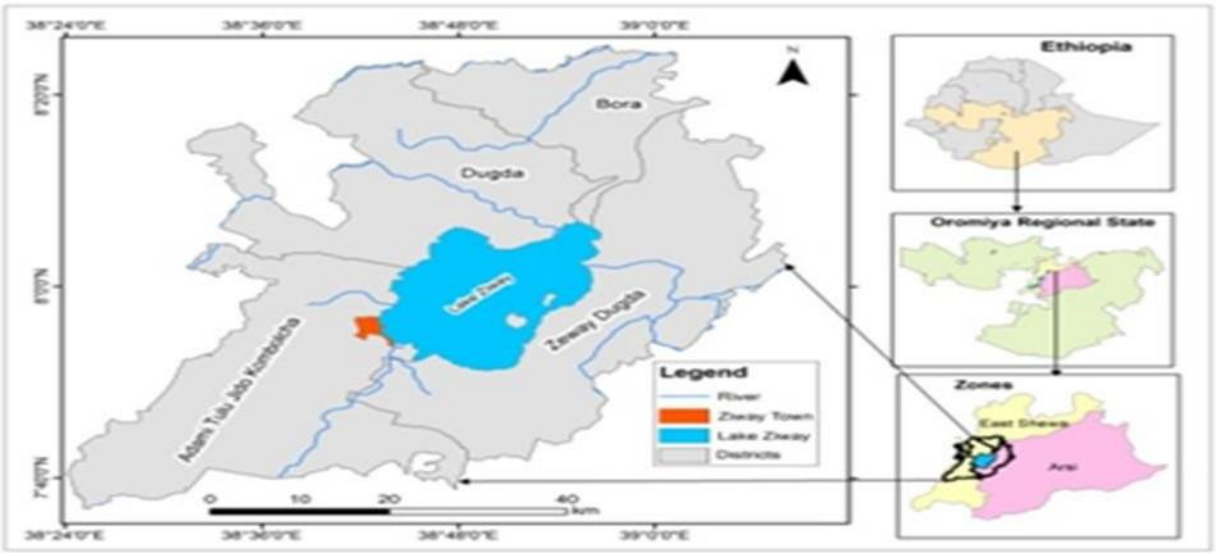
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE





Fact-Sheet of Lake Ziway and its Buffer Zone

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Acronyms and Abbreviations

AEO: African environment out look

ATJKWFEDevR: Adami Tulu Jido Kombolch Woreda Finance and Economic Development report.

CRV: Central rift valley

CSA: Central statistics agency

CSI: Christian service International

DPSIR: Driver, Pressure, State, Impact and Response

FGD: Focus group discussion

GDP: Gross Domestic Product

GEO: Global environment out look

GIS: Geographic Information Science

GTP: Growth and Transformation Plan

GWPEA: Global water partnerships East Africa

HDI: Human development index

IPCC: Inter governmental panel on climate change

ITCZ ꞉Inter tropical convergence Zone

IUCN: International Union for Conservation of Nature

MoWR: Management of Water Resources

NAPA꞉National adaptation Programme Of Action

NBP: National Biodiversity Policy

NGO: Non-governmental organization

NMA: National meteorological Agency

PASDEP: Plan for Accelerated sustainable development to end poverty

UNEP: United nation environment program

WMO: World meteorological organized

1. General Background

1.1. Environment for Green Economy Development

Human societies of different interests and values, with the objective of using resources, have interacted with the environment throughout history and, in the process; they have altered it. Most African economies depend highly on natural resources, aim to achieve industrialization and economic diversification, and face challenges of poverty and unemployment Therefore, a pathway to a green economy requires action on three fronts: capitalizing on Africa's natural capital, exploiting opportunities for industrial growth and establishing enabling policies and institutions.

First, the economic importance of natural capital in wealth creation, employment, livelihoods, and poverty reduction in Africa needs to be recognized. Africa's natural resources support its social and economic systems. They provide a basis for livelihood to the poor and most vulnerable, which depend primarily on nature for survival. Natural capital assets sustain much of the tourism and associated service industries, which have become essential pillars of external trade, foreign exchange revenue generation and employment creation in African countries.

Second, Africa's early stage of industrialization offers avenues for an industrial development supported by the deployment of clean, efficient, and resource-saving technologies. Such technologies would increase energy and resource efficiency in the exploitation of the continent's natural resources, whilst avoiding wasteful consumption, undue economic costs and risks of resource depletion. While the technological and financial requirements of green industrialization are considerable, there are indications that existing opportunities for leapfrogging yield very high potential returns, as can be observed in the African aluminum industry.

Lastly, driving green economic transformation will require a set of enabling policies and institutions that imply a critical role for the State, through public investment, fiscal policies, regulations, government procurement, and market creation at national, regional and international levels, as well as the facilitation of an active participation of non-State actors.

As development policy has evolved, different approaches have been emphasized at different times that range from promoting more productive agriculture and industrialization to structural adjustment. Global efforts made in the last 50-60 years are known to have brought significant advances both in GDP and in Human Development Index (HDI) measures in most countries of the world. 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.

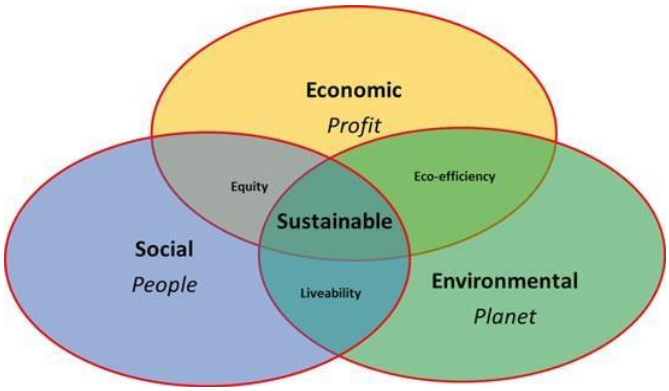


Figure 1 the Three Dimensions of Sustainability

Source: Green Growth, Green Economy And Sustainable Development: Terminological and Relational Discourse 2017

The kind of economy developed in this case is green economy that results in improved human-wellbeing and social equity while significantly reducing environmental risks and ecological scarcities.

Green Economy: A green economy can be defined as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities (UNEP 2011). It can also define as an economy where economic prosperity can go hand-in-hand with ecological sustainability.

Table 1.Selected Definitions of Green Economy

Source	Definition
UNEP's working definition (UNEP, 2010b)	"…A system of economic activities related to the production, distribution and consumption of goods and services that result in improved human well- being over the long term, while not exposing future generations to significant environmental risks or ecological scarcities…"
Green Economy Coalition, 2010	"…A resilient economy that provides a better quality of life for all within the ecological limits of the planet…"
The UNEP-led Green Economy Initiative (UNEP, 2011)	Economy "that result in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is low carbon, resource efficient, and socially inclusive."
International Chamber of Commerce, 2012	"…An economy in which economic growth and environmental responsibility work together in a mutually reinforcing fashion, while supporting progression social development…"
Diyar*et al.*, 2014	"…The economy where the growth of the people's welfare and employment increase are provided owing to the state and social investments ensuring reduction of emissions and environmental pollution and stimulating effective use of energy and resources as well as preventing from any harm to biodiversity and ecosystem"

Source: Green Growth, Green Economy And Sustainable Development: Terminological and Relational Discourse 2017

In practical terms, in a green economy investing in ecological resources and services, such as a stable climate, bio-diversity and clean air and water, can be an opportunity for profit, employment

and growth rather than cost and burden on economy. Green Growth is the process of greening conventional economic system and a strategy to arrive at a green economy. Thus, pursuing a Green Economy and Green Growth means more than just investing in ecological resources and green technologies, such as renewable energy technologies.

Green Economy/Green Growth is a new strategy in a sense that it focuses on greening economic systems through a system change, while sustainable development as defined in Agenda 21 describes the need for incorporating environmental sustainability into economic policies without providing guidance on "how". It evolved into a new development paradigm illustrating how economic development and environmental sustainability can reinforce each other and create a win-win synergy to overcome the trade-offs of the conventional paradigm. The idea that the ecological crisis can provide new opportunities for greening the economic growth has also emerged recently. Green Economy/Green Growth can be a leapfrogging strategy for developing countries to pursue economic development without repeating the conventional "grow first, clean up later" path. Today, the concept of green economy has evolved to consider also social issues. Some individuals and firms have been implementing environmentally responsible practices for over a decade or more; however, currently the green sector of the development industry is experiencing rapid growth. Innovative firms have embraced principles of sustainable design, creating projects having a minimal impact on the environment. Governments have encouraged expansion of the green sector through policies promoting green development practices.

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 securities ensure adequate functioning of infrastructure, provide a climate Conducive 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. One of the activities outlined within the environment sector plan of the GTP is the preparation of the Fact sheet of the country through undertaking fast assessment and study. To this end, The Ministry of Environment, Forest and Climate Change of the Federal Democratic Republic of Ethiopia has conducted assessment on Lake Ziway buffer zone. The study was conducted through a team of multidisciplinary professionals in an integrated approach.

1.2. Frameworks /Approaches

1.2.1. The Driver-Pressure-State-Impact-Response Framework

The DPSIR framework 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 feedbacks in terms of environmental change, or could be an intentional or un-intentional by-products of other human activities (i.e., pollution);

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

IMPACTS: Environmental change may positively or negatively influence human wellbeing (as reflected in international goals and targets) through changes in environmental services and environmental stress. Vulnerability to change varies between groups of people depending on their geographic, economic and social location, exposure to change and capacity to mitigate or adapt to

change Human well-being, vulnerability and coping capacity is dependent on access to social and economic goods and services and exposure to social and economic stress;

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

2 Social and Economic Environment

2.1 Social Environments

2.1.1 States of Social Environment Lake Ziway Buffer Zone

2.1.1.1 Population

Population in urban areas has growing more rapidly than rural population worldwide, particularly in developing countries including Ethiopia.

According to the (***ATJKW,FEDevR. 2017)***, the population of the district was 235,593 (See Table 2). The details of the population data of year 2013-2016 is presented in the population trend of the district shows rapid growth from 167,169 to 235,593.

Table 2 Population Projection of Adami Tulu Kombolcha Woreda

	Year											
	2013			2014			2015			2016		
Sex	**Rural**	**Urban**	**Total**	**Rural**	**Urban**	**Total**	**Rural**	**Urban**	**Total**	**Rural**	**Urban**	**Total**
Male	70,405	13,758	84,163	73221	14,157	87,378	103,220	14,440	117,660	103,530	14,483	118,013
Female	70,137	12,869	83,006	72942	13,242	86,185	103,722	13,506	117,228	104,033	13,547	117,580
Total	140,542	26,627	167,169	146164	27,399	173,563	206,942	27,946	234,888	207,563	28,030	235,593

Population size Adami Tulu Jido kombolcha woreda

Sourse Adami Tulu Jido kombolcha woreda finance and economic development office (2017)

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 primary goals of FDRE and Ministry of Education is

promoting primary education in every corner of the country, based on the motto “quality education for all". Accordingly, regions are working in line with this objective.

In the last one decade enrolment figures area, as seen from figure 2, at primary education levels revealed significant increase, still large proportion of school age population remains outside school system. Emphasis given by the government to extend education to all segments of the society, primary and secondary enrolment in the basin has increased sharply over the past five years. When considering the enrolment of female students at primary education, it shares 48.9 percent in 2013/14 academic year but, in 2015/2016 decrease to 47.5 for secondary level can’t get efficient data.

According to data for the year 2013 to 2016 there were a total of 91 schools of different types and levels. Accordingly there were 85 (1-8) and 6 (9-12) schools. Among these institutions of them 11of the mare non-governmental and the rest are all governmental. The number of students in the case of both sex shows increment and in 2016 the number shows significant change.

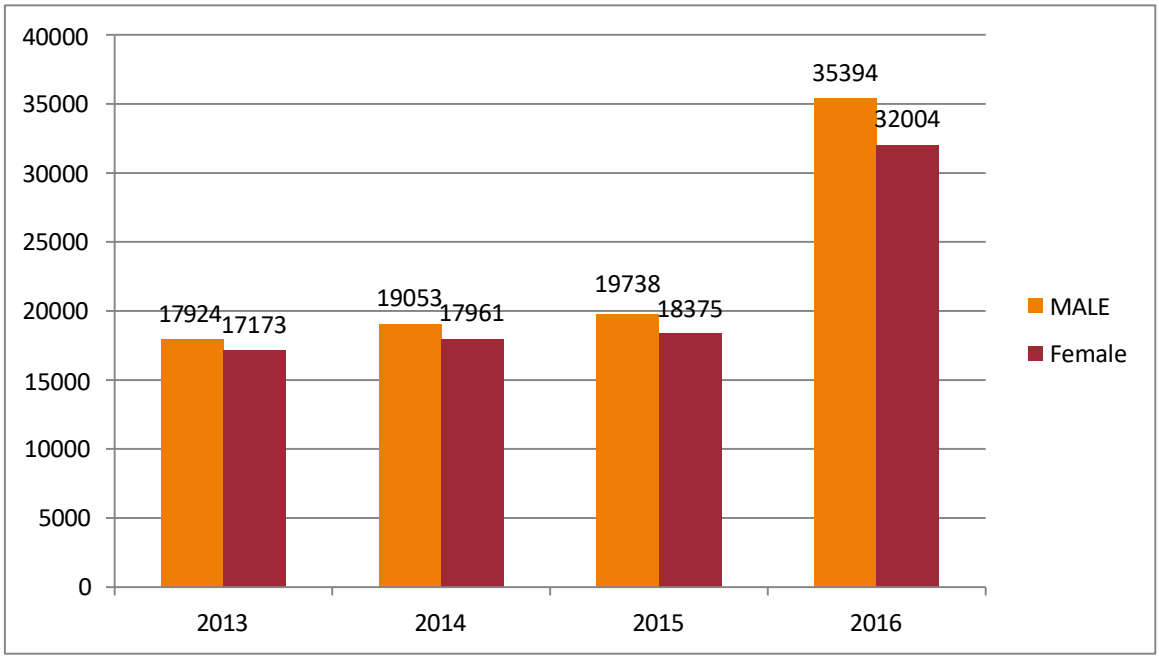


Figure 2 the Number of Students in Adami Tulu Jido Komblcha

Source: *www.moe. Gov. et.*

2.1.1.3 Health

Health is one of the most preeminent social sectors. It can be broadly defined as the state of being well physiologically and psychologically. It also has overarching effect on sustainable socio economic development. Health is a fundamental prerequisite for the successful achievement of any work which has significant importance for family, organization and for the country in general.

According to Adami Tulu Jido Kombolcha woreda report (2017) the coverage of antenatal, postnatal care, modern contraceptive, maternal mortality rate and delivery by health professional of woreda. (Fig 3)

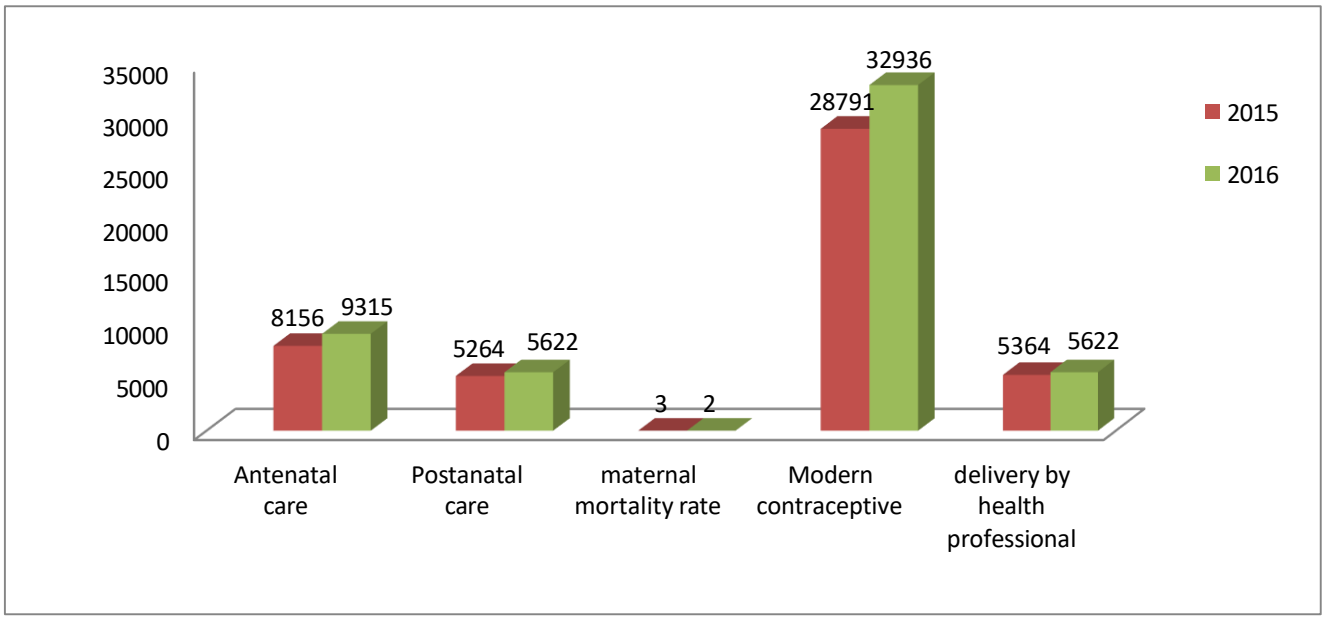


Figure 3Coverage of antenatal care, postnatal care, modern contraceptive, maternal mortality rate and delivery by health professional

The health institutions indicated below (Fig.4), the woreda's profile shows that drug shop and malaria controlling, rural drug vendor was under construction at the woreda.

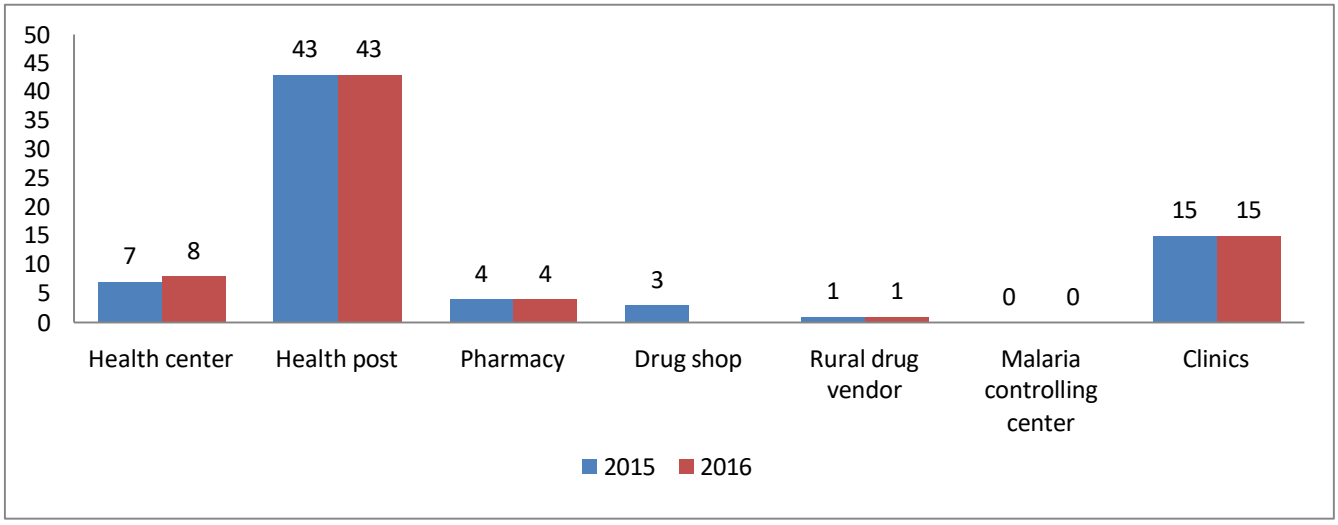


Figure 4 Health institutions found Adami Tulu Jido Kombolcha Woreda (2015 & 2016)

According to Adami Tulu Jido Kombolcha woreda profile (2015-2016), the health service coverage of the district was 80% in the year of 2016.

The district also indicated that the top twelve diseases of the area are acute fever, malaria, Intestinal parasite, pneumonia, upper respiratory infection, urinary tract infection, gastric diseases, anemic and Skin infections and wounds. (fig5)

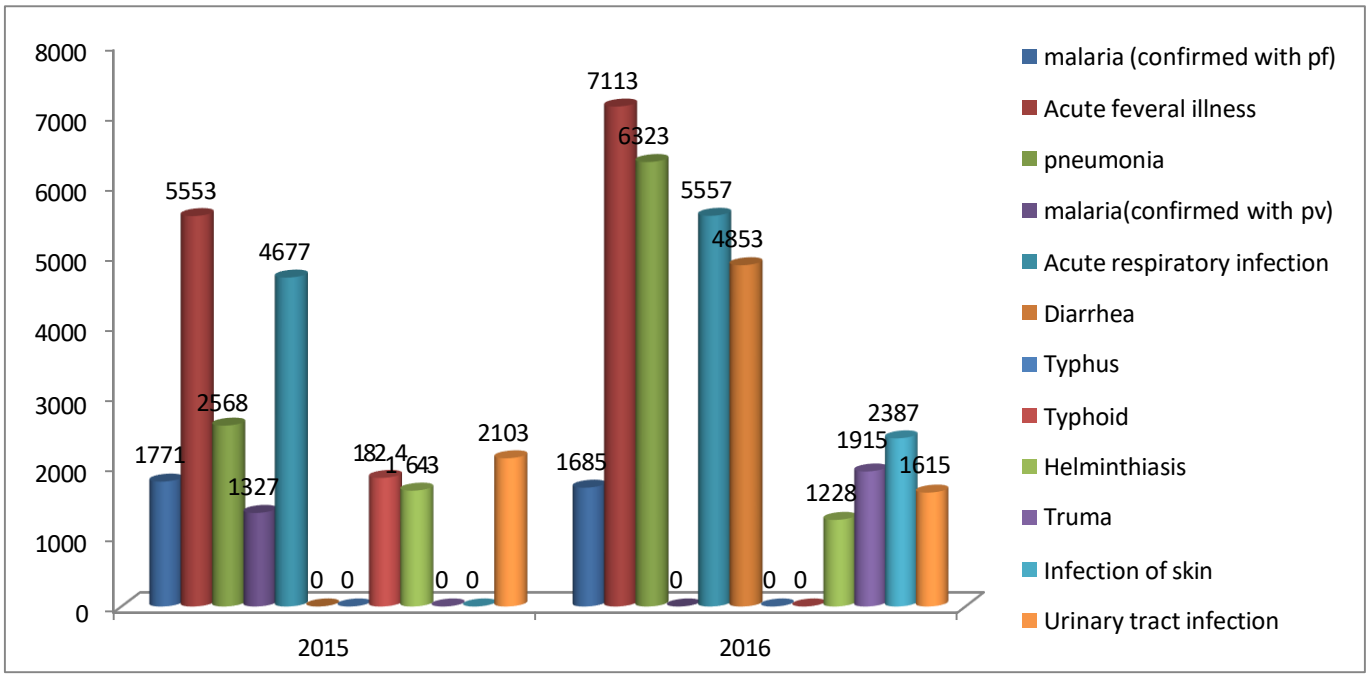


Figure 5 the First Top Ten Diseases in the Woreda (2015 & 2016)

According to ATJKW profile, the major causes of death of children in the woreda are Pneumonia**,** Diarrheal and malnutrition. The profile also indicated that vaccination of children was almost undertaken fully except small gap in 2016.

The health risks at the woreda level includes; lack of clean water, sanitation and hygiene (Adami Tulu Jido Kombolcha woreda profile, 2015). It indicated that, various diarrheal and other diseases are spread via fecal-oral routes, especially when water supplies and sanitary conditions are inadequate. According to the profile, diarrheal diseases are almost entirely caused by the poor sanitation, hygiene and access to clean water and food.

2.1.1.4 Transport

The length of dry and all weather roads in Admi Tulu Jido kombolcha district is 692 km, the length of asphalt 59 km, gravel/rural roads 136 km (Adami Tulu Jido Kombolcha Report 2016)

In 2016 Batu town has 66.93kmroad, which is 8km asphalt, 9.7coble road, 49.23km are local roads. In 2017,the coverage of Batu town all weather road reaches 198.34 km, which is10.2km

asphalt,20.99 km coble road, Red ash 13.15 kmEarthen road 78.81km and Gravel road 75.19 km are local roads followed by collector road. (Batu town Report 2016 and 2017)

2.1.1.5 Water Supply

Majority of woreda population drinks well and spring and the total population supplied with potable water is 163,088**.** As we had observed, Lake Ziway buffer zone suffers from siltation and diminishing water size mainly caused by soil erosion in upstream areas, particularly by run downs of Meki and Katar rivers. As a result the size of water is threatened to diminish.

During FGD large number of rural communities, people living downstream of lake Ziway and their livestock have to travel long distances to get water .Currently the Bulbula River has stopped and the Local communities along the river have been suffering from the shortage of water for their livestock drink and loss vegetable product.

2.1.2 Drivers and Pressure of Social Environment

The causes of environmental change are complex and there are numerous factors that lead to deterioration of ecosystems and the pollution of water resources, and land.

The driver of environmental deterioration is mainly the results of population growth. The population of the buffer area increases rapidly with an average annual growth rate of 2.9 percent. In the last two decades basically due to a number of drivers the population of the district shows increment. Among them the following are the important ones,

(i) In the rural communities, due to high labor demand and old age presence, 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.

(ii) Low educational background and less exposure to contraceptive methods aggravate high birth rates among the rural population.

(iii) 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 is much more delivery and an increase to the existing population.

(iv) An increased access to health and drug facilities has further complicated the situation of population pressure and thereby greatly impact natural environment base of the area.

(v) Rural-urban migration, for seeking better life and wages are the major factors triggering the existing socioeconomic and environmental problem in the area

(vi) The current high fertility rates and youthful population affects adversely the quality and distribution of schools and health facilities and major infrastructural amenities.

Due to low agricultural production and weak economic settings, most school age populations from the upland villages are prone to rural-urban migration in search for off-farm employments like domestic works in urban centers. Furthermore, there are high school dropouts in the upland areas due to labor shortage during weeding and harvesting season.

Generally, it is possible to conclude that a reduction in the rate of population growth that would ultimately result in a decrease in the growth rate of school age population will highly contribute to the provision of better quality education and the attainment of the goal of universal primary education. Environmental degradation adversely affects human health in conjunction with communicable diseases, specifically Malaria. These health problems are increasing because of human disruption of the ecosystems through deforestation and stagnation of water in irrigated agricultural areas. Low accessibility of health service, professionals and medicines exacerbate health related problems in the area. Moreover, poverty and poor nutrition has also contributed to low health status.

2.1.3 Impacts of Social Environmental 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 (Bils borrow, 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 ecologically fragile and marginal hill sides (farming slope greater than is 30^0,not recommended by agronomists),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, thereby resulted in declined food security. Average soil loss is 42 tons/ha/annum at the national level (Hurni, 1985) where mean soil generation rate is 6 tons/ha/year. Agronomists recommend

conservation measures for an area having annual soil loss greater than, 30 tons/ha/annum. Due to misuse of natural resources in the upland areas; down streams are severely flooded and dominated by sedimentation of gravel brought by streams. Vulnerability to food crisis referred as people's inability to secure a regular supply of food from their own farmlands of through off-farm incomes. Thus, it is the product of shock or drought and low resilience due to poverty, climatic variability, soil degradation, crop failure, scarcity of farmland, dependency of food aid, lack of off-farm employment opportunity and other related variables. These are the perceived causes of vulnerability to household livelihood in ziway buffer. Due to the aforementioned causes farm production in the buffer is unsatisfactory and it resulted in low nutritional intake, where children are stunted and adults are prone to sickness and poor rate of recovery. This is usually happened for decades in ziway buffer area, because of extreme soil degradation in crop area and climatic variability in 42 kebeles locality every year ziway buffer 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, exploit rare and endangered species to supplement the income; which aggravates environmental degradation.

Due to scares of the quality water the population scarifies to get pure water for domestic use, and leads to water borne diseases. Because of this happening the population exposed to extra expense.

2.1.4 Responses to Social Impact

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) Reducing the rate of rural to urban migration;

(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 in accordance with national priorities as stated below

- Expansion of population information education and communication;
- Provision of expanded family planning services;

- Strengthening of training in population; and
- 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. To alleviate the problem and attain the Sustainable Development Goals by 2030, both the government and society are working together to achieve universal primary quality education in the buffer.

As a result to reduce the problem and provide quality education at primary school level, schools were constructed at village level, teachers are trained and placed, syllabus and textbooks are developed and supplied, and girl's participation is greatly increased. In recent years as a part of Growth and transformation plan, health service coverage and school enrolment at all levels improved remarkably as human capital development also received significant attention from the Ethiopian government. The government by allocating budget for various sectors, such as agriculture, education, health, and water and road development has shown promising effort in eradicating poverty in the district. Integrating the Sustainable Development Goals (SDG) in its policy documents and tried to reverse the spread of malaria and other major disease by 2015. As a part of government health policy document health professionals in the buffer are working on maternal and child care, immunization, control of basic infectious diseases, epidemic and sexually transmitted diseases. Individually, the communities are engaged in implementing community sanitation programs through cleaning springs, poor quality water wells and the use of latrine and contraceptive methods. In the implementation of the health policy, the involvements of private sectors are also great in the delivery of health services. The role of private health clinics and drug vendors is growing in importance, particularly in urban areas.

2.2 Economic Environment

2.2.1 State and Trend of the Economic Environment

Ethiopia's economy is highly dependent on Agriculture. At present the economy of the country is growing at fastest rate. The economy uses natural and environmental resources as essential inputs in the production process. During the production process, resource material and energy are transformed from one state to another. Economics and the environment are inextricably linked, as natural resources are the basis of production, manufacturing, and waste disposal.

The study area is characterized as agrarian economy whereby the main social, economic and political aspects are expressed in terms of traditional and backward features. The agricultural production system is mainly mixed farming, including crop and livestock productions. Major harvests are tomato, maize, banana, mango, lemon, haricot bean, Water Melon and others. Similarly, animal fattening and fishing are another major source of livelihood in the area.

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. As there are high rates of population growth 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 sectorial production methods and techniques can be considered to understand the economic growth.

Thus, the agricultural, industrial and service sectors are used. The first two are to have a higher direct impact on the environment than the third sector. Natural resources where the communities rely on are degraded, based on findings 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 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. There is a higher risk and vulnerability to food insecurity.

2.2.4 Response of Economic environment

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 up with the changing situation such as climate change and natural resources degradation and depletion.

GTP's vision in the economic sector is "to build an economy which has a modern and productive agricultural sector with enhanced technology and an industrial sector that plays a leading role in the economy; to sustain economic development and Secure social justice; and, increase per capita income of citizens so that it reaches at the level of those in middle-income countries."

The major objectives of GTP are to

- Maintain at least an average real GDP growth rate of 11% and meet the Sustainable Development Goals,
- Expand and ensure the qualities of education and health services there by achieving the (SDGs) 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 macroeconomic framework. This broad social, economic, and political aspect of the GTP are hanged 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

3 The Physical Environment

The Ethiopian Rift Valley is one of the great East African Rift Valleys and also called the Afro-Arabian Rift Valley which was created by volcanic activities that formed volcano-tectonic depressions in the floor of the rift, which later became lakes. Lake Ziwaye is one of it. It is located some 163 km south from the capital city of Ethiopia, Addis Ababa. It is situated between 07051'- 080 07'N latitude and 38043'- 38050'E longitude (Figure:6.). The Lake has an open water surface area of 434 km^2, which makes it the third largest Rift Valley Lake; and Islands of 6.9 km2 area size together. The islands at the Lake are used as breeding grounds and roosting areas for water-birds, but affected by land-use change influences. Lake Ziway has catchments area of about 6834 km2, a maximum depth of 9 m, and volume 1.7M km3 (Lagesse *et al.*, 2005). The lake is mostly used for irrigation in the central Rift Valley area. The lake is bordered by swamp, except along the south-eastern and southern margins where the shores are relatively steep.

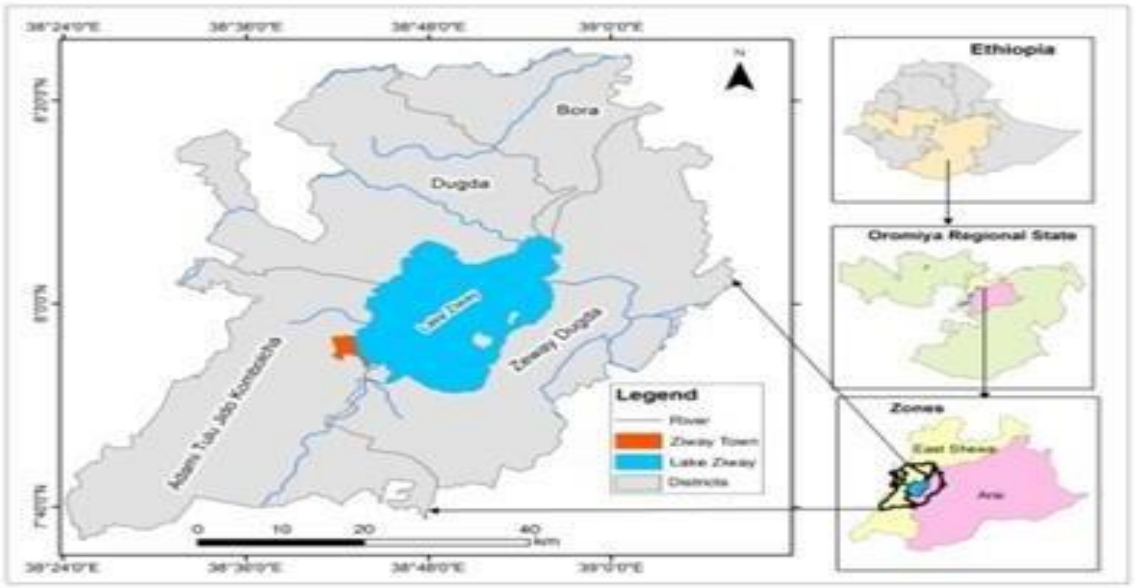


Figure 6 Location Map Of Lake Ziway.

3.1 Land

Land is a delineable area of the earth's surface comprising attributes such as the atmosphere (near-surface climate), the rocks, land forms (geomorphology), the soils and underlying human ecology, the hydrology, plant and animal populations, features which result from past and present human activity e.g. terracing, water storage or drainage structures, roads, buildings.

Land provides human beings with food and raw materials, space for our housing 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 its 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, soda ash, and etc. Land use and land cover are highly interrelated. Degradation begins with the loss of the protective cover types.

People living within the ziwaye Lakes' buffer have a high dependency upon the land, including the lacustrine, wood land, rangeland, arable land and other resources for their daily livelihood.

3.1.1. State and Trends of Land

In this study to understand the status and trend pertaining to land, first close and open ended questioner for focuses group and for key informant was responded by them. There were three focus groups which represent 42 kebels from 3 districts which are cluster to Ziway Lake. Then identification of the land use types of the zeway Lakes' Basin was carried out. Thread, to extract tangible information regarding the status of the land cover from year 1992 to year 2017.Field observation work was carried out starting from Jun 9 up to 30, 2017.

Land in ziway buffer zone was cultivated both in rain fed and irrigation. As we observed the land was becomes bear and exposed for both wind and water erosion. According to focus group discussion– ziwaye buffer zone used to be a forest area but, starting from 1997 due to population growth, huge amount of Forest and grazing land had been changed to cultivated land. The remnants trees are an indicator of ziway buffer areas as it was a forest area.



Figure 7 Remnant of forest/trees in the buffer zone of Lake Ziway (filed observation photos)

Many illegal investments are allocated to the lake buffer zone and in the side of Lake Embankment without any permission of governmental organization.

Adami Tulu Jido kombolcha woreda land administration office also described illegal investment in the woreda was the Challenging problem that was out of the scope of the district. Not only being illegal there was also land certification contradiction between farmers and investor who took farmers land by renting.



Figure 8 Illegal investments by extracting lake water and Lake buffer zone in Ziway Lake and their product (Field Observation Photo)

According to farmers, in each year, the cultivated area was increasing but the productivity of the land becoming low. Unless they use more amount of production input like fertilizer and agrochemicals. Farmer's fertilizer and agrochemical demand is increasing drastically. Harvesting of produces became very difficult. As we observed the land was bare as a result of deforestation and land degradation.

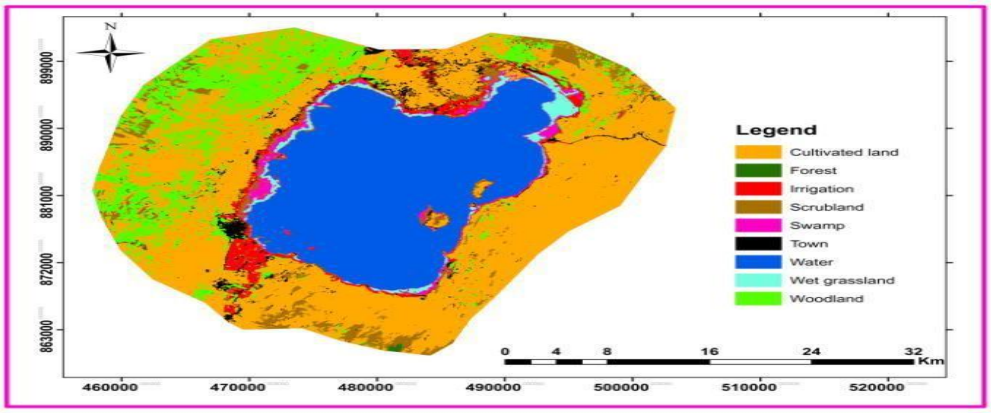


Figure 9 Land-use and cover types in lake-Ziway 2003.

(Sources journal of science and development 20014)

The cultivated land in the surrounding area of the lake also increased in 2003 observation as compared to 1986. This increase was happened at the expense of woodland vegetation cover decrease in 2003. In year 2011, there was an increase in the wet grassland in the surrounding area of the lake accompanied with shrinkage in the size of open water (Fig. 9). Between year 2003 and 2011, woodland vegetation cover decreased while cultivated land cover increased, especially in the south, north and eastern side of the lake.

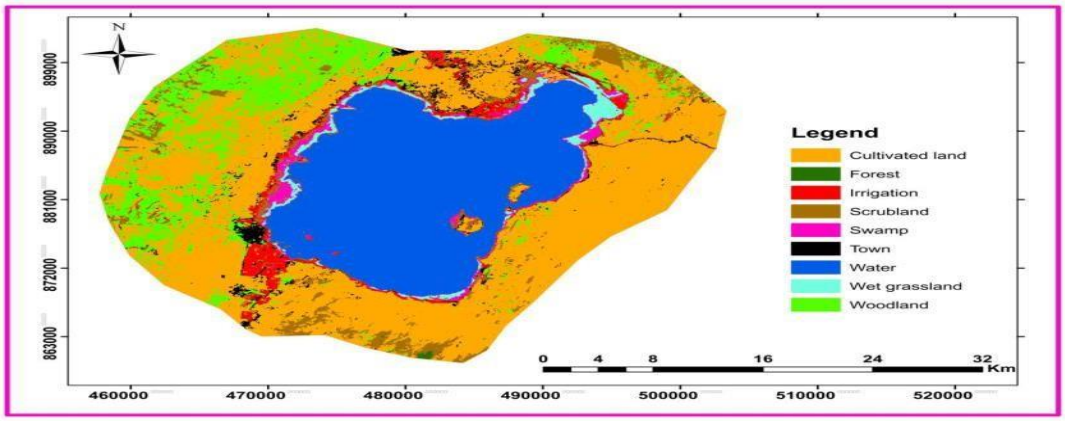


Figure 10 Land-use and land cover of Ziway in 2011.

Sources: journal of science and development 2014

The land-use and its cover changes detection revealed an increase in the rate of cultivated land by 6.9% and irrigated land by 32.3% between 2003 and 2011 (Table 3). In the same period, the lake water size was reduced by 4.5%, whereas woodland vegetation decreased by 37.5%, and wet grassland increased by 96.9% (Table 3)

Table 3 Existing Land-use and land cover between 2003 and 2011

Habitat types (ha)	Yr. 2003	Yr. 2011	**Change in surface cover (ha)**	**Proportion of change (%)**
Cultivated land	63163	67523	4360	6.90
Forest	131.0	093.00	38.00	-41.5
Irrigated land	4100	5422	1322	32.3
Scrubland	7560	3823	-3737	-49.4
Swamp	2520	1431	-1090	-43.2
Town	1963	3219	1256	39.0
Lake Water	41010	39153	-1857	-4.5
Wet grassland	2534	4991	2456	96.9
Woodland	17109	10689	-6420	37.5

Sources: *- : journal of science and development 2014*

3.1.2 Driver and Pressure for Land Degradation

The driving force of agricultural land degradation was both human and natural process interference. Natural process, climate, intense rainfall, mass movement of land to downstream and topography of land are under category of it. Anthropogenic effects come from population pressure. As the population increase, land degradation also aggravates. In Ziway, the population is increasing. As we have discussed during governmental stakeholders in Adami Tulu Jido kombolcha woreda about driver and pressure of this problem. They had stated that, In Ziway Lake buffer area, the population is showing an increment every year and the average family size is about 6 persons per household

Table 4Population Size of the District

	Year											
	2013			**2014**			**2015**			**2016**		
Sex	**Rural**	**Urban**	**Total**	**Rural**	**Urban**	**Total**	**Rural**	**Urban**	**Total**	**Rural**	**Urban**	**Total**
Male	70,405	13,758	84,163	73221	14,157	87,378	103,220	14,440	117,660	103,530	14,483	118,013
Female	70,137	12,869	83,006	72942	13,242	86,185	103,722	13,506	117,228	104,033	13,547	117,580
Total	140,542	26,627	167,169	146164	27,399	173,563	206,942	27,946	234,888	207,563	28,030	235,593

Source: - Adami Tulu Jido Kombolcha woreda finance and economic development office (2017*)*

When we discus with focus group in *Adami Tulu Jido kombolcha woreda*, they have emphasized that the 11 hectare of grazing and large amount of forest land was changed to cultivated land b/c of population pressure .Similarly (Hurni, 1993) have stated among human related factor, population growth as an important driving force which results from land cover dynamics in least developed economies. Farmers in ziway buffer area are cultivating by using plenty of production input like fertilizer and agrochemical input. Illegal settlement and extension of urbanization also contributed to land degradation on ziway. Illegal investment around ziway Lake also the main driver of land degradation. As we have discussed with Adami Tulu Jido kombolcha woreda land administration coordinator there were more than 200 illegal investors who are engaged in cash crop production by renting land from farmers starting 5 years up to 25 years. These investors use the land improperly .Farmers told us investors use more amounts of fertilizer and agrochemical. Deforestation in this area is ongoing activity and it becomes an economic activity.



Figure 11: People who were collecting natural forest woods in Ziway buffer area (field observation Photo)

3.1.3. Impact of Land Degradation

Land degradation in Ziway has an impact on buffer areas. There was huge amount of siltation every year. The lake buffer area became cultivated land. For this reason farmers had described large amount of fish variety had vanished.

Peoples in ziway are exposing to drinking water problem due to poor land management. Irrigation water which was drained from this site was polluted by these chemicals. This polluted irrigation water was enter to the lake by this case lake water could not be drinking. So, Batu town people got

drinking water from Bulbula town by ten birr cost /20 litter / from Bulebula River which is 10 km far from Batu town.

There was only little ziway lake fish production supply. It was not wanted because the lake water was polluted by chemical that disposed from floriculture investment.

Fish cooperatives were exposed for food insecurity problem because of lake water was polluted by agrochemicals from farmers and floriculture investments the amount of fish in the fishery net is low.

The Soil fertility of the lake catchments becomes very low. For indicator, In Adami Tulu Jido Kombollcha Wereda, in the past five years production per hectare of major cereals – crops like *Teff*, Wheat, Maize, and Sorghum, decreased from 16.15 quintals to 9.04 quintals, for respective years 2003 and 2008. This means per annum the average loss of productivity amounts to 1.42 quintals per hectare. The rate of loss in productivity was different for different crops, as high as 2.52 quintals per annum for wheat and as low in relative terms for maize, 1.03 quintals per annum per hectare. (Abijata and Shala (Quartet) Lakes' SOE Report 2015 PP. 47)

Land in ziway catchments could not give production unless the farmers use fertilizer. As farmers' description in Adami Tulu Jido kombolcha woreda, fertilizer demands were increasing year to year. This was because of soil fertilities declination. This demand also extra expense to farmers Adami Tulu Jido kombolcha woreda Agricultural input distributed by the year (2014/2016).

Table 5: Agricultural input application in 3 sequential years

No	Types of input	2014	2015	2016	Deference 2014-2015 increment	Deference 2015-2016 increment
1	Fertilizers (in quintals)					
	DAP	13,062	13683	15,079	621	1396
	Urea	2,887.5	1531.5	3107.5	-1356	1576
2	Herbicide (in liter)					
		162liter		10,478 liter		10316

Source Adami Tulu Jido kombolcha woreda finance and economic development office (2017)

There are gully which transport huge amount of soil to Lake Ziway. This is the main problem in this buffer area.



Figure 12 Gully formations in Ziway buffer zone (field observation)

3.1.4. Response of Land Degradation in Ziway

From the Community

People in ziway were wake up how land degradation has affected their life. There was soil and water conservation structure done by the people, not only; this but also there was closer areas to do plantation by community participation. But as expected the structures did not be functional for conservation.

Table 6: soil and water conservation work with participants in 2012, 2014 and 2017

No	2012		2013	2014		2015	2016	2017	
	Plan	action		Plan	Action			Plan	action
Bund constriction (k.m)	900	8206		13117	14801			7750	6415.5
Gully treatment(m^3)	8521	75432		35412	36295			11323	21335
Other structures (No)	38584	379376		206498	283732			235714	150054
Area closer (ha)	9887	9697		9098.	9098			4000	3590
Equipment(No)	There is no data			There is no data				29043	26545
Labor force (No)	3623	3611		44101	43718			55073	44596

We cannot get data

We cannot get data

Source: - Adami Tulu Jido kombolcha woreda, agriculture office yearly report (2012, 2014 and 2017)

Key= other structures consists: - eyebrow basin, micro basin, half moon, and improved pit.

From Government

Mobilization of people for soil and water conservation and awareness creation about land degradation and its impact were done by the government side.

The equipment, spirit or line level, spade, digging hoe are gets from region agricultural office and also for biological treatment, seeds and seedlings were donated from the region agricultural office.

Problems which Needs Response

- Farmer's contradiction by land certification,
- Sustainability Soil and water conservation structure.
- Illegal investor production input of fertilizer and agrochemical without recommendation.

3.1.5 Outlook of land degradation of ziway buffer zone

- In this buffer area the population is increasing in alarming rate .In three year deference between 2005 and 2008 the population reaches 68464. Contrarily the production capacity of the land is becoming very poor. In every year it lose 1.42 quintal per hectare per. unless there will trust full and sustainable technology that can reverse the production capacity land, like fanayajuu terrace and green manicuring, the people will expose to food insecurity.
- Unless the government set solution for illegal inverses, the contradiction will grow up and may be national contradiction case

3.2. Biodiversity

3.2.1. State and Trend of Biodiversity on Lake Ziway

Biodiversity is the variety of life on Earth, it includes all organisms, species, and populations; the genetic variation among these; and their complex assemblages of communities and ecosystems.

Ethiopia has10 major lakes with a total area of 7400 km^2 , with substantial quantity of fish stocks.. Most of these lakes are located in the Ethiopian Rift Valley depression, which is part of the Great East African Rift Valley system. (Brook. 2012)

These lakes are considered to be centers of biodiversity, corridors of countless migratory birds as well as in ameliorating the effects of drought of the region. The lakes in the rift valley are used for

multiple purposes like irrigation, fishing, domestic water supply, transportation, recreation and supply of fresh water to Lake Abiyata (e.g. Lake Ziway) through the out flowing Bulbula River.

About 50% of the bird species in Ethiopia have been recorded in the Rift valley area. Current commercial fisheries cover most of the countries freshwater resources, including Lake Ziway which is one of the most intensively fished lakes in Ethiopia. (Lemma, 2016)

Lake Ziway is shallowest lake, located in the Ziway-Shala basin in Central Ethiopia. The Lake is located in mid-altitude regions. The vegetation of the area is characterized by Acacia open woodland, now extensively overgrazed, while deciduous forests occupy the ridges and slopes.

Lake Ziway forms a complex and vulnerable hydrological system with unique ecological characteristics and well-known for its biodiversity. The most important component of the water resources of the lake is precipitation and river inflow and the lake is used for smallholder to large scale agriculture, domestic water use, and fishery, industrial and associated eco-tourism.



Figure 13 Ziway Lake used for floriculture and small irrigation (Filed visit photo 2017

Recently, the problem is aggravated due to uncontrolled pumping of the lake water by private investors for floriculture and horticulture development. As irrigation in this area is a year-round process, its effect on the water level is magnified, especially during times of low precipitation and high evaporation during the months of November or December.This uncontrolled over-irrigation, if unabated, might bring the same disastrous effects on the fertile plains around the lake and harems flora and fauna of the eco systems.

3.2.1.1 Flora Biodiversity of Lake Ziway

Historically Ziway Lake area was known for its dense cover of acacia tree with typically savanna grass land. However, recently Due to unwise utilization of forest resource by local community for charcoal making, cultivation and over grazing, those natural species like *Acacia albida*, *Acacia tortoise*, *Ficus vasta* has been destroyed tremendously. (Lemma, 2016)

Apart from the natural forests found in the islands of Lake Ziway, Adami Tulu Jido Kombolcha Woreda has no sizable natural forests. This is largely as result of continued deforestation of the area triggered by the demand for additional farm land, household energy and construction requirements of the people. However; there are plantations in different kebele of the Woreda covering a total area of 9348 hectares natural plantation and 3252 hectares reforested, (ATJKW Profile, 2017). The plantations are distributed over Kamo Garbi, Warja Washgula, Galo Hirpha, Dodicha, Abine Germama, Wayiso Kanchero, G/W/Boramo, Wolicho Boramo, Andola Chebi, Suro Kodosa, Gale Migira, Jela Aluto, Bochesa, Abay Denaba, O'itu Basuma, I/Chalamo, G/Rasa, Reji, Naqa, E/Ababu, H/Qalbo, Aluto and Hobicho kebeles of the Woreda.

The current loss of floral biodiversity and the related changes in the environment are now faster than ever before and there is no sign of this process slowing down and local plant populations like; Birbirsa (*Podocarpus falcatus*(*p.glacilor*), Ajo(*Acacia oerfota*), Badana (*Balanitesa egyptiaca*),Waaccuu (*Acacia seyal*), Mokonisa (*Croton macrostachyus*), Laaftoo(*Acaci alabia*), Baddeessaa (Strychnos spinosa), Ejersaa(*Oleaeuropaea sub.Sp.* Cuspadata(oleaafricana), Qulqaali/adamii(*euphorbia abyssinica*), Qurquuraa(*Ziziphus mauritiana*), Odaa (*Ficus sycomorus*),Biiqqaa\bika (*Cambre tummolle*),Kombolchaa (*Maytenus arbutifolia*), Garbii (Acacia labia), Xaxesaa (*Rhus glutinosa*), Qararuu (*Acokantheras chimperi*) etc. local plantation which are declined in species and area coverage.

3.2.1.2 Faunal Biodiversity of Lake Ziway

There are six indigenous fish species in Lake Ziway comprising *Barbus ethiopicus*, *Barbus paludinosus*, *Labeobarbus intermedius*, *Garra makiensis*, *Garra dembecha* and *Oreochromis niloticus* (Golubtsov et al., 2002; Eshete Dejenet al., 2010).

The lake also have harbors four exotic fish species (*Tilapia zillii, Carassius carassius* and *Carassius auratus)* which were introduced to enhance its production and *Clarias gariepinus* that slipped into the lake accidentally (Golubtsov *et al.,* 2002).

The landings of lake Ziway is highly dominated by fish specious like Tilapia nilotica (*Oreochromis niloticus*), but recently African catfish (*Clarias gariepinus*) and Crucian carp (*Caracius caracius*) are appearing in small amounts in the total landings.



Figure 14 (A) Nile Tilapia (Qoroosoo) (Oreochromis niloticus (B) Sicilia, Tilapia zillii (c)Ambazza, African catfish (Clarias gariepinus) fish sp. of Lake Ziway

Many wild animals like Hyena (*Crocuta crocuta*) Warthog (*Phacochlerus aethiopicus)* Monkey (*Cereopithecus aethiops*) Wild cat, apes, antelopes, fox, rabbit, are the main wild animals found around the lake.

Birds such as white tailed swallow, red eyed dove , wattle lapwing , Marabous stroke, Great White pelican, Fulvous Whistling Duck and White-Faced Whistling Duck, Black-headed Gull, Grey-headed Gull, Whiskered-Tern, White-winged Black Tern, White-breasted Cormorants, Reed Cormorants, Hammer Kops, African Spoon bill, King fish, Egyptian goose and Herons, are found around Lake Ziway. Some of the above species are listed as Least Concern and Vulnerable on the IUCN Red List (Lemma, 2016), also during FGD the participants suggested that wild animals like elephant, lion are totally extinct**.**

Table 7 Functional groups fauna and macro organisms of Lake Ziway

No	**Functional group**	**Group members**
1	Water fowls	Great white Pelican, Cormorant, African fish eagle and king fisher
2	Cat fish	*Clariasgariepinus*
3	Carp	*Carassiusauratus*and *Carassiuscarrasius*
4	Tilapia	*Oreochromisniloticus*and *Tilapia zilli*
5	Barbus	*Barbus paludinosus*
6	Garra	*Garra dembecha and Garra makiensis*
7	Macro zoo benthos,	Insects, Oligochaets Nematods and Mollusks
8	Carnivores zoo plankton	*Mesocyclopsae quatorialis*
9	Herbivores zooplankton	Thermocyclops, Cladocerans and Rotifers
10	Phytoplankton	Cyanophyta, Chlorophyta, Bacilariophyta and Euglenophyta
11	Macrophyte	*Typha, Arunda, Echinochola, Potamogeton, Cyprus*and*Nympheas.*

Table 8 Phytoplankton identified from Lake Ziway

Cladoceras	**Copepods**	**Rotifer**
Moinamicrura	*Mesocyclopsaequat*	*Anuraeopsis sp.*
Diaphanosomaex	*Thermocyclopsdeci*	*Asplanchna sp.*
Daphnia barbata		*Daphnia*
Ceriodaphniacorn		*B. caudatus*
		B. quadridentatus
		Brachionus sp.
		Filinia sp.
		Keratellatropica
		Lecane sp.
		Polyarthra sp.
		Trichocerca sp.

Table 9 Phytoplankton identified from Lake Ziway

Cyanobacteria	**Chlorophyta**	**Bacilariophyta**	**Euglenophyta**
Anabena Spp.	*Closteriumspp*	*Cyclotela sp.*	*Phacussp*
Cylindrospermopsis Spp.	*Cosmarium sp.*	*Naviculasp*	
MicrocystisSpp	*Pediastrumboryanum*	*Nitzichia sp.*	
	Pediastrum duplex	*Gyrosigma sp.*	
	Pediastrum simplex	*Meliosera sp.*	
	Senedesmus spp.	*Surirella sp.*	
	Staurastrum spp.		

Source (Mathewos Hailu, 2011)

Aquatic biodiversity is directly or indirectly affected by several conditions occurring in the area. Soil erosion has affect and continues to affect all parts of the lake ecosystem. The accumulation of silt in water leads to degradation of water quality for aquatic organisms, for human consumption and loss of storage capacity for livestock, irrigation. As part of complex environmental and socioeconomic systems and linked through the hydrological system to upstream catchments and downstream areas.



Figure 15 Accumulation of silt in Lake Ziway leads to loss of aquatic habitat

The spread of invasive species within wetland areas like *parthiniun* and others are the other cause for biodiversity depletion in the area. All of these contribute to loss of wetlands, water tables, and aquatic and non-aquatic biodiversity in the area.

During the FGD local people specifically states to conserve the biological diversity need over all participation to conserve the lake biodiversity and need integration/collaboration work of the three woreds. During conservation work focusing only on hilly sides is not important rather all areas needs attention by the government and the regarding body.

3.2.2. Drivers and Pressure on Biodiversity Degradation on Lake Ziway

Anthropogenic factors have major impacts on ecosystem functioning and stability, which are often reflected in changes to biodiversity that includes wildlife. This is because abundance and diversity of the ecosystem community are changed.

Development schemes, such as pumping of water from the Lake for irrigation, over utilization of water from Feeder Rivers has rapidly reduced water levels of the lake. This is threatening the lake's viability for suitable nesting/roosting/stopover habitats of birds and other life.

Biodiversity is declining rapidly due to factors such as overexploitation of the lake water; for instance only in Adami Tulu Jido Combolcha Wereda in2016\17 15,000 hectares of land is used for irrigation with 267 water pumps only in ATJKW. In Lake Ziway there are 734 water pumps used for irrigation and 36 hydroelectric pumps used by floriculture farms another 36 hydroelectric pumps are used for the out late of Bulbula River directly, and the geothermal electric power of Aluto also used this lake water, (Muhammad and Birhanu, 2016).

While changes in biodiversity are more clearly linked to direct drivers such as habitat loss because of the amount of water needed for different purpose from the lake is 28M m^3 but, it reaches today 150M m^3 the level of the lake is dramatically lost, some fish species are goes to extinct specially the

endemic one *Barbus ethiopicus* and they are also linked to indirect drivers that are at the root of many changes in ecosystems. (MoWR, 1999)



Figure 16 Water Irrigation Pumps on Ziway Lake (source field visit, 2017)

Overall, the main factors directly driving biodiversity loss are: habitat change, such as fragmentation of wetlands for grazing and irrigation purpose, deforestation around the lake for charcoal and agricultural land; invasive alien species that establish like *parthinium* and spread outside their normal distribution; *Parthenium* colonizes disturbed sites very aggressively, impacting crop lands, pastures. Thus, reduces growth and depresses forage production. *Parthenium* weed is a serious problem to natural plant communities



Figure 17 Parthenium weed invention in Lake Ziway (source own 2017 field visit photo)

Reductions in community biodiversity leads to other serious community problems such as increased soil erosion and the extinction of certain native flora or fauna, and pollution from industry,

excessive fertilizer use for irrigation and agricultural purpose leading to excessive levels of nutrients in soil and water. Discharge of waste water from nearby industry mainly from floriculture sites leads to lake water to pollution.



Figure 18 Water pollution from floriculture direct to the lake (source; field visit photo, 2017)

3.2.3. Impact of Biodiversity Degradation on Lively Hood System of the Local People of Lake Ziway

As population increase, agricultural land will expand and forest cover will shrink, particularly in developing countries like Ethiopia. This will lead to a continuing decline in local and global biodiversity, mainly as a result of habitat loss.

Lake Ziway is one of such lake that is under great impact of land-use changes mainly due to extensive and irrigation based agricultural farms and industries which are established around the lake. Human well-being will be affected by biodiversity loss both directly and indirectly. Direct effects include an increased risk of sudden environmental changes such as fisheries collapses; floods distraction, diseases out break and drought affects the livelihood of the community.

There was drought in 2015- 2017, in ATJKW even if there is climate change effect totally in Ethiopia (EL Nino) the condition of the area is increase from year to year, for example in 2015 24,860 families and 2016 133,979 families were affected by drought and the government support them by food(ATJKW Profile, 2017). This was shown in all kebeles of the woreda, this was also true for the buffer zone.

Disease outbreak such as, Malaria (Confirmed with PF malaria 1,685 Acute Febrile illness 7,113) Pneumonia 6,323, peoples were recorded as they were affected (ATJKW Profile, 2017).

Biodiversity loss also affect human well-being indirectly, for instance in the form of conflicts due to water use of the lake, sand extraction from the Lake Zway.

Economic problems that threaten the sustainability of fish populations or overfishing, extinction of some fish species, inefficient use of variable inputs and low returns of fishing industries are caused by open access to a fishery. During FGD the participants from the fishery association confirmed that they are on the way to see other source of income because the amount and the quality of fish decrease from year to year.

As a result of flood some individuals of trees became uprooted, caused considerable damage on the natural vegetation which are ruminants out of which deforested.



Figure 19 Flood distracted natural vegetation by uprooting in Lake Ziway

(Source ATJKW Environment, Forest and Climate Change Bureau, 2016)

On the other hand due to climate variability in the area of Lake Ziway there were a high amount of economic loss from the local community near and around the lake such as:- domestic animals loss , settlements and road infrastructure distraction by high amount of flood.



Figure 20 loss of livelihood and distraction of road infrastructure in ziway (source ATJKW Environment, Forest and Climate Change Bureau, 2016)

3.2.4. Responses to Biodiversity Degradation

The community with government done: - Tree planting, soil bund, check dam, stone bund, trench, hearing bone, cut of drain, micro basin, hill side trace gabion and area closure are underway in different areas of the Woreda especially in Galo and Rape, Warja Washgula and Aluto are currently under way with possible long term positive effects on the rehabilitation of the natural environment. During the FGD the participants suggested as result the forest is regenerating on hill sides and mountains areas.

Policy Response

A. National Biodiversity Policy and Strategies

The National Biodiversity Policy (NBP) was established in 1998 based on a holistic ecosystem approach to conserve, develop and utilize the country's biodiversity resources. Integration of biodiversity conservation and development in federal and regional sectoral development initiatives, and mobilization of international cooperation and assistance, have been identified as the principal strategies for implementation of the policy. The policy provides for guidance towards effective conservation, rational development and sustainable utilization of the country’s biodiversity, and contains comprehensive policy provisions for the conservation and sustainable utilization of biodiversity.

Protection of biodiversity-related traditional indigenous knowledge and communities' benefit sharing arrangements are not yet effective. Similarly, the potential of biodiversity-related opportunities has not yet been exploited to enhance sustainable livelihood to the desired level. However, there is a general understanding with respect to changing the management approach in order to bring about the desired benefits.

3.2.5. Outlook

The main objective of the adaptation options is to reduce loss of biodiversity. Hence, the adaptation options should focus on increasing water utilization efficiency and water availability, and on ensuring better management of biodiversity.

Among the adaptation options the most important ones are: implementation of appropriate irrigation water management practices; adoption of efficient irrigation systems and awareness creation on efficient water utilization; implementation of water pricing and water recycling; development of effective rainwater harvesting technologies; construction of small to medium sized storage reservoirs with a minimum impact on the environment; and establishment and implementation of policy measures that govern the amount of water to be abstracted. Besides, watershed based integrated water resources management should be the core part of the adaptation options.

For the interests of the majority of the fishermen in lake Ziway, the management of fisheries is preferably to rely on closed seasons, closed fishing areas, restriction on number of fishers, catch quotas, mesh size restriction, restriction on beach seines and banning beach seines.

The other measure which needs from the governmental body need to collaborate different governmental body to which have direct and indirect relations on biodiversity loss and management therefore it needs to be biodiversity to be mainstreaming.

3.3. Wetland Ecosystems of Lake Ziway

3.3.1 State and Trend on Wetland

Wetlands are the ecosystems that are found on the interface between land and water. It is also areas of marsh, ponds and swamps, whether natural or artificial, permanent or temporary, with water, that is static or flowing, fresh, brackish or salty, including areas of marine water, the depth of which at low tide, does not exceed six meters. (Davis, 1994)

Ethiopia exhibits a wide range of geologic formations and climatic conditions which create numerous wetland ecosystems including 12 rivers, eight major lakes and many swamps and floodplains. It is found on every agro-ecological zone from alpine (high mountains) to desert ecosystem in the low-lying regions and across all traditional climatic zones. Based on scattered information, the total wetlands coverage of Ethiopia is approximately 2% (22,600 km^2). These, wetlands provide natural resources and services for humanity. They are a source of food, tourism,

cultural resources, flood control and improved water quality. They are also important for biodiversity and wildlife conservation (Mulugeta, 2010)

Lake Ziway Wetland is most productive environment important in: Maintaining key ecological processes (reduce siltation, purifies water, ground water recharge and discharge, etc.) Supporting high biodiversity (such as waterfowl, mammals, reptiles, amphibians, fish and invertebrate species, medicinal plant species)

Lake Ziway Wetland also provides functions such as assimilation of wastes, aesthetic values, tourism to the islands for birds, hippopotamus, even religious functions, etc.

Providing socio-economic benefits to local communities include: Provision of clean water supplies throughout the year; wetland vegetation, such as "cheffe", reeds, palms, bamboos and papyrus, etc. are harvested by the local people for roofing and making of various crafts including boats. Wetland plants, such as *Hygrophila auriculata* (locally known as balan woranti) are used for medicinal purpose; also for cattle grazing and watering.

On the other hand, Ziway (a severely threatened wetland in the Ethiopian Rift Valley) supports livelihoods of the people in the watershed and also hydrological ensures the continuity of biodiversity in Lakes Langano, Abijata and Shala.

In terms of biodiversity, Lake Ziway is a special wetland in which diverse plant and animal lives ranging from microscopic to the large mammals such as hippopotamus strive. Among diverse fish species that thrive in Lake Ziway, *Barbus ethiopicus*is an endemic species, which one found in Lake Ziway only. Today, it is a rare event to see *B. ethiopicus* in fishermen's nets, like the trees and game animals that have very slowly disappeared from the wetland. The fate of hippopotamus in Lake Ziway seems to face the same problems with increasing global warming, population and their requirement for freshwater for various development efforts increased and illegal hunting on the hippos (Lemma, 2016).

3.3.2 Driver and Pressure on Wetlands of Lake Ziway

Humans or even pollution by excessive pesticides/herbicides, nutrients use, or release of heavy metals can obviously discharge into the downstream wetlands and lake. Any impact of conserving and wise use of the wetland can be reflected on the other lakes in the basin.

Recent changes in water level fluctuations at Lake Ziway due to reduction in seasonal rainfall, over extraction for irrigation and over used by industries had resulted in water volume reduction in Lakes Abijata and Shala (Lemma, 2016). Lack of grazing land on the farmers own; all surrounding domestic animals were late in the wetland leads to highly over graze. Wetland papyrus was also burned which supports many biodiversity and protect the lake water.

Deforestation, siltation, soil erosion, and land degradation within a wetland catchment area the starting cause for an accumulation of silt within the wetland ecosystem.

3.3.3 Impact of Ziway Wetland Degradation on Lively Hood

Compaction of the wetland by livestock is also known to have a significant impact on the infiltration capacity of the soil, hence affecting the hydrological system and balance of the wetland itself. Loss of biodiversity is another negative impact of the system which includes:-

- Overexploitation of wetland resources for water, food and raw materials (fish, reeds, water, medicinal plants, papyrus, etc.) that sustain the livelihoods of significant populations.

Apparently the livelihoods of the people of the watershed of Lake Ziway are dependent directly or indirectly on the presence of this wetland. Water abstraction for irrigation, city supply household and industries uses are the most apparent practices.



Figure 21: Children searching for javelin fish in Ziway Wetland (source own during field visit 2017)

3.3.4 Policy Response

Wetlands are considered among the most productive type of ecosystem in the world, providing benefits far in excess of those obtained from alternative uses to which they are subjected. Ethiopia is endowed with vast wetlands, including a tract in the lake Ziway; however, efforts towards their

conservation and sustainable utilization are very limited, and no clear policy and legislative framework have been designed.

3.3.5 Wetland Outlook

- Needs effective policy and legislative framework
- Buffer zone both the wetland and the lake
- Some parts of the lake needs protection
- Responsible organ from the government needs to be set
- Ziway wetland needs measurement

3.4. Forest

3.4.1. State and Trend of Forest

Apart from the natural forests found of the islands of Lake Ziway, Adami Tulu JidoKombolchaWoreda has no sizable natural forests. This is largely a result of continued deforestation of the area triggered by the demand for additional farm land, household energy and construction requirements of the people. Historically the district was known for its dense cover of acacia tree with typical savanna grass land. However, there are plantations in different kebeles of the Woreda covering a total area of 2,592.5 hectares. The plantations are distributed over Kamo Garbi, WarjaW ashgula, Galo Hirpha, Dodicha, Abine Germama, Wayiso Kanchero, G/W/Boramo, WolichoBoramo, Andola Chebi, Suro Kodosa, Gale Migira, Jela Aluto, Bochesa, Abay Denaba, O‟itu Basuma, I/chalamo, G/Rasa, Reji, Naqa, E/Ababu, H/qalbo, Aluto and Hobicho kebeles of the Woreda. Major tree species found in these plantations are Acacia Tortitls, Acacia Albida and Acacia Senegal. Efforts to rehabilitate the environment of the Woreda by the office of Agriculture through conducting biological and physical conservation measures appear to be fruitful. As a result the forest is regenerating on hill sides and mountain areas. Tree planting, soil bund, check dam, stone bund, trench, hearing bone, cut of drain, micro basin, hill side trace gabion and area closure are underway in different areas of the Woreda especially in Galo and Rape, Walda Ashkula and Aluto are currently under way with possible long term positive effects on the rehabilitation of the natural environment.

3.4.2. Driver and Pressures of Forest Degradations

A ‘driving force’ is a need. Examples of primary driving forces for an individual are the need for shelter, food and water, while examples of secondary driving forces are the need for mobility,

entertainment and culture. For an industrial sector a driving force could be the need to be profitable and to produce at low costs, while for a nation a driving force could be the need to keep unemployment levels low.

Driving forces lead to human activities such as transportation or food production, i.e. result in meeting a need. These human activities exert 'pressures' on the environment, as a result of production or consumption processes, which can be divided into three main types:

(i) excessive use of environmental resources,
(ii) changes in land use, and
(iii) Air, water and soil.

Based on the above population information the pressure on the forest resources is related to the driving force like – Population connection with Energy use, Agriculture, Land use.

More forest lands are changed to farm lands, settlement areas, and energy sources for household use. Communities are using forests for fuel wood, Charcoal and for construction of their residences (house). The ground truth which we observe in the field is –

- The farm land is highly eroded by running water and wind.
- The wetland around the Lake is changed into farm and grazing land
- The farm land and grazing is invaded by invasive weeds like *Parthenium hysterophorus, Xanthium spp. (Spinosum strumarium*) and *Lantana camara*.
- The riverine and wetland trees and bushy plants are cleared and changed to grazing and horticultural farms
- Birds and aquatic animals lost their habitat and in forced to migration
- Because of high run – off the water percolation is getting very low, the evapotranspiration is a balanced and the direct evaporation of water from the farm land is very high it leads to water scarcity and un seasonal drought.



Figure 22 Areas Changed to Farm Land According to Population Increase by Clearing the Bush and Forest Land

Source: Filed survey photo2017



Figure 23 Areas Affected by Wind Erosion Because Of Forest Cover removal.



Figure 24: The Remaining Trees and Shrubs around the Lake Ecosystem and Land Changed to Grazing.



Figure 25 Sparsely Distributed Ficus spp. In Lake Ziway.



Figure 26:The People around Lake Ziway Collecting Fuel Wood.

3.4.3. Impacts of Forest Degradation

The changes in the physical, chemical or biological state of the forest cover determine the quality of ecosystems and the welfare of human beings. In other words changes in the state may have environmental or economic 'impacts' on the functioning of ecosystems, their life supporting abilities, and ultimately on human health and on the economic and social performance of society.

During the focus group discussion the representatives of the community told and forwarded ideas; the farm land is becoming unproductive the production is falling. Most forest land is becoming farm land and covered with invasive weeds, even if the plants and grass species are not palatable for the

animals reared by the community, the quality and amount of products expected is deteriorating time to time.

There had been more than 40 species of trees in the surrounding area of the lake Ziway. Most of the bushy and medicinal plants are lost.



Figure 27: Shrinking Lake Ziway because of Deforestation and High Sediment Load from the Upper Catchment of the Area, and the Loss of the riverine Plants.

3.4.4. Responses to Forest Degradation

A 'response' by society or policy makers is the result of an undesired impact and can affect any part of the chain between driving forces and impacts. An example of a response related to driving forces is a policy to change mode of forest management and rehabilitation.

In the time of the field focus group discussion, the community is aware of managing forest resources by protecting the natural forest areas in assigning guards paying compensation for their services. By the action taken in the community they are starting to protect the lake siltation by closing areas as an example 75 hectares and above is covered by physical soil conservation structures and planted by indigenous species like acacia spp. Around Worga Woshbula and Qaamo Garbi Kebeles.

The community is taking an action creating awareness in protecting the land and forest resources

based on watershed management activities with the adjacent Woredas of the South Nation Nationalities and People Regional State, Gurage Zone. Constructing soil conservation measures and planting trees to save the precious forest, soil d water for sustainable



Figure 28 :Reforestation measures by the community. (Source: Field survey Photo; 2017)

3.4.5. Outlook of Forest Degradation

According to the field visit and the discussion with the community and the other stakeholders if the management and utilization situation is continuing like this, the area will

- kept under severe moisture stress
- Unless the community try to conduct mutual and cooperative conservation measures with the neighbouring SNNPRS especially with the Guragea Zone, the eroded soil sediment load of the lake Ziway is gating huge and lead it to disappear.
- The population trend is 142,861 in 2007 and 257,434 in 2017 the difference with in this 10 years period is 114,573. Based on the population growth rate the fuel wood demand is booming as the population is increasing, the indigenous species of the forest will lose their identity.
- The afforestation program started, have to be conducted sustainably.

3.5 Climate

According to (IPCC 2012), climate is the average weather occurring within a given geographic location over a long period of time (usually more than 30 years). It also refers to the range and frequency of occurrence of extreme weather conditions such as drought, flood, tropical cyclone and tornado.

According to (Massimilano, 2015) the climate of Ethiopia is mostly controlled by the seasonal migration of the Inter tropical Convergence Zone (ITCZ) and associated atmospheric circulations as well as by the complex topography of the country. The highlands and the lowland experience a variety of climates. Ethiopia has different microclimatic zone like cool, temperate and hot zone.

According to the Ethiopian National Meteorological Service Agency (NMSA) Ethiopia has three seasons such as Kiremt, Bega and Belg. Kiremt (summer) it is starting from mid-June up to mid-September during this seasons long and heavy rainfall occurs. Bega (winter) is the dry season that occurs during the month of October up to January and during Belg seasons on the month of February, March, April and May were short or moderate rainfall occurs.

3.5.1. State and Trend of Climate

Weather and climate has worldwide interaction winds that originate over the Atlantic Ocean and blow across Equatorial Africa have a marked seasonal effect on much of Ethiopia (Berry, 1991).Inter tropical convergence zone ITCZ has great influence on Ethiopian Kiremt seasons which is one of the main rainy seasons (Fekadu, 2015). Weather pattern provides the highlands with most of its rainfall during a period that generally lasts from mid-June to mid-September. Due to difference in elevation and seasonal change in atmospheric pressure that causes Variations in precipitation throughout the country and several regions receive rainfall throughout most of the year, but in other areas precipitation is seasonal. In the more arid lowlands, rainfall is always inadequate Berry, (1991). On the FGD most of the community supposed that even though their economy is based on the livestock but due to degradation and climate variability it is difficult to feed their livestock so they shift to the crop production yet, crop production also not more productive due to low soil fertility and high rain fall variability. They perceived that due to climate change temperature increase, rainfall amount decline and highly variable season to seasons and year to year. They agreed that months of rainfall seasons decrease from six month to two month so this conditions make difficult to survive because their agricultural production like any other place of Ethiopia depend on rainfall. The perception of the people about climate is there is real climate change because they feel that temperature increase year to year and make their life difficult to live. Almost they fill the change around 20 years, since that began from 1985 of Ethiopian calendar. As the previous year's it difficult to use the Belg rain for different purposes because Belg rainfall almost at this time not available.

3.5.1.1 Rain Fall

Variations in Rainfall throughout the country is the result of differences in elevation and based on the rainfall distribution pattern, Central, eastern and northern areas of the country experience a bimodal rainfall pattern, receiving the majority of their rainfall from the Atlantic, while some derives from the Indian Ocean. The big rains from June to September come mainly from the

Atlantic, while the light spring rains between February and May come from the Indian Ocean (www.national parks-world wide.info/eaf/ethiopia/ethiopia-weather.html).

For this fact sheet from national Meteorology agency (NMA) we received five meteorological stations' data, Adamitule, Bulbula, Langano, Meki and Ziway from these stations Adamitule, Bulbula and Langano are fourth class stations which means they recorded only rainfall while Meki and Ziway are third and principal class stations respectively. Third class stations records rainfall and minimum and maximum temperature and principal class stations they recorded all parameter of meteorological data. We asked from NMA for 30 years ground based observation data and 30 year's gridded data for Lake Ziway.

For each station we can see that from Figure 29 the amount of annual rainfall highly variable. At Bulbula from the available meteorological data in 2012 the annual rainfall was recorded around 1729mm and at Langano the total annual rain fall was recorded 1615.6mm and 1602.8mm in 2008 and in 2010 respectively.

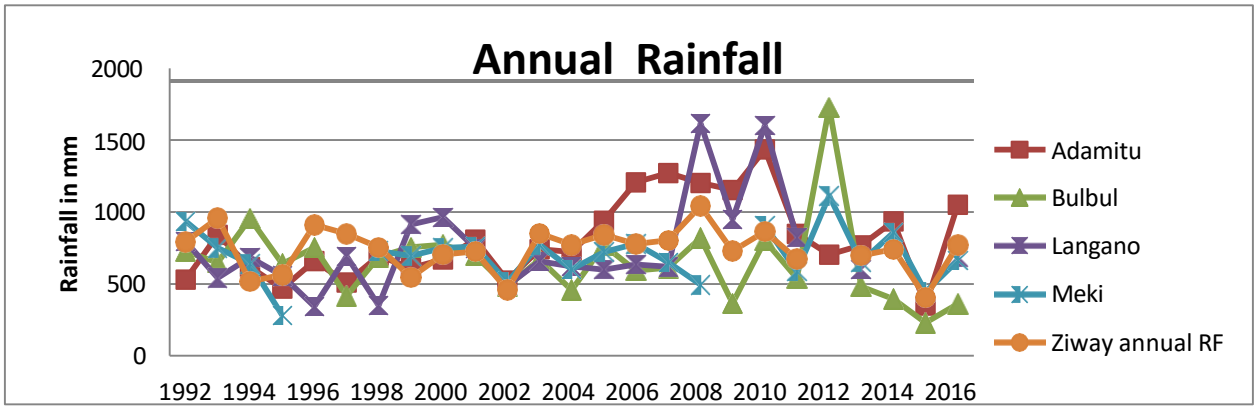


Figure 29: Annual rainfall for different stations of Ziway

From figure 30, Ziway station which is one of the stations its elevations rich up to 1640m above sea level. The circle show as the main rainy seasons for Ziway Peak rainfall was recorded during July month at Ziway station when we compare to the other months. From the 30 years total sum of monthly gridded data the amount of rainfall was high in month of July and August when compare to the other months

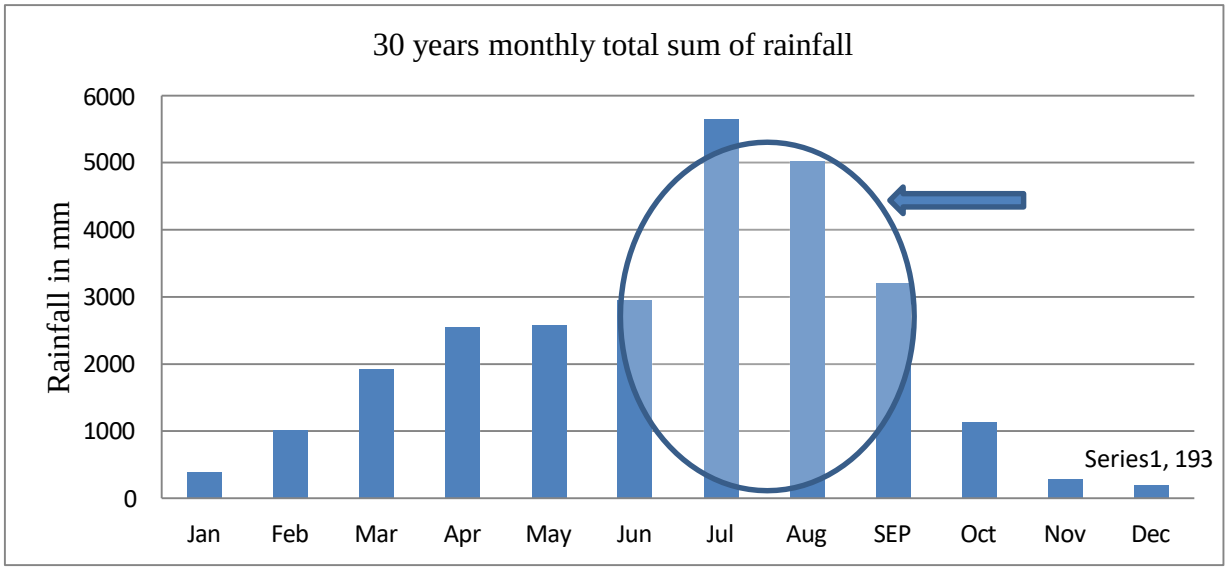


Figure 30 Ziway gridded monthly total sum of rainfall from 1983 to 2014

From figure 31, we see that the annual rainfall for Ziway the maximum rainfall was recorded in 2008 around 1042.1mm.Comparatively minimum rainfall was recorded around 407.7mm in 2015 these conditions related with the ENSO conditions.

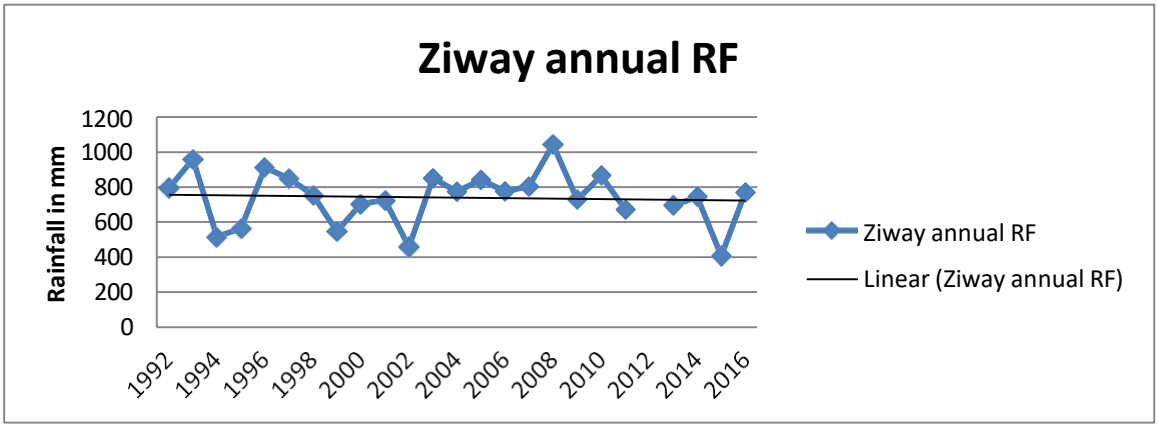


Figure 31 Ziway annual rainfalls from 1992 to 2016

3.5.1.2 Temperature

According to the International Panel on Climate Change (IPCC fifth assessment report, 2014) the global surface temperature increase by the end of the 21st century is likely to exceed 1.5 °C relative to the 1850 to 1900 period for most scenarios, and is likely to exceed 2.0 °C for many scenarios Climate conditions change with elevation, the average temperature drops 0.6°C for every 100m increase in elevation (https://earthobservatory.nasa.gov/IOTD/view.php?id=1510).

When we see from figure 32 the trend of average temperature for Ziway is increasing and also on the FGD the participant agreed that the temperature is increasing when compare to the past years.

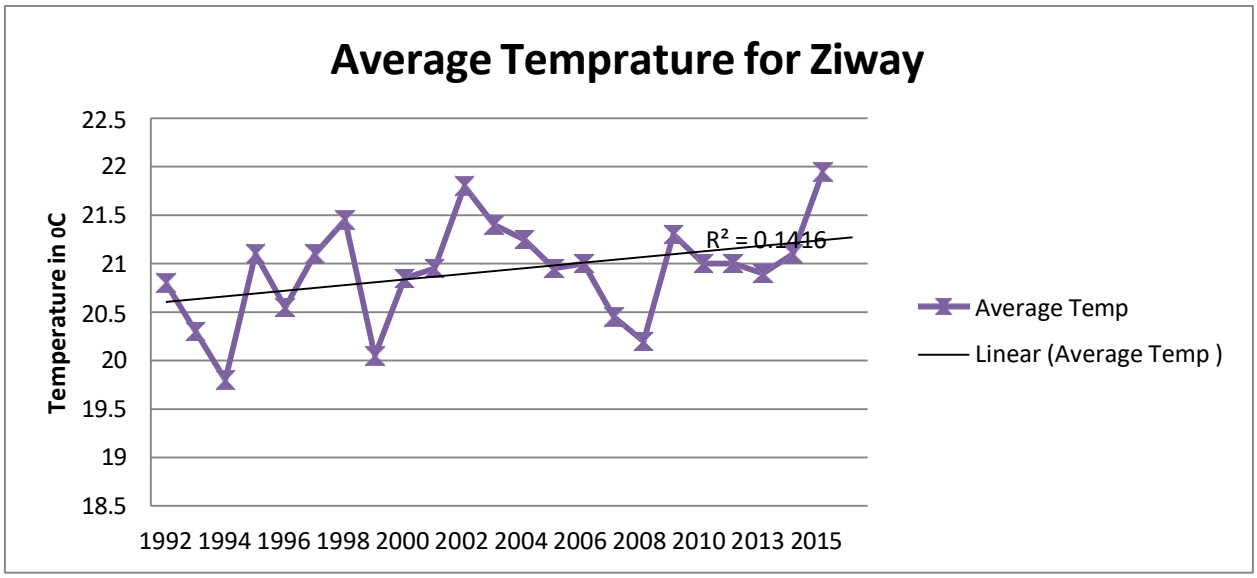


Figure 32 Ziway average temperatures of ziway.

From figure 33, annual average maximum temperatures exists in between 26 °C -29 °C also the trend line shows that there is an increment of maximum temperature.

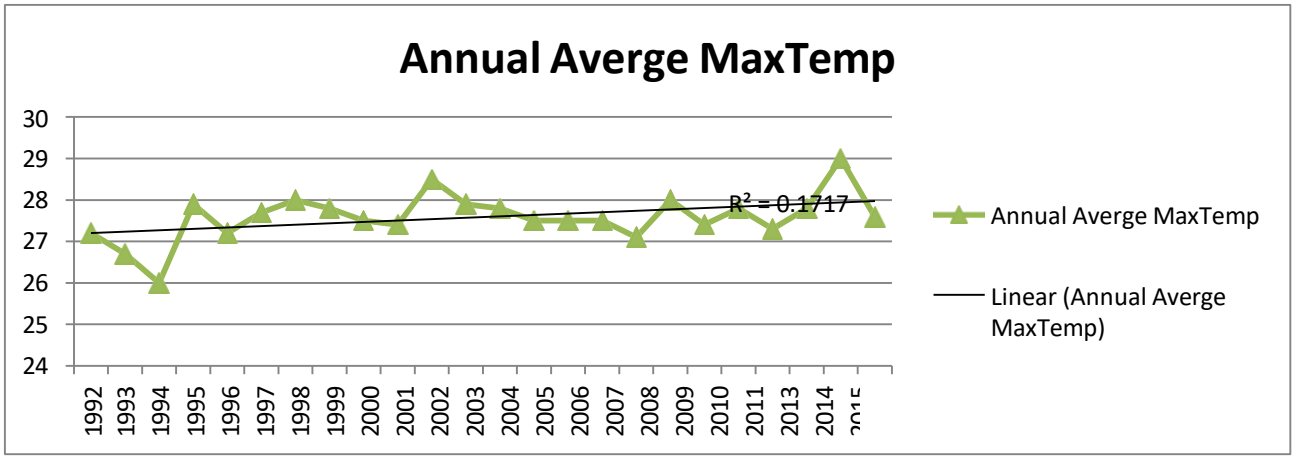


Figure 33 Ziway Annual Average Maximum Temperatures

From below graph annual average minimum temperature for Ziway it reaches from 12.3°C–15.1°C. In 1999 the minimum temperature was recorded 12.3°C in Ziway. From below graph we can see that the trend of minimum temperature is increase.

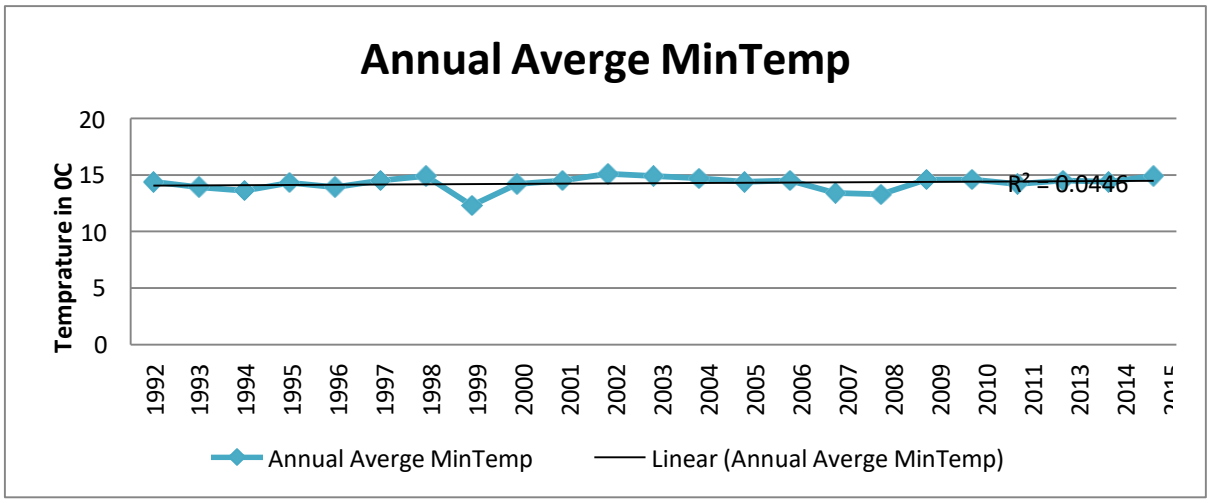


Figure 34 Ziway annual average minimum temperatures

3.5.1.3 Drought and Flood

On the FGD the community explains that during the past year, the drought frequency occur every eight years but now due to climate change the frequency of drought occurrence become every two years and also after 2000 years flood occurs every consecutive year.

3.5.2. Driver and Pressure for Climate Variability and Change, Drought and Flood

Deforestation is one of the main cause for climate change and variability for Ziway. On the FGD the community are agreed that they are one of responsible for the local climate change by make great pressure on the forest through, cutting the tress for household purpose and sell those cutting trees by making charcoals in order to full their economic interests.

During FGD they explained that there is intensive Overgrazing around the lake area, we also observed that on the field number of livestock's goes to wetland for grazing (figure 35).



Figure 35 livestock late to wetland for grazing.

Over population is one of the main reasons for environmental degradation, to achieve better lives for themselves and for their children and also to secure their economy use nature unsustainable manner. Unsustainable use of natural resource makes difficult to current peoples and their future generation to fight natural disastrous like flood, drought etc. On the FGD community described that increasing in population that lead destroyed forest in order to expand their farm lands and to secure their economy. So, this affects the local climate.

Extensively water usage and high agrochemicals discharge to the Lake by floriculture industry and by irrigated farm investments. We can see that from figure 36 photos diversion of Lake Ziway for irrigation purposes by using much motor pipes.



Figure 36 use of Lake Ziway for irrigation purpose.

3.5.3. Impact of Climate Change /Variability on Livelihood System of the Local People

Global temperature were increasing due to increasing greenhouse gases in the atmosphere this conditions largely affect developing countries like Ethiopia (Gebeyehu, 2016). Climate change is not one regions concern while it is worldwide issue. Changes in climate forcing affect the physical environment of lake ecosystems and thereby alter their chemical and biological properties so these changes affect the capacity of lakes to provide ecosystem services (Vincent, 2009). 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.

Due to climate change the people living around Lake Ziway become more vulnerable to drought and flood. The frequency of drought occurrence becomes every two years this affect the people and livestock's that undermine the food security. On the FGD the community explain that due to drought number of livestock died and there economy also highly decline and this makes difficult to feed their children and for themselves due to this they become helped by safety net food program. Due to various factors like diversion of water for irrigation farm from Ketar and Meki River and increasing number of water pump around Lake Ziway with expansion irrigation. Over grazing makes the land become more degraded year to year so this condition makes difficult to control sedimentation over Lake Ziway and the live stokes become vulnerable to drought. Climate change that cause decreasing the amount of rainfall that in flow to the lake, so this condition affects the Lake Ecosystem by decreasing fish population which coupled affect the economy of the people who are depend there income by fish product. As (Chimdesa, 2016) sited World Bank, 2010 increasing in temperature has a negative impact on livestock productivity as warming is expected to alter the feed intake, mortality, growth, reproduction, maintenance, and production of animals.

At figure 37 FGD at different Woreda with the community they believe that there is uncomfortable situation happen to live due to temperature increase. Since 2000 flood affects farm land, home and kills' livestock generally affects the economy of the people and their health.



Figure 37: Focused group discussions with community at Ziway**.**

3.5.4. Response to Climate Change

According to IPCC, A changing climate creates pervasive risks but opportunities exist for effective responses (2014) impacts of climate change have already affected agriculture, human health, ecosystems on land and in the oceans, water supplies, and people's livelihoods to reduce the impact of climate change adaptation play key role to reduce vulnerability and reduce exposure overlapping with hazards. Increasing adaptive capacity to climate change that improves food security and water availability, protect land degradation, reducing loss of biodiversity and ecosystem services (Chimdesa, 2016). So climate change directly and indirectly affect the natural ecosystem and the livelihood of the people, so to reduce the impact of climate change it needs different mechanisms. To reduce the impact of climate there is little bright within the community of Ziway. On FGD the participant explained that some Kebeles were done some water conservation work even thought, their improvement is very low because there is less integrated water conservation work together with the government and with the community of Lake Ziway tributaries.

The FDRE put water resource environmental policies. The polices

a. To ensure that the control of environmental health hazards be a necessary condition in the design, construction and use of dams and irrigation systems;

b. To recognize that natural ecosystems, particularly wetlands and upstream forests, are fundamental in regulating water quality and quantity and to integrate their rehabilitation and protection into the conservation, development and management of water resources;

c. To ensure that any proposed introduction of exotic species into water ecosystems be subject to detailed ecological studies and environmental impact assessment;

d. To promote the protection of the interface between water bodies and land (e.g. lake shores, river banks and wetlands) etc…

3.5.5. Outlook for Climate Change

The main problem for lake Ziway are inefficient use of water by big flower plantation, expansion of intensive irrigation practice for agriculture, deforestation, overgrazing, charging of visible residue from big flower plantation of floriculture farm and sedimentation from those tributaries of Meki and Ketar river and from the farm land during flash flood and climate variability if those problem continued without any solution the benefit get from Lake Ziway like environmental benefit and economic benefit will be diminish. So, to reduce the impact different adaptation options needed for the case of Lake Ziway Adaptation options should focus on increasing water utilization efficiency and availability and on ensuring better management. According to (Lijalem Zeray Abraham1, 2007) put the important adaptation option for lake Ziway such implementation of appropriate irrigation water management practices; adoption of efficient irrigation systems and awareness creation on efficient water utilization; implementation of water pricing and water recycling; development of effective rainwater harvesting technologies; construction of micro to macro storage reservoirs with a minimum impact on the environment; consideration of climate change and its impacts at all levels of water resource development projects; and establishment and implementation of policy measures that govern the amount of water to be abstracted. Besides, watershed based integrated water resources Management should be the core part of the adaptation options.

According to (GWPEA 2016) put some Technologies used to mitigate drought and improve water security for Lake Ziway such as Participatory development of water and land use plans, Establishment of a 'constructed wetland' created a buffer zone between the commercial flower farm and the lake, which prevented the run off of fertilizers and other pollutants, Water monitoring and regulation, Environmental education and Farmers have been encouraged to adopt climate-smart agriculture with a focus on dealing with water scarcity and drought.

According to (Napa, 2007) put different potentials adaptation options for different policy and program for instance for water resource

- Conduct water resources assessment studies (inventory of water quality and quantity, surface and underground water in time and space to develop proper use of available water resources
- Introduce improved methods of water conservation, storage and rational use
- Construction of small check dams and rainwater harvesting schemes to meet water supply for domestic and irrigation use
- Undertake soil conservation measures that help to reduce soil erosion & siltation and also protect the pollution of water sources
- Implement watershed management and water conservation programs & projects that promote local community participation
- Introduce methods to tackle & prevent flood protection, disaster prevention actions; and maintenance of flood control structures
- Manage and tackle droughts as well as the associated slow on-set diseases

3.6. Air Pollutions

Air is a mixture of different gases like oxygen, nitrogen, carbon dioxide and other gases fill the atmosphere and it's very essential for our planets that is as condiment for earth without air it is not possible survive in life. But due to anthropogenic and natural factors that change the amount of those mixture of gases beyond the capacity of the atmosphere, if this conditions affects human life and the environment called air pollution. According to (Hutton, 2011) Air pollution defined as an introduction chemical, particulate matter, or biological material into the atmospheres that cause harm to humans or other living organisms and damage the natural environment. Pollutant gases are includes (SOX, NOX, CO, HCS, etc.) and particulate matter (smoke, dust, fumes and aerosols) radioactive materials and many others (Mengesha Admassu, 2006).

Polluted gases and dust particulate matter can be generated from industry, traditional burring of biomass full, agriculture and those vehicles transports. Source of air pollution can be categorized in to anthropogenic and natural source. During field visit in Ziway the source of air pollution mainly from factory, vehicles, agriculture and use of burning wood and crop residues.

Indoor air pollutions: - Pollutions from the housing in case of Ethiopia indoor air pollution causes due to burning of traditional biomass full for cooking and for heating home.

Outdoor air pollution: - Pollutions from outdoor services and environmental mixings like automobiles, industries, and different human activity outside the door that aggravate the atmospheric air pollutions.

3.6.1. State and Trend

From NMA we were asked data of Ziway air pollutant gases but there is no air pollutant gases data but, from the report of Adami Tulu Jido kombolcha woreda (ATJKW) profile, we can see that in 2007, 2008 and 2009 there were 3175, 4677 and 5557 people affected by acute respiratory infection disease respectively. The number infected people by acute respiratory infection disease increase year to year this indicate that air pollution increase because most of respiratory disease is related with air pollution.

3.6.2 Driver and Pressure

The main driving force for air pollution is increasing the number of population when the population increase that increase deforestation for charcoal and for cooking purpose this increment is indoor air pollution as well as outdoor air pollution during the process of making charcoal that produce Carbon monoxide. The community they are living around Soda ash factory they explain that the factory produce smoke to the environment that increase outdoor air pollution and transport sectors that increase outdoor air pollution.

3.6.3. Impact of Air Pollution

Nature gives for us clean and quality air while mostly due to anthropogenic effect that the quality of air deteriorated that affects the human health. Respiratory diseases are the most common adverse effect of air pollution due to this it can be causes death. According to (Mengesha Admassu 2006) Air pollution is associated with increased risk of death from heart disease and lung diseases and high concentrations of particulate and photochemical oxidants and especially aldehydes that causes eye irritation. During FGD the community explains that due to air pollution they are repeatedly affected by cough and asthma disease.

According to (Hutton 2011), air pollution has direct and indirect impact. Direct impact that affect the health of human being, damages materials and affect the ecosystem the indirect impact of air pollution are that decrease the interest of tourist to visit the polluted area, acid rain which results from chemical being released into the atmospheres and aggravate climate change by burning of fossil fuels and biomass that cause air pollution and causes increase global warming by increasing

greenhouse gases to the atmosphere. Contact with large amounts of soda ash to the eyes or skin can cause burns as well as a rash. (MCGuire, 2017).

Soda ash Cause severe respiratory side effects, such as difficulty breathing or shortness of breath, Stomach Upset, Skin or Eye Irritation (Uddin, 2017).

Polluted air that affect the life of living things in our planet such as human beings ,animals and agricultural production and habitat that living in land and in water body. Indoor air pollution is one of the pollution in Ethiopia as well as for Ziway community. During FGD the communities explain that for cooking purpose they use charcoal, wood fuel, animal dung and crop residues at home this aggravate indoor air pollution and affects their health mostly women and children are vulnerable for respiratory diseases from the figure 38 we can see that women and children they carry wood for cooking and for market purpose from this we can say that the main cause of indoor air pollution is burning of wood for cooking and heating.



Figure 38:Sources of indoor air pollution in Ziway**.**

Source: Filed Survey Photo 2017

During FGD the community describe that factory of Soda ash put the residues in open land that affects the life of peoples, animals and crop specially children they play on the open land and they have caught by skin disease we can see from figure 39 Soda ash residue during wind blows Soda ash dust enter to the surrounding home put on eating dish and on their drinking water that affect their health. According to (WHO, 2016) Outdoor air pollution it causes 3 million premature deaths worldwide in 2012. Beside outdoor air pollution indoor air pollution it causes health risk for 3 billon people who cook and heat their homes with biomass fuels and coal.

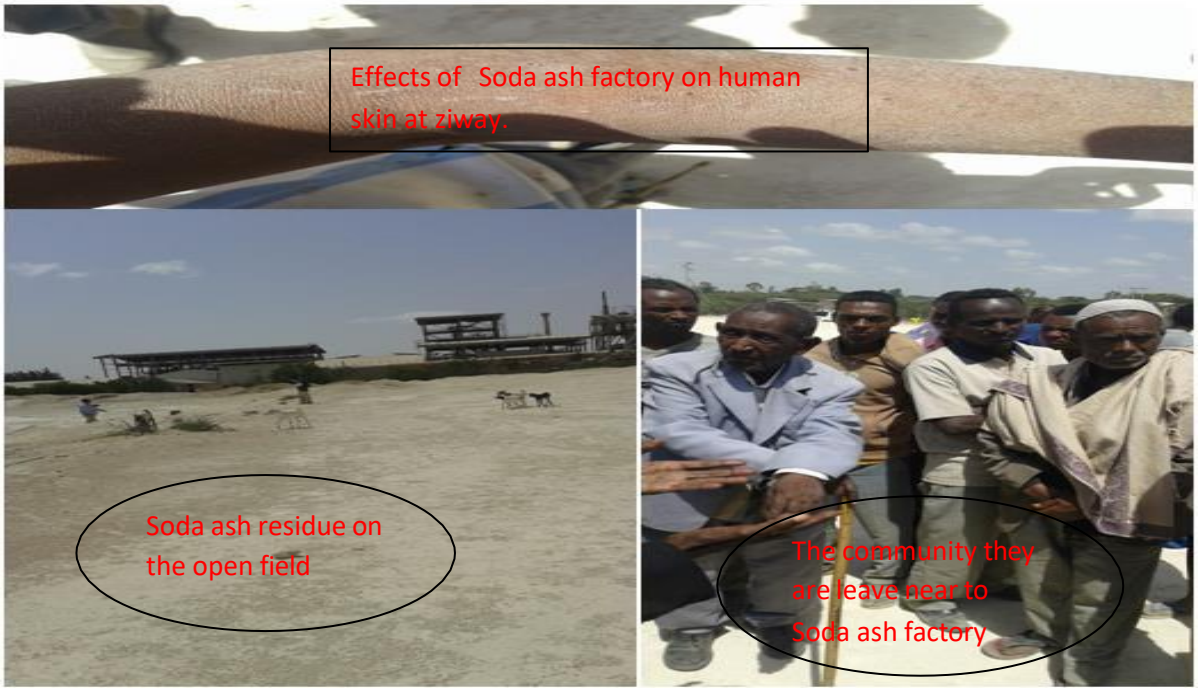


Figure 39 Soda ash residues on the open field and its effect.

Source: Filed Survey Photo 2017

3.6.4. Response for Air Pollution

According to the constitution of the 1995 Federal democratic Republic of Ethiopia give attention to the environment. The main objectives of the environment policy are:

1. Preventing the pollution of the atmosphere, air, earth and water.
2. Improving the environment of human settlement to satisfy the needs of their inhabitants on a sustainable basis.
3. Ensuring the participation of the people at all levels in the environmental management activities.
4. Raising public awareness on environmental issues.
5. Ensuring the essential environmental process and life support system are sustained, biological diversity is preserved and renewable natural resources are used.

3.6.5. Outlook of Air Pollution

According to profile Adami Tulu Jido kombolcha woreda (ATJK), in 2015 and 2016 wood fire is one of the first domestic energy sources for both rural and urban community from this dung, crop

residues and charcoal are ranked as 2nd, 3rd and 4th respectively. Therefor to reduce indoor air pollution it needs develop efficient cooking stoves, increase the accesses of biogas fuels and increasing accesses of electric to community unless it will be difficult to reduce the impact of air pollution and maintain forest source.

Unless control old vehicles, improve good maintenance practice and use good quality fuels it will be difficult to reduce air pollution that produces by vehicles. Beside, instead use individual car use mass transport, increase use of by cycle's and awareness creation are necessary.

3.7. Urban and Environment

Urbanization refers to general increase in population and the amount of industrialization of a settlement. It includes increase in the number and extent of cities. It symbolizes the movement of people from rural to urban areas. Urbanization happens because of the increase in the extent and density of urban areas.

3.7.1. State and Trend of Urbanization

The informal urban settlements, which account for the largest share of the urban population, are overcrowded with poorly developed infrastructure, inadequate housing, and limited facilities. These areas lack the social services capacity to educate and train new entrants.

Among the Woreda`s total population 235,593 more than 28,030 population are now living in urban areas. The number of people living in Urban increased from 26,627in 2013 to over 28,030 in 2016.

Table 10 Urban dweller of ATJKW

S.n	Year	Total Population	Urban Population	Percent of Urban Population
1	2016	235,593	28,030	11.8976
2	2015	234,888	27,946	11.8975
3	2014	173,563	27,399	15.786
4	2013	167,169	26,627	15.928

Source: Adami Tulu Jido Kombolcha Woreda Profile (2017)

Rate of employment opportunity in the Woreda is in 2013 (36.02%), 2014(21.42%), 2015(80.86%) and 2016(47.45%). This data shows that the opportunity is vary year to year depending on the

number of unemployed. As we discussed in focused group some industries get employee from neighbor Woreda and as well as other regions. This implies that the Woreda's unemployed number is less than expected.

Table 11 Number of Unemployment and employed ATJKW

S.n	Year	Number of unemployment	Number of employment	Percent of employment
1	2016	5,199	2,866	55.13
2	2015	12,650	10,229	80.86
3	2014	12,682	2,717	21.42
4	2013	17,161	6,183	36.02

Source: Adami Tulu JidoKombolchaWoredaProfile (2017)

Generally in the woreda there are sanitation and waste management facility. But there are households without access to these facility and problem of work in collaboration industry manager with urban manager as assessed in focused group desiccation.

As woreda profile shows 30.78% of the woreda population no access to get clean water. During FGD the population of the woreda uses Lake Ziway water for all purpose like for drink, livestock, sanitation, irrigation.

3.7.2. Driver and Pressure of Urbanization

Rate of rural to urban migration of the area is increasing from time to time because of many of the woreda rural kebeles felt under food insecurity or safety net program.

During the June, 2017 the focused group desiccation assessment in the woreda there is population growth and yearly data of population number indicate. These are due to two reason migration and birth rate is greater than death rate.

Particularly in urban areas, population growth puts additional strain on housing and infrastructural facilities. On the other hand, most urban infrastructure also relies on sufficient population densities to uphold its use, maintenance and financing.

In one district if population growth rate is available there is high utilization of renewable and non-renewable environmental resource. Like in Lake Ziway brings water extraction, utilization of fish, land use land cover change and Woredas poverty.

Industrialization affects Lake Ziway and environment of the district by dumping their waste or residue improperly and water contaminated with many chemicals release without treated.

3.7.3. Impacts of Urbanization on Environment

Rapid urbanization in Adami Tulu Jido Kombolcha Woreda is having an increasing impact on the health of the growing urban population.

The process of urbanization engenders both positive and negative impacts. These impacts affect both rural and urban people as well as the environment and natural resources in both areas. Cities concentrate and, in many ways, symbolize environmentally destructive practices. With rapid urbanization and industrialization, huge quantities of wastewater enter rivers.

The health impacts associated with rapid urbanization are also significant. The lack of sanitary facilities and potable water, coupled with poorly developed solid waste disposal and crowded housing conditions contributes to a high incidence of water-borne illnesses, epidemics and rodent infestations, and higher infant mortality rates. Poor medical facilities, lack of awareness of socially transmitted diseases, and limited family planning in the informal settlements contributes to health risks.

3.7.4. Response for Urbanization

To incorporate rural urban migration, human settlement and environmental health concerns which arise from urbanization created by social and economic development into regional, wereda and local level planning and development activities;

The government taking action on the kebels of under food insecurity by implementing safety net program and enhance different conservation practice of natural resources. And also integrated urban management and development plan implement;

Expanding of infrastructure for both rural and urban communities;

Awareness creation implemented on contraceptive mated by government body.

3.7.5. Outlook for Urbanization

Serious attention should be given to the need for improving urban strategies, which promote efficiency in resource use.

In case adequate responses are not taken to prevent pollution and to improve the quality of life by providing more social facilities, the life of the urban dwellers of town may become more miserable this may be the cause of health hazards and worst devastation.

Urgent attention should be given to reduce or put limitation on the rural to urban migration of the community.

Urban solid waste management and development policies and systems for the district must be drafted from countries policy.

4. Gender and Environment

Gender refers to the social attributes and opportunities associated with being male and female, the relationships between women and men and girls and boys, these attributes, opportunities and relationships are socially constructed and learned through the socialization processes (OCHA Gender Toolkit, 2012).

Environment is usually defined as the system of biological and physical resources and their processes of interaction that affect lives and livelihoods. However, these biophysical systems are also in constant interaction with human and social systems that live in them (Momtaz, 2008).

4.1. State and Trend of Gender and Environment

In the world, half of the population figure is accounted for females. As well as in Ethiopia more than half population accounted for female. This means, their contribution to sustainable development is a severe reality.

During the June, 2017 the focused group desiccation under the impending environmental degradation, much of the livelihood burden is on the shoulder of women. For instance, at Ziway, currently, women and children travel from 5 to 10 km to collecting fuel wood for house cooking and selling, usually on their backs. The same is true for fetch water.

Over the past few years the reduced water flow caused a critical water shortage along the spill regime between Ziway and Abyata where the 10 km distance Bulbula River represents the source of fresh water for a large number of rural communities.



Figure 40 Women and children caring wood and going to town in Adami Tulu Jido Kombolcha Woreda

Source: The data collector team (2017)

The most vulnerable in environmental degradation are women, especially during extreme episodes, like drought. The burden intensifies, especially in times of famine. Poor lactation to feed babies, unable to support their husbands, this condition makes the whole family at a very venerable situation.

Environmental degradation has become a crucial issue in the existing world. Although women and men relate to the environment the same way in many ways, they also use plant and animals, land and water in different ways. Whether the air, water or land is clean or polluted may not have the same effect on men and women because of their different activities and socio economic role.

4.2. Driver and Pressure of Gender

The presently increasing population growth rates are, put simply, due to rapid population growth.
As the team discussed in focused group desiccation there is population growth and the lack of awareness on the utilization or use of environmental resource such as Lake Ziway water, forest and land.
Poverty is the main determinant of food insecurity and malnutrition, and acts with poor environmental quality.
The lack of awarnes and population growth are problematic on the use of limited environmental resource. This means in the district there is high extraction of natural resource like upper and ground water, forest, soil and air.

4.3. Impacts of Environmental Change on Gender

Over utilization of environmental resource without take care bring different environmental degradation like land, forest and water degradation. The impacts of degradation of land decrease the productivity, this can cause for food insecurity. Deforestation also cause for air pollution and water degradation (in quality and quantity) absence of potable water or travel long distance or about long distance to fetch it especially for women of the Woreda.

Environmental change has different impacts on women and men. The most vlunrable due to environmental degeradation has women for the reason of their nature and more related to environment.

4.4 Outlook

Developing and using efficient cooking stoves instead of using firewood for energy purposes unless this makes difficult to improve living standards without keeping the environment and the climate.

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