | 2 | 12 | |
| | Total | 61 | 72 | |

Source: - Debub Ari Woreda Health Report 2016 and 2017

As indicated on the above tables, the numbers of Governmental Health Institutions and health professionals in Debub Ari *Woreda* increasing in consecutive year, from 2016 to 2017 are changed from 59 to 60, for government Health Institutions and 5 to 16 for Private Health Centers.

### 2.1.1.4. Road and Transport

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*. Debub Ari *woreda*, (Gazer) town being an ancient town in Debub Omo Zone had an old age with the development of such infrastructures and great service coverage problem in the area. However their progress in terms of service coverage and technological advancement is rather stagnant *(SAWFEDO, 2018*).

Road is an essential infrastructure for a given area for economic and social development. It eases mobilization of resources and communication and there by hasten the socio economic development of a given area. Thus road type, network connectivity, accessibility and its

organization with various facilities and services have major impacts on its key role of development (SAFEDO, 2018).

The total existing road in the *Woreda* is 127 kilometers. Most of the rural roads are seasonal and deteriorated, thus their role to the *woreda* socio economic development is limited.

The population who has access to Road infrastructure is around 88,735, which is 34.5 % of the woreda population. According to focal groups and key informant discussion in *Dordora* and Shengema *Arki* kebele there is a great problem of road infrastructure (table 6), which leads to continuous conflicts b/n the community and Debub Ari administration.

Table 6: Types and length of Roads, existing Debub Ari woreda in the year 2018

| **No** | **Road type** | **Length in km** | % of population who has access to Road |
|---|---|---|---|
| 1 | Asphalt | 45 | **In building** |
| 2 | Gravel | 127 | 34.5 |
| | Total | 127 | 34.5 |

Source: (S A F and E D O, 2018)

The quality of the road infrastructure in the woreda is poor quality, which is mainly due to lack of proper maintenance. In addition, the road network system, which affects the connectivity and accessibility of the community, is properly organized. The road network flow from town to kebele road distance

1. Gazer: - to Senegal ..... 33 km
   Woset…..... 18 km
   Kure..... 22 km

   Tolta ..... 42 km

2. Tolta to Tembel.....12 km and total road coverage is 127 km, including different kebeles like *Komer, Aynalem, Kyisa, Arkisha, Shishir, Metser, Aykamer, Pilla, Shepi, and Gezza.*

Thus, such poor road network system and deterioration have been hindering the *woreda's* development activates and even affect the day-to-day life of the community. Moreover, most of the existing routes, particularly in the town are constructed against the slope, which resulted in the traffic accidents.

There is development in improving the road network by constructing new asphalt roads planned and on the progressing that connects the *woreda* with the Omo sugar factory (*SAWFEDOR, 2018*).

**Water Resource and Supply**

In the *woreda,* there are a number of small stream and four rivers. The four rivers (Neri,Wati, Maki and Orti) , about 40 spring water originated from Shangam mountain level forest ecosystem and water flow towards different directions of the *woreda*. The above stated surface water resources and various springs were used to provide the *Woreda* with considerable amount of water that was sufficient for domestic water use and even for all year round human, animal water consumption and for irrigation purposes. However, elder in the *woreda* under lined that currently due to various environmental problems some streams and springs were dried, while the volume of existing small streams and river as well as the discharge rate of springs has been decreasing from time to time. Leave alone for the other purpose water resources for basic use / domestic consumption/ have been critical issues both in urban and rural areas of the area since a decade. According to Thus, currently water supply is top development agenda of the *woreda*(S A F E D O, 2018).

According to the formal discussion of (KI) Key informants and Focus Group Discussions (FGD) Shngema Mountain Forest Ecosystem is a big **water tower** of the area. However do to deterioration of Shengama mountain level forest ecosystem water quality and quantity decreased. In Recent data, the water supply coverage of the *woreda* is **36.74** percent clean drinking water including hand well water. (*SAWFDOR, 2018*)

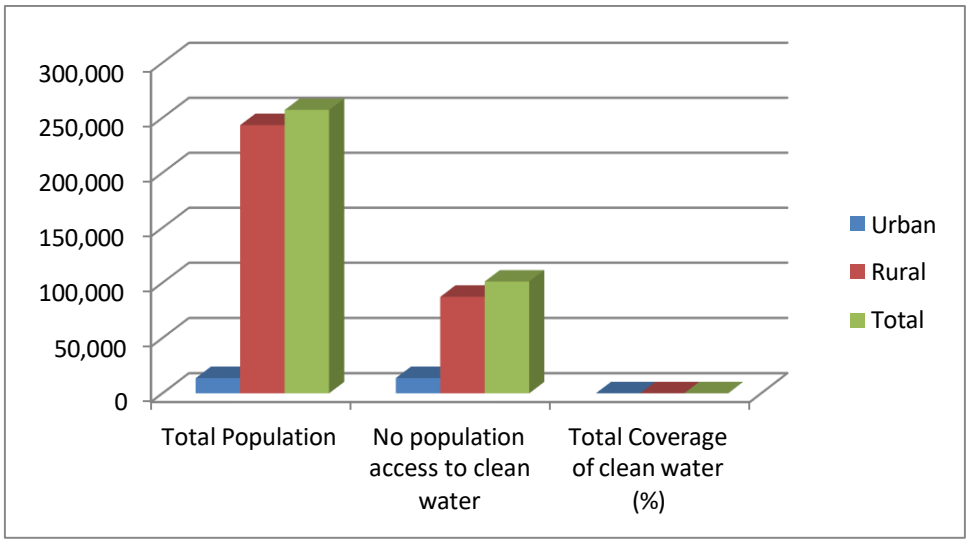



Figure 4: Water Supply Coverage and Population Change

Source; (SAWFDOR, 2018)

#### 2.1.1.5. 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. Debub Ari *Woreda*, Gazer town gets 24 hours telephone services, from total kebeles, a small amounts are access of network by semi-automatic exchange station and digital system.

#### 2.1.1.6. Housing

Housing is one of the three basic needs for human being; there is no problem of housing as mentioned during key informant, group discussion and 2010 Debub ari *woreda* final report. In the woreda the houses mostly where constructed by woods and mud. Debub Ari *Woreda* have three small towns (Tolta, wubihar, and Meter,) and one *Woreda* town ( Gazer ) there is no big housing problem as comparing to population density*(SAWFEDOR, 2010*).

#### 2.1.1.7. Electricity

*Electricity* is an essential infrastructure for a given area of economic and social development. In Debub Ari *woreda* the total coverage of Electricity is 25.4 percent, in which only 13 kebele out of the total kebeles have accesses of electric services. The other residents used fuel wood, charcoal as the source of energy and also they used kerosene as a source of light.

### 2.1.2. Drivers and pressure of social environment

Shengama mountains forest Ecosystem is one of highly degraded ecosystem. The main drivers for the deterioration of the ecosystem are mainly population growth and that leads to overstocking Natural resource which results to degradation. The society use forest for fuel wood and for different household's construction materials. In Debub Ari woreda the real growth domestic products of 5%, Rate of poverty, 60% and full involvement of female in some parts of activities like private associations in d/t income generation.

- In the last two decades basically due to a number of drivers among them the following are the important ones,
  - The rural communities, due to high labor demand and old age security, prefer large number of children. Thus, the need for more labor force in the agrarian economy (for plowing, weeding, harvesting, looking after cattle, and various household duties, etc.) are among others the major cause aggravating pressure on natural resources.
  - Low educational background and less exposure to contraceptive technologies aggravate high birth rates among the rural population.
  - 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.
  - An increased access to health and drug facilities has further complicated the situation of population pressure and there by greatly impact natural environment base of the area.
  - The most significant drivers of environmental degradation are land use and land cover changes, resulting from agricultural farmland and settlement expansion.

### *2.1.3.* Impacts due to social environment change

Two hundred years ago, Malthus predicted that the power of population is indefinitely greater than the power of the earth to produce subsistence for man (Bilsborrow, 1991). In a latter period Ester Boserup (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 2.9 percent, there is a very high demand over the available natural resources to satisfy the increasing demand by cultivating on ecologically fragile and marginal hill sides, 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 dwindling proximate environmental resources and, there by resulted in declined food security. This is usually happened for decades in shengama mountain area, because of extreme soil degradation in crop area and climatic irregularity in all kebeles and locality every year in Debub Ari woreda is under assistance of relief aid. In order to cope up the food shortage, people in the vicinity collect wood for fuel and cultivate hilly areas, and exploit rare and endangered species to supplement the income; which aggravates environmental degradation.

- Due to deforestation different habitat, fruits, animals and medicinal plant disappear, Due to this the society their life depend on the Shengam Mountains 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.
- Due to over degradation of Shengam Mountain Level forest ecosystem the society who lives surrounding Shengam have got problem of drinking water and impurely as a result of this women and children go to long distance to fiche clean water.
- Climate variability change make for the society more vulnerable for drought and flood because of this the society become food unsecured and as Debub Ari woreda data indicates 60 percent of the people are below poverty rate.
- Over grazing due to Increasing animal population around Shengema Mountain forest ecosystem is one problem for ecosystem degradation.

### 2.1.4. Responses to social Environment Change

There are many potential policy responses to the environmental implications of local population pressure. 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.

A number of livelihood strategies were adopted by the communities at a grass root level to reduce their vulnerability to risk situations and recover from the unhealthy events. For instance, income diversification, engaged in off-farm activities, livestock fattening, and changing the cropping pattern from subsistence crop to perennial cash crops. In addition, population policy, family planning policy, forest protection policy and others has practically implemented at grass root level. To alleviate the problem and attain the Millennium Development Goals both the government and society are working together to achieve sustainable natural resource conservation.

Finally Different response measure were taken to decrease the growth of population they were apply different family planning method. The society who live around Shengam mountain forest ecosystem they were done conservation work and without affecting social and Economic value of ecosystem for the community they were tries to beekeeping and produce nursery.

### 2.1.5. Outlook for Socio Environment of SMFE

If everything continues as it is practiced as percent, population growth within the study area is nearly increase in 2.9 will continue. In year 2018, there are 257,200 people living in the *woreda*. Then, deforestations occur as a result of conversion from forest and shrub to farm land because of overpopulation that demands additional farm land. Due to this reason, from 2000 to 2018 Crop land is increased by 3,004.8 hectare while forest, shrub, and wet land decreased by 1332.25, 1934.89 and 236.16 hectare respectively (land classification of land sat image of 2000, 2008 and 2018).

In the year 2036 the population figure of Sauth Ari *Woreda* would be beyond carrying capacity of the environment. There will be nearly 433960 people living in the *woreda*. If everything continuous as present, the coverage of forest, shrub and wetland will be decrease by 2664.5, 3869.8, 472.3% respectively from 2019 to 2036 in the *woreda*. If the whole social and economic activities, over population and the land use /land cover change continue under present condition: soil erosion, land degradation, injured people and livestock by natural and human induced caused would aggravate, leading to increase loss of soil fertility and highly affecting agricultural productivity in the Shengema mountain forest ecosystem.

## 2.2. Economic Environment

### 2.2.1. State and trend of the economic Environment

Agriculture is the most important determinant of the Southern Nations, Nationality and Peoples' Region's economy and it will continue to play the leading role in the overall economy development of the region. The livelihood of the people is dependent on agriculture, however, agricultural system in the region is at subsistence level and food insecurity problem is increasing at alarming rate.

According to the current (FEDO) report in 2010, Contribution of Agriculture sector to Debub Ari *woreda* gross domestic product (GDP) is very high, which is:-

- Agriculture Sector 86.37 %
- Industry Sector 11.67 %
- Investment Sector 1.96 % (Percent) and it doesn't get information about service sector.

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 **202,018 cattle**, **108,167 sheep**, **52,160 goats**, **14,113 equines**, **117,519 chickens** and more than **15,000 bee families**. Livestock production management is poor, almost all farmers in the area follow traditional production system and extensive management practice rather than intensive and semi-intensive system. Production performance of the animals was estimated to be in average 2lit/day/cow for indigenous cow. According to the first GTP Ethiopia applying the AI technology to improve the quality of animal and animal products, but in Debub Ari *Woreda,*There is a limited provision of **AI services** for farm households in order to improve their indigenous cattle production and productivity without increasing the number of animal.

As key informant and group discussion the main food crops utilized are maize, vegetables and root crops. They mainly consume cereal based foods together with vegetables and livestock product. Maize, sorghum, barley, wheat, teff and coffee are the major crops grown in the area. However, the topography of the woreda is highly dominated with steep land which is unfavorably to agriculture, resulting in low production and productivity. The proportion of cultivated land, grazing land, forest land, cultivable land, non- cultivable land and others are17, 15.08, 22.43, and 8315. 36 and 21.81 percent respectively in 2018.The Ari ethnic group is the only one in the *woreda* with mixed /crop- livestock/ farming system.

**Table 7 : Farmers land owner ship in Debub ari *woreda***

| No | Woreda | Farmers have no land | | | Farmers have land Owner ship per /hectares | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | From 0.1 he-o.5hek | | | From 0.5 he-1hek | | | From 1 he-1.5hek | | | From 1.5 he-2 hek | | | From 2 and above | | | Total land owners | | |
| | | | Fem | Total | Male | Fem | Total | Male | Fem | Total | Male | Fem | Total | Male | Fem | Total | Male | Fem | Total | Male | Fem | Total |
| 1 | D. A | | 227 | 538 | 17124 | 1050 | 18174 | 7674 | 481 | 8155 | 2730 | 171 | 2901 | 816 | 54 | 870 | 3177 | 219 | 3396 | 31521 | 1975 | 33496 |

Source: - SOZANRDO and DLUMDR, 2011

As indicated in the above table the farming of steep land is common because of shortage of land this results low production and productivity and this leads to reduced income of the community.

In addition low production and productivity of the agriculture sector is aggravated by the poor provision of improved crop vAriety, except maize, common bean, vegetables and agricultural packages from the respective of woreda office. During focus group dissociation, they explained that even though there is a high potential coffee growing area, however, the farmers have no market linkage except one private coffee.

In Debub Ari *woreda*, there is no market linkage, market information and no accessibility in terms of road and alternative market. 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 cash crop. The only credit access in most high land areas is OMFSAB supporting the farmers for credit and saving of money. This Shengam mountain level Forest ecosystem has five names like Ager, Yeziyete, Gazer, Zulta, and Wuset. From this Ager is the steepest and denser forest mountain at the bottom there is dense forest, and people used to cultivate Honey bee hives.

Table 8: The major pests and Diseases in the High land, Mid Land and Low Land areas of Debub Ari woreda in terms of crop type

| No | Crop type | Area of Cropping | | | Common Insect Pests and Disease | | Weeds |
|---|---|---|---|---|---|---|---|
| | | High Land | Mid Land | Low Land | **Insect and Pests** | **Disease** | |
| 1 | **Cereal crops** | | | | | | Seksi, Amaranthus (hukuma), kuskuta spp.(konene), Bermuda grass (gilma), Guzotis scabra spp.(mech), Commelina benghalensis (aba ayele) and Cynodon dactylon (serdo |
| | Maize | ✓ | ✓ | ✓ | stalk borer, cut worms | Maize Lethal Necrosis Disease (MLND), smut | |
| | Sorghum | ✓ | ✓ | ✓ | Stalk borer, bird | Smut and anthracnose | |
| | Barley | ✓ | - | - | Brown wheat mites, | Rust and Smut | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Wheat | ✓ | - | - | Brown wheat mites | Rust and Smut | |
| | Teff | ✓ | - | ✓ | Brown wheat mites | Smut and rust | |
| 2 | **Pulse and Oils** | | | | | | |
| | Common Bean | ✓ | - | ✓ | - | - | |
| | Line Seed | ✓ | - | ✓ | - | - | |
| | Ground Nut | - | ✓ | ✓ | - | - | |
| 3 | **Root And Tuber** | | | | | | |
| | Inset | ✓ | ✓ | ✓ | Mealy bug, mole rat | Enset bacterial wilt | |
| | Sweet Potato | ✓ | ✓ | ✓ | potato weevil, mole rat, cut worms | | |
| | Yam | - | ✓ | ✓ | | | |
| | Irish Potato | ✓ | - | ✓ | Spotted leaf beetles, cut worms | Early and Late blight, bacterial wilt | |
| 4 | Fruit | | | | | | |
| | Avocado | ✓ | ✓ | ✓ | Fruit fly | Anthracnose and phaytophthora | |
| | Banana | ✓ | ✓ | ✓ | Mole rat | Banana bacterial wilt /pucarium wilt | |
| | Mango | ✓ | ✓ | ✓ | Fruit fly | Anthracnose and phaytophthora | |
| 5 | Coffee and | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Spices | | | | | | |
| | Coffee | ✓ | ✓ | ✓ | - | Coffee berry disease, bacterial wilt, coffee leaf rust | |
| | Coro Rima | ✓ | ✓ | ✓ | - | - | |
| | Jigger | ✓ | ✓ | ✓ | - | - | |
| 6 | Vegetables | | | | | | |
| | Cabbage | ✓ | ✓ | ✓ | Aphid, cabbage looper | | |
| | Onion | ✓ | ✓ | ✓ | Crickets, cut worms | Rusts, Botrytis leaf blight | |
| | Beet root | ✓ | ✓ | ✓ | Mole rat, cut worms | Blight | |
| | Tomato | ✓ | ✓ | ✓ | Tomato fruit worms | Blights | |
| | | | | | | | |

Source: - JARC September, 2016

As describing in the above table Cereal crops (Maize, sorghum), Root and Tuber Crops (Inset), Fruits (Avocado, Banana, Mango), Coffee and Spices, (Coffee, Coro Rima, Jigger), and Vegetables, (Cabbage, Onion, Beetroot, Tomato), grown in High land, Low Land, and Midland areas of Debub Ari *woreda*. Coro Rima, Jigger Common bean and Line seed are dominant crops in the local community and high resistant value crop in all Agro Ecological zone.

The major trend of agricultural technology is practices in the area such as

- The rate of application of fertilizer is blanket ( No area specific recommendation)
- Integrated soil fertility management (inorganic fertilizer and organic fertilizer application) practice is not fulfilled for better yield from soil and sustainable healthy fertility management.

- No scientific compost preparation and application compared to its importance for the soils in the environment.

Beekeeper's of the district follow traditional production system by hanging their hive in forests. In the district, both transitional and modern hive were not introduced much.

### 2.2.2. Drivers and pressures of the economy

The driving force behind economic policy-making lies in the macro-economic objectives. 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 Debub Ari *woreda* the rate of change in labor force 5%, rate of change in capital asset 5%, rate of industrialization 11.67%. As there are high rates of population growth2.9 in the study area, the demand to satisfy the increasing new comers increases in over exploitation of the available natural resources.

### 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.

Thus, the agricultural, industrial and service sectors are used. The first two tend to have a higher direct impact on the environment than the third sector. Natural resources of Shengama Mountain forest Ecosystem where degraded aproxmetly 90%, based on SAFEDOR and discussions from different members of the community. Soil fertility is declining every production season. Forest coverage is very low and decreasing every year, 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 strategy and pattern is a challenging task to promote sustainable development by protecting the environment. The population density around Shengema mountain forest ecosystem is increasing in higher amount is arisen of cultivating small piece of land for

different consecutive year without rest, As A result indicate, there is a higher risk of degradation and vulnerability to food insecurity and rate of purchasing parity 60%, change in the living standard 15% and About 60 percent of population live under poverty rate as report of SAFEDOR.

### 2.2.4. Response Measures

There are many potential policy responses to the environmental implications of local population pressure. 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).

A number of livelihood strategies were adopted by the communities at a grass root level to reduce their vulnerability to risk situations and recover from the unhealthy events. For instance, income diversification, engaged in off-farm activities, livestock fattening, and changing the cropping pattern from subsistence crop to perennial cash crops e.g., banana ,Coffee ,other spaces (Coro Rima, Jigger ) and to develop crop rotation practices from cereal crops to leguminous crops which facilitate soil development/increasing soil fertility to increase production and productivity. In addition, population policy, family planning policy, forest protection policy and health policy (family planning, human health), education policy and sector plan (quality education for all) has practically implemented at grass root level.

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 andSecure 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

### 2.2.5. Outlook for Economy

If everything continues as business as usual, if the population in the study area continues to from by 2.9 % in 2030 the population of Debub Ari Woreda will be 362455. Assuming that the population is projected every year by 2.9% with starting year 2018 with the population of

257,200 then by year 2019 it will be 264659 by year 2020 (274334),by year 2021 (280232), by year 2022 (288359) by year 2023 (296721), by year 2024 (305326), by year 2025 (3141180), by year 2026 (323291), by year 2027 (332666), by year 2028 (342313), by year 2029 (352240), and by year 2030 the number of population around Shengama Mountain Forest Ecosystem in Debub Ari Woreda will be 362455. And the subsistence mode of economic situation that based on farming, Animal husbandry fuel wood collection will minimalize the limited natural resources. Then natural environment could not be able to provide the environment service.

### 2.2.6. Options for future Action

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.

- Integrated soil fertility management (inorganic fertilizer and organic fertilizer application) practice is too fulfilled for better yield from soil and sustainable healthy fertility management.
- To increase scientific compost preparation and application to improve soil organic compound in the environment.
- 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 estimated to be in average 2lit/day/cow for indigenous cows by giving additional feed and improve farming system.
- By increasing honey and honey products by using both transitional and modern hive to improve productivity of honey yield and honey products.

Awareness creation should be given on the links of climate change, overpopulation natural resource degradation to the overall environment

### 3. The physical Environment of Shengema mountain ecosystem

In Ethiopia from all land use and cover types, the severity of degradation is worst on cropland, where the annual soil loss rate is in a range of 42 tons ha-1 yr-1. The Ethiopian Highland Reclamation Study (EHRS) estimated that the annual soil erosion rate on the highlands is 1.9 billion tons, of which 10% of it is carried away irretrievably by the highland rivers. The highlands of Ethiopia account for more than half of the total area of the country. The Shengema mountain forest ecosystem is also part of the Ethiopian highlands since it is found in an elevation higher than 1000 meter above sea level.

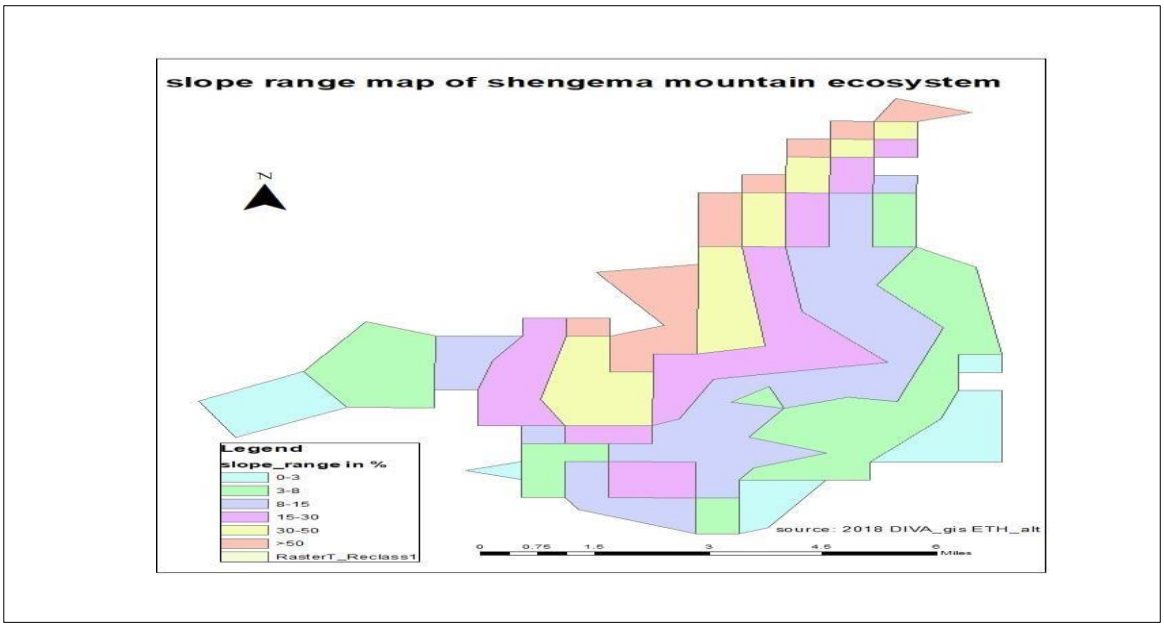



Figure 5: Shengema mountain forest ecosystem slope range Map.

Source: DIVA_GIs,ETH_alt, 2018

Shengema Mountains is one of the Debub western portions steep slope mountainous areas of Ethiopia highlands. It is mountainous chain and the water tower of the district and surrounding area. The area is mainly classified as forest land, shrub land, bamboo forest, grazing land & crop land

## 3.1. Land

Land is internationally defined as "a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface, including those of the near-surface climate, the soils and the terrain forms, the surface hydrology (including shallow lakes, rivers, marshes, and swamps), the near-surface sedimentary layers and associated groundwater reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity" (UN, 1994; CSD, 1996).

Land provides basic needs to human beings like: food and raw materials, shelter and recreation. The land on which we live in, its condition, and how we use and manage it, are therefore vital components of our existence.

The status of land includes both the land use and cover. The land use refers to the purpose for which that particular land is being used. During the land use activities, may be an existing forest cover would be cleared for instance to expand farm plots, or for investment like floriculture etc. Land use and land cover are highly interrelated.

### 3.1.1. Land Degradation Shengema Mountain Forest Ecosystem

#### 3.1.1.1. State and Trends of Land Degradation in Shengema Mountain Forest Ecosystem

**Land Degradation**: According to (Porta 2009).there is two general types of land degradation: soil displacement (mass movements, water erosion and wind erosion causing onsite and offsite effects) and internal soil deterioration (chemical deterioration and physical deterioration, also known as soil degradation stress) (Porta2009).

Temporary or permanent reduction in the productive capacity of land to provide ecosystem goods and services (FAO, 2010) Degradation begins with the loss of the protective cover types.

People living in the Shengema Mountain are highly dependent on the land, which includes the grazing land, wood land, crop land, wet land and other resources for their live -hood.

In addition, during the field survey it was clear that Shengema Mountain was degraded. People in the FGD also emphasized that around 25 years Shengema Mountain was covered by forest but

now due to rapid population growth huge amount of forest and Shrub land have changed to cultivating (agriculture) land.



Figure 6: photo which show current land scape was covered by forest

Source: 2018 field observation

Table 9; - Shengema mountain ecosystem land use land cover % change from total each feature class

| | 2000 (Ha) year | 2000 % change | 2008 | 2008 % change | 2018 | % 2018 each feature class | Total |
|---|---|---|---|---|---|---|---|
| Bare Land | 532.29 | 58.5 0% | 187.39 | 20.59% | 190.23 | 20.91% | 909.91 |
| Crop land | 2751.26 | 22.59% | 3671.35 | 30.14% | 5756.06 | 47.26% | 12178.67 |
| Forest | 1399.68 | 75.64% | 383.32 | 20.71% | 67.43 | 3.64% | 1850.43 |
| Grazing Land | 145.70 | 14.4% | 414.65 | 40.98% | 451.36 | 44.61% | 1011.71 |
| Settlement | 104.09 | 8.47% | 485.61 | 39.52% | 638.99 | 52% | 1228.69 |
| Shrub Land | 3107.11 | 42.35% | 3056.58 | 41.66% | 1172.22 | 15.98% | 7335.91 |
| Wet Land | 268.91 | 65.3% | 110.129 | 26.74% | 32.74 | 7.95% | 411.779 |

Source; from 2018 Landsat image land use land cover detection

From the above table we can see that crop land in year 2000 was covered 22.59%, in year 2008 increased to 30.14% and in year2018 increased to 47.26%, in other ways crop land from year 2000 up to 2008 increased by 7.55% and from 2008up to 2018 increased by 17.12%.while forest land in year 2000 is cover 75.64% which is decreased in to 20.71% in year 2008 and finally in year 2018 decreased in to 3.64%.and totally settlement, grazing land, crop land are increased but forest ,wet land ,shrub land are decreased.

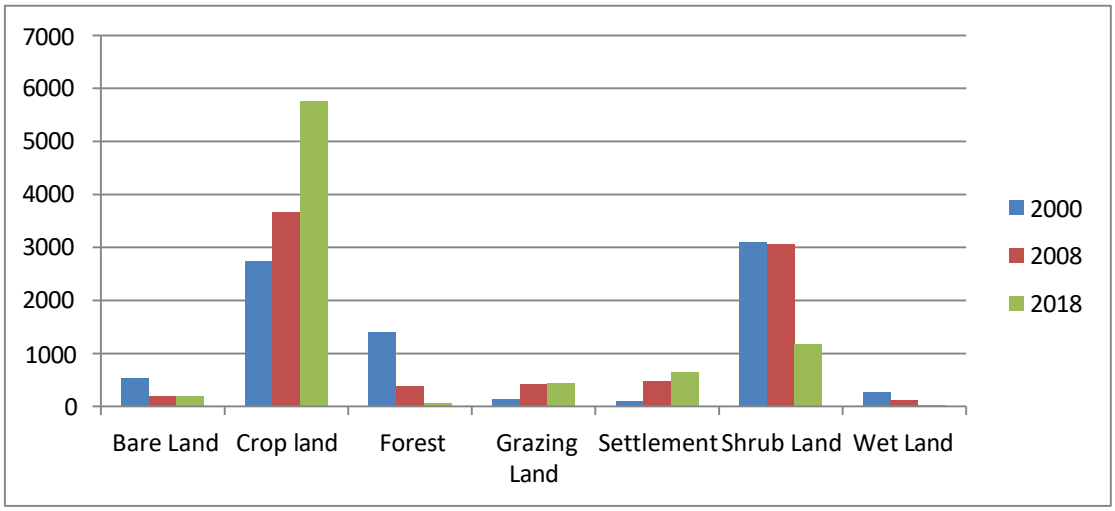



Figure 7: Land use land cover change from the year 2000, 2008 and 2018

Source: 2018 Landsat image

The Land Us Land Cover Change (LULCC) Detection indicates that, nearly 95.2% of forest and woodland had already been lost. The rate of forest and woodland removal has been at an alarming rate. On the average 5.3 % of forest and woodland had already been lost each year.

Agriculture is the most important determinant of the Debub ern Nations, Nationality and Peoples' Region's Economy and it will continue to play the leading role in the overall economy development of the region. The Livelihood of over 93 % of the people of the region dependens on it, however, agricultural system in the region is at subsistence level and food insecurity problem is increasing at alarming rate (FRE, 2009).The major cropping season in the Debub Ari woreda includ Shengema mountain forest ecosystem are;'Belg' and 'Mehere'. Farmers mostly depends on rain fed agriculture for the major crops but also practice traditional irrigation practice for vegetables on dry 'bega' season. In addition, farmers in some areas also practice mixed farming system. According to FGD and key informant the farmer explained that before

inorganic fertilizer were not used but now they are using it to increase crop production due to the reduction in land productivity.

The major crops grown in the woreda includes cereals(maize, sorghum, barley, wheat and teff), pulse and oils *(*common bean, faba bean and linseed*)*, root and tuber(enset, taro, sweet potato, cassava and Irish potato), fruits (avocado, banana, mango, and papaya), coffee and spices (, coriander, ginger, Tenadam, nechsar, dinbilal, erdd) and vegetables (cabbages, head cabbage, onion, beet root, garlic, spanich plant, Pepper, tomato, carrot) in respective order of their total production and potential.

In this area the number of livestock & crop land increase in size but the productivity decreased through time. During the focus group discussion, the community explained that before 20 years four to five quintals was used to be produced from four hectare of land but now only one to two quintals are produced. This is due to land degradation as a result of increase in soil erosion, which is aggravated by illegal cultivation of steep slope area in the mountain. The land degradation that observed in Shengama Mountain was affected by soil erosion hazards such as rill erosion 15%, sheet erosion 10%, gully erosion 10%, and flood 15% while about 80% of land was affected by agrochemicals, (SAWLAEPUOR, 2018). FGD described us because of weak land use system there was so many legal and illegal farmers scramble the mountain, forest ecosystem and other natural resource. Those illegal farmers do not have land owner ship certificate and most of those farmers were immigrants. Debub ari woreda land administration office also told that illegal farmers are one of the challenging problems of the area. Not only illegal farmers but also legal farmers were extracting the natural resource and expand their farm land to the mountain and forest side.

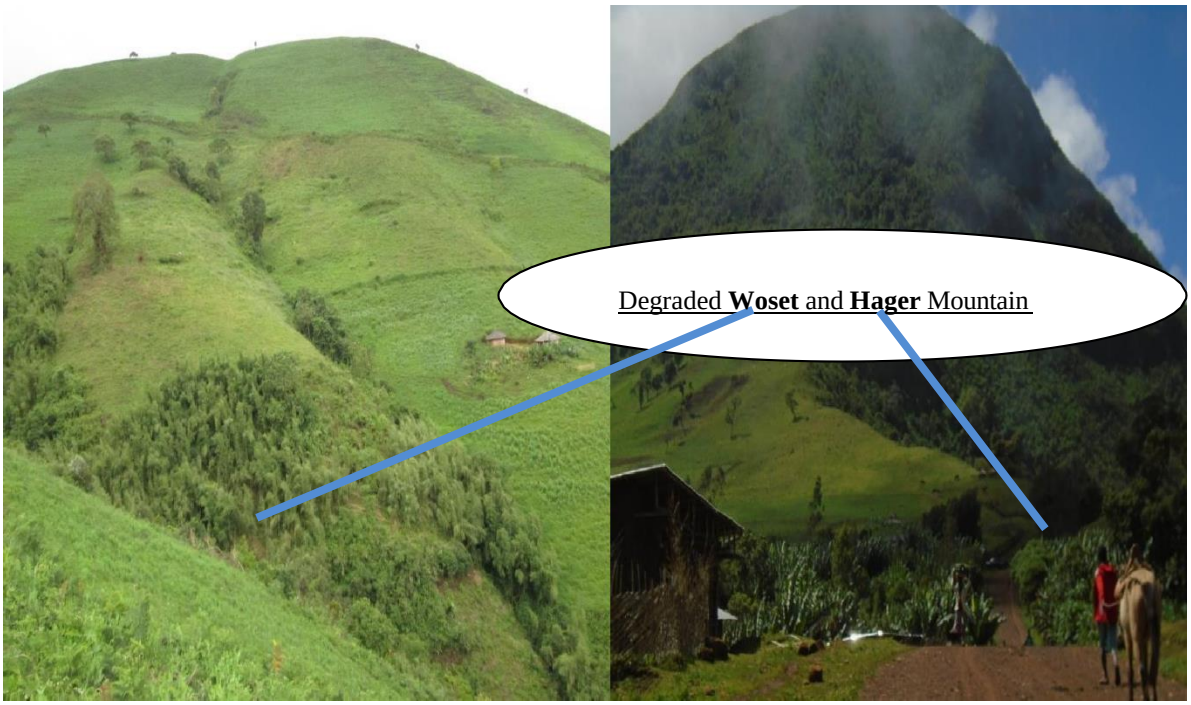



Figure 8: Farmer's expansion to Shengema Mountain forest ecosystem

Source:-Field observation photo 2018

### 3.1.1.2. Driver and Pressure of Shengema Mountain Forest Ecosystem Land Degradation

The driving force of land degradation is human factor. Anthropogenic factor come from population pressure on the environment, As a result of human population growth, nutrient depletion particularly associated with a lack of phosphorous in the soil and the decline in agricultural production (Webb et al. 2004;Fernándezet al. 2005). This is confirmed by key informant and FDG in the study area because of high population growth rate there were over cultivated,land fragmentation and over grazing, this situation may depleted soil nutrients. Soil erosion is one of major threat to the agricultural economic development in Debub ari Woreda. Soil erosion contributes to the prevailing food insecurity in a in the woreda particularly in shengema. It is sever in the high lands where largest portion of population mainly dependent on agricultural production. There are different factors that cause such an alarming increase in the soil erosion and loss of agricultural productivity in the area. The survey indicates that the major factors for the occurrence and increment of erosion in the area is: cultivated of steep slope land, high demand for agricultural land and Population pressure, if the population number increase

land degradation also increase, Key informant and FGD pointed out that in the study land scape number of population has been increased time to time, the number of people per house hold in average was 6 and this became worsen the land in Shengema mountain forest ecosystem.

**Table 10: Ari woreda population size**

| Year<br>g.c | Rural population | urban population | Total population |
|---|---|---|---|
| 2007 | 233,843 | 7625 | 241,468 |
| 2008 | 233756 | 7901 | 243,210 |
| 2009 | 238989 | 11250 | 250,239 |
| 2010 | 224,471 | 12,792 | 257,200 |

Source: - Debub omo zone Debub ari district finance office.

The number of people per house hold in average was 6. From the above table the Population growth rate of Debub ari woreda from is 2.5%. And population density is 437.96/square mile or 0.169 $km^2$.

**Driving force for Shengema mountain ecosystem land degradation**

Population growth, Cultivating of steep slope area, stone query, insecure land tenure, and increment of unemployment rate are the main **driving force**.

**Pressure that leads to Shengema mountain land degradation**

Land fragmentation, monoculture trends, uses of agrochemical, Accelerated soil erosion & conflict of land holding are the main pressure force.

The participants on FGD told us when the conflict happened within the family & the community; disappointed persons, more than 98 illegal farmers were deforested & degraded the land over 95 hectares through cultivation of the mountain.

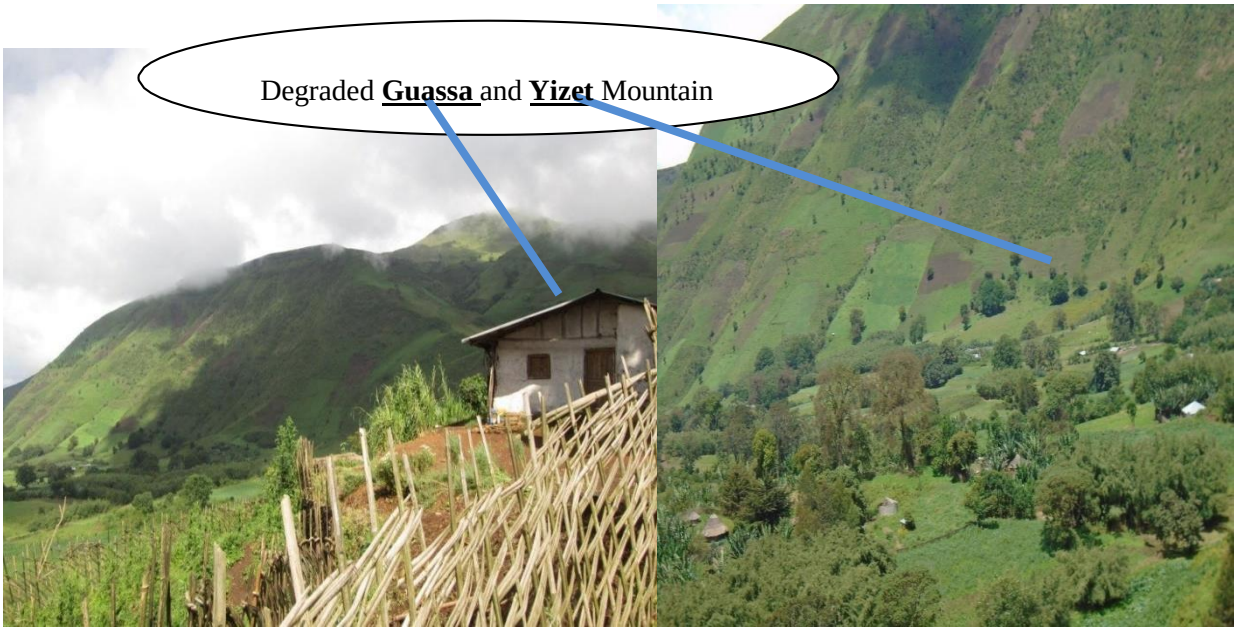



Figure 9: Shengema mountain forest ecosystem land degraded by legal and illegal farmers

Source: Field photo observation 2018

### 3.1.1.3. Impact of Shengema Mountain Forest Ecosystem Land Degradation

Related to land degradation on Shengema Mountain; decline productivity of agriculture, deterioration of forest ecosystem and biodiversity, decline water availability and quality. All these exert pressure on the environment and it has harmful result on environment. All these consequences, with wide variation in different systems, characteristics and practices throughout the world, arise at site specific level but can have impacts at local to global level which means when land is degraded; wildlife, plants and people suffer and can worsen the effects of poverty and bring about hunger.

The food insecurity problem is caused by complex of factors ranging from natural ones such as recurrent Drought, degradation of natural resources, pest infestation to institutional one which includes population pressure, Lack of appropriate technologies, weak institutional support and lack of alternative employment (Matous and P.Y.Tado, 2013) .Land Degradation in shengema

has serious impact for livelihood food security. Many small scale farmers in areas of degraded land can only watch in dismay as their soil grows less each year to feed their families. This situation is made worse by droughts and unpredictable weather patterns caused by climate change.

Table 11: Impact flood and land slid in Shengema

| kebel | Shengema weset | | | Shengema Arki | | | | | | Shengema Bila | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lost property | Damaged land Hecta | Lost domestic animal | Lost people | Damaged land In hectare | | Domestic animal | Lost | | displa | Damaged of land & Crop | Lost domestic animal | | | Displacement |
| Agent | Land slid | | | Land | flood | | Land | flood | | Land slid | flood | Land | fl oo | Flood |
| year | | | | | | | | | | | | | | |
| 2007 | 3 | | | 100 | 170 with crop | 16 | 10 | 2 | 21 | above2 hectare | above2 hectare | >6 | > 6 | One(1) farmer displaced & five(5) farmers lose their farm land |
| 2008 | 3 | 8 | 2 | | | | 2 | | | | | | | |
| 2009 | 2 | 8 | | | | | | | | | | | | |
| 2010 | 4 | | | | | | 3 | | | | | | | |
| total | 11 | 16 | 2 | 100 | 170 | 45 | 17 | | 21 | >2 | >2 | >6 | > 6 | |

Source: FGD 2018.

Land degradation was play a great impact on Shengema Mountain in many ways, huge amount of crop lands were destroyed and changed in to abandoned land. According to (SAWLEPUOR, 2018) about 3-5% of agricultural land was changed in to abandoned land.

As a result of Deforestation and land degradation, environmental change is manifested at Shengema Mountain. As FGD told us in the case of consequent drought (1976, 1986, 1994, 2004and 2010), due to wide spread of many animals were reduced, large amount of springs and wet lands like Hager are dried and Summer and Choka wet land decreased from 1 hectare0.25 hectare within 10 years, many wild animals and there ecosystem eliminated & destroyed, farm production in the area highly reduced, Inset and Goderia product are decreased. Huge amount of farm land & people were exposed to land slide, flood, scarcity of water, land holding conflict, expansion of bribery & tiff related to land holding

As we can see from the above table by the case of land slid and flood problem three kebeles such as Shengema weset, Shengema Arki and Shengema Bila was injured in the consequent year i.e.:- From the year 2007 -2010 totally Two (2) people were died, 16 domestic animals lost and 2 hectare land was damaged in Shengema weset kebeles. And From 2007 -2010 totally 17 people were lost their life, 21 households are displacement, 100hectare land and 170 hectare land with crop was damaged in Shengema Arki kebeles. In Shengema Bila Kebeles; - above 4 hectare land with crop, more than 6 animals were lost and one farmer displacement from their farm land. Totally 5 farmers were lost their farm land with crop.




Figure 10: Flood and land slid hazard.

Source: - Debub ari woreda land administration) in Shengema mountain ecosystem

As FGD explained that the Soil fertility status of the mountain areas decreased time to time, due to these cereal crops- like Wheat, Maize, and Sorghum & decreased productivity from 16 quintals per hectare to 4 quintals, for consequent years of 2000 and 2008.

Totally 1200 hectare of land was degraded and it affects a loss of crop cultivation, the proportion of land affected by landslides is 551.25 hectare. And also the agricultural productivity reduces by 50% rate, and 65% of land is affected by deforestation (SAWLAEPUOR, 2018)

#### 3.1.1.4. Response for Land Degradation Shengema Mountain Forest Ecosystem

**From Community**

- 3740 male and 38182 female was participated. (What they did?)
- To maintain soil fertility, some farmers were applied organic fertilizers or manure on their home garden.
- To avoid land slid consequence, only few Communities was Ask questions to the Keble administrator, like if other immigrants could be away from Shengema Mountain we can refuse our land holding from the mountain.

**From Government**

- In Shengema even if there is no strong soil and water conservation now in the woreda they try to create awareness about farming season and some actions like:-
- In (2018), seven integrated watersheds development activities were implemented by SLM project. Such as Physical soil and water conservation measures like; Soil bund. Stone faced soil bund Fan juu etc.

#### 3.1.1.5. Out look

The principal issue related to land degradation in Shengema mountain ecosystem are mainly land slid, flood, soil erosion, water runoff and deforestations as a result of conversion from forest and shrub to farm land because of over population that demand additional farm land. For example from 2000, 2008, 2018 Crop land is increased by 3,004.8 hectare while forest, shrub and wet land decreased by 1332.25, 1934.89 and 236.16 hectare respectively.

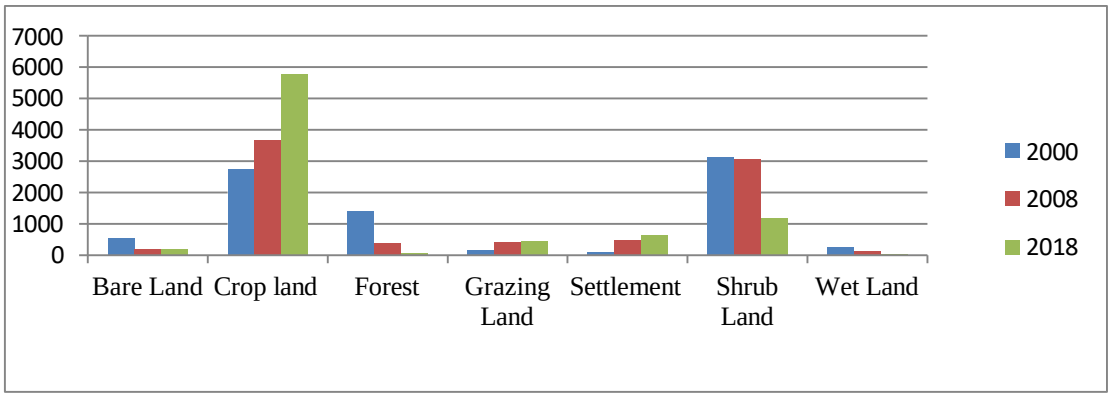



**Figure 11: LULCC**

If the whole social and economic activities, like over population, soil erosion, land degradation and the land use /land cover change will continue under the present condition, increase loss of soil fertility, people and livestock affected by natural and human induced factors and highly affecting agricultural productivity about 965 households are affected by land degradation within two years. In the coming 10 years, about 4825 people will affect by land degradation, food insecure and impoverished the livelihood of local inhabitant's potential of the Shengema mountain ecosystem.

### 3.1.2. Land use land cover change Shengema mountain forest ecosystem

**Location of Shengema mountain forest ecosystem**

Shengema Mountain is found in Debub ern Nation Nationality and Peoples Regional State, Debub Omo zone in Debub ari woreda. It is located 767 km away from Addis Ababa Geographically between $5^0$40'21''N - $6^0$12'2'' N latitude $36^0$18'22''E - $36^0$ 44'10''E longitude with an altitude of 1632m above sea level.the woreda has 46 kebeles and 4 mazegajas (administration).The study was conducted on 4 kebeles namelyshengema weset, Shengema bila, Shengema arki & dordora, which are selected because the Shengema mountain forest ecosystem is located in this kebeles between $36^0$35'4''- $36^0$44'10''E longitude $5^0$ 53'26'' - $6^0$ 5'27''N Latitude. The traditional agro ecologies Shengema mountain and buffer area is classified as Dega and woina-dega., in Shengama Mountain we were observed gussa, HAGER and yezet (ይሸት) in which they are located at the elevation points on

3003, 2977 and 2846meters respectively. The entire three mountain collectively known by the people/woreda /is shengama mountain.

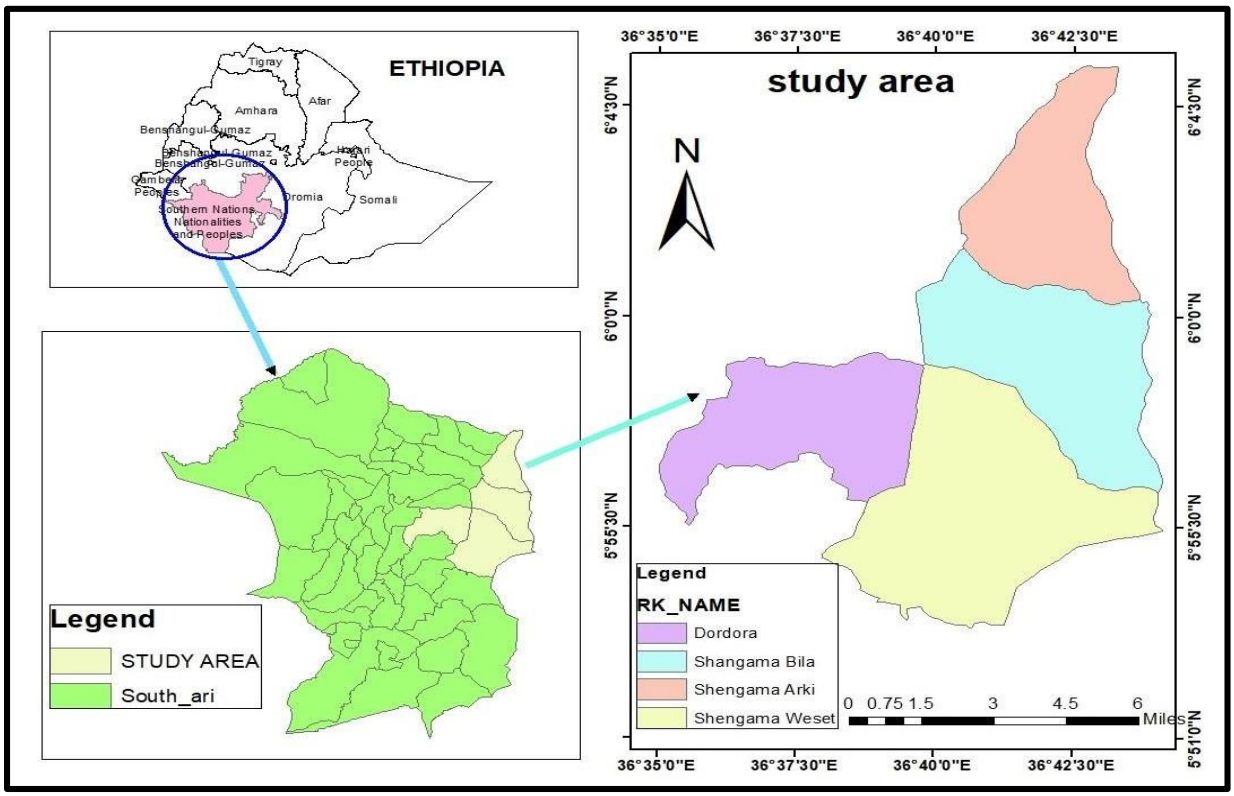



Figure 12: Map of the Study area.

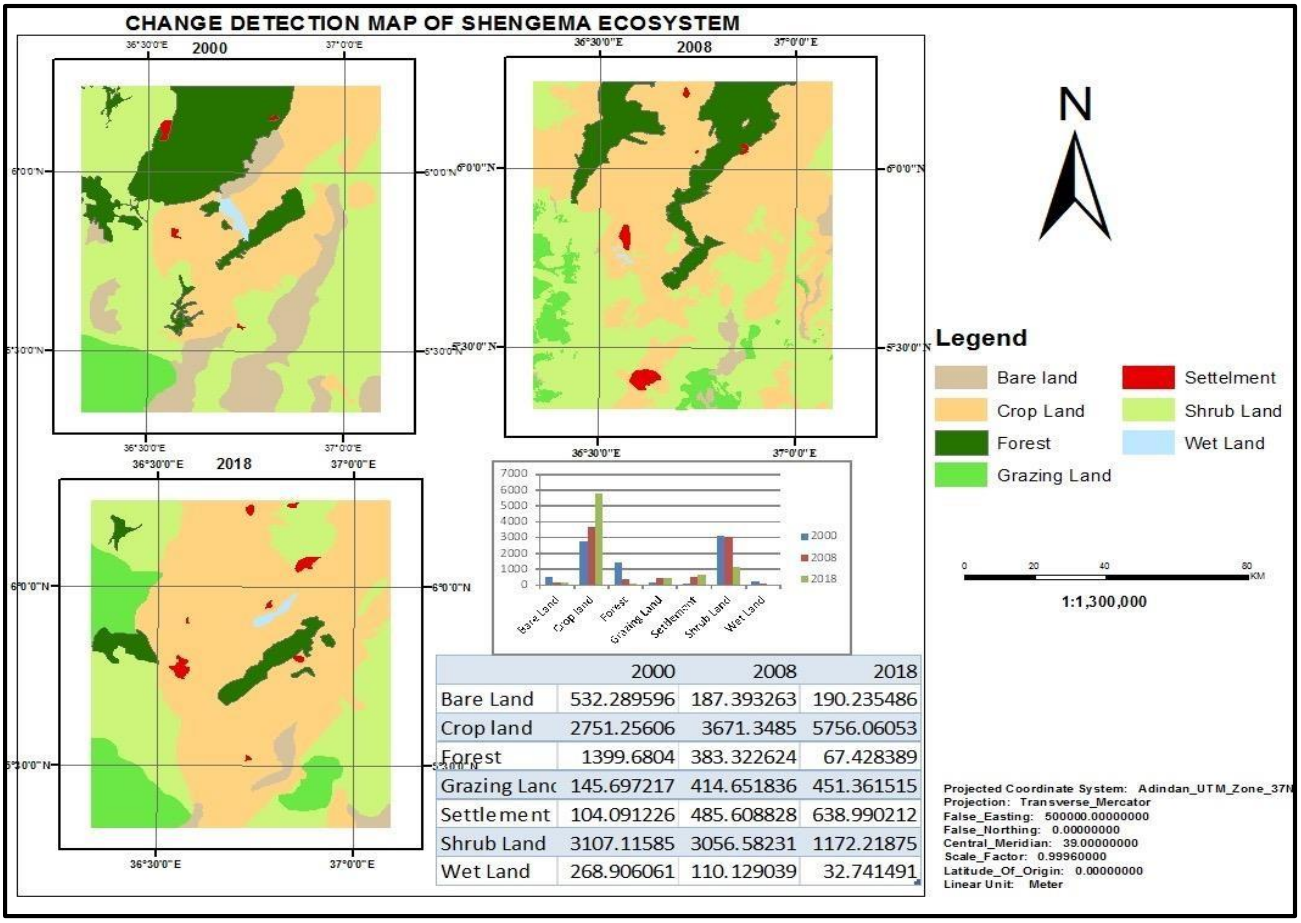
Map is prepared only to indicate study area but not boundary.

### 3.1.2.1. State and Trends of LU/LC Change in Shengema Mountain Forest Ecosystem

Land use refers to man's activities and the vAried uses which are carried on over land and land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and others noticed on the land (NRSA, 1989). During the land use activities, may be an existing forest cover would be cleared for instance to expand farm plots, or for investment like floriculture etc. Land use and land cover are highly interrelated.

In this study to understand the status and trend of land, close and open ended questionnaires was prepared for focuses group discussion and key informant. There was one focus group discussion and two key informants for each four (4) Kebele to understand the trend and status of the land use in the woreda. In addition, to understand the land use type of the Shengema mountain forest

ecosystem from year 2000 - 2018 land use/land cover classification method and ground truth (field observation) was conducted in detail.




| | 2000 | 2008 | 2018 |
|---|---|---|---|
| Bare Land | 532.289596 | 187.393263 | 190.235486 |
| Crop land | 2751.25606 | 3671.3485 | 5756.06053 |
| Forest | 1399.6804 | 383.322624 | 67.428389 |
| Grazing Lanc | 145.697217 | 414.651836 | 451.361515 |
| Settlement | 104.091226 | 485.608828 | 638.990212 |
| Shrub Land | 3107.11585 | 3056.58231 | 1172.21875 |
| Wet Land | 268.906061 | 110.129039 | 32.741491 |

Figure 13: Land-use / land cover change between 2000, 2008 and 2018 in Shengema Mountain ecosystem and surrounding area.

Source: Land sat image source EMA2018

Table 12: Change detection of LU/LCC in the year2000, 2008 and 2018, Change in surface Cover (ha) and Proportion of change (%) from 2000-2018.

| Feature class | *2000* | 2008 | 2018 | Change in surface cover (ha) from 2000-2018 | Proportion of change (%) from 2000-2008 | Proportion of (%) change from 2008-2018 | Proportion of change (%) from 2000-2018 |
|---|---|---|---|---|---|---|---|
| Bare Land | 532.29 | 187.4 | 190.23 | -342.05 | -64.79 | 1.51 | -64.26 |
| Crop Land | 2751.26 | 3671.35 | 5756.1 | 3,004.80 | 33.44 | 56.78 | 1.09 |
| Forest Land | 1399.68 | 383.32 | 67.43 | -1332.25 | -72.61 | -82.41 | -95.18 |
| Grazing Land | 145.70 | 414.65 | 451.36 | 305.66 | 184.59 | 8.85 | 2.1 |
| Settlement | 104.1 | 485.61 | 638.99 | 534.9 | 366.48 | 31.58 | 5.13 |
| Shrub Land | 3107.11 | 3056.58 | 1172.22 | -1934.9 | 1.62 | 61.66 | -62.27 |
| Wet Land | 268.91 | 110.13 | 32.74 | -236.16 | -59.04 | -70.27 | -87.82 |
| Total | 8309.06 | 8309.06 | 8309.06 | | | | |

As we have seen from the table cultivated land, settlement and grazing land in Shengema Mountain forest ecosystem increasing starting from year 2000, 2008 and 2018 respectively. But forest, wet land and shrub land covers decreased in 2000, 2008 and 2018.

The land-use and cover changes detection matrix show that increase in % of Crop land by 1.09 and Grazing Land by 2.09 %, Settlement by 5.13 % between 2000 and 2018. However, the wet Land, shrub land and forest decreased by 87.82%, 62.27% and 95.18 % respectively. Accordingly we observed from the field, Shengema Mountain ecosystem was dramatically converted.

Table 13; - Shengema mountain ecosystem land use land cover in % and hectare

| Feature class | 2000 (Ha) year | % 2000 each feature | 2008 | % 2000 each feature | 2018 | % 2018 each feature class | Total |
|---|---|---|---|---|---|---|---|
| Bare Land | 532.29 | 58.50% | 187.39 | 20.59% | 190.23 | 20.91% | 909.91 |
| Crop land | 2751.26 | 22.59% | 3671.35 | 30.14% | 5756.06 | 47.26% | 12178.67 |
| Forest | 1399.68 | 75.64% | 383.32 | 20.71% | 67.43 | 3.64% | 1850.43 |
| Grazing Land | 145.70 | 14.4% | 414.65 | 40.98% | 451.36 | 44.61% | 1011.71 |
| Settlement | 104.09 | 8.47% | 485.61 | 39.52% | 638.99 | 52% | 1228.69 |
| Shrub Land | 3107.11 | 42.35% | 3056.58 | 41.66% | 1172.2 | 15.98% | 7335.91 |
| Wet Land | 268.91 | 65.3% | 110.129 | 26.74% | 32.74 | 7.95% | 411.779 |

From the above table we can understand that crop land in year 2000 was covered 22.59%, in year 2008 increased to 30.14% and in year2018 increased to 47.26%, in other ways crop land from year 2000 up to 2008 increased by 7.55% and from 2008 up to 2018 increased by 17.12%.while forest land in year 2000 is cover 75.64% which is decreased in to 20.71% in year 2008 and finally in year 2018 decreased in to 3.64%.

Table 14Each feature class from total land coverage % change.

| Feature class | 2000 (Ha) year | Year 2000 % change of LU/ LC from total coverage. | 2008 | year 2008 % of LC from total | 2018 | year 2018 % of LC from total |
|---|---|---|---|---|---|---|
| Bare Land | 532.29 | 6.41 | 187.39 | 2.25 | 190.23 | 2.29% |
| Crop land | 2751.26 | 33.31 | 3671.35 | 44.18 | 5756.06 | 69.27% |
| Forest | 1399.68 | 16.84 | 383.32 | 4.61 | 67.43 | 0.81% |
| Grazing Land | 145.70 | 1.75 | 414.65 | 4.99 | 451.36 | 5.43% |
| Settlement | 104.09 | 1.25 | 485.61 | 5.84 | 638.99 | 7.69% |
| Shrub Land | 3107.11 | 37.39 | 3056.58 | 36.79 | 1172.22 | 14.11% |
| Wet Land | 268.91 | 3.23 | 110.129 | 1.32 | 32.74 | 0.39 |
| Total | 8309.06 | 100 | 8309.06 | 100 | 8309.06 | 100 |

From total land coverage the % change of LU/ LC crop land in year 2000 covered by 33.31%, in year 2008increased to 44.18% and in year 2018increased to 69.27%. Settlement 2000 is cover 1.25 % which is increased to 5.84in year 2000 and grazing land was covered 1.75% in year 2000which increased to 4.99% in year 2008and finally in year 2018 in increased to 5.43%.but forest land in 2000was covered 16.84% next by 2008year decreased to 4.61% and in year 2018 decreased to 0.81% and shrub land in year 2000 was covered 37.39 next by year 2008 decreased to 36.79% and inyear2018 decreased to 14.11%.In the same way wet land covered by 3.23% in 2000 year ,decreased to 1.32% in year 2008and in year 2018 decreased to 0.39%.from this we can understand that, the whole % change of LU/ LC , crop land in 2018 show highest and wet land show least.

Table 15:- Growth rate 2000 - 2008 and 2008 - 2018.

| Feature class | 2000 (Ha) year | 2008 | Year 2000-2008 of LCC growth rate | 2018 | Growth rate b/n 2008 - 2018 |
|---|---|---|---|---|---|
| Bare Land | 532.29 | 187.39 | *-3.51*% | 190.23 | 0.08 % |
| Crop land | 2751.26 | 3671.35 | *4.18* % | 5756.06 | 3.15 |
| Forest | 1399.68 | 383.32 | *-4.03*% | 67.43 | 4.58 |
| Grazing Land | 145.70 | 414.65 | *23.1* % | 451.36 | 0.88 |
| Settlement | 104.09 | 485.61 | *45.82*% | 638.99 | 27.88 |
| Shrub Land | 3107.11 | 3056.58 | *-0.09* % | 1172.22 | -3.42 |
| Wet Land | 268.91 | 110.129 | *-3.28* % | 32.74 | -3.9 |
| Total | 8309.06 | 8309.06 | *82.14*% | 8309.06 | 28.86 |

As shown in the table: 15from year 2000 to year 2008 farm land increased by *4.18*% growth rate, bare land decreased by *-3.51*% growth rate, Settlement increased by *45.82*% growth rate, and grazing land increased by*23.1* %while wet land decreased by 1.37% growth rate, forest land decreased by 3.81%, shrubs land decreased by *-0.09* % and wet land decreased by *-3.28* % rate this indicated that there was a rapid land use change or land conversion from one type of land to others land.

In addition, during the field survey it was clear that in Shengema Mountain there were dynamic LU/LC change. According to the four 4 Keble focus group discussion before 20 years Shengema mountain was covered by dense forest and was habitat for different wild species but now a day's the natural resource has deteriorated or eliminated by legal and illegal farmers, few shrubs, sparse forest and forest indicate natural trees are located.

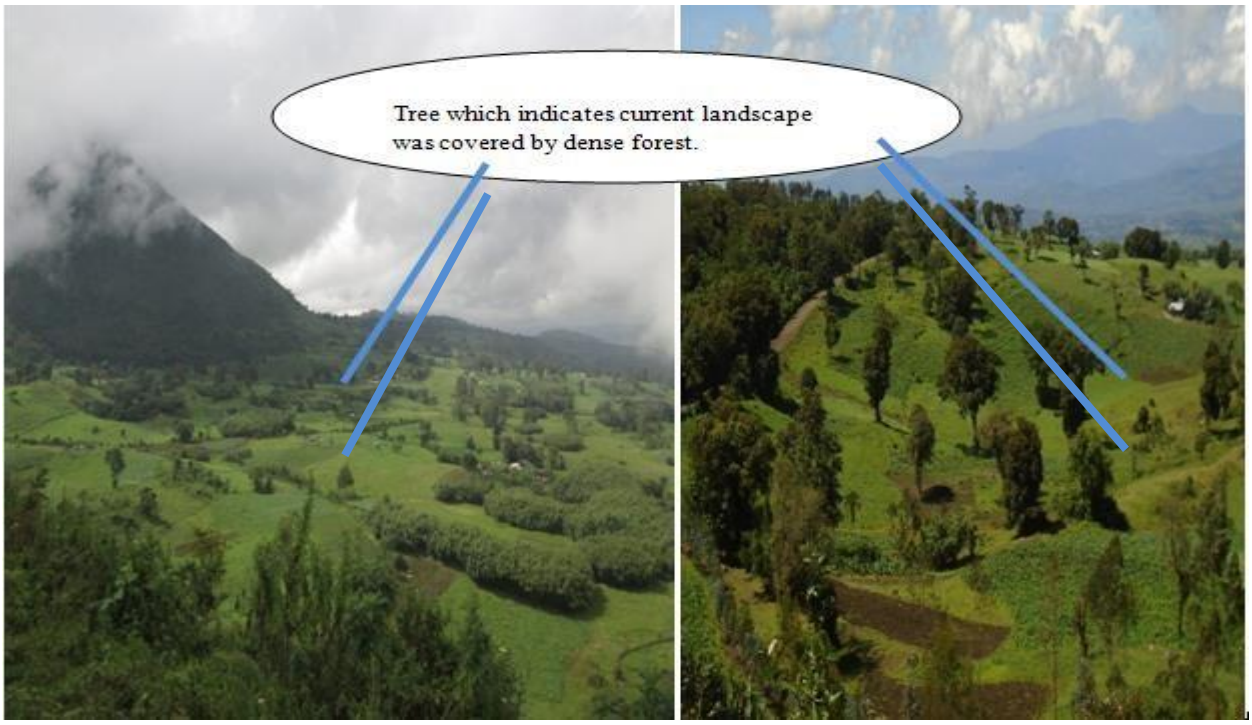



Figure 14: Natural trees photo which show current land scape was covered by dense forest

Source: (2018 field observation)

According to SAWLAEPOR the proportion of land affected by deforestation was 65% and 35% of land is affected by over grazing likewise the report displayed that the many land values changed in to other land values, for example water logged land changed to non-water logged land and about 3-5% of agricultural land was changed in to abandoned land.

#### 3.1.2.2. Driver of Shengema Mountain forest ecosystem LU/LCC

In this study, an attempt has been made to identify the main drivers behind the LULC changes that had occurred in the past 18 year in Shengema mountain ecosystem of the Debub -western highlands of Ethiopia. Therefore lack of alternative fuel wood technology, rapid Population growth, Agricultural land expansion, Scrambling of the whole land, informal settlement (illegal farmer), expansion of urbanization were the top significant drivers of LULC changes. SAWLAEPOR revealed the population of the Land scape has increased from 241,468 to 257,200 in 2007up to 2018, indicating an increase of 2.5% growth rate during the period and 6.5% change from year 2007 up to 2010.If the population number increases the demand for agricultural land also increase. FGD confirmed that in the study area from many land use conversion for agricultural land purpose was taken highest present. A similar trend has been observed from LULCC map, in the area covers of croplands with an expansion about 33.44 % from the year 2000 up to 2008 and 56.78 % from year 2008up to 2018 this cropland expansion exert pressure on forest, wet land and shrub cover change, this is because, the more the land occupied by croplands, the greater probability of occurrence of LULC changes, and the more bare land exists. Key informant & FGD explained that because lack of alternative fuel wood technology especially electric city both urban and rural community highly dependent on natural vegetation's. The majority of the respondents, reported house construction (settlement), fuel wood collection, and charcoal making, also important causes for the observed LULC changes in the study landscape. It was also understood from the account of the elder people during the FGDs that illegal lunging is increasing over time in the study landscape.

#### 3.1.2.3. Pressure that leads to Shengema mountain forest ecosystem LU/LCC

Deforestation, Immigrants & conflict of community and family especially by land holding are the main pressure factor for Shengema mountain forest ecosystem LULCC**.** During the focused group discussions (FGDs) and key formant pointed out human Immigrants from the neighboring areas, have intensified the pressure to the LULC change, particularly affecting forest, shrub &

wet land resources negatively and increasing the area coverage of croplands and decrease wetland and water body. Both Immigrants & indigenous people exert pressure by exploited the ecosystem illegally. In addition to this they told us when the conflict happened within the family & the community; disappointed persons and more than 98 illegal farmers were defrosted & degraded the land over 95 hectares through cultivation of the mountain.

#### 3.1.2.4. Impact of LU/LCC in Shengema mountain ecosystem

Land use and land cover changes (LULCC) are linked to climate change, biodiversity loss and pollution of water, soil and air (Waltert et al., 2004; Ellis and Pontius, 2011).

The LULCC affect the climate of an area which in turn affects natural resources such as water, wetlands and biodiversity (IPCC, 2001; Gibbard et al., 2005). Though wetlands are important in the global cycling of water and chemicals, including greenhouse gases and stabilize climate changes, wetlands and their biota are at risk from the combined effects of the changes (Sanz, 2002; Finlayson et al., 2006). Thus, degradation of the environment, which negatively impact ecosystem processes and function, especially conversion of wetlands to irrigated lands, represent significant challenges to biodiversity (Sharsm et al., 2007).

Land use land/cover (LULC) is perhaps the most prominent form of environmental change phenomenon occurring at spatial and temporal scales in the study area. The changes in land use and land cover aggravate land degradation/, soil degradation, Loss of biodiversity, habitat destruction, species transfer and environmental deterioration, negative impact on both the environment and socio-economic settings are largely results of LULC change. The other consequence of LULC change, particularly of deforestation is the shortage of fuel wood. At the FGD there were numerous plant and animal spacious in Shngema forest ecosystem like Phoenix reclineata/ዘምባባ, Ameja/English name/አምጃ, OlivaAfricana(ወይራ) currently eliminating in alarming rate, not only plant spacious but also animal spacious are eliminated. As a result of LU/LCC, environmental change specially drought, land slid and flood was manifested in the study area, in the case of consequent drought (1976, 1986, 1994, 2004and 2010) poverty and hunger increased, Large amount of springs and wet lands are dried, many wild animals and there ecosystem eliminated & destroyed. As an example they told us summer (ሰሞር) and choka (ጮቃ)

wet land decrease from 1 hectare 0.25 hectare within 10 years. And Hager wet land is totally dried.

#### 3.1.2.5. Response

Woreda of Debub ari established integrated water shade management activity approaches to enhance the area of Shengema ecosystem like, nursery sites preparation, bee keeping activity and soil and water conservations practices.

SNNPRS Environmental Protection Authority has done biodiversity conservation media in 2015. Not only this but also the Woreda have done coordination of NGOs to establish the nursery sit to rise seedling for afforestation purpose of Shengema forest eco system.

Some peoples are starting planting of trees with in their farm lands to protect the environment from climatic change. Little have been successful in maintain the environment by improving the well-being of the community.

NGOs like /Christians Lemat/, Agricultural growth program /AGP/works on afforestation program by preparing nursery site, awareness creation for the community and capacity building for experts.

Woreda forest sector prepare four model nursery sites for the future to produce seedlings for afforestation purposes of individual and communal land in the Shengema forest ecosystem.

Woreda of Debub ari established integrated water shade management activity approaches to enhance the area of Shengema ecosystem like, nursery sites preparation, bee keeping activity and soil and water conservations practices.

Debub omo zone integrated with Debub ari district allocated higher judges that follow the case of forests.

## 3.2. Water

Water is among natural resources which are very important for life. It is part of the life supporting systems and it is one of the precious gifts to mankind. It is also extremely needed for drinking, washing, hydroelectric power; irrigation, for watering plants and many other uses

which are basic for human and many natural resources survival. It can be found liquid, solid and gaseous forms. (1) Lily Mersha (2014),

However, lack of access to safe drinking water and basic sanitation is one of the problems affecting billions of people around the world. (2) (Hesperian Foundation, 2005). This is particularly in the developing countries where level of access to water and water related facilities are said to be very low.

Ethiopia has a huge potential of water resources which can be used for various purposes. This water resources is rivers, lakes, streams which are distributed all over the country though it's uneven because of different in geographical distribution, weather condition and forest coverage of the area. However, though Ethiopia is endowed with huge potential of water resources and efforts has been made to make use of it the country has not yet utilized its water resources fully.

Similarly, Shengema Mountain is one part of the country which has high potential of water in the area due to its high forest coverage.

### 3.2.1. STATE AND TREND OF WATER AVALABILITY

Water plays a major role both in social and developmental activities in Ethiopia. But to many African countries, parts of Ethiopia face water shortage; poor sanitation and lack of access to clean water sources. The study conducted at Debub Ari woreda indicates that, 36.74% of the population has access to a clean water supply. In rural areas of the woreda, the figures drop even lower, resulting in health problems in the villages as well as their animals. (3)(Debub ari woreda water office)

Shengema Mountain is found in Debub Omo zone in Debub Ari woreda. It was a water tower for different springs, lakes, rivers and wet lands of the area and it's surrounding for long time. But now's a day, the water potential of the area becomes decreasing.

Table 16 Rivers, spring and wetlands

| RIVERS | SPRINGS | WETLANDS |
|---|---|---|
| *Gebra (ገብራ)* | *Feket (ፈቀት)* | *Dabet (ዳበት)* |
| *Waze (ዋዜ)* | *Chenget (ጭንገት)* | *Toligafet (ቶሊጋፈት)* |
| *Kont (ኮንት)* | *Timket (ጥምቀት)* | *Kendel (ቀንደል)* |
| *Angelsi (አንገሊስ)* | *Dubeket(ዱበቀት)* | *Tuchagebza(ቱጫገብዛ)* |
| *Neri (ነሪ)* | *Ager (አገር)* | |
| *Uti (ኡቲ)* | *Baki (ባኪ)* | |
| *Enzakaysa (ኢንዛካይሳ)* | *Zeyeshet (ዝይእሸት)* | |
| *Bonbo (ቦንቦ)* | *Babi(ባቢ)* | |
| *Maki (ማኪ)* | *Summer (ሰመር)* | |
| *Ledi (ለዲ)* | *Choka (ጭቃ)* | |
| *Borti (ቦርቲ)* | | |
| *Wati (ዋቲ)* | | |
| *Bekeza (በቀዛ)* | | |
| *Debele (ደበሌ)* | | |
| *Weyto (ወይጦ)* | | |
| *Ganstala (ጋንፃላ)* | | |
| *Zaka(ዛቃ)* | | |
| *Seni (ሰኒ)* | | |
| *Gan (ጋን)* | | |

Source: Field survey with FGD



Figure 15: Neri River

Source: Field survey

The Rivers springs and wetlands are the heart of the community because they used for different purpose such as:

 Drinking fresh water for both human and animals

For bath in

 For Irrigation

For day to day activities

According to the information taken from Debub  Ari water and development office report, the availability of water reservoirs both ground and surface are 24 developed springs and 5 ground safe water a total of 29 springs and ground water reservoirs. As per the respondents before some years the quality and quantity of the water was at excellent condition, but now it is drying up  time to time. For instance choka (ጮቃ), summer (ሰመር), toligafet (ቶሊጋፈት), dabet(ዳበት) , babi(ባቢ) are wetlands and springs which are not existing.

### 3.2.2. DRIVER AND PRESSURE

#### *3.2.2.1. DRIVER OF WATER SCARCITY ON Shengema MOUNTAIN FOREST ECOSYSTEM*

**Driver Mean:** Factors acting upon the environment and which are responsible for the state of the environment. These factors which explain the situation of water scarcity. Accordingly to the respondents the area was rich in water both in quality and quantity. This is due to Shengema mountain which was highly covered by forest and makes the area to have high water potential, but now it is observed that decrease and loss of water body.

The main drivers of decreasing and loss of water bodies are:

**Deforestation as driver of water scarcity**

Forest and water are highly important correlated resources which provide many socio economic functions and services to human societies and the environment. However, the occurrence of disturbance on forests modifies and alters the recharge and discharge capacity, chemical quality and physical properties of water. This alarming decrement of forest cover exposed the water bodies to drying and disappears.

**Investment as driver of water scarcity**

Investment is paramount to sustained economic growth and the creation of wealth. But in other hand it has negative impact on the environment, when there is poor management. In our study area we observed there is coffee processing industry. The wastes are disposed from this industry directly enters to the NERI River which is very dangerous to the river to be polluted.

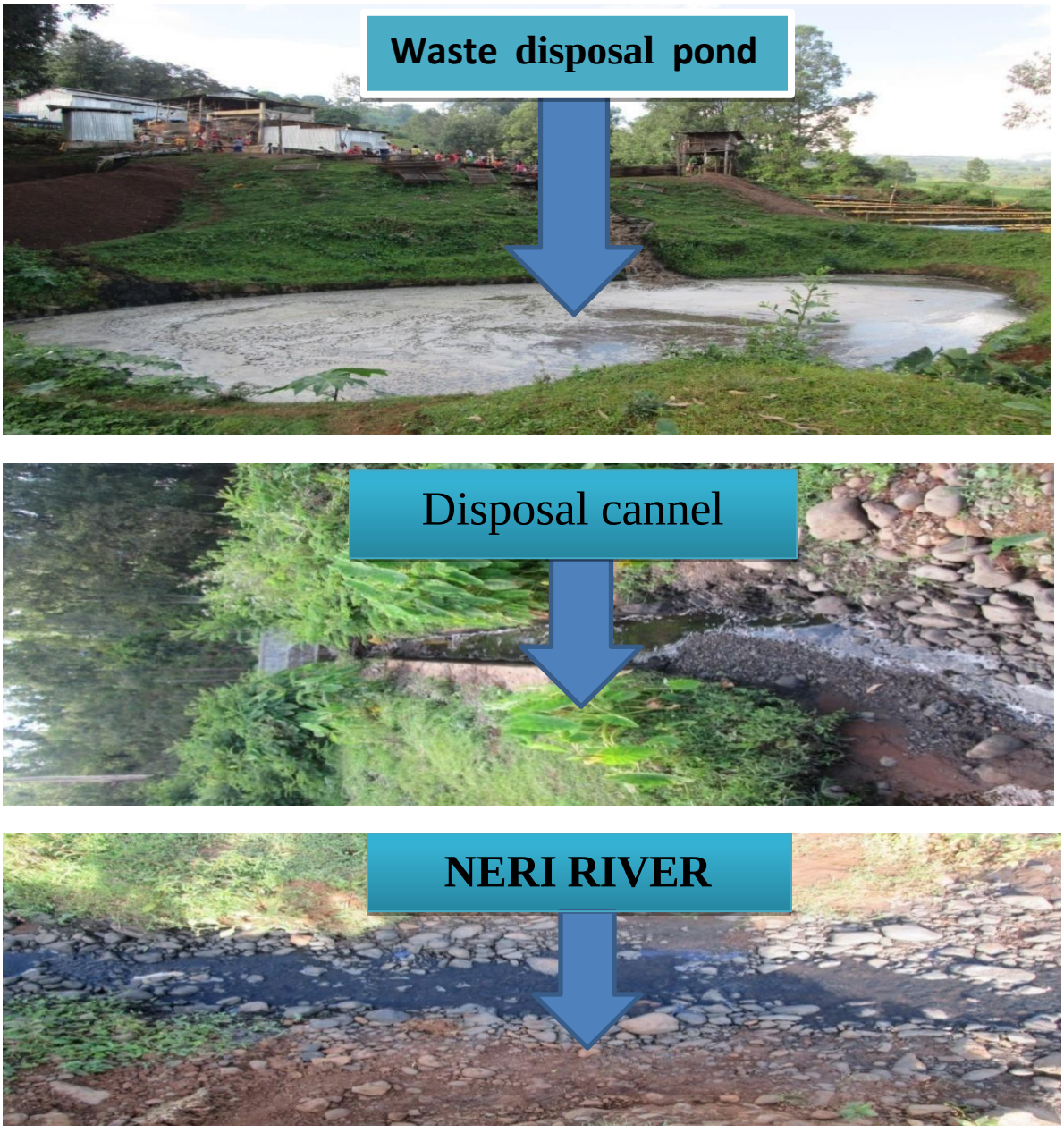



Figure 16: Water disposal pond, cannel and inter river

Source: Field photo at coffee industry

**Conversion of wetlands to grazing and agricultural land as driver to water Scarcity**

Wetlands are species-rich habitats performing valuable ecosystem services such as flood protection, water quality enhancement and food chain support. Wetlands have been drained to convert them into grazing, agricultural land and settlement. So due the disappearance of these wetlands the area lost these benefits from the wetland ecosystems.

Table 17: Disappeared wetlands

| Wetlands | Before(ha) | Now |
|---|---|---|
| *Dabet(ዳበት)* | 0.25 | Not exist |
| *Toligafet(ቶሊጋፈት)* | 0.25 | Not Exist |
| *Zeyshet(ዝይእሸት)* | 0.5 | Not Exist |
| *Kenedel(ቀንደል)* | 0.625 | Not Exist |
| *Tuchagebza(ቱጫገብዛ)* | 0.5 | Not Exist |

Source: Field survey with FGD

**Land degradation as a driver to water scarcity**

Land degradation refers to the loss of the productivity of the land due to human activity compounded by climatic variability. The close link between land and water makes land degradation the hidden face of water scarcity: the health of the land is critical in the search for sustainable solutions to water resource provision and management. Land degradation is followed by the inability of the soil to soak in and hold water when the rain falls. Over time, the replenishment of the water aquifer declines; the water table falls, and eventually collapses. Without vegetation cover, water run-off increases, wreaking more havoc on the land, and the cycle continues. In other words, land degradation leads to water degradation and eventual scarcity.

**Over grazing as driver to water scarcity**

Overgrazing represents an environmental hazard whereby wildlife or livestock excessively feeds on pasture. It is also the practice of grazing livestock on vegetation before it has recovered from a former grazing state, also known as intensive grazing. Otherwise stated, overgrazing takes place when vegetation or pasture is repeatedly removed from land and it is not given enough time to continue growing.

Intensive grazing thus causes the plant residual matter to decline and further contributes to numerous negative consequences to both the animals and the land. Consequently, overgrazing signifies a serious environmental challenge in maintaining the natural balance of livestock on grazing lands, which reduces the productivity, usefulness, and biodiversity of the land.

#### 3.2.2.2. Pressure of Water Scarcity on Shengema Mountain Forest Ecosystem

The major pressure that leads to scarcity of water in the study area is population growth. Due to the population growth there is high deforestation, expansion of agricultural land, land degradation and exploitation of natural resources for supplying the unlimited demand of the people. According to the data taken from the woreda finance and economic development office about population growth for the year 1985, 1995, 2005, and 2010 as follow

Table 18: population growth

| Years | Male | Female | Total | Percent (%) |
|---|---|---|---|---|
| 1985 | 70476 | 58937 | 129513 | |
| 1995 | 86437 | 89761 | 176198 | 73.5% |
| 2005 | 114612 | 119739 | 234351 | 75.18% |
| 2010 | 126314 | 130886 | 257200 | 91.11% |

SOURCE; Debub Ari Finance and economy development office report

### 3.2.3. IMPACT OF FRESH WATER SCARCITY ON COMMUNITY

As a result of drivers of water resource scarcity and depletion and pressure behind it, there is high deterioration of water resource, and the study areais getting dried overtime. In our study area due to high population growth many of the water systems that keep ecosystems thriving and feed a growing human population have become stressed. Rivers, springs, lakes and ground water are drying up or becoming too polluted to use. Many hectares of wetlands are disappeared. In addition to this the main impacts that are responded by the community are:

- Women,s and children's are obligated to go too far distance to fetch fresh water for consumption purpose.

- The peoples are exposed to diseases such as common cold, cholera, diarrhea and other water born diseases.

### 3.2.4. RESPONSE ON IMPROVING FRESH WATRE SCARCITY

In our field discussion with FGD, the local community said that, they have been deal many things with the woreda experts about improving fresh water scarcity.The community in the four kebeles mentioned that some public awareness and regulatory measures to improve the water use efficiency and to conserve the water resources are done. For instance hand dug well and spring development other activities are undertaken in dordora and billy kebeles.

**Recommendation**

- Implementation of natural resource management activities such as environmental rehabilitation, watershed management and reforestation program, improving extension services, public awareness and regulatory measures should be taken to improve the water use efficiency and to conserve the water resources.

- Encouraging and promoting local community participation in watershed management and water conservation measures and practices should be taken as remedy for the problem of water resources of the area.

- Women should be empowered on the development of water committee at woreda, kebele and water scheme levels, to enhance the active movement of women for sustainable development, design and management of water projects. In addition to implement water projects we have to give special training program to strength their technical capacities in Operation and Maintenance.

### 3.3. Forest and wood land degradation in Shengema mountain forest ecosystem

#### 3.3.1. State and trend of forest and wood land

Forest is 'Land spanning more than 0.1ha covered by trees (including bamboo) (with a minimum width of 20m or not more than two-thirds of its length) attaining a height of more than 5m and a canopy cover of more than10% or trees with the potential to reach these thresholds in situ whereas shrub is a small to medium sized woody plant un like herbs ,shrubs' have persistent woody stems above the ground they are distinguished from trees by their multiple stems and shorter height and are usually under 6 meter tall .small low shrubs generally less than 2 meter tall.

Forests are important sources of livelihood for millions of people and contribute to the national Economic development of many countries like Ethiopia. Despite their crucial importance in livelihood and climate regulation, forest resources all over the globe are subjected to enormous pressure resulting in deforestation and degradation due to the increase in human and cattle population and wide spread rural poverty. The depletion of forests has many ecological, social and economic consequences, including the extinction of biotic communities leading to reduction in biodiversity, soil erosion, global warming and loss of income to forest dwellers.

The source of data was primary data from focus Group Discussion, stakeholders and secondary data sources. A reconnaissance survey was conducted to have a broader understanding of the study areas. During this exploratory survey, discussions were held with different stake holders, farmers group and development agents.

We conducted 4 group discussions, key informants with farmers and development agents. Each group was composed of about 12individuals and the topics for the discussion were related to their perception of forest cover change, drivers of deforestation, their impact, existing remedies and possible solutions. Each focus group had a trained facilitator who guided the participants through sets of prepared questions.

Shengma forest ecosystem was rich both in ɨndigenous and exotic species. The community and the forest sector stated that there were more than 1000 different types of species found in the command area .The forest ecosystem gives high economic value for the community and environment. Syzygium Guineans' (Wild.)/ዶቅማ/and Bamboo species /Arundinaria alpine/ have

large spatial coverage making them the dominant species on the area. Some of those tree and shrub species are listed in the below table .

But recently the forest coverage of the study area becomes reduced. The critical issues concerning forest and woodland vegetation is deforestation and forest degradation.

Table 19: List of tree species found in Shengema mountain forest ecosystem.

| No | Scientific Name | Family | Amharic Name | Local Name |
|---|---|---|---|---|
| 1 | Hagenia abyssinica | Rosaceae | ኮሶ (Koso) | Gurma |
| 2 | Cordia Aafricana Lam. | Boraginaceae | ዋንዛ (Wanza) | Asha |
| 3 | Maesa lanceolata Forssk | primuiaceae | ቀላዋ (Qelawa) | Terrii |
| 4 | Vernonia amygdalina Del. | Asteraceae | ግራዋ (Girawa) | Garra |
| 5 | Prunus Africana | Rosaceae | ጥቁርእንጨት(Tiqu richet | Getsii |
| 6 | Eucalyptus globulus | Myrtaceae | ባህርዛፍ (Bahirzafi) | Barzaf |
| 7 | Croton macrostachyus | Euphorbiaceae | ብሳና (Bisana) | bataa |
| 9 | Syzygium guineense (Wild.) | Myrtaceae | ዶቅማ (Doq'ima) | Shiringi |
| 10 | Moringa stenopetala (Bak. f.)Cuf | Moringacea | Shifera/halako | Q'alingi |
| 11 | Schinus molle L. | Anacardiaceae | ቁንዶበርበሬ (QundoBerbere) | Bachetawo smi |
| 12 | Embelia schimperiVatke. | myrsinacee | እንቆቆ (Inkoko) | Shaida |
| 14 | Arundinaria alpine | POACEAE | ቀረቀሃ /kerqha/ | Ayice |
| 15 | Millietia ferruginea Mike. | Fabaceae | ብርብራbirbra | Zaagii |
| 16 | Afrocarpus falcatus | podocarpaceae | ዝገባ /zegba / | |

Source- from the Debub Arie Worde, Environmental protection and Forest Conservation reports October 2018

**Table 19: List of Shrubs found in the study area**

| no | Scientific Name | Family | Amharic Name | Local Name |
|---|---|---|---|---|
| 1 | OcimumlamiifoliumHochst.exBenth. | Lamiaceae | የሚችመድሃኒት (Yemichmedihanit | Michidheshi |
| 2 | Phytolacaceae | Phytolacaceae | እንዶድ (Endodi) | Endod |
| 3 | Calpurnia aurea (Ait.) Benth. | Fabaceae | ዲጊጣ (Digita) | kaineka |
| 4 | Dodonea angustifolia | spanindaceae | ክትከታ/kitkita | |
| 5 | Solanum in canum | | እምባይ | |
| 6 | Mulberry | Morus Genus | /እንጆሪ/enjori | |
| 7 | Clucia abyssinica Var. | Euphorbiaceae | ፍየልፈጅ (fyelfeji) | Gas a |
| 8 | Coriandrum sativum L. | Apiaceae | ዲምብላል (Dimbilal | Début |
| 9 | Foeniculum vulgare Miller. | Apiaceae | እንስላል (Insilal) | Ensilal |
| 10 | Clerodendrum myricoides | Lamiaceae. | ምስሪች (Misrich) | Dumpeken |

Source from the Debub Arie Worde, Environmental protection and Forest Conservation reports October 2011E.C)

**Table 20 List of fruits**

| no | Scientific l Name | Amharic Name | Local Name |
|---|---|---|---|
| 1 | avocado | ፓፓያ | Simra |
| 2 | Rhamnus prinoides | ጌሾ/Gasho/ | Simaq'i |
| 3 | Banana | ሙዝ | |

Source from the Worde Environmental protection and Forest Conservation reports October 2018

Deforestation is defined as the human induced conversion of forest land in to non-forested land (UNFCCC-Marrakech accords). Forest Degradation is defined as changes within the forest which negatively affect the structure or function of the stand on site and there by lower the capacity to supply produces and/or service/ FAO 2001/. A degraded forest is a secondary forest that has lost, through human activities, the structure, function, species composition or productivity normally associated with a natural forest type expected on that site. Hence, a degraded forest delivers a reduced supply of goods and services from the given site and maintains only limited biological diversity. Biological diversity of degraded forests includes many non-tree components, which may dominate in the under-canopy vegetation (CBD in 2015)

According to the World Bank collection of development the forest cover in Ethiopia is

estimated to 12.3% .The vegetation's of Ethiopia that may qualify as 'forests' are natural high forests, woodlands, plantations and bamboo forests. In 2015 the forest cover of the Debub nations and nationalities region was 19% but now the forest coverage in Debub Arie Worde is 10.99 % from the total area. (Debub e ari Worde forest sector). During the focus group discussions (FGDs), key informants and development agents, the participants had perceived that the changes in government in 1985 (from Dreg's regime to EPRDF regime), had brought changes about natural resource management approaches. From top down to bottom up, and ultimately to its current status of the forest. The participants further explained that there was little effort to protect the forest before 1991. But on wards from this year, people were scrambling forest areas for settlement, farm land (agricultural purpose), the poorest for incoming generating, charcoal and fencing activity. In this case the forest land becomes bare from time to time by gathering for sell (Income generating activity), for fuel wood consumption, animal fodder, and medicinal value. As we were observed the whole part of the eco system, it is dramatically changed from forest and wood land to human settlement, agricultural land, grazing land, and stone quarrying site.



Figure 17: Controlled forest areas in Shengema with in a pilot of land

Source; field photo capture



Figure 18: Forest land changed in to farm land

Field photo capture



Figure 19: FGD on change of forest land into other uses in the area



Figure 20: Use of forest for fuel food in Shengema forest eco system

Source: from the area ground survey

Table 22: LULCC

| No | Years | Forest land /km2/ | Shrubs /km2/ | Farm land /km2/ | Settlement /km2/ | Wet land /km2/ | Grazing Land /km2/ | Bare land /km2/ |
|---|---|---|---|---|---|---|---|---|
| 1 | 2000 | 1399.68 | 3107.11 | 2751.25 | 104.09 | 268.90 | 145.69 | 532.28 |
| 2 | 2008 | 383.32 | 3056.58 | 3671.32 | 485.60 | 110.12 | 414.65 | 187.39 |
| 3 | 2018 | 67.428 | 1172.21 | 5756.06 | 638.99 | 32.74 | 451.36 | 190.25 |

Source: From GIS land use land cover detection

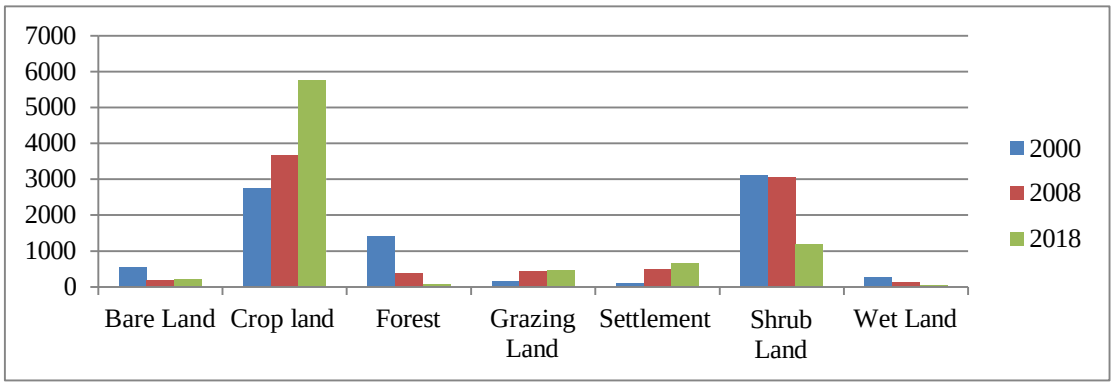



Figure 21: Land use land cover change from the year 2000, 2008, and 2018

Source- map detection

The Land Us Land Cover Change (LULCC) Detection indicates that, nearly 95.2%of forest and woodland had already been lost. The rate of forest and woodland removal has been at an alarming rate. On the average 5.3 % of forest and woodland had already been lost each year.



Figure 22: Previously this area was forests land FGD and office of forest

### 3.3.2. Driver and pressure of Shengema Mountain forest eco system.

A „driving force" is a need of primary and secondary activates. Driving forces for an individual are the need for shelter, food, water, profit and entertainment. The local inhabitants have been exercising unplanned Forest and woodland clearance. From the ground truth observations in the Shengema forest ecosystem and discussions with the local communities, forest sectors, woreda administrator and by collected different data, six critical drivers have been identified.

**Population growth** -the major cause for the observed decline in forest and wood land ecosystem in Shengema ecosystem is rapid population growth that resulted in increased demand for cropping land, fuel wood, construction materials and land for settlement. Because almost all of the local community depends on agriculture for their livelihood. With the gradual expansion of population due to immigration has been continually pressure on the vegetation which in turn led either to degradation or alteration of the forest condition.

The population of Debub Arie Worde in 25 year's data is increasing in alarming rate. This exert pressure on wood land and natural forest of shngma forest eco system

Table 21 : Population data of Debub Ari

| no | Years | male | female | Total | Increments in % |
|---|---|---|---|---|---|
| 1 | 1993 | 70476 | 59037 | 129513 | |
| 2 | 2003 | 86437 | 89761 | 176198 | 73.5 |
| 3 | 2013 | 114612 | 119739 | 234351 | 75.18 |
| 4 | 2018 | 126314 | 130886 | 257200 | 91.11 |

Source: - Debub Ari worda finance and development office.

In the year 1993 the population of Debub Arie Worde was 129513 but know in 2018 reaches 257200 from this 45928 are in urban. This increment of population in both rural and urban side's leads to fuel wood consumption and agricultural land expansion becomes higher. From this we recognized that population increment is the pressure of deforestation in this command area

**Consumption of fuel wood for domestic usage and for market**; fuel wood is the primary source of meeting rural population energy demand and also the major source for the in habitants of Debub Arie Woreda and jinka town. Fuel wood is collected from wood lands and forest land for house hold consumption and to generate income by selling to urban.

**Stone quarrying**: - infrastructure development activity contributes minimum role in degradation of vegetation in the area; the construction of roads as part of the current endeavor to improve the transport network involving clearance of forests;

**Illegal settlement and Economic activity**

**Increments of Livestock population**

**Land certification problem** As long as there is no real responsibility among the local population for the common forest resources; forest laws and regulations are not enforced. It is impossible to stop another person from exploiting forests. If the local communities get the power to utilize and protect the surrounding natural forest sustainably, they can defend from outsiders..

### 3.3.3. Impacts of Forest and Woodlands degradation

Due to population increment the forest cover of Shengema reduced from time to time. As result, different problems occurred in the area.

**Run off /removal of top soils by erosion: - as** the wood land and forest land of the surrounding area is converting to agricultural land, harvested for firewood and construction material, lead to loss of forest and Woody biomass in the study area and the vegetation coverage of the Shengama maintain forest ecosystem deceased. This results to negative impact on the environment as well as high run off and soil erosion. The farm lands on the plains are covered by gravel and sandy deposits. This overall results on deter ration of soil quality leading to low productivity of crop and destroying the carbon sink mechanisms.

**Siltation of rivers, stream and wet lands** .as result of this problem physical, chemical and biological structure of the water source and the wet land of the command areas Changed.

**Destruction of habitat and biodiversity**. At the focus group discussion there were numerous plant and animal spacious in SHNGMA forest eco system on the command area but currently both plants and animals are eliminating in alarming rate.

Table 22 : From extinct and endangered forest species are

| | Biological Name | Amharic Name | Local Name |
|---|---|---|---|
| 1 | Phoenix reclineata | ዘምባባ | Gurma |
| 2 | Ameja/English name/ | አምጃ | Zayeza |
| 3 | Foeniculu mvulgare Miller | እንስላል | Ensilal |
| 4 | OlivaAfricana | ወይራ | |
| 5 | Millsata ferruginea mike | ጥርጥራ | Zaagii |

Source - Farmers groups on the ground /FGD/

Table 23: wild animals extinct and endangered in the area are

| No | English name | Amharic name | Locale name |
|---|---|---|---|
| 1 | Pig | አሳማ | gudme |
| 2 | Antelope | ድኩላ | Ambi |
| 3 | Hayne | ጅብ | godri |

| | | | |
|---|---|---|---|
| 4 | Tiger | ኑብር | notia |
| 6 | Monkey | ዝንጀሮ | gayse |
| 7 | Fox | ቀበሮ | wokesak |

Source – FGD and Debub ari worda environmental protection and Forest conservation office.

**Drought**: is the critical problem in the command area. The problem was created within four consecutive years as results many people and animals was died , migrated from their residential area and also expose to food in security.



Figure 23: The tip part of HAGER forest area 2,977masl which is degraded like this.

### 3.3.4. Response for mitigating forest and wood land degradation

SNNPRS Environmental Protection Authority has done biodiversity conservation media in 2015. Not only this but also the Woreda have done coordination of NGOs to establish the nursery sit to rise seedling for afforestation purpose of Shengema forest eco system.

Some peoples are starting planting of trees with in their farm lands to protect the environment from climatic change. Little have been successful in maintain the environment by improving the well-being of the community.

NGOs like /Christians Lemat/, Agricultural growth program /AGP/works on afforestation program by preparing nursery site, awareness creation for the community and capacity building for experts.

Woreda forest sector prepare four model nursery sites for the future to produce seedlings for afforestation purposes of individual and communal land in the Shengema forest ecosystem.

Woreda of Debub ari established integrated water shade management activity approaches to enhance the area of Shengema ecosystem like, nursery sites preparation, bee keeping activity and soil and water conservations practices.

Debub omo zone integrated with Debub Arie district allocated higher judges that follows the case of forests.

### 3.3.4. Options for the future measures

Developing alternative and renewable energy source both for domestic and industrial consumption by using efficient fuel wood saving and improve electric power supply.

Establishes forest nursery seedling site in the command area and produce sufficient amount of seedlings for plantation purpose.

They give awareness for the community about climate change, result and conscience.

Improving and enforcing the current land use and forest policy that suits the changing of the environment Therefore, it is normally better to provide land for private and community woodlots and local households, while closing the natural forests from humans and livestock.

### 3.3.5. Outlook

Unless SNNPRS try to reverse forest coverage of the area, the people will lose the total forest and shrub area for the next 10 years. The runoff will increase and devastate the environment, the quality and quantity of water will be decrease and results siltation on the lower catchment area, gullies will increase in width, length and depth results distraction of roads, agricultural lands, settlement areas and infrastructure

## 3.4. Biodiversity of Shengama's Mountain forest ecosystem

### 3.4.1. State and trends of biodiversity of Shengama's Mountain forest ecosystem.

Debub Omo nation nationality people of Ethiopia are one of the zone in Ethiopia endow with unique biodiversity resources and many ethnic groups of people. It is well known Debub Omo nation nationality people of Ethiopia zone is rich in plant and animal genetic diversity specially

those of indigenous and medicinal plants. According to the key informant and FGD in 2018 stated that Shengama's people also had well developed indigenous knowledge practices both to conserve and utilize these resources sustainably, but the current vegetation covers of Shengama's mountain forest ecosystem are remains of out of what has been deforested by people surrounding the four district and by those subsistence farmers.

According to the Debub *Ari Woreda Environmental protection and Forest Conservation reports in 2018 indicated that* In the Shengama's mountain forest ecosystem there were more than 1000spices of plant and more than 300spices of animals, but now decline the number of species, in which there are 10 Bird species, 100 Plant species, and below 30Animal species. The size of the ecosystem is decrease from 83, 0900 hectares to27, 030hectare (from 1994-2018) because of agricultural expansions, urban settlements, grazing land and illegal scrambling of forest and wet lands for agriculture purpose. All forest ecosystem, and wet land ecosystem converted into agriculture, settlements and replaced by eucalyptus trees, due to that the amount of forest coverage, and wet land biodiversity decreases time to time. Not only these but also, indigenous plant species, animal species, medicinal plant species, amount of water and water quality decreases.





Figure 24: Crop land and human settlement's photo which shows current landscape is covered with sparse indigenous plants

Source : Filed survey, 2018

This Filed survey, 2018 showed that the steep slope of the mountain completely deforested and converted into crop land and human settlements. But some indigenous plants are oversight in crop land to prevent flood and completely destroying from their environment.

In the focal group discussion, they were expressed the Shengama's mountain biodiversity before1988 was gives the following functions;

- ❖ It gives physical protection in some cases.
- ❖ Prevents flooding and storming
- ❖ The poor and landless people can get diet from wild life.
- ❖ Many drugs obtained from plants and animals.
- ❖ Supporting of nutrient recycling, soil formation and primary production.

- Provision of food, fresh water, fiber and fuel.
- Regulation of microclimate, flood and disease, and water purification..
- Used to cultivate and harvest honey products from the forest.But, now the above functions are decreased, due to biodiversity loss or degradation's.



Figure 25: Forest coverage converted into crop land

Source: Filed survey of 2018

#### 3.4.1.1. Flora Resource

The floral resources of shengama's mountain forest ecosystem are rich in Indigenous plants like *Coffee arabica*/coffee/, *Eragros tistef*/tef/, *Ensete ventricosum*/Ensete/, *Guizotia abyssinica*/niger seed/nug/, *Brassica carinata*/Ethiopian gomenzer/, *Carthamustirrtures*/sun flower, suf/, *Sorghum spp*/barley, *Hordemspp*/barley/, *Ricinuscommunis*/caster bean, gulo/.

The most common dominant plants at Shengama's Mountain forest ecosystem was Doqima /*Syzygium guineense* /, Kosso/*Hagenia abyssinica*, Zeyza, Bamboo, etc. but now they are the most endangered and threatened species. People were used wiled fruits as food such as Doqima, /*Syzygium guineense* /, Wanza, */Cordial Africana* Chede, Enjory, Agame (Haleme) */Carisaspinarum* L. / ,Gorka, Kusheme etc.

The endangered and extinct plant species includes Chede /ጫዲ/, Kosso, Wanza /ዋንዛ/, Arebi/ኦርቢ/, Duri /ዱሪ/, Falke /ፋልካ/, Blackwood etc. whereas animal species like Pig, Midaqua, Hyena, Dicula, Tiger, etc.

**Medicinal plant resources in Shengama's Mountain forest ecosystem**

*According to study on actual situation of medicinal plants in Ethiopia by (Endeshaw Bekel 2007) research* stated that the plant genetic resource of the country exhibit an enormous/large/ diversity as seen in fact that Ethiopia is one of the 12 vavilov centers of origin for domesticated crops and their wild and weedy relatives. According to (Ensermu and Sebesebe 2014), it is estimated that there are more than 7000spices of flowering plants recorded in Ethiopia, of which 12% or more are probably endemic.

A medicinal plant comprises one of the important components of the vegetation. On recorded there do 600species of medicinal plants constitute a little over 10% of Ethiopian's vascular flora? The wood lands of shengama's forest were the sources of most of the medicinal plants. (*In 2017 and 2018 SAWEPFCR) were indicated that* the well-developed tradition knowledge of shengama's people to use cultural medicines enable them to sustain different species of medicinal plants which are more than 24 species are identified with their use. Some of the medicinal plants at shengama's forest ecosystem are listed as follows.

Table 24: Medicinal plant species SAWEPFCR in 2015and 2018

| • Traditional medicinal plant | | | | |
|---|---|---|---|---|
| | Biological Name | Family | Amharic Name | Local Name |
| 1 | *Hageniaabyssinica* Bruce | Rosaceae | ኮሶ (Koso) | Gurma |
| 2 | *Cordial Africana* | Boraginaceae | ዋንዛ (Wanza) | Asha |
| 3 | *Maesalanceolata* | Primulaceae | ቀላዋ (Qelawa) | Terrii |
| 4 | *Vernoniaamygdalina* Del. | Asteraceae | ግራዋ (Girawa) | Garra |
| 5 | *Prunus Africana hook.f.* | Rosaceae | ጥቁርእንጨት (Tiqurichet) | Gets'ii |
| 6 | *Eucalptusglobulus* | Myrtaceae | ባህርዛፍ (Bahirzafi) | Barzaf |
| 7 | *Cluciaabyssinica*Var. | *Euphorbiaceae* | ፍየልፈጅ (fyelfeji) | Gasa |
| 8 | *Carica papaya* L. | *Caricaceae* | ፓፓያ (Papaya) | Papa |
| 9 | *Calpurnia aurea*(Ait.) Benth. | *Fabaceae* | ዲጊጣ (Digita) | Kaineka |
| 10 | *Clerodendrummyricoyides* | *Lamiaceae.* | ምስሪች (Misrich) | Dumpeken |
| 11 | *Carisaspinarum* L. | *Apocynaceae* | አጋም (Agam) | H'almii |
| 12 | *Moringastenopetala*(Bak. f.)Cuf | *Moringaceae* | Shifera/halako | Q'alingi |
| 13 | *Citrus limon*(L.) | *Rutaceae* | Lomi | Lomi |
| 14 | *Allium sativum*L. | *Lialiaceae* | ነጭሽንኩርትNechishinkurt | Tsamishinkurt |
| 15 | *Allium cepa*L. | *Alliaceae* | ቀይሽንኩርት (Qeyishinkurt) | Zeyimishinkurt |
| 16 | *Musa paradisiacal*Rajesh N. | *Musaceae* | ሙዝ (muz) | Muszi |
| 17 | *Ocimumamericunum* | *Lamiaceae* | በሶብላBesobila | Besobila |
| 18 | *Solanumincanum* | *Solanaceae* | እንቧይEnbuayi | Garintii |

| | | | | |
|---|---|---|---|---|
| 19 | *Solanumdesphylum* | *Solanaceae* | የፈረንጅእንቧይYeferEnbuayi | Garintii(ቅ.ይበላል) |
| 20 | *Millietiaferruginea*Mike. | *Fabaceae* | ብርብራbirbra | Zaagii |
| 21 | *Osmium lamiifolium* | *Lamiaceae* | ዳማከሴDamakese | Tsiisii |
| 22 | *Artemisia absinthium* | *Asteraceae* | አርቲሚዚያartemizia | Nater |
| 23 | *Rutachalapesis* | *Rutaceae* | ጤናዳምTenadam | Tsaltii |
| 24 | *Gymbopagon citrates* | *Gramineae* | ጤጅሳር | |

The value and role of these traditional health care system will not reduce in the future because they are both culturally viable and expected to remain affordable while the modern health care services is both limited and expensive. The local community has long history of traditional health care based largely on rich, though unstandardized, pharmacopoeia/list of medicinal plant and their utilization/, drawn mostly from plants used by woman in home in self-administration and traditional health care worker. The efficacy is few of these plants /*Hagenia abyssinica*/ for the treatment of tape worm, and *Phytolaca dodecandra* as mollucicide in the control of schistosomiasis. However, many of these plant species used in traditional system by woman and traditional herbal people are becoming rare and limited in distribution; they are treated by several factors, both anthropogenic and natural.agricultural expansion, loss of forest, and wood lands, overharvesting, fire and urbanization appear to be the principal threats to the medicinal plants.

**Table 25: The spice species plants that used for different purposes, listed as follow**

| Scientific name pla | Local name of plants | Uses of medicinal plants |
|---|---|---|
| rutachaepensis | Tinadam /Rue | to sweaty watt and coffee |
| *Echinopskebericho*/ | Kebercho/ቀበርቾ/ | for evil eye |
| *Withania* | Gisewa | for malaria headache, cough, asthma |
| *Ocimumlamifolium*/ | Damakese/ዳማከስይ/ | ✓ For cough, eye infection Mich, fever, headache. |
| *Coriadrum sativum* | Dimebelale/ድምብላል/ | Stomach ache. |
| *Cuminum cyminm* | Enssellale/አንሰላል/ | for bleeding blood; |
| *Trigonellafoenumgraceum* | Abeshi/አበሽ/ | stomach, antispasmodic, wound dressing |

| | | |
|---|---|---|
| *Menthe oiperita* | Nana(peppermint/ | for common cold, headache |
| *Curcuma loga* | Turmeric | treats crying eyes in children |
| *Phytolaca dodecandra* | Enkoko | for tape warm |
| *Alluvium sativum* | Nechshinkurt (garlic | treats common cold, malaria, cough, pulmonary tiuberclosis |
| *Zingier officinal* | Ginger | treat stomach ache, cough, fever, influenza |
| *rutachaepensis* | Tinadam /Rue | used to sweaty watt and coffee |

According to the FGD 2018; steel now the shengama's people's use these spice for different purpose by growing around their homes

Table 26: The plant species found in Debub Arie woreda *(SAWEPFCR 2018)*

| **No** | **Scientific name pla** | **Local name of plants** | **No** | **Scientific ame plants** | **Local name of plants** |
|---|---|---|---|---|---|
| *1* | *Acacia abyssinca* | የሀበሻግራር | *41* | *celtis Africana* | ቀወጥ |
| *2* | *Acacia albida* | ግራር | *42* | *callistemon citrinus* | የጠርሙስማጠቢያ |
| *3* | *Acacia decurrense* | ግራር | *43* | *Syzygiumguineense* | ዶቅማ |
| *4* | *Acacia melonoxylon* | ግራር | *44* | *Arundinaria* | ቀርቀሀ |
| *5* | *Acacia nilotica* | ግራር | *45* | *Ephorbiaabyssinica* | ቁልቃል |
| *6* | *Acacia tortilis* | ግራር | *46* | *Scheffleraabyssinica* | ቂጤማ |
| *7* | *Albizaiagummifera* | ስሳ | *47* | *Masealanceolata* | ቀለዋ |
| *8* | *Albizaialebbeck* | ሰሳ | *48* | *Phoenix reclinata* | ዘምባባ |
| *9* | *Albizaiaschimpeiana* | ሰሳ | *49* | *Vernoniaamygdalina* | ግራዋ |
| *10* | *Annonamuricata* | ግሽታ | *50* | *Agave sislalana* | ቃጫ |
| *11* | *Azadirachtaindica* | ክንኒ | *51* | *Aningeriaadolfi-fredericii* | ቀረር |
| *12* | *Balanitesaegyptica* | | *52* | *Carica papaya* | ፓፓያ |
| *13* | *Cajanuscajan* | የርግብአተር | *53* | *Dodoneaangustifolia* | ክትከታ |
| *14* | *Cassia siamea* | የፈረንጅድግጣ | *54* | *Ekebergiacapensis* | ሎል |
| *15* | *Casurinacunnghamnia* | ሸዋሸወ/አርዘሊባኖሰ | *55* | *Dovyalisabyssinica* | ኮሽሚ |
| *16* | *Casurinaequisetifolia* | ሸዋሸወ/አርዘሊባኖሰ | *56* | *Grevillearobusta* | የጠመንጃዘፋ |
| *17* | *Catheedulis* | ጫት | *57* | *Jacaranda mimosifolia* | ጃካራንዳ |
| *18* | *Citrus retculata* | ሎሚ | *58* | *Meliaazedarach* | ኒም |
| *19* | *Citrus aurantifolia* | መንደሪን | *59* | *Muse ensete* | እንሰት |
| *20* | *Cordial Africana* | ዋንዛ | *60* | *Perseaamericna* | አቦካዶ |
| *21* | *Croton macrostachyus* | ብሳና | *61* | *Acrocarpusfalcatus* | ዝግባ |
| *22* | *Erythrinablucel* | ኮርች | *62* | *Polyscianfulva* | የዝንጀሮወንብር |
| *23* | *Eucalyptus camaldulenlsis* | ቀይባህርአፍ | *63* | *Schinusmolle* | ቁንዶበርበሬ |
| *24* | *Eucalyptus gilabilus* | ነጭባህርዛፍ | *64* | *Saccaranoficinarum* | ሸንኮርአገዳ |
| *25* | *Eucalyptus viminalis* | ቀይባህርዛፍ | *65* | *Sabeniaaculeta* | ሰስባና/የቡናጥላ |

| | | | | | |
|---|---|---|---|---|---|
| *26* | *Leueaenaleucocarpus* | ሉሱናዛፍ | *66* | *Spathodeanilotica/campanulata* | የጫካነበልባል |
| *27* | *Mangiferaindica* | ማንጎ | *67* | *Ficussur* | ሾላ |
| *28* | *Milletiaferruginea* | ብርብራ | *68* | *Ficusvasta* | ዋርካ |
| *29* | *Moringaoleifera* | ሸፈራዉ | *69* | *Mores alba* | እንጆሪ |
| *30* | *Oleaafricana* | ወይራ | *70* | *Carissa edulis* | አጋም |
| *31* | *Derkinsoniaaculeleata* | የእየሩሳሌምእሾህ | *71* | *Balanitesaegyptica* | ባደና |
| *32* | *Juniperusprocera* | የአበሻጥድ | *72* | *Adathodascemperiana* | ሰንሰል |
| *33* | *Psidiumgujava* | ዘይቱና | *73* | *Coffee arebica* | ቡና |
| *34* | *Rhamnusprinoides* | ጌሾ | *74* | *Prunusafricanum* | ጥቁርእንጨት |
| *35* | *Ricnuscommvnis* | ጉሎ | *75* | *Solanumincanum* | እምቡይ |
| *36* | *Tamaricixaphylla* | አባሎ | *76* | *Calpuneaaurea* | ዝግባ |
| *37* | *Citrus sinensis* | ብርቱካን | *77* | *Venoniaauriclifera* | ግራዋ |
| *38* | *Copresssulustanica* | የፈረንጅጥድ | *78* | *Acacia saligma* | ግራር |
| *39* | *Hageman abyssinca* | ኮሶ | *79* | *Citirusparadis* | ወይን |
| *40* | *Ardodonax* | ሸንበቆ | *80* | *Prunuspersica* | ኮክ |

Table.28: Shows that there are above 80 plant species are found at shengama's mountain forest ecosystem; when we compare to the previous the number of plant species decrease apace way.



Figure 26: Forest coverage of Hager Mountain

Source: Field survay2018;

Field survay2018; show that there were high biodiversity populations at shengama's Mountains before in 1988.

### 3.4.1.2. Wild Faunal Resources

According to the FGD in 2018Shengama's mountain forest ecosystem encompasses a broad range of ecosystems with great Arieties of habitats contributing for the occurrence of high faunal diversity. However, information on terrestrial fauna as a whole was limited to arthropods birds, reptiles, amphibians and mammals, including:- Hyena/ *Hyaenida*e *carnivore*/, Rabbit / *Wart hog*/, Fox*/Cannisvulpesa* / Common baboon , Squirrel, koke,jigra, ,borofahowever; the number of these wild fauna resources are currently seen in less amount also some are extinct from the forest like qoke,jigera,hayena,midaqua,nebere,assama,dikula, as it was stated in focused group discussion in 2018.

Table 27: Faunal species was found in shengama mountain forest ecosystem (FGD in October 2018)

| NO | Local name of animals | English name | Scientific name animals |
|---|---|---|---|
| 1 | Jibe | Hyena | Hyaenidaecarnivora |
| 2 | Assama | Pig | |
| 3 | Midaqua | Antelope | Aepyceros melampus |
| 4 | Dekula | Impala | Aepyceros melampus |
| 5 | Tota | Ape | |
| 6 | Zinjero | Monkey | Papiohamadryas |
| 7 | Ebabe | Sneak | |
| 8 | Ayete | Rate | Dipodomys ordii |
| 9 | Felefele | Marmot/mole/shrew | Aremadelo |
| 10 | Tinchele | Rabbit | |
| 11 | Anner | Tiger | Pantheratigris |
| 12 | Kebero | Fox | Cannisvulpes |
| 13 | Shikoke | Shrew | |

| | | | |
|---|---|---|---|
| 14 | Gureza | Ape | |
| 15 | Shelemitimate | Shrew | |
| 16 | ጋጋሮ | Ibis | |
| 17 | Yewuhadero | Dog | Cannisfamiliaris |
| 18 | Anbessa | Lion | Pantheraleo |

### 3.4.2. Driver and pressure of biodiversity on Shengama's Mountain forest ecosystem

The main drivers of biodiversity loss are; inadequate forest ecosystems use through selective extraction of individual species with high commercial contributes to degradation of ecosystem and represents another threat to biodiversity. Regarding to the FGD and woreda environmental reports in 2018 are the direct effects in shengama's mountain forest ecosystem habitat loss/ degradation is caused by the following factors like;

- Deforestation causes removal of entire ecosystem.
- Over grazing by stock animals, and carelessness use of natural resources
- Fuel wood collection, illegal logging, and forest fire
- Overhunting/poaching/ Illegal hunting
- Introduction of improved crop Arieties/decrease genetic diversity of indigenous crops/
- the incidence of plant and animal disease like faciola hepatica and fungal diseases

Land use change, in shengama's mountain biodiversity loss and Land use change is driven by produce agricultural crop, grazing land for agricultural land and new human settlements is a cause of deforestation and a direct threat to biodiversity. This system has caused extensive disappearance of biodiversity in this area, leaving only remnant forests.

Table 28: Land use Change

| YEAR | Bare Land | Crop land | Forest | Grazing Land | Settlement | Shrub Land | Wet Land | Total |
|---|---|---|---|---|---|---|---|---|
| 2000 | 532.3 | 2751.3 | 1399.7 | 145.7 | 104.1 | 3107.1 | 268.9 | 8309.1 |
| 2008 | 187.4 | 3671.3 | 383.3 | 414.6 | 485.6 | 3056.58 | 110.12 | 8309.1 |
| 2018 | 190.2 | 5756.1 | 67.4 | 451.4 | 638.9 | 1172.2 | 32.7 | 8309.1 |

From table 28, crop land, grazing land and human settlements are increased, while forest, shrub land and wet lands are decreases.

**Over-harvest;** of both woody and non-woody Products of shengama's mountain biodiversity was occurring on a widespread basis leading to deforestation, ecosystem degradation and biodiversity loss. Root causes include demographic pressures and growing demand, especially urban community demand of shengama's mountain forest product for firewood, charcoal and for other products.

**Overgrazing;** results in decreased soil cover, increased erosion, decreased quality and productivity of range resources, reduction or elimination of the natural regeneration of woody species and preferred forage species, bush encroachment in the area and loss of biodiversity. As we have observed during field visit removal of the forest for livestock feed without replacement, continued loss and degradation of shrub.

**Over-hunting;** is the wildlife populations have been severely depleted by hunting in the area of shengama's mountain biodiversity. Like qoke, jigera, midaqua, dikula

**Deforestation;** while deforestation could be considered minor at the individual property level, the aggregated deforestation is estimated to be significant and also occurs on land that is being cleared by increasing populations for agriculture. In shengama's mountain biodiversity ecosystems charcoal production and fuel wood consumption are the greatest drivers for deforestation mainly in the areas.

Increments of urban expansions and human settlements on the bottom parts and on the upper parts of mountain peaks,
Radical growth of human population and the incensement of releasing of greenhouse gases to the air.

Table 29: human population growth of Debub ari woreda

| YEAR/G.C) | RURALP0PN. | | | URBAN P0PN. | | | TOTAL P0PN. | | |
|---|---|---|---|---|---|---|---|---|---|
| | MALE | FEMALE | TOTAL | MALE | FEMALE | TOTAL | MALE | FEMALE | TOTAL |
| 2014 | 114280 | 119563 | 233843 | 3887 | 3794 | 7625 | 118114 | 123354 | 241468 |
| 2015 | 115114 | 118642 | 233756 | 3947 | 3954 | 7901 | 1118951 | 124259 | 243210 |
| 2017 | 116757 | 122232 | 238989 | 5633 | 5617 | 11250 | 122390 | 127849 | 250239 |
| 2018 | 120539 | 123932 | 244471 | 5775 | 6954 | 13792 | 126,314 | 130,886 | 258,263 |

From table 29 we can understand that the rural and urban human population growth rate is 6.5% and rapidly increased from 241468to 258263 this shows that number of people affect the environment in different aspects.

Under valuation of biodiversity resource by government bodies.(i.e. The government bodies do not give more attention about the implementation of water shed managements program, do not prepare nursery site in each districts, they do not regulate the illegal scrambling of forest land by the people, the government were not take actions on the illegal settlement, and agricultural land owner ships, steal now they populate the forest land illegally ,most landless people go up on the mountainous forest ecosystem without the provision of the people but the government do not give command to stop it.

### 3.4.3. Impacts on biodiversity losses at shengama's Mountain forest ecosystem

According to the KI and FGD the loss of biodiversity resources that leads the community to shortage of wild fruits, wild animals, fire wood, charcoal, medicinal plants, and the climate is changed, productivity decreases, land slid and soil erosion increased, animals are move into other areas, people are suffer to build houses and house hold materials like hut coverage grasses, fence wood, reduction of honeybee and honey products, cereal crop productivity, increases environmental pollution, continuous drought occurring starting from in 1984 up to 2018with in each four years intervals and the forest coverage highly degraded and deforested, almost all people economically and nutritionally insecure, because they are depends up on only on

biodiversity. They didn't get enough fruits, wild animals for hunting, raw materials to make furniture, build houses and agricultural farming materials (like mofer, kenber or farming utensils.) Amount of water and wet land area coverage decreased; Peoples are move away from their residential area to other area due to continuous soil erosion and landslides. Due to biodiversity degradation it results high flow of flood into drinking water and streams. In general the Shengama's Mountain biodiversity loss contributes the people to;

- Worsening health
- scarcity material wealth
- worsening social relations
- Food insecurity

Table 30: the productivity of crops from 1994-2018

| No | Name of crops | Before 25 yrs. products/hectare. | Now products /hectare |
|---|---|---|---|
| 1 | Wheat | 1600-2000kg | 400kg |
| 2 | Barley | 2000-2400kg | 400kg |
| 3 | Bean | 1300-1400kg | 60kg |
| 4 | Pea | 1300-1400kg | 60kg |
| 5 | Corn/mashila/ | 2800-3200kg | 400-800kg |
| 6 | Corn/maize/bekollo | not known | New species to the environment |

Table 30 showed that productivity of the crop is decrease and new crops adapt to the environment, due to biodiversity degradation, soil infertility and climate change

### 3.4.4. Responses on biodiversity of shengama's Mountain forest ecosystem

**The government responses**

According to the FGD and SAWEPCR in 2018 explained that the agricultural developing experts and the people try to apply the integrated water shed management program to protect the biodiversity ecosystem. The government also tries to create awareness on 1075 peoples and other stakeholder about the forest ecosystem, wet land ecosystem, medicinal plants, and seedling

(nursery) site uses and biodegradation problems to the community. The woreda forest regulatory take actions on 17 persons in which they are deforests the forest mountainous land illegally and without green papers converted in to farming and grazing lands

The woreda tries to do local rule and regulation to protect the biodiversity, from illegal hunting ,forest land scrambling ,land ownership conflicts between kebeles (wuset and doredora),and they conducts in-situ conservation methods ,i.e. projects are conducted on the capacity building for access and benefit sharing and conservation of medicinal plant project(June 2014).and conducts on shiferaw (moringa),rate, gizawa, qenqeso, zingible and temenay plants which is located between Debub omoariworeda,andjinka town. In doing theses above 22.8 hectares of land is rehabilitated into forest ecosystem by growing eucalyptus tree and some indigenous plant.
/regarding on the Debub Ari Woreda Environmental protection and Forest Conservation office reports in 2018/

**Community responses**

In the study area the FGD and SAWEPCR in 2018 indicted that ,the community tries to collect 2kg indigenous tree seeds by 2018 for the nursery/the preparation of seedling site/ and prepared 157,500 seedlings. People tries to omission indigenous plants like doqima, kosso, bamboos, and grow eucalyptus, etc…around their houses to keeps their farming land from heavy flooding, landslides and soil erosion, and also preserves indigenous trees completely destroying from their environments. Starting from 1985-2018 the shengama's forest ecosystem were affected continuously by drought. Due to climate change people tries to adopt new crop species like Bekollo (corn), Teffe, Mango, Avocado, etc. but sometimes don't repine on the expected time.

### 3.4.5. Outlooks

According to the woreda environmental protection reports in 2018 shows that the number of plant and animal species decreases from 1000plant and 300 animal species into 100 plant and 30 animal species, this rate of biodiversity loss is continue estimated to eliminate or destroyed by 2040 because of high rate of population growth this can be elaborated by the recent study of biodiversity in modern biology published book in 2004 E.C. According to this literature we are losing 10% of our biodiversity every 50 years, but, this rate of loss is estimated to increase by 10 times in the future! So, as action is needed at individual, local, regional, national and

international levels. Ethiopia ratified the Convention on 31 May1994 through Proclamation 98/1994. The UNDP supported Ethiopia to prepare the National Biodiversity Strategy, Action Plan, and its participation in Clearing House Mechanism for CBD, including the preparation of the Country Report to the COP of UNCBD.

Under the UNCBD, the UNDP also supported a Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources, Sustainable Development of the Protected Area System and Mainstreaming Agro-biodiversity Conservation into the Farming Systems of Ethiopia. UNEP provided support for Capacity Building for Access and Benefit Sharing and Conservation and Sustainable Use of Medicinal Plants. IBRD also supported a project on the Conservation and Sustainable Use of Medicinal Plants.

The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa (known as the Desertification Convention – adopted in 1994). The Government of Ethiopia signed the Convention to Combat Desertification (CCD) in October 1994 and ratified it in June 1997. As a first step in the implementation of the Convention, the Government of Ethiopia designated the Environmental Protection Authority (EPA) as the Focal Point to coordinate the implementation of the Convention in Ethiopia. To carry out this mandate, EPA established a National Steering Committee (NSC) for the formulation of a National Action Program to Combat Desertification and Mitigate the Effects of Drought (in short, NAP) as well as formed a task force for the formulation of a National Desertification Fund (NDF).

**Recommendations**

Research should be conducted on shengama's forest ecosystem, acts up on minimum interventions on the forest.

Repair rather than replace by other species like eucalyptus tree.

Conducts ecological principles of conservation methods, such as

- Biodiversity is supported by protection of any spps and vArieties
- Habitat maintenance is fundamental to species conservation
- Habitat disturbances reshape an ecosystem.
- Climate change will affect an ecosystem

- We can start planting trees at an individual community level to restore our degraded environments.

## 3.5. Climate change/variability of Shengema mountainous forest

### 3.5.1. State and trend of climate for Shengema mountainous forest

**Climate**

According(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 of Shengema mountainous forest**

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer accordingly, for this fact sheet we use Jinka and Gazer meteorological station and We use excel for the analysis of data.

We received data From Ethiopian national meteorology of Hawassa branch directorate for Jinka and Gazer stations. For Jinka station Meteorological data collected for the last 43 years (1974-2017) which is located 34. Km from Shengema mountainous forest and for Gazer stations meteorological data obtained for 11years (2006-2017) which is located, around 25km from Shengema mountainous forest.

Based on the available data, state and trend of rainfall, maximum and minimum Temperature were analyzed. FGD were carried out across four Kebelles such as, Shengema Wosit, Bilay, Arikiye and Dordora Kebelles.

**State and trend of Rainfall for Shengema mountainous forest**

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), Debub Atlantic Ocean and Debub 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 Debub West Indian Ocean and ENSO are 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. Accordingly Shengema mountainous ecosystem have two wet and two dry seasons which is influenced by the above mentioned rain baring factors and topographic variation.

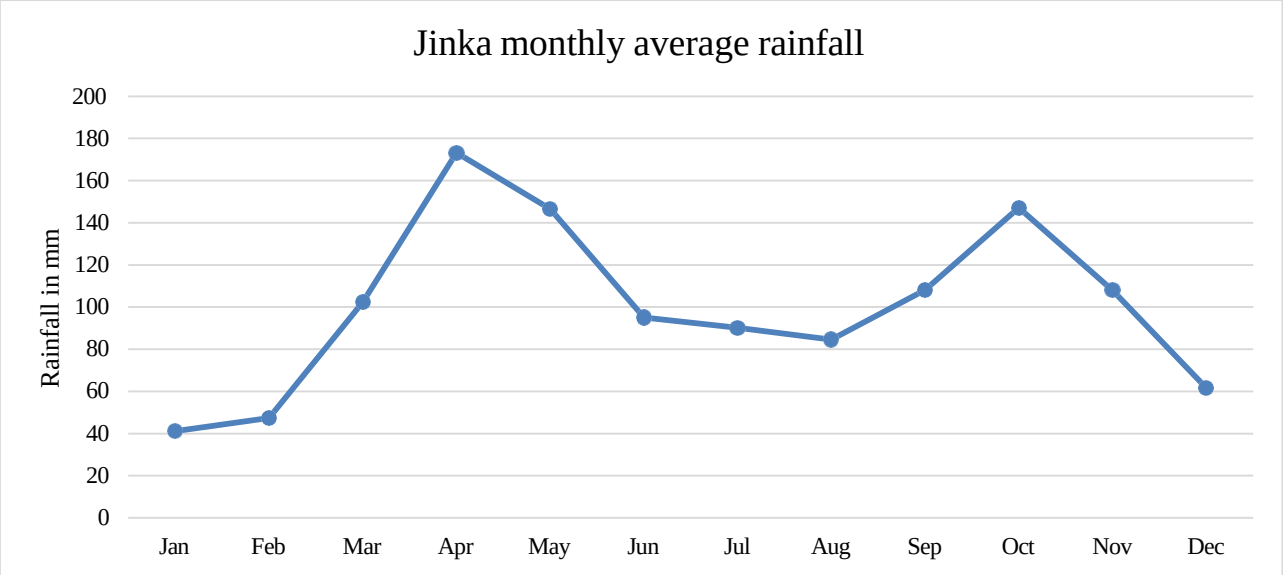



Figure 27: Jinka Monthly Average rainfall from 1974-2017

From figure 27 we can see that Jinka monthly average rainfall, the peak rainfall was recorded during April in Belg seasons and during October in Bega seasons it was reached around 173.2mm and 147.1mm respectively. The lowest rainfall was recorded during January it was 41.2mm.

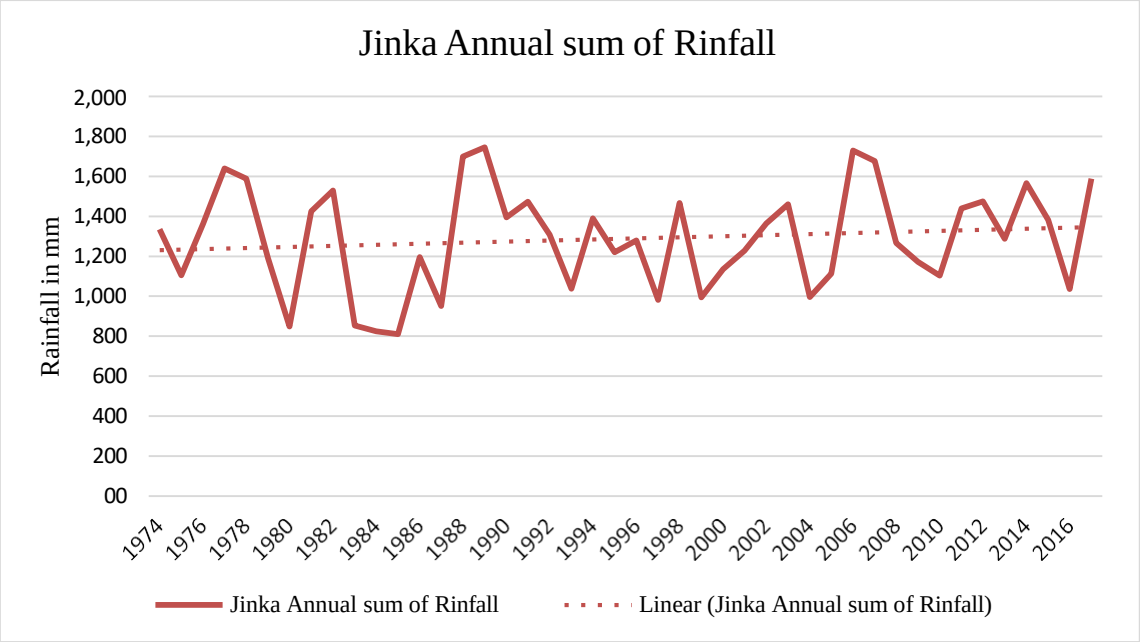



Figure 28: Jinka annual sum of Rainfall from 1974 up to 2017

Figure 28 show that the rain fall is highly variable from year to year. In 1989 the highest Rainfall were recorded around 1745.5 mm and the lowest Rainfall were recorded in 1985 which was 809.6mm. From the available data long year annual average rain fall 1287.8 mm was recorded.

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, while wet weather and a secondary peak in rainfall over the Debub (MetOffice, 2016). Accordingly, figure 3 also show as in Jinka there was better coverage of rainfall during Belg seasons than Kiremt and Bega seasons.

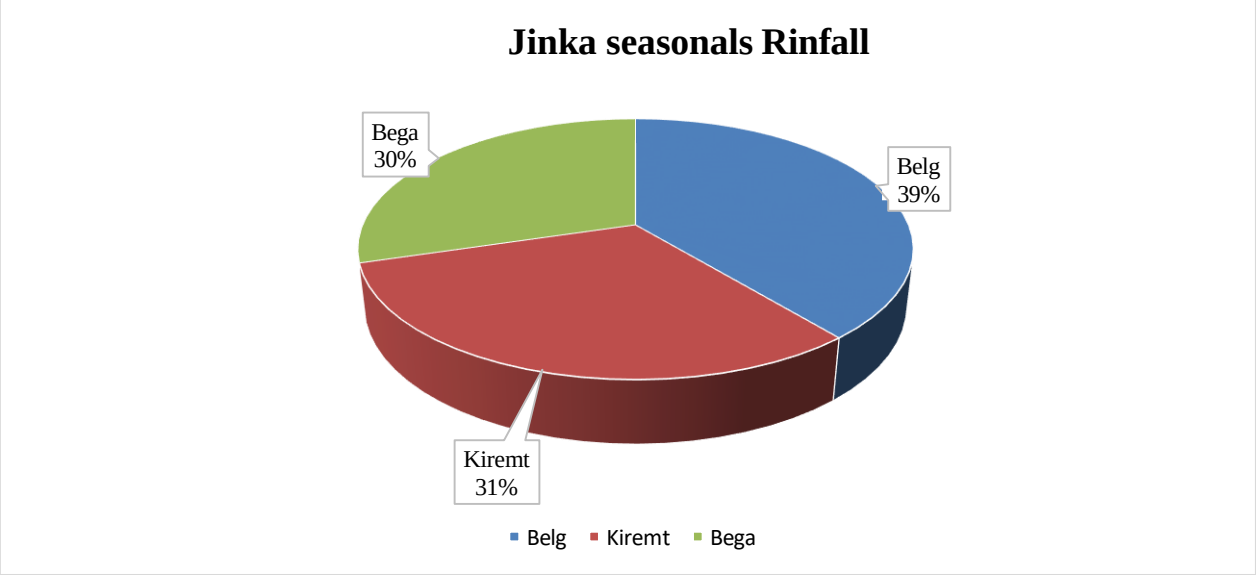



Figure 29: Jinka seasonal rainfall coverage from 1974-2017

The Belg rainfall is important for crop production in  Debub ern parts of the country as this tends to bring the most rainfall to this region. Across  Debub ern and eastern parts of the country there is an increase in the probability of above-average rainfall during the Belg rains (MetOffice, 2016). This is also true for Shengema mountainous forest community. From the available meteorological data of Jinka the average rainfall of Kiremt, Bega and Belg season was recorded around 378mm, 357.1mm and 469mm respectively.

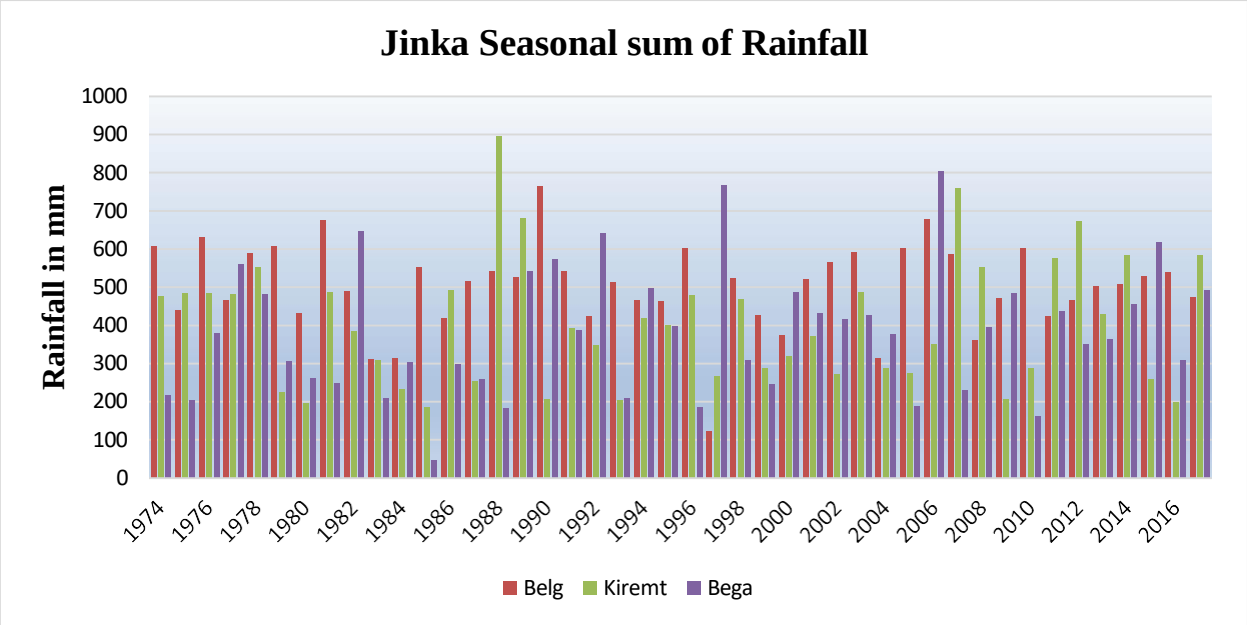



Figure 30 Jinka Seasonal sum of Rainfall from 1974-2017

Figure 30 show that during Kiremt season the peak rainfall was recorded in 1988 the value was 896mm and the lowest rainfall was recorded in 1985 the value was 184.5. In Belg seasons the peak rainfall was recorded in 1990 the value was 764.7 mm and the lowest rainfall was recorded in 1997 the value was 124mm. In Bega seasons the peak rainfall was recorded in 2006 the value was 804.4 mm and the lowest rainfall was recorded in 1985 the value was 45.7.

**State and trend of Temperature for Shengema mountainous forest**

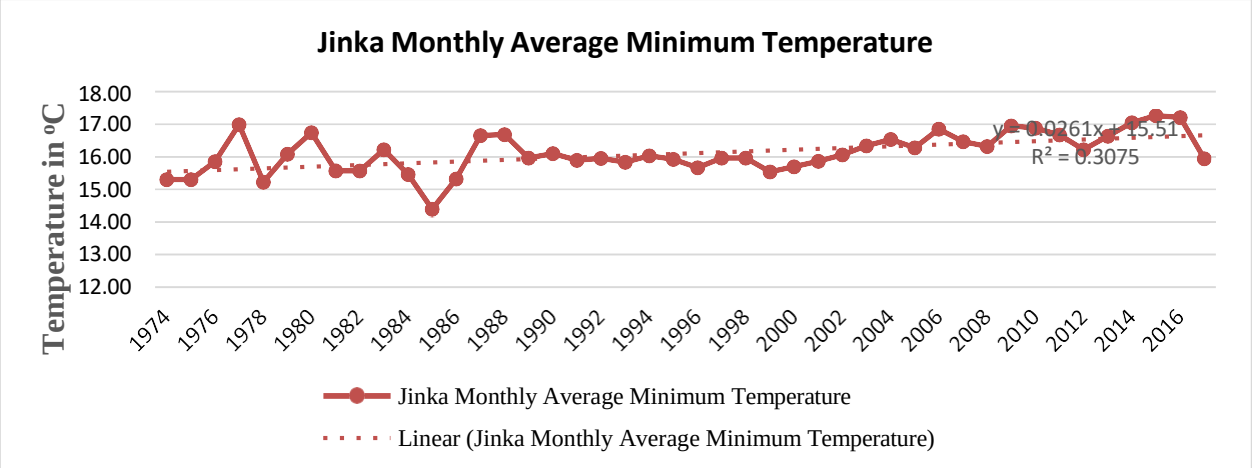



Figure 31 Jinka Monthly Average Minimum Temperature from 1974-2017

From figure 31 we can see that the lowest value was 14.4 $^{o}$C recorded in 1985 and peak value was 17.2$^{o}$C recorded in 2015 and monthly minimum temperature trend increased year to year.

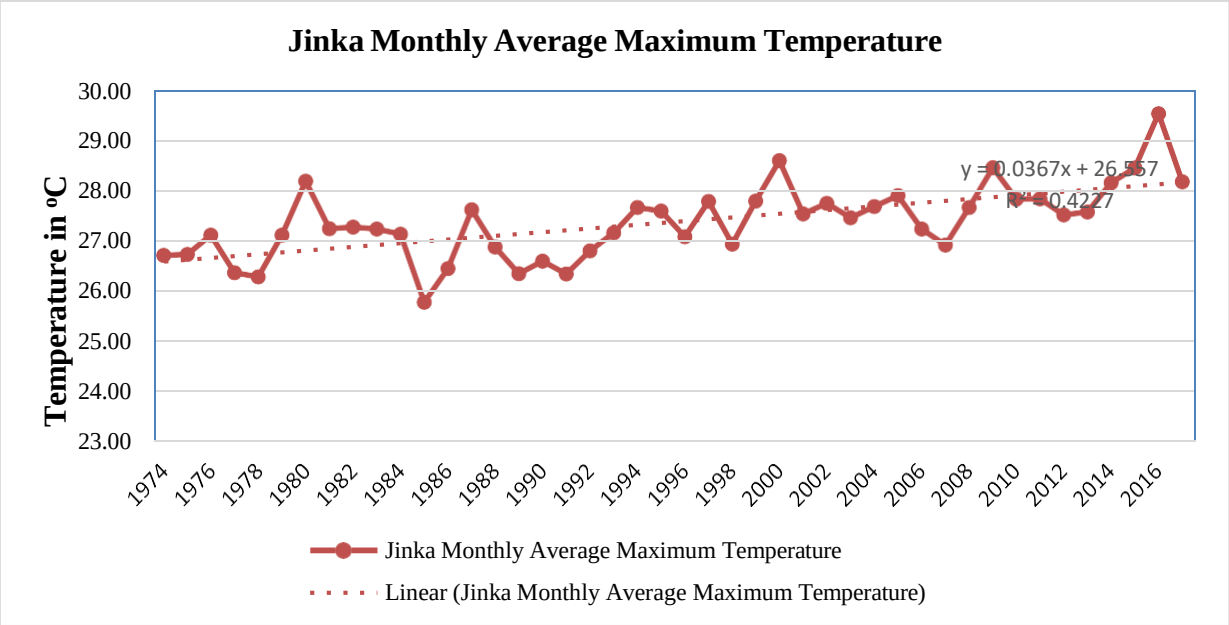



Figure 32: Jinka Monthly Average Maximum Temperature

From figure 32 we can see that the monthly average maximum temperature trend is increased. The lowest value was 25.7 $^{o}$C in 1985 and peak value was 29.5 $^{o}$C in 2016.

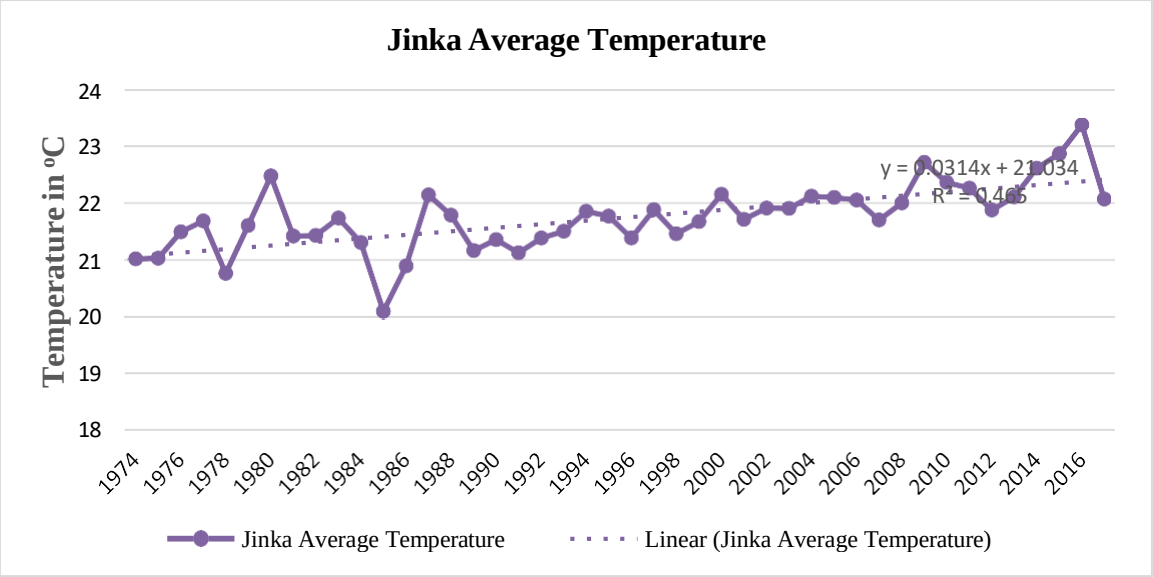



Figure 33: Jinka Average Monthly Temperature from 1974-2017

The average temperature range was in between 20.1 $^{o}$C up to 23.4 $^{o}$C and the trend also increased. The lowest and the highest value were recorded in 1985 and 2016 respectively.

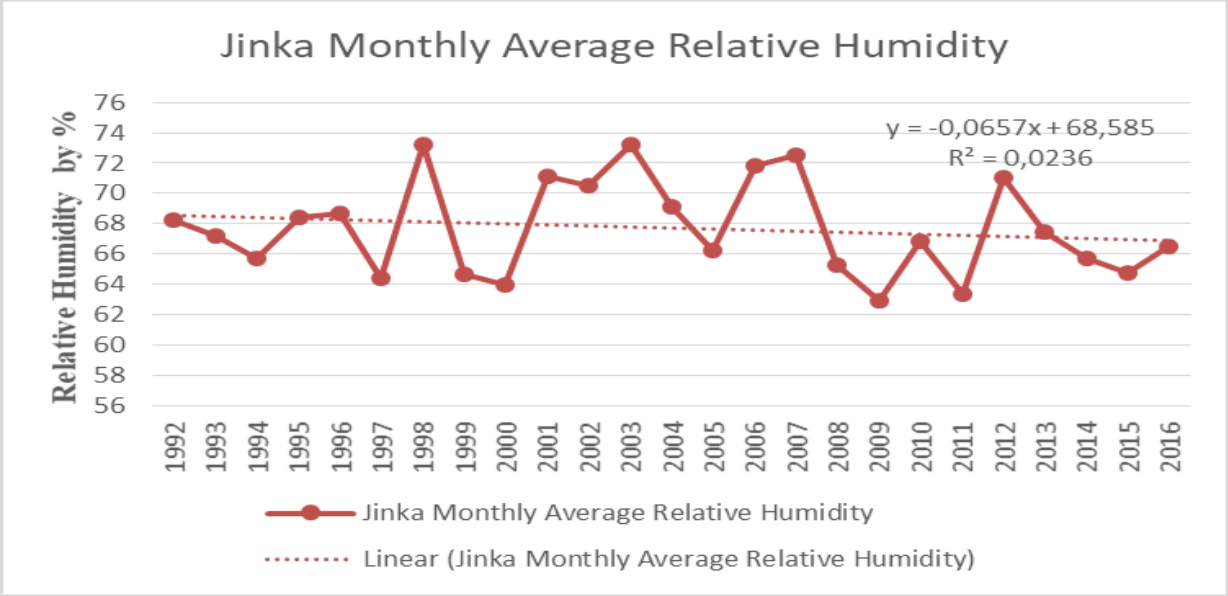



Figure 34: Jinka Monthly Average Relative Humidity from 1992- 2017

Figure 34 show that relative humidity trend is decreased accordingly, this implies that the amount much water vapor is in the air become decreased. And the high and lowest value was 73% and 62% respectively. High relative humidity indicates lots of moisture in the air while low relative humidity indicates very little moisture in the air.

### 3.5.2. Driver and Pressure for Climate Change/Variability of Sehengema

- Over population; on the FGD the participants explained that population continues to grow, accordingly the need to provide housing, agricultural land expansion and fuel wood consumption also increases result of this exert pressure on natural resource like on forest.
- Forests are a stabilizing force for the climate. They 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 Shengema mountainous forest ecosystem deforestation is one of the Pressures for regional climate change and increasing greenhouse gas emissions

### 3.5.3. Impact of climate change on Shengema

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 Shengema mountainous forest flood and drought occurred in different year and affect the community and the environment. According to (RBM, 2015), Malaria is one of climate sensitive disease and has significant association between changes in temperature, rainfall and humidity as identified by the World Health Organization and the World Meteorological Organization. Based on SOZHD, 2010 report, the number of people affected by Malaria disease in 2009 and 2010 was 1084 and 2250 respectively in Debub Ari Woreda.

On the FGD the participants were clarified that the amount of different water source like springs and rivers deteriorate, 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.

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 were explained that Due to climate change the temperature were increased consequently Dega agro climatic condition changed to Woyina-Dega.

Climate change 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.

Wosit participants were described that there was climate change, due to this unseasonal rainfall and temperature variability were increased and erratic rainfall cause crop diseases. In the previous year rain in July and August month but now it was difficult to get rain as usual as a result yield production was become decrease.

In the past years Maize were grown Belg season but now it is difficult to get Maize in Belg seasons and also changes in seasonal rainfall that affected the grown crop. Flood also causes land slide. Maize were grown in the previous years since Belg seasons but now it is

According to Debub Ari Woreda administration office was indicated that Flood was occurred 1988, 1994, 2007, 2009 and 2010 and drought was occurred in 1988,1997,1999,2004 and 2008 and also stated that that in Wosit Kebelle there was high deforestation for agricultural purpose due to this, forest become degraded and climate variability become high as a result of this river amount become deteriorateand flash flood occurrence was become high and caused landslide, damage farm land and non-farm land and affect human and animal life.Especially in 2008 Kolla parts of Debub Arey was affected by drought consequently most of livestock were died.More than 18 Kebelles of community affected and around 66 cattle's were died.

From the following tablewe can see that impact of drought and flood across four Kebelles of Shengema mountainous forest ecosystem were described by participants on the FGD.

Table 31: Impact of Drought and Flood in Wosit, Bilay, Arikiye and Derdera Kebelles.

| Place/Kebelle | Drought year | Flood year | Impact |
|---|---|---|---|
| Wosit | 1986, 1995, 2004 and 2010 | 2008,2009 and 2010 | ✓ Banana, coffee, sugarcane farm and 3hectares of land devastated by flood.<br>✓ Around 3ha, 2ha and 4ha of farm land were damaged by flood in 2008, 2009 and 2010 respectively.<br>✓ Drought causes decreased animal forage due to this number of animals and their productivity were decreased and<br>✓ their common food sources, Enset production decline<br>✓ The community become Food insecure<br>✓ Maize, Wheat, Bean, Barely etc. production |

| | | | |
|---|---|---|---|
| | | | decline<br>✓ Land slide |
| Bilay | 1977, 1986, 1994, 2004, 2008 and 2010 | 2010 | ✓ Yield production decline<br>✓ The community become food insecure<br>✓ Flood caused land slide, 6cattle have been died, and 1.5ha grazing land and 0.75 ha of farm land and 5person's land were landslides set off by the flooding. |
| Arikiye | 1997, 1986, `2004, 2008 and 2010 | 2007,2008,2010 | ✓ 2007 floods that have killed 2 person, 10 house, 6 cattle, and 17hactar farming land and 5hactar land damaged as a result 21households have been left homeless.<br>✓ 15ha of farmland and 10ha of non-farm land were damaged and 45 cattle were died by flood.<br>✓ Flood also causes land slide<br>✓ Drought makes them vulnerable to food insecurity. |
| Derdera | 2010, 1988, 1997,1994 and starting from 2000 still drought exist | 2010 | ✓ Cause food insecure<br>✓ Flood affect around 4 household and around 2ha of land were landslides set off by the flooding. |

### 3.5.4. RESPONSE TO CLIMATE CHANGE

**The current response measures or practices**

As SNNPRS Debub-Omo zone Debub Ari Woreda administration officestated that to they were give awareness to the society about climate change effect. Nursery site were opened around Gazar and in collaboration with the AGP in Wosit Kebelle they were on the way to open nursery site.

In the case of climate change response, since it is global phenomenon, it should be started from the global perspective, then regional, national and local

**Future option**

**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 Shengema mountainous 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

ii. 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.

### 3.5.5. 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 on the Shengema mountainous forest ecosystem continue regional climate change will increases. So this condition increase climate variability thus, unexpected hazards like flood, drought etc. will become accelerated so this condition will affect community livelihood and the environment at all.

At the global level warming is currently increasing at 0.3-0.7 $^{o}$C per 30 years (Folland etal, 2018). Accordingly based on the available meteorological data in Shengema mountainous forest area temperature was increased by 0.12$^{o}$C. If this condition continuous without any strong adaptation option it will lead increase climate related hazards in Shengema mountainous forest area.

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agro climatic or agro-ecological zones (Dejene, 2003; Mengistu 2006b; Chamberlin and Schmidt, 2012):

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