



BEHAVIOUR CHANGE

TRAINING MANUAL FOR THE PROJECT "WATER FOR LIFE –
PARTNERSHIP FOR A SUSTAINABLE FUTURE OF THE LAKE TANA
WATERSHED, ETHIOPIA



Imprint

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NABU Project

“Water for Life – Partnership for a sustainable future of the Lake Tana Watershed, in Ethiopia”

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Cover page picture, central person

In memorium of our dear colleague Tadesse Mesfin, who passed away on the 12th October, 2020.

Contact

Naturschutzbund Deutschland (NABU) e.V. /
The Nature and Biodiversity Conservation Union

Charitéstraße 3
10117 Berlin
Germany

www.en.NABU.de
International@NABU.de

Text

Getinet Fetene, Beatriz Waldmann, Bayeh Tiruneh

Editors

Getinet Fetene, Beatriz Waldmann, Karin Altvater, Bayeh Tiruneh

Design and Layout

Greeneducation4all / Stefanie Gendera

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Photos

P1 Bruno D'Amicis (edited), p4 below Bruno D'Amicis, p5 above Bruno D'Amicis, middle Sevens & Maltry, p6 Bruno D'Amicis, p8 NABU Bahir Dar, p9 NABU Bahir Dar, p12/13 Bruno D'Amicis, p14/15 Bruno D'Amicis, p16 Bruno D'Amicis, p17 Philip Schütz, p18 Bruno D'Amicis p19 Bruno D'Amicis, p20 Bruno D'Amicis, p21 Bruno D'Amicis, p22 Bruno D'Amicis, p23 left Bruno D'Amicis, p23 right above Bruno D'Amicis, p23 right below Philip Schütz, p24 left Philip Schütz, p24 right above Philip Schütz, p24 right below Bruno D'Amicis, p25 Bruno D'Amicis, p35 Bruno D'Amicis, p38 Philip Schütz, p40 Philip Schütz, p46 Stefanie Gendera, p47 Bruno D'Amicis, p49 Philip Schütz, p50 above NABU/ Abdurazak Mussa, below Bruno D'Amicis, p51/52 Bruno D'Amicis, p53 Philip Schütz, p54 Philip Schütz, p55 Philip Schütz, p56 Pixabay, p57 Bruno D'Amicis, p59 Philip Schütz, p60 Bruno D'Amicis, p61 NABU/ Abdurazak Mussa p63 NABU/ Abdurazak Mussa, p65 NABU Bahir Dar, p72 and p74 Lake Tana Biosphere Reserve Day manual, p75 and p76 Stefanie Gendera, p77 Bruno D'Amicis, p78 U.S. Fish and Wildlife Service, p79 U.S. Geological Survey, Office of Water Quality, p80 Phillip Schütz, p81 Bruno D'Amicis, p85 Bruno D'Amicis

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Bureau of Finance and Economic Cooperation - Amhara National Regional State

Dr. Tsega Tibebe

Deputy Bureau Head

Dear local community members, dear partners,

Lake Tana is the source of the Blue Nile River. It provides significant economic and social benefits for the region as well as the whole country, and is characterised by a rich endemic plant and animal diversity. The lake furthermore provides water for irrigation agriculture and hydroelectric power generation, including the Ethiopian Great Renaissance Dam. It also provides transport services and fish to the local community, which is directly or indirectly dependent on it. Furthermore, thanks to the beautiful nature of the lake and the presence of historical and religious monasteries and islands, it serves as major tourist site in the country. The increase of human population leads to serious soil erosion in the Lake Tana Watershed (LTW), water pollution, the depletion of fish stock, and the loss of biodiversity, including wetlands. Other serious challenges include the invasion of water hyacinths, the result of sedimentation and pollution of the lake. This invasive weed is highly affecting the lake and its ecosystem.

The regional government has been taking several measures to overcome and minimise these challenges, e.g. carrying out watershed development activities in the LTW. Today, with continuous and collaborative effort, first positive changes in the natural resource rehabilitation can be observed. The 'Lake Tana and Other Water bodies Protection and Development Agency' was established to manage all these challenges existing in the LTW.

NABU has been supporting the regional government's efforts to conserve the lake and its watershed with different projects since 2012. NABU, in collaboration with the regional government, established the Lake Tana area as UNESCO Biosphere Reserve in 2015.

Currently, NABU has initiated and started implementing the project 'Water for Life – Partnership for a joint sustainable future of Lake Tana Watershed', which is in line with the regional government's objective. The project comes up with a new approach, the Multi-stakeholder Partnership (MSP), which will give us a lesson how to work together to achieve common goals and objectives.

Capacity building and training will be main activities to be implemented under this project, with special emphasis on behavioural change of local actors, to conserve and use the natural resources of LTW in a sustainable way.

We hope that this training manual builds on existing capacities of the community members in the LTW and will therefore be used as basic reference material by community development practitioners and community members in the day to day development activities.

Thank you!





The Nature and Biodiversity Conservation Union - NABU
Svane Bender

Head of Africa Program and deputy head of international affairs

Dear partners of Lake Tana Watershed sustainable development,

For over a hundred years, The Nature and Biodiversity Conservation Union (NABU) has been promoting the interests of people and nature with more than 720,000 members and supporters. In addition to promote the interests of people and nature in Germany, NABU has been supporting various conservation initiatives in Africa, Asia and Caucasus.

NABU is working in Ethiopia since 2006, with a clear focus on planning and establishment of UNESCO Biosphere Reserves, adaptation to climate change, reforestation and forest management including PFM, sustainable development for the benefit of local community, and capacity building. In 2010, the first UNESCO Biosphere Reserve was set up in Kafa. Concerning Lake Tana, NABU has been working together with the regional government of Amhara in protecting Lake Tana and its environs since 2012, and successfully establishing an UNESCO Biosphere Reserve at Lake Tana in 2015.

Currently, there is high pressure on the lake by increasing human activity, causing destruction of this unique area. Water quality is degrading due to the inflow of wastewater, fertilisers and pesticides used in agriculture. The consequence is a decrease in the number of fish species and an increase in algal blooms and alien species such as water hyacinths. Also the forest is affected. In the last 40 to 50 years there has been a reduction in the dense natural forest cover from 40% to less than 3%. On the other hand, Lake Tana provides the means of existence for millions of people and supplies 50% of the country's freshwater. If these negative trends continue, the watershed with its numerous services for millions of people is at stake and may eventually lead to a total collapse of the aquatic ecosystem and thus to reinforced poverty and migration.

In addition to the first two projects, NABU, in collaboration with Amhara National Regional State, initiates the third project entitled 'Water for Life – Partnership for a joint sustainable future of Lake Tana Watershed'. This project builds on partnerships to secure sustainable development in Lake Tana Watershed (LTW). Joint forces, knowledge, and capacities will create a sustainable and well-functioning 'Water for Life' structure to save the water and biodiversity of the Lake Tana.

The project will bring all relevant stakeholders of civil society, government, international development cooperation, academia, and business around a table in order to jointly tackle challenges and problems, and to contribute to the common good and sustainable development of LTW.

This manual is designed to provide an overview of the complexity of LTW, its biodiversity, nature conservation, and the need of partnerships to achieve sustainable development in LTW. It will assist you in understanding each subject and in passing your knowledge to the local community and other partners.

I would like to thank all Training of Trainers (ToT) trainees, regional government partners, NABU colleagues, and especially our NABU team in Bahir Dar for the development of this wonderful manual.

Enjoy and make use of it!



Abbreviations

°C	Degree Celsius
ADA	Amhara Development Association
BDU	Bahir Dar University
BMZ	German Federal Ministry for Economic Cooperation and Development
BoCTaPD	Bureau of Culture, Tourism and Park Development
cm	Centimetres
DTU	Debre Tabor University
GIZ	German Corporation for International Cooperation GmbH
ha	Hectares
IU	Injibara University
IUCN	International Union for Conservation of Nature
km	Kilometres
LTBR	Lake Tana Biosphere Reserve
LTW	Lake Tana Watershed
m	Metres
MAB	Man and the Biosphere Programme
MSP	Multi-stakeholder Partnership
NABU	The Nature and Biodiversity Conservation Union
NGO	Non-governmental Organisation
ORDA	Organization for Rehabilitation and Development in Amhara
ToT	Training of Trainers
UNESCO	United Nations Educational, Scientific and Cultural Organization
UoG	University of Gondar

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Background information about NABU and its contribution in Ethiopia

The Nature and Biodiversity Conservation Union (NABU) is an international NGO based in Germany, with the NABU Headquarter in Berlin. It is one of the oldest conservation organisations in Germany, established in 1899, and currently with more than 750,000 members. In addition to promote the interests of people and nature in Germany, NABU has been supporting various conservation initiatives in Africa, Asia and Caucasus.

NABU is working in Ethiopia since 2006, with a clear focus on planning and establishment of UNESCO Biosphere Reserves, adaptation to climate change, reforestation and forest management including PFM, sustainable development for the benefit of local community, and capacity building.

Regarding Lake Tana, NABU has been working together with the regional government of Amhara on protecting Lake Tana and its environs since 2012. The first project funded by BMZ was entitled "For people and nature - establishment of a UNESCO

Biosphere Reserve at Lake Tana". The major achievement of this project, in collaboration with the regional government, was the establishment of an UNESCO Biosphere Reserve at Lake Tana in 2015. The following-up project, also funded by BMZ, was then called "Community-based climate adaptation and biodiversity conservation in the model region Lake Tana Biosphere Reserve, Ethiopia (2016-2018)".

Now, the third project 'Water for Life - Partnership for a Joint Sustainable Future of Lake Tana Watershed, Ethiopia (2019 - 2022)' has been implemented by NABU, also funded by BMZ, to continue the successful work in this region.



Foto: NABU project office in Bahir Dar, NABU staff (Source: NABU website)

Lake Tana UNESCO Biosphere Reserve

A biosphere reserve is an area created to conserve the biological and cultural diversity of a region while promoting sustainable economic and social development. Its goal is to strike a balance between conservation and use, as people depend on intact ecosystems to survive. On the other hand, it promotes solutions reconciling the conservation of biodiversity with its sustainable use, towards sustainable development at the regional scale. The inhabitants may use the area's natural resources in a sustainable way and at the same time contributing to the conservation of precious habitats. A biosphere reserve is a place for cooperation, education and research to better understand human's impact on nature and a demonstration area to test new and innovative

of Biosphere Reserves". This network allows the exchange of knowledge and experience among the biosphere reserves. UNESCO's MAB Programme was launched in 1971.

Considering the case of Lake Tana, the natural resources are under great threat mostly due to human pressure. Consequently, NABU has been working together with the regional government of Amhara on protecting Lake Tana and its environs since 2012. With the first project, the Lake Tana Biosphere Reserve (LTBR) was officially nominated and included in the world network of biosphere reserves on 9 June 2015.

LTBR is located in the Amhara National Regional State in the north-western parts of the Ethiopian highlands, between 10°58`-12°47` northern latitude and 36°45`- 38°14` eastern longitude. LTBR comprises Lake Tana itself, all immediate surroundings, and parts of the higher catchment area of the Blue Nile. The project area therefore covers 695,885.056 ha, of which the core zones constitute an area of 22,841.584 ha, buffer zones 187,566.66 ha, and transition zones 485,476.806 ha. LTBR includes parts of three administrative zones namely West Gojam, South Gondar and North Gondar, and 10 Woredas/districts. The specific Woredas are Bahir Dar Zuria, North Achefer, Alefa, Takusa, Dembia, Gondar Zuria, Libo Kemkem, Fogera, Dera Woreda, and Bahir Dar City Administration. 137 Kebeles in these Woredas form the LTBR.



Foto: Inauguration celebration for Lake Tana Biosphere Reserve (Source: NABU Bahir Dar)

ideas for sustainable development. According to this approach, all members of society, including local communities, environmental groups, and economic parties are involved and work together to address conservation and development issues.



According to UNESCO website, biosphere reserves are established by countries and recognised by UNESCO as part of the Man and the Biosphere

(MAB) Programme. Potential sites are nominated by national governments and approved by UNESCO and become part of the worldwide network of biosphere reserves. Still, the sites remain under sovereign jurisdiction of the states. All biosphere reserves form a global network, the "World Network

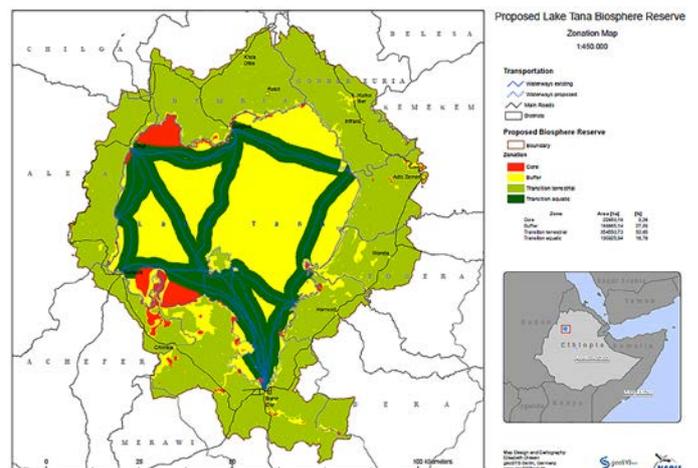


Figure 1. Map of the Lake Tana Biosphere Reserve boundaries (Sources: geoSYSnet, NABU)

Water for Life - for a joint sustainable future of Lake Tana Watershed

As continuation of the previous projects, NABU is implementing the project ‘Water for Life - Partnership for a Joint Sustainable Future of Lake Tana Watershed, Ethiopia (2019 –2022)’. Lake Tana Watershed (LTW) harbours roughly four million people whose livelihoods are directly and indirectly dependent on Lake Tana and its tributaries. With its 15,000 km², the LTW encompasses 429 Kebeles and the three large cities Gondar, Debre Tabor and Bahir Dar. Administratively, the watershed is divided into 29 districts (Woredas) and four administrative zones, all of which are located in the Amhara region. Lake Tana is the basis for productive agriculture and food supply (especially fish), serves as a means of transport and electricity generation, and provides a source of income in the growing tourism sector.

Growing population accompanied by food and housing needs, water pollution due to untreated inflow of sewage from cities and communities, water abstraction for industrial irrigation e.g. rice and flower production, deforestation of the last forest stands with erosion consequences as well as weather extremes with heavy rainfall as a result of climate change, lead to extreme soil erosion.

The major components of the project are:

- Stakeholder mapping and capacity building for Initiation Committee,
- ‘Water for Life’ – Multi-stakeholder Partnership (MSP) structure development,

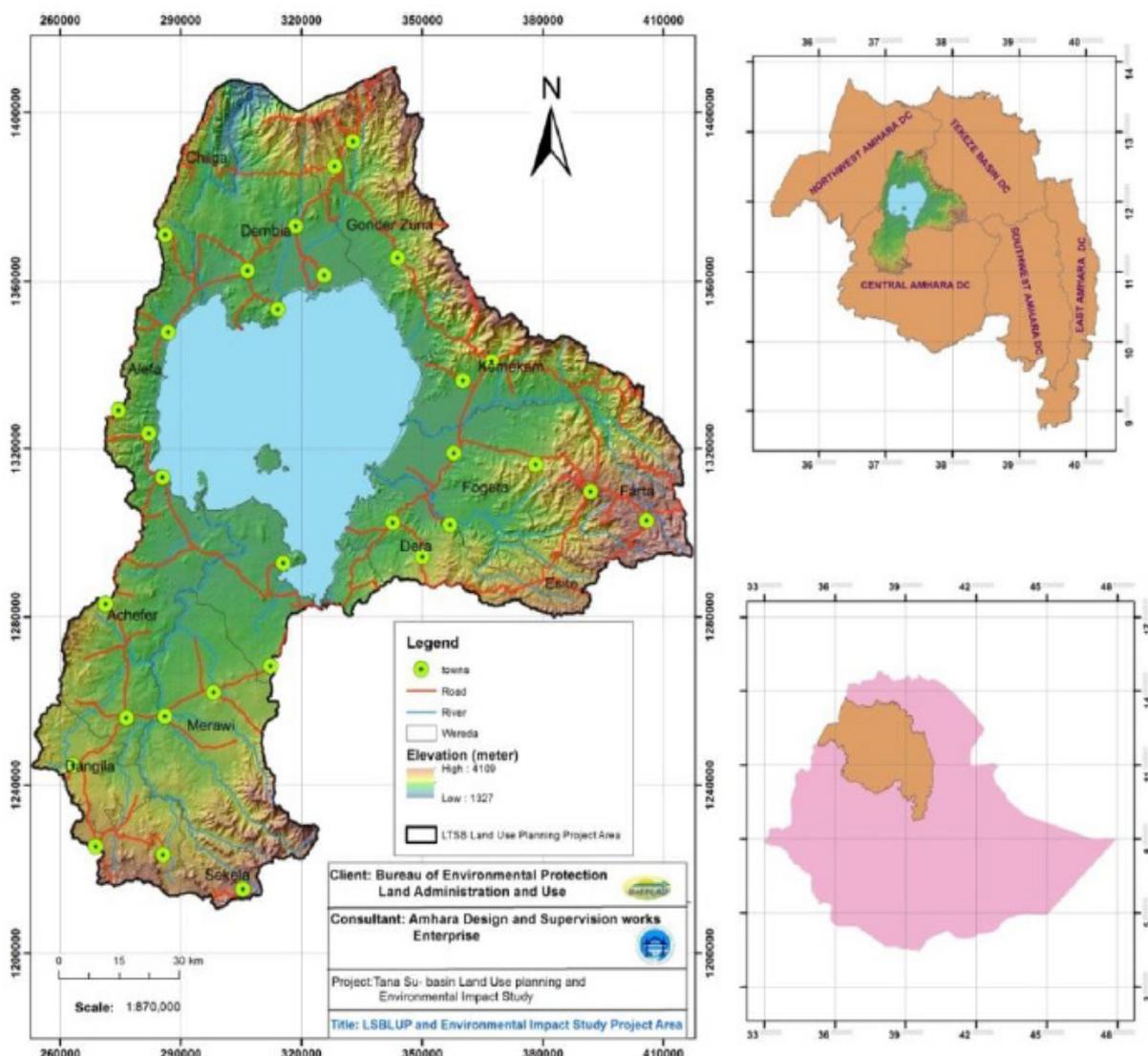


Figure 2. Map of Lake Tana Watershed (Source: BoEPLAU, 2011)

- Capacity building for wider community and other partners,
- Establishing working groups and implementation of pilot activities,
- Supporting the transformation of legislative processes for securing access to and protection of water resources,
- Establishment of a local NGO, and
- Public relation and communication

campaign.

The focus of this project is water. Water is essential for the existence of life on the planet. It is needed for drinking, washing, transport, agriculture, electricity, and the like. The source of water is nature, so to get water we need to protect and conserve nature. Otherwise, water sources like lakes, rivers/streams, underground water, or ponds will be polluted and finally disappear.

The concept of Multi-stakeholder Partnerships and its importance for protecting and conserving the resources of Lake Tana Watershed

The concept of MSPs build on the idea that different groups can share a common problem or aspiration, while nonetheless having different interests or opinions. It is a method for groups to work together to solve a large and complex problem, or exploit a promising new opportunity (Brouwer and Brouwers, 2017).

MSP is a form of governance – in other words, a way in which groups of people can make decisions and take action for the collective good, be it at local, national, or international level. It provides a platform where stakeholders can learn together in an interactive way, where people can speak and be heard, and where everybody’s ideas can be harnessed to drive innovation and finding ways forward that are more likely to be in the interests of all. In practice, MSPs will be very diverse.

A well-functioning MSP is likely to have all or most of the following characteristics:

- Shared and defined ‘problem situation’ or opportunity,
- Key stakeholders are engaged in the partnership,
- Works across different sectors and scales,
- Follows an agreed but dynamic process and

timeframe,

- Works with power differences and conflicts,
- Fosters stakeholder learning,
- Balances bottom-up and top-down approaches,
- Makes transformative and institutional change possible,
- Long, time-consuming, and expensive process.

LTW has several stakeholders with different interests. As indicated in different studies, the collaboration and cooperation among stakeholders is very weak. Thus, resources are under great and increasing pressure. MSP comes as promising approach to bring these different actors together and address existing complex issues in the LTW. This is due to the following:

- LTW is a complex and fragile environment with diverse services and diverse life. It builds the main source of life for millions.
- LTW has interrelated and interdependent elements and subsystems forming the whole ecosystem.
- Declining water quality and quantity due

to unwise resource management and use highly threatens environmental integrity and therefore the livelihoods of the people.

- LTW's stakeholder matrix is quite complex and therefore requires a bold and sustainably anchored governance structure.

- The stakeholders, individually, see themselves as part of the LTW collaboration.

There are several success factors for any MSP, including the following:

- Clear and interlinked objectives,
- Clear roles and responsibilities for

participating stakeholders,

- Leveraging of resources and sequencing of projects,

- Joint sustainability values,

- Adequate generation of interests for collaboration,

- Sufficient budget allocation,

- Skilled facilitators of dialogues,

- Knowledge management for continuity and evaluation of progress, and

- Involved leadership structure.

How to use the training manual

This manual was created to support development agents and trainers with concepts, information and strategies that are important to generate positive behaviour change towards the environment in the LTW region. It will be prepared in both English and Amharic, in order to expand the range of possible users.

Aiming to facilitate the understanding, the manual is divided into three parts:

Part One: Concepts

In this part, the trainer can familiarize him/herself with the terms that should be introduced to the



trainees, such as sustainability, natural resources, behaviour, etc. Those themes are also adapted to the reality of the LTW, and have rich illustrations and examples that can be presented as well. The presentation of the concepts is a more passive part of the training, and should ideally take place in the first portion of the time, in order to build a base to the participants and generate curiosity.

Part Two: Stakeholders

Aiming to approach the stakeholders in an accurate way, this part was developed to address the issues and advantages of the natural resources within the LTW to each specific sector. It is important to keep in mind that the Part Two should always be linked with the Part One, in order to create connection between the general conceptual explanations and the reality of each trainee. For an optimal use of the manual, this sessions should also be read before the training takes place, so that the trainer has a better idea of which topics are more relevant to which stakeholders.

Part Three: Exercises

Taking action into creating positive change is the measurable result of appropriate awareness

creation, and one of the manifestations of the intervention's success. Through the exercises herewith proposed, the trainees will be able to place their selves in the position of harming and protecting the environment. This is crucial to assume responsibility towards their local ecosystem services, and indeed adopt a better behaviour towards them. Not all games need to be undertaken in every training. It is upon to the trainer to select, adapt and implement the ones he/she feels most appropriate.

The manual can also be used for shorter training sessions, being divided in a didactic way to facilitate the separation of its parts. For example, for a smaller group of informed participants, the trainer can focus on Parts Two and Three, and come back to Part One if necessary.

As means of properly using the manual and applying behaviour change trainings, the trainer should be acquainted with the manual and the participants before the trainings. In that way, he/she will be able to adapt the content of the manual adequately, and therefore achieve better results.







PART ONE

1. Natural Resources

Before presenting the resource potentials and existing threats to the natural resources of Lake Tana Watershed (LTW) to trainees and local community members, it will be good to ask the following questions and receive their reflections:

- What was the situation of the natural resources in your area like 40 years ago?
- What is the current situation of the natural resources in your area like today?
- What are the reasons for these differences?
- What is expected from the local community and other partners to rehabilitate the resources and pass them to the next generations?

1.1. The concept of natural resources

Natural resources are all naturally occurring materials on this planet that support life and are used by people for their livelihoods. Water, plants, animals, air, soil, solar energy, wetlands, and minerals are examples of natural resources. They can be grouped in renewable and non-renewable natural resources (Chan, 2016).

Renewable resources can be replaced. For example, plants, animals, water, soil, and solar energy are renewable resources. Plants might be cut down and

animals might be used. But plants can grow back, and animals can reproduce. The source of solar energy is the sun. No matter how much solar energy you use, there will always be more.

Non-renewable resources cannot be replaced easily. Coal, oil, and natural gas are fossil fuels. Fossil fuels come from plants and animals that died millions of years ago, while ore comes from rocks that formed millions of years ago, which makes them hardly replaceable.



1.2. The importance of conservation

Benefits of natural resources to humans

There are different types of natural resources with various direct or indirect benefits to human beings. Some of these benefits are summarized as follows (Chan, 2016 and ODI, 2015):

Natural Resource	Benefits
Air	Oxygen, wind energy
Animals	Food (meat, milk, cheese, eggs), bags, pets, transport, recreation, and clothing (mink cloaks, wool sweaters, silk shirts, leather belts)
Coal	Electricity, fuel for furnace
Minerals	Diamond cutters, coins, knives, cars, wire, steel, aluminium cans, jewellery
Natural gas	Electricity, heating
Oil	Electricity, fuel for cars and airplanes, plastic
Plants/forest	Medicines, roof covers, wood, paper, cotton clothing, food, sources of fuel wood
Radiation	Solar power, photosynthesis
Water	Hydro-electricity, drinking, cleaning, recreation
Land	Soil, housing, agriculture
River	Irrigation, transportation, power generation, drainage

Mountains/ other landscapes	Recreation
Rocks	Sources of construction of raw materials

Benefits of natural resources to natural systems/ecosystem services

In addition to benefiting human beings, natural resources are beneficial to the existence of other natural resources or ecosystems (Daily et al., 1997):

- Purification of air and water,
- Mitigation of droughts and floods,
- Generation and preservation of soils and renewal of their fertility,
- Detoxification and decomposition of wastes,
- Pollination of crops and natural vegetation,
- Dispersal of seeds,
- Protection of coastal shores from erosion by waves,
- Buffering services of lake water from waste disposal,
- Used as home for animals and plants,
- Source of water (mountains/forests),
- Source of food for animals,
- Source of clean air.



1.3. Resources of Lake Tana Watershed

LTW is rich both in natural and cultural resources. Some of the major cultural resources are the lifestyles of local communities, annual religious and cultural festivals, historical castles, churches and monasteries from 13th and 14th century, with beautiful mural paintings, crosses, crowns, clothes

of former kings, etc. Some of the major natural resources on the other hand are water, diversified plant species, diversified animal species, natural landscape (like wetlands, mountains, flood plains), favourable climate, fertile soil, and construction materials. The focus of this manual lies on natural resources.



1.3.1. Natural resource potential of Lake Tana Watershed

Water resources

Underground water, streams, rivers, and rainfall are the major sources of water for Lake Tana. More than 60 smaller streams and seven major rivers (Gilgel Abay, Rib, Gumara, Megech, Dirma, Geldaw, and Arno Garo) flow into Lake Tana. The water resources of LTW are used for irrigation, fish

According to the Ministry of Water Resources (2009), Lake Tana and its surroundings inhabit 213 bird species, of which more than 50 are of great ecological importance and key species (endemic, biome restricted, endangered, or conservation dependent). Many species of migratory birds also make a twice-annual stop-over in LTW, making its existence in good condition essential for successful migration. Furthermore, more than 200 fish species can be found in Ethiopia, of which 40 are endemic. In Lake Tana, there are 28 fish species of which 19 are endemic, mainly the following categories:

<i>Amharic</i>	<i>English</i>
Kereso	Tilapia
Ambaza	Catfish
Nech asa	Barbus
Bezo	Varicorhinus beso

On the other hand, 284 species of mammals are found in Ethiopia, of which 29 are endemic. Among these, many mammals are found in and around Lake Tana, e.g. monkey species, hippopotamus, and the common hyena.

In addition, there are 201 species of reptiles and amphibians in Ethiopia. Some of the reptiles that are found in the Lake Tana region are crocodiles, water snakes, and pythons. For amphibians, toads and frogs are domiciled in this area.

Ethiopia is home to 861 different bird species, of which 18 are endemic. According to the study by the Ministry of Water Resources (2009) and other professionals, more than 300 types of birds inhabit the Lake Tana region, of which 50 are ecologically crucial to preserve biodiversity. Migratory birds, such as the Eurasian or Common Crane, are sheltered in this area during the northern winter. These migratory birds come to Lake Tana from west Europe, to escape from the snow and the cold during winter season and return to their home countries at the beginning of March every year.

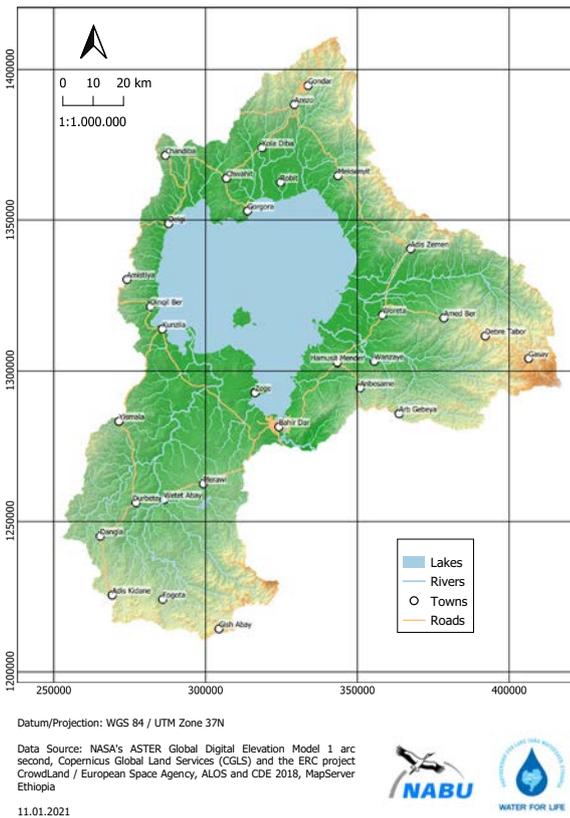


Figure 3. Tributaries of Lake Tana and outgoing rivers

production, transportation, tourism, hydro-electric power generation, and as habitat for different species of animals and plants.

Diversified plant species

There are more than 6,000 species of big plants in Ethiopia, of which 10% are endemic. As indicated in various studies, there are 181 species of trees and shrubs in and around Lake Tana. According to the Ministry of Water Resources (2009), there are 13 endemic species of plants in the LTW, of which eight are registered in the IUCN red list.

Diversified wild animal species

LTW is rich in animal diversity. There are varieties of birds, fish, mammals, reptiles, and insects.

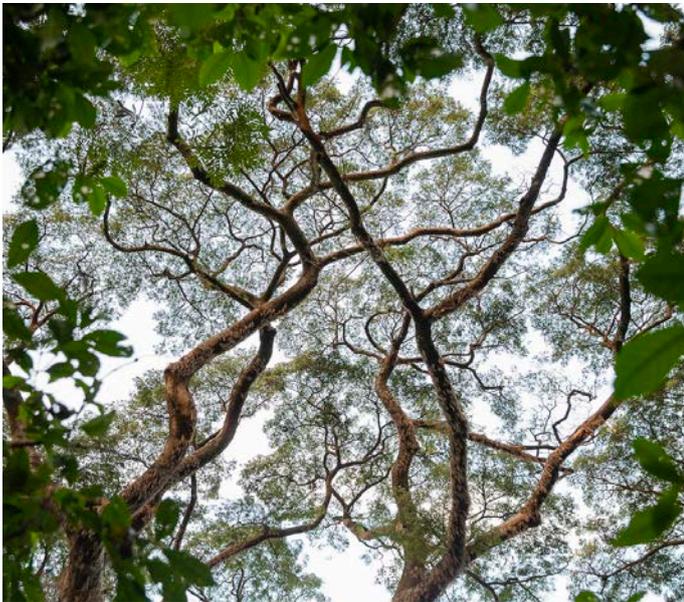


Do you know their names?
The solution is at the end of
this manual (Part Three).

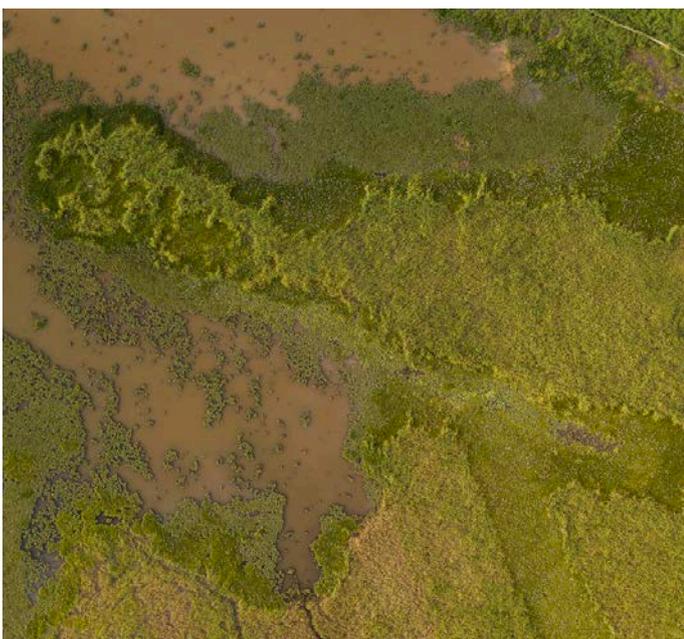


Natural landscapes

LTW offers diverse landscapes suitable for agricultural production, as home for great biodiversity, and as tourist attraction. The major landscapes are wetlands and floodplains, islands, forests, and mountains.



Some parts of the watershed are covered with natural and manmade forests that are very important for the microclimate and as home for a variety of small and large animals. The major natural and manmade forest sites are around Gorgora, Zege, Tara Gedam, Alem Saga, Lijome, Kulkal Ber in Gondar Zuria, Awai, etc.



Wetlands and floodplains are mainly marshy and swampy areas alongside the lake, with a dominant flora of papyrus and Typha, poorly drained soils, and hydrophytic vegetation and animals. Wetlands have many socio-economic and ecological values.

These values and services can be categorised into the following functions, products, and attributes:

- **Functions:** Flood alleviation, erosion control, stream flow regulation, water storage, ground water recharge, retention of pollutants, water purification, nutrient cycling, and exchange of water (exchange between surface and groundwater, and surface and atmosphere).
- **Products:** Fish, fuel wood, timber, fodder for domestic animals, habitat for wetland dependent species, rich sediments used for agriculture in the floodplains, fibre for thatching roofs and handicrafts.
- **Attributes:** Diversity of species, aesthetic beauty, cultural heritage, tourist attractions, recreation (bird watching, sailing, etc.), education, and archaeology.

Prominent wetlands of LTW are Fogera, Dembia, Kirstos Semera islands, Zege, Gorgora, Koga, some pocket sites in Awi, pockets of Bahir Dar and Kunzila.

Another interesting landscape at Lake Tana are the islands. There are 37 islands in Lake Tana. Among these islands, 19 possess historical and religious monasteries and churches. Some of the islands are rocky and serve as nesting places for birds, while others are covered by trees. There are numerous lowlands and hills in the watershed, the high peak is Mount Guna (4113 m) and lowest elevation 1786 m along the lakeshore of Bahir Dar or Blue Nile River outlet (BoCTaPD, 2005). Mount Guna is Community Conservation Area and inhibits great biodiversity. It is currently under development to be one the major tourist attraction sites within Amhara Regional State.



Construction resources

The watershed is also rich in resources for the construction sector. The major construction materials currently in use are red ash, stone, and sand, and due to the increasing urbanisation, their demand is steadily on the rise. However, at some sites these materials are not extracted in a sustainable way, natural landscapes are depleted, and the natural habitats are affected. Therefore, it needs continuous awareness raising and advice to relevant stakeholders for a wise and sustainable use.

Fertile soils

LTW is favourable for agricultural, and therefore it is the predominant economic activity in this area. 92% of the livelihoods in the watershed depend on

it. The productivity of the watershed depends on the fertility of the soil. The region exhibits a variety of soil types. Especially downstream, but also some parts of upstream are well known for its fertile soil. The major soil types are vertisol, luvisol, nitosol, litosol, cambisol, and fluvisol. Soil depth continues to diminish in the upstream whereas increases in the lower stream, resulting in lower yields around the upstream. Reduced soil depth reduces moisture-holding capacity of the soil, which in turn causes high run-off in the upstream areas that carry sand and gravel to the plain and the lake. Gully erosion is common at uplands and plains. Soil erosion in the upstream is due to continuous cultivation, overgrazing, cultivation of steep slopes, and deforestation. Because of siltation it is not such a serious problem in the lower stream.



1.3.2. Threats to the natural resources of Lake Tana Watershed

LTW is rich in natural resources, and the local communities of the watershed directly and indirectly depend on these resources. However, these natural resources are currently under threat because of human activities and natural factors.

Natural factors

There are natural factors that can negatively affect the resources of Lake Tana, e.g. climate change or natural hazards like floods. Climate change has

an impact on the water resources by changing the hydrological cycle. For example, a change in temperature and precipitation components of the cycle can have a direct consequence on the quantity of evapotranspiration and run-off. Consequently, the spatial and temporal water resource availability of the lake would be significantly affected. Flooding, on the other hand, is common in plain areas or downstreams when there is a lot of rain or unsustainable land use at upland streams.

Human activities

The second major category affecting the natural resources of LTW are manmade activities. As indicated in various studies, the major ones are uncontrolled expansion of agriculture, unsustainable use of natural resources (overgrazing, overfishing, unwisely extraction of construction materials), invasion of exotic species, deforestation, pollution, spontaneous and horizontal urban growth, and siltation. The major consequences are loss of biodiversity or species, alteration of ecosystems, siltation (decrease in volume in the lake), decline of productivity (agricultural crops and livestock, fish, hydroelectric power, etc.), poverty and social chaos, habitat loss or fragmentation (like forests, wetlands), and land degradation/loss of soil.

Uncontrolled agricultural expansion towards wetlands

An increasing population in the Lake Tana area is one of the causes for farm land expansion, like using wetlands for crop production. Local residents have been draining water from the wetlands and drying them through vegetation clearing for seasonal crop production, causing alterations in land use and land cover at LTW. As a result, the ecosystem and the organisms dependent on wetlands are lost, and the whole lake ecosystem changes.



Deforestation

The natural forest has declined significantly in most areas of LTW due to unmanaged utilisation for charcoal and firewood, expansion of agriculture, timber production, etc. In addition to a loss of species and ecosystems, deforestation results in extensive soil erosion. Massive soil erosion causes high sediment loading of rivers, and run-off leads to severe siltation of the lake and smothering of wetlands.



Unsustainable utilisation of natural resources (overgrazing, overfishing, and unwise extraction of construction materials)

Even though fish harvesting sites, fishing seasons, and controlled sites are identified at Lake Tana, the local communities are not respecting the laws. This has direct impact on the amount and productivity of fish at Lake Tana. Due to relatively large numbers of livestock populations at LTW, and most wetlands and open lands being communal grazing lands, especially in the dry season almost all parts of wetlands and open lands are used for grazing beyond its carrying capacity. Such intensive grazing is becoming a major challenge, contributing to the loss of wetlands and other ecosystems of LTW. Red ash, sand, and stone are commonly extracted within LTW for construction. At some sites, the local communities and investors are not extracting in a sustainable way, consequently leading to a loss of biodiversity and the natural landscape.



Pollution

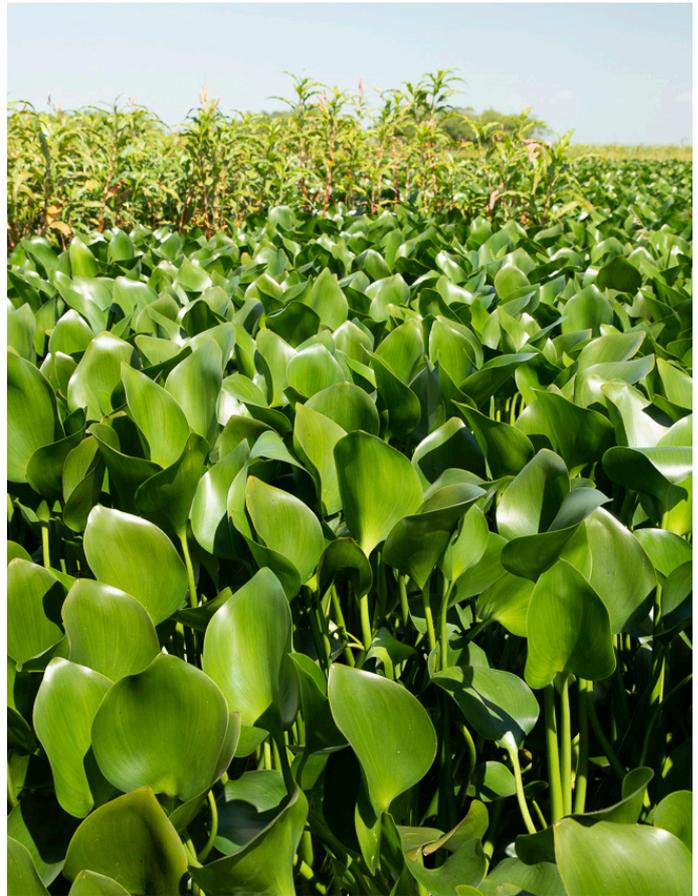
Pollution happens when pollutants harmful to living organisms get into the environment. The most common pollutants are garbage produced by households, chemicals produced by factories and used on farmlands (like pesticides and inorganic fertiliser), oil leaks from boats, and smoke produced from factories and vehicles. Pollution can kill or sicken plants, animals, and people, and can affect the whole environment, emitting into the air, soil, and water. They can also enter the food chain. Plants take the pollution from the soil, animals eat the plants, bigger animals and even people might eat the effected animals. Polluted water and soil can also create conducive environments for the expansion of exotic weeds like water hyacinth.

As indicated by different studies, the unavailability of a well-managed dry and liquid waste collection system with waste treatment facilities in most cities in the LTW is the major cause of discharging waste directly to the lake. Hence, appropriate measures should be considered to minimise the pollution caused by a rapidly increasing population and urbanisation around Lake Tana.



Invasion of exotic species

Among the exotic or so-called invasive weeds, the water hyacinth has been noted as the type of alien weed posing the biggest challenge to the lake. As it forms a cover on the water surface, it prevents the oxygen intake by the lake, decreasing water quality and consequently resulting in fish loss.



Spontaneous and horizontal growth of urban centres

Urban related constructions are growing rapidly around Lake Tana. In most cases, the existing urban development does not consider international standards for buffer zones around the lake, concerning building heights and types of buildings. This aggravates the pollution around the lake and wetlands visually and reduces the available space for the ecosystem around the lake. Therefore, spontaneous and uncontrolled horizontal growth of urban centres negatively affects the resources of Lake Tana and the quality of the lake as tourist attraction.

More about the Threats to the water resources of LTW in Part Two of the manual.

Major Stakeholders involved: Municipalities, government authorities

1.4. Management of natural resources

How we can manage natural resources?

Natural resources build the basis for our survival, but still we have already lost some of these due to unwise use, and now they exist at a minimal level. In Ethiopia, there is population pressure on natural resources, and forest land, wetlands, and pasture land is converted to farm land and settlements. The absence of land use planning in the country has significantly contributed to natural resource degradation.

Due to unwise use of resources, soil degradation becomes a serious problem, causing shortages of food, shelter, clothing, and construction materials. This is especially critical in rural areas, as the majority of livelihoods there are based on natural resources.

1.4.1. Concept of natural resource management

As discussed earlier, natural resources are becoming scarce. Therefore, wise use and sustainable management of natural resources is highly essential, as it has significant contribution to:

- Avoiding further degradation and destruction,
- Solving water balance problems, and
- Improving the conditions of the resources.

What have we done so far?

What are we doing now?

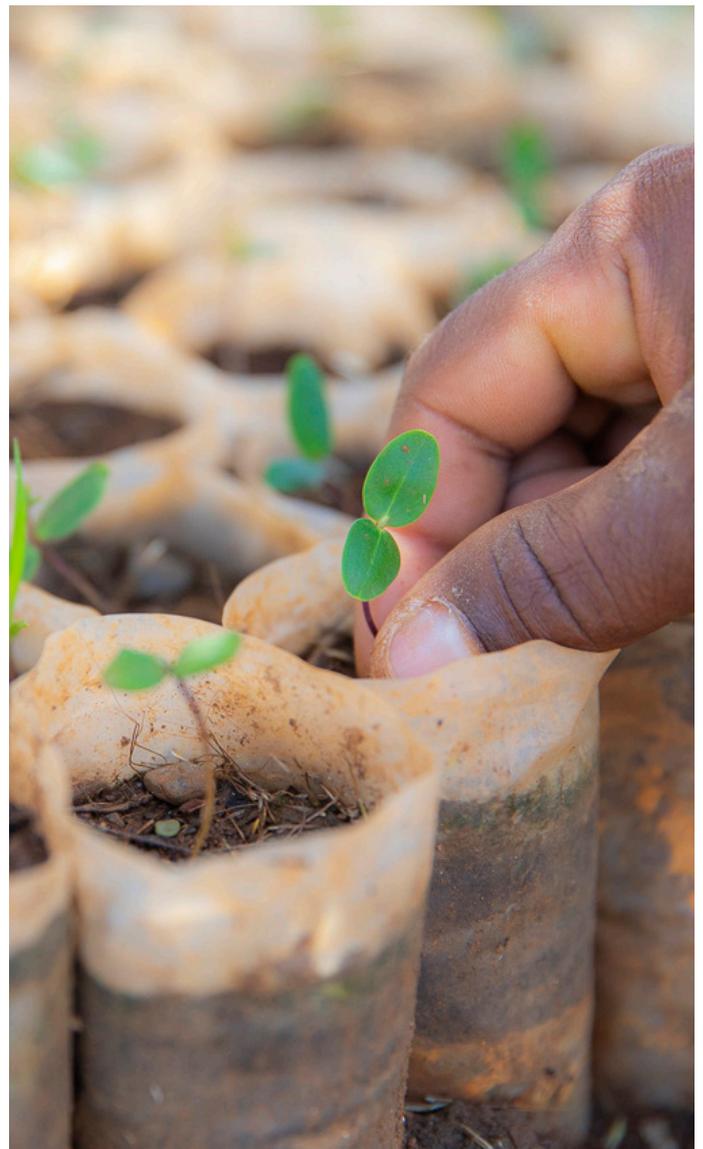
What have we planned in the future? What can the community contribute?

In Ethiopia, including Lake Tana Watershed (LTW) areas, there is serious soil erosion and deforestation. To combat these problems, the government has made several efforts in the last years, e.g. awareness creation of the community, to understand the causes of degradation and its consequences, developing legal frameworks, training community leaders on conservation measures, and public mobilisation to contribute voluntary free labour for 60 days every year for natural resource conservation activities. As a result, successful achievements have been recorded, still these efforts must be continued.

What have you observed in your area, in the past and at present, regarding natural resources?

Is there forest cover loss? Is productivity of the soil increasing or decreasing? Are springs/ rivers dried up? Birds and wildlife lost? Is there less water resource availability?

If you have observed less productivity of the land, less forest cover, less water availability and security, it indicates critical natural resource degradation or unsustainable management of natural resources. Food production and rural livelihoods may be threatened, as well as resource use conflicts may become serious problems. You may have also observed flooding, droughts, rainfall irregularity, or high temperature, as they are also possible consequences.



1.4.2. Watershed management

Definition “Watershed”

The topography of any region may be subdivided into several ecological units, each of which drains to a common point. Each such ecological unit is referred to as watershed (catchment). The size of a watershed may vary from a few ha to thousands of km². The term watershed is used in natural resource conservation, to apply all conservation technical measures.

Watershed management

Its goal is the rational utilisation of land and water resources for gaining optimum production and with minimum hazards to natural resources.

1.4.2.1 Major causes of watershed degradation

- Agricultural land: Cultivation on sloping land without adequate precautions and along the slope, cultivation of erosion permitting crops, and over-cropping without replenishing soil fertility.
- Forestland: Clear felling on steep slopes, drastic thinning of plants along slopes, faulty logging roads, and disturbance of forest floors during removal of the felled trees.
- Grasslands: Excessive grazing resulting in disappearance of protective cover, development of cattle tracks into channels, compaction of soil resulting in lower infiltration rates, etc.
- Fire: Intentional or accidental fire resulting in loss of vegetation, organic matter, and microorganisms.
- Shifting cultivation: Destroying protective and productive vegetation in preference for a very brief period of immediate crop production, eventually resulting in soil loss.
- Unscientific quarrying: Results in exposure and digging up of slopes, causing considerable damage to the landscape by destroying vegetation.
- Bad road alignment and construction: Contribute largely coarse sediment to the drainage channels causing blockage of flow.

1.4.2.2. Consequences of watershed degradation

- Low productivity of land with respect to food, fuel, fibre and fruits,
- Erosion and denudation within and adjoining watersheds,
- Quick siltation of reservoirs, lakes, etc. (Lake Tana as good example),
- Deterioration of water quality due to heavy sedimentation,
- Increased incidences of floods and droughts.

All these consequences are currently observed in the LTW, including water hyacinth infestation in the lake.

1.5. Soil and water conservation measures

These measures of natural resource conservation are based on building physical structures and biological measures to control soil erosion and to rehabilitate degraded lands. These measures can be applied according to the context of agro-ecological zones.

Conservation measures on cultivated land

Bench terraces:

Bench terrace is a conservation structure where a slope is converted into a series of steps, with a horizontal cultivated area on the step and steep risers between two steps. Bench terraces are levelled along the contour in dry to moist agro-ecological zones. In moist to wet agro-ecological zones, they are graded to drain excess run-off sideways to the next river or waterway. Bench terraces must be spaced with a vertical interval, which is two-and-a-half times the depth of reworkable soil. If the soil is 1 m deep, the vertical interval is 2.5 m.

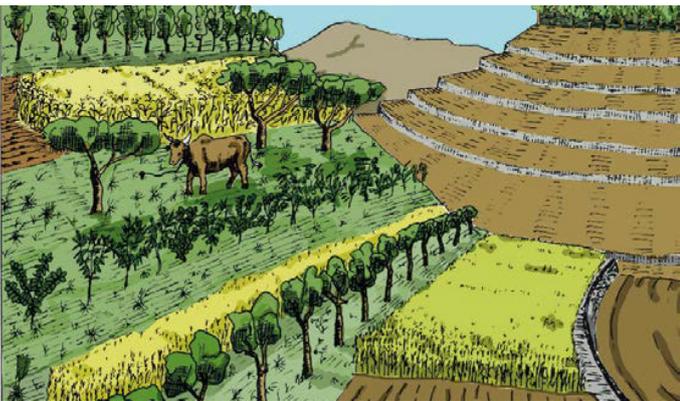


Figure 4. Model Bench terrace

The bench terraces shown here are slope slightly outwards. They have been developed from stone-faced bunds still visible in the middle of the riser slope. Above and below the stone wall, there are grasses and legumes which can be used for fodder. Ploughing is automatically along the contour. Erosion from such terraces is reduced to almost zero. (Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Graded bund:

Graded bund is similar to Level bund, but slightly graded sideways, with a gradient of up to 1% towards a waterway or river. Such a gradient is for surplus run-off to be drained, if the retention of the bund is not sufficient. Tied ridges with top heights lower than the bund height serve to retard such flow and to provide small basins for water storage. The

vertical interval between two bunds is 1 m for slope gradients of less than 15%. For steeper slopes, the vertical interval must be two-and-a-half times the depth of reworkable soil.

If the bunds are long, the basins behind them must be increased towards the waterway, as more and more run-off will have to pass during storms. The size of the ditch can be 25 cm deep by 50 cm wide at the beginning of the bund, but 50 cm deep by 100 cm wide, after 100 to 150 m when the bund reaches the river or the waterway.



Figure 5. Model Graded bund

The graded bund in the foreground enters a natural drainage channel which has been protected with a check dam just below the entry point of the graded bund. The basin behind the bund still has small tied ridges to prevent run-off from flowing too fast and creating erosion behind the bund. Earth bunds are stabilised with revegetation and their outlets reinforced with stones. (Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Waterways:

Waterways are needed for draining the excess run-off. They must be developed one year before graded bunds are applied. A waterway is a natural or artificial channel along the steepest slope or in the valley used to accommodate run-off. Artificial waterways need to be paved with grasses or stone. Traditional waterways need improvement according to the technical standards given. On cultivated land with graded structures, waterways must be placed every 250 m to avoid graded ditches that are too long. Waterways enable run-off water that is not stored behind bunds or does not infiltrate on the land during a storm, to be drained safely to the next river.



Figure 6. Model Waterway

This is a typical artificial waterway in an area with land scarcity. Therefore, it has been dug deep into the soil, with steep borders and a stone pavement with intermittent small check dams at the bottom. At the top, a cut-off drain leads into the waterway from the left side, while graded bunds are led into it from the cultivated land, alternating from each side.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Cut-off drain:

A cut-off drain is a channel used to collect run-off from the land above and to divert it safely to a waterway or river, thus protecting the land below from excessive erosion. Cut-off drains usually protect cultivated land from upslope forestland or grassland and downslope land from upslope run-off and erosion.

Cut-off drains are combined with waterways, to be constructed one year earlier, with area closure, controlled grazing, Cut and carry, hillside terraces, and micro basin. For stabilising the ditch, revegetation is needed. On very long slopes, repeat cut-off drains several times as needed according to the amount of water collected.

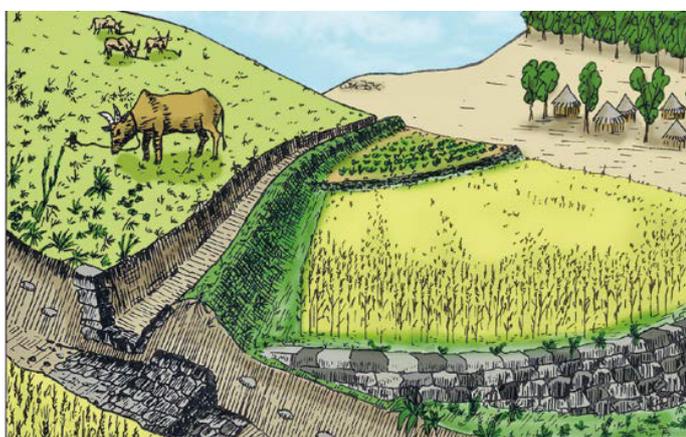


Figure 7. Model Cut-off drain

This cut-off drain protects the terraced cultivated land to the right from excessive run-off from the

grassland to the left and above, where controlled grazing is used with tied cattle. At the point where the cut-off drain enters the waterway, stone protection is needed, and a check dam has been constructed in the waterway just below the entry point, as shown. Cut-off drains have to be covered with much more vegetation than on the recently constructed embankment shown here.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Grass strip:

A grass strip is a ribbon-like band of grass laid out on cultivated land along the contour. Usually, grass strips are about 1 m wide and spaced at 1 m vertical intervals. They are mainly used to replace physical structures on soil with good infiltration (sandy, silty) on gentle slopes. Grass strips are planted along the contour or along cut-off drains. Grass strips help to reduce run-off and to filter out sediments carried by run-off.

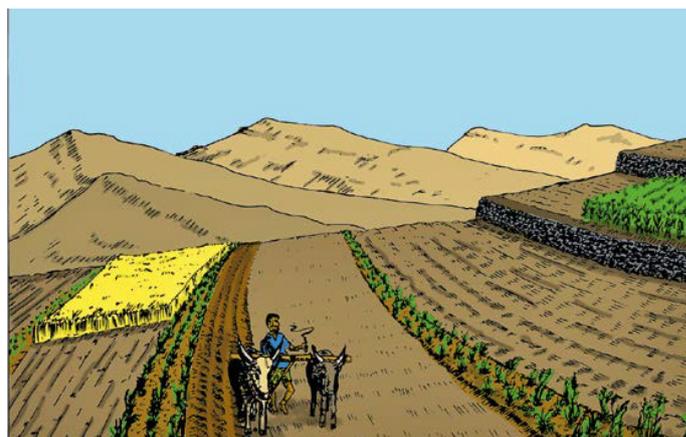


Figure 8. Model Grass strip

Grass strips are used on gentle cultivated land (on the left). On the steeper slopes on the right, terrace development is needed. The farmer automatically ploughs parallel to the strips, a measure which reduces erosion further. The individual sods of grass planted into the strip can still be seen. On the right, the grass strip has already developed into a small terrace.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Conservation tillage:

Conservation tillage is a tillage practice aimed at creating a favourable soil environment for germination, establishment, and plant growth with minimal soil disturbance. Conservation tillage reduces or avoids full ploughing operations, which are used to remove weeds and prepare moisture uptake, but destroy the soil structure and disturb

soil organisms. Conservation tillage reduces run-off and conserves water in the soil after the soil organisms softened the soil. It greatly reduces erosion, improves the soil structure, and conserves organic matter in the soil. The most important thing in conservation tillage is weed control, which requires special attention. In most countries where conservation tillage is applied, herbicides are widely used for weed control.

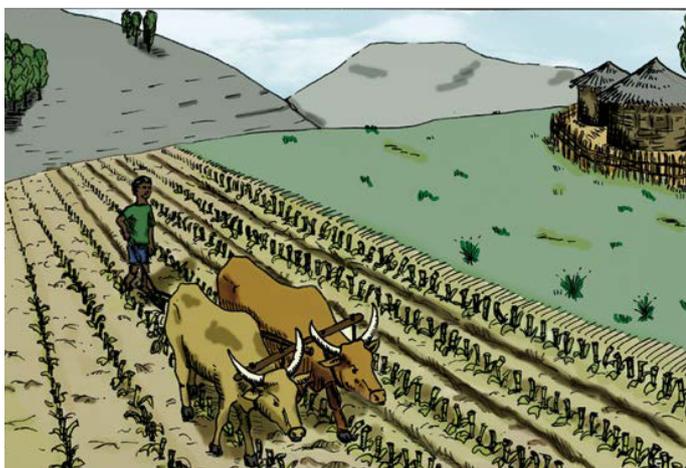


Figure 9. Model Conservation tillage
Farmer is applying conservation tillage on a field where he previously harvested maize. He is applying strip tillage, meaning he only ploughs single rows where he will plant new crops, but not the area in between. This way he can minimise soil erosion and considerably improve soil moisture.
(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

There are different types of conservation tillage:

- Minimum or reduced tillage: Minimum tillage means ploughing the whole field as lightly as possible, just to break up hard pans or compacted layers. This can be used with crops that are broadcast, such as teff, wheat, or barley.
- Strip tillage: Strip tillage means to plough just the strips of the soil where the crop will be planted, leaving the spaces in between undisturbed.
- Zero tillage: Zero tillage means planting directly into the soil, using equipment to make planting holes or narrow furrows to put seeds and fertiliser. Mulch, cover crops, or herbicides can be used to control weeds.
- Alley cropping: Alley cropping is used in an agroforestry system where food crops are grown in alleys between rows of hedges.

The hedges follow the contour and consist of trees and shrubs such as *Leucaena* or pigeon peas. Leguminous perennials are more suitable as they fix nitrogen, such as *Acacia albida*, *Sassanid*, or *Lucanea*, and are commonly used for agroforestry in Ethiopia. Spacing between rows should not exceed 5 m.

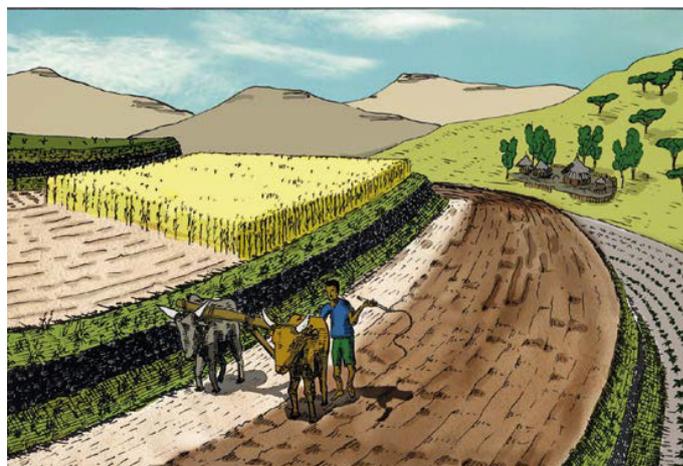


Figure 10. Model Alley cropping
Alley cropping on a steep slope: Rows of trees and hedges alternate with strips of grassland or cultivated land. Controlled grazing with cattle is possible between the rows. Crops can be grown for some time until the soil is left fallow to improve fertility, supported by organic material from tree leaves and fixation of nitrogen through some trees.
(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Mulching:

Mulching is the process of applying mulch, covering the soil with crop residues such as straw, maize and sorghum stalks, tree leaves, other plant material, or standing stubbles. The cover protects the soil from the hot sun and from the impact of raindrops, minimising soil crusting, erosion, and run-off. Maintaining crop residues or mulch on the field reduces soil erosion and has a considerable potential for the restoration and maintenance of soil fertility.

Applying mulch is of most practical use with row crops such as maize and sorghum, and for widely spaced perennial fruit trees such as mango, avocado, citrus, enset, and banana. Large amounts of organic material are needed to get the full benefit of mulching. Any organic debris (straw, prunings from hedgerows, weeds removed from fields) can be used.

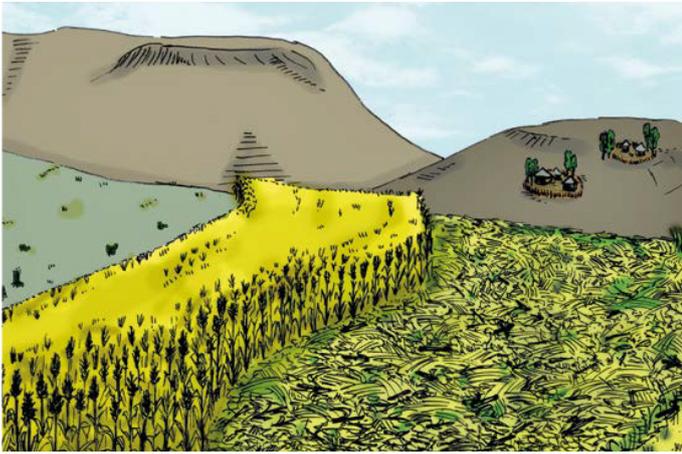


Figure 11. Model Mulching
Mulching is a system in which part of the crop residues are spread over the field after harvest instead of being removed. This retains soil moisture and softness, so that direct seeding is possible, unless the material is ploughed into the soil to improve humus content. Post-harvest grazing should be avoided if possible. (Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Trash lines:

Trash lines are made from crop residues, grass, or other organic materials collected from the field or its surrounding. Trash lines can be used instead of physical structures on gentle slopes. They slow down run-off and reduce soil erosion. Trash lines can be combined with alley cropping, covering the space from tree to tree.

Trash lines are aligned along the contour at appropriate intervals exactly like physical structures. Mark out the contour line by using a line level. The spacing between the trash lines depends on the slope. The spacing is normally about 5 m, but on gentle slopes it can be more than that. The trash lines are usually up to 1 m wide.

Trash lines slow down surface run-off and thereby reduce soil erosion. They retain soil and may gradually build up terraces along the contour. They also allow rainwater to seep into the soil, increasing its moisture content. The trash eventually decomposes, adding organic matter and nutrients to the soil. All these effects of trash lines help to increase yields.

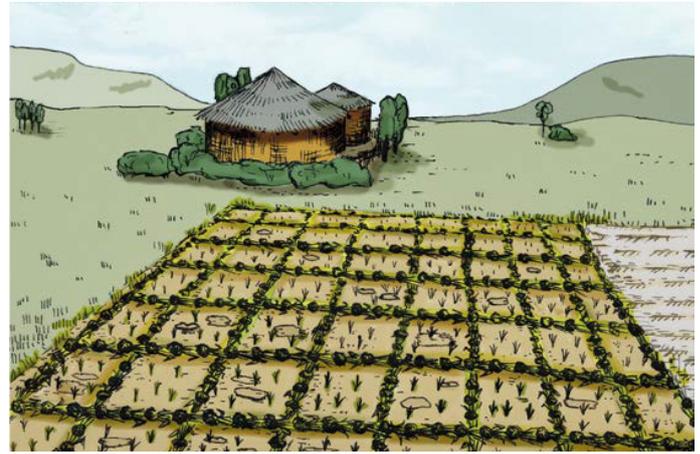


Figure 12. Model Trash lines
Trash lines reduce soil erosion on gently sloping cultivated land and improve soil moisture and humus, like mulch. They are widely applied in southern Ethiopia in places such as the Gidole lowlands. (Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Vetiver grass:

Vetiver grass (*Vetiveria zizanioides*) is a tough grass, which is very suitable for erosion control in various forms. In its general appearance, a vetiver plant looks like a big, coarse clump of grass. Vetiver barriers are planted along the contour in two alternating rows, 10 cm apart and with 10 cm spacing. It can grow very tall. Under favourable conditions, the erect stems (culms) can reach up to 3 m in height. It develops a dense, interwoven root system.

The vertical interval of the vetiver barrier may vary from case to case: on cultivated land, on slopes below 15%, the vertical interval is 1 m. Spacing with a 1 m vertical interval means that on a 3% slope, the vetiver strips will be 33 m apart, and on a 15% slope, only 7 m apart, still sufficient for ploughing between the strips. On slopes above 15%, the vertical interval is two-and-a-half times the depth of the reworkable soil.

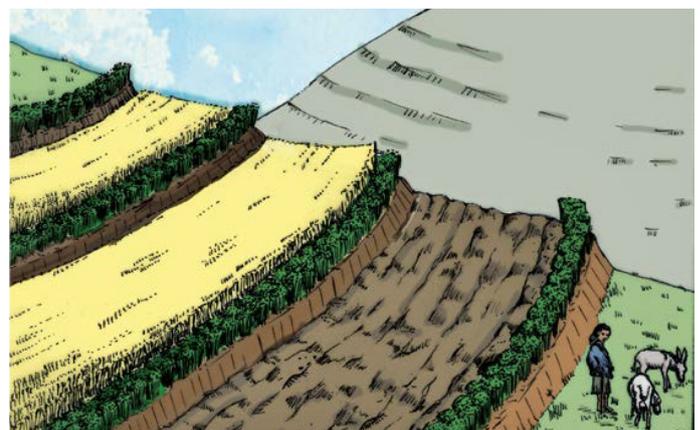


Figure 13. Model Vetiver barriers

The sketch shows well-developed vetiver barriers which have built up terraces due to tillage combined with soil erosion. The vertical interval between the barriers is about 2 m on this picture, and the vetiver has been cut recently.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Check dams:

A check dam is an obstruction wall across the bottom of a gully or a small river, to reduce the velocity of the run-off and prevent deepening or widening of the gully, and helps to fill it up with sediments. Check dams can be made of any material available locally, such as stones, live or dead branches, wooden poles, gabions, etc.

The vertical interval between check dams is equal to the height of a check dam. Stone check dams, for example, are 1 m high and about 1 m thick and have a depression in the middle to allow run-off to flow through. Note the hyperbolic shape: the centre of the check dam has to be at the lowest point to guide the water flow to the gully centre.

There are three major principles for controlling gullies:

- Reducing the run-off coming into the gully by conserving water in the catchment, so that it does not reach the gully, e.g. by bunds, mulch, micro basins, trenches, area closure, etc.
- Diverting the water away from the gully with cut-off drains or safe waterways.
- Conveying the water safely through the gully by reducing its speed and breaking its erosive force with check dams and/or various vegetative barriers.

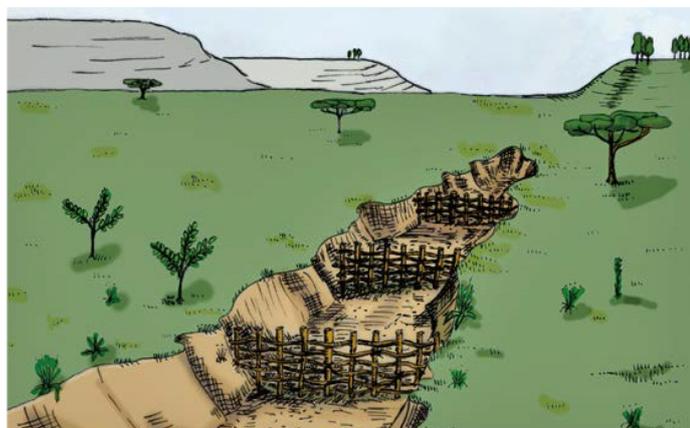


Figure 14. Model Check dams

This gully has been treated with a check dam, which in this case consists of brushwood. This can be very effective, particularly for smaller gullies, which are refilled with soil over a longer period. The structures should not be too far apart.

(Source: MoA (2016). Guidelines for development

agents on soil and water conservation in Ethiopia.)

Conservation measures on grassland

Controlled grazing:

Controlled grazing is defined as direct utilisation of grassland with livestock in such a way that no degradation of vegetation and soil occurs, allowing the grass to recover and to retain the quality of the range land. Controlled grazing can be in rotation or continuous, if well managed. Rotational grazing is the best method of ensuring periodic recovery of grassland. All forms of controlled grazing provide for better animal fodder, in amount as well as in quality, and help to prevent degradation of grassland and conserve soil, water, and vegetation.

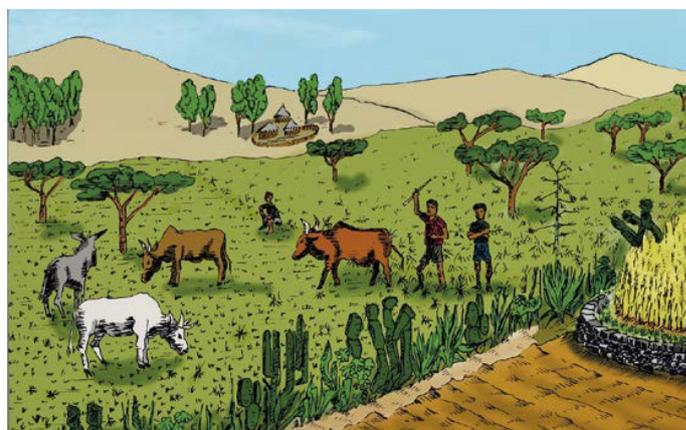


Figure 15. Model Controlled grazing

Controlled grazing is applied here by herders who prevent livestock from entering the portion of grassland on the right. They do this merely by guarding, while the animals are allowed to move freely in the area on the left. When all the grass has been eaten by livestock, the herd shifts to the right part of the grassland so that the left part can regenerate.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Area Closure:

Area closure is a protection system to improve land with degraded vegetation and/or soil through natural regeneration. No livestock is allowed to graze and no human interference is tolerated for two to three years, until a 50% natural grass cover is obtained. Area closure is a temporary action to protect degraded land until a certain degree of recovery has been attained. In area closures no specific actions are taken, except that all human and livestock interference is excluded.

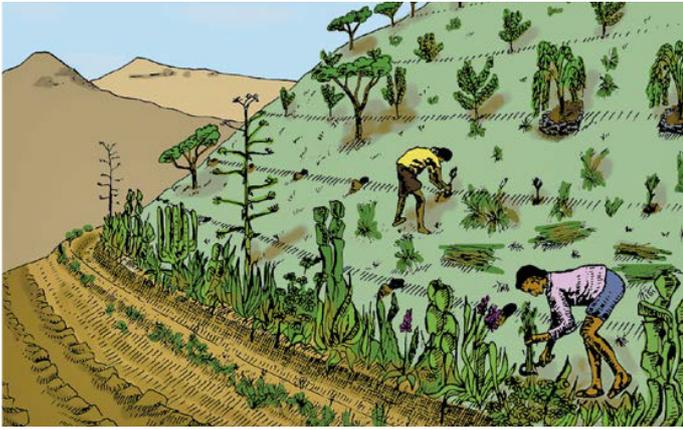


Figure 16. Model Area closure
This closed area has been fenced by living plants to protect it from livestock grazing. A cut-off drain diverts excess run-off from the area. After a good recovery of the natural vegetation for a period of years, it was decided to develop the closed area here into forestland. Therefore, trees are now planted in rows, the grass is regularly cut, and tree seedlings are well managed for rapid growth.
 (Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Cut and carry:

Cut and carry is a system of utilising forage for stall feeding. It can be applied in area closure, in forests, on conservation structures, and in all areas where livestock are excluded from grazing. Grassland improvement includes all activities aimed at improving the productivity of grassland whereby run-off and soil erosion are reduced. Activities include the introduction of better forage species, moisture conservation, removal of unpalatable species, the cutting of shrubs, regular weeding, and maintenance of fertilisation.



Figure 17. Model Cut and carry
The farmer on the right cuts the grass at flowering stage in a closed area. Cows and oxen are tied at a place nearby and fed directly. This way they do not disturb the grassland. Therefore, more fodder is

produced. Leguminous trees are planted in rows in the closed area and they can be lopped when they are well established. Branches of grown-up Acacia trees on the slope can be cut and fed to goats and donkeys.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Conservation on forest land

Hillside terraces:

Hillside terrace is a structure along the contour, where a strip of land is levelled for tree planting. Hillside terraces are up to 1 m wide and constructed at about 2 to 5 m vertical intervals. Hillside terraces help to retain run-off and sediments on steep sloping land and to accommodate tree seedlings planted on them. They are also effective for conserving water on Badlands and in areas with low rainfall. Hillside terraces are mainly used to prevent damage from flooding below steep slopes.



Figure 18. Model Hillside terraces
On these heavily degraded slopes, hillside terraces were necessary. Trees were planted just recently, while terrace construction was done in the previous year to support soil formation around the pits. Spacing between trees is 2 m, and the vertical interval between terraces is also 2 m. The area between two terraces is undisturbed and used for forage production.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Micro basin:

Micro basin is a small structure with the shape of a half or a full circle, excavated to obtain a small basin for planting a tree. Micro basins vary in size according to their designation to conserve water. They are small in moist agro-ecological zones and large in dry ones. Micro basins have multiple effects: In moist areas, they provide a small platform for tree planting. In dry areas, they are used to harvest

water from a larger area (2 to 3 m diameter) on gentle slopes, sometimes with additional water collection ditches.



Figure 19. Model Micro basin
Micro basins are used for tree planting in this dry area. Pits are dug in the centre of the basin for optimum use of stored water. The farmer plants a tree after removing the plastic around the roots of the seedling. Soft earth is prepared beside the pit to accommodate the seedling in the pit. The micro basins are prepared in rows, always one micro basin in the lower row between the two micro basins in the higher row.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Tree planting:

Tree planting for conservation is an activity to improve the vegetative ground cover, thereby reducing run-off and soil erosion, and producing wood. Tree planting supports many other conservation activities when combined with them. Tree planting by itself is a soil and water conservation measure because the tree roots stabilise the soil and the tree protects the ground from the impact of raindrops.

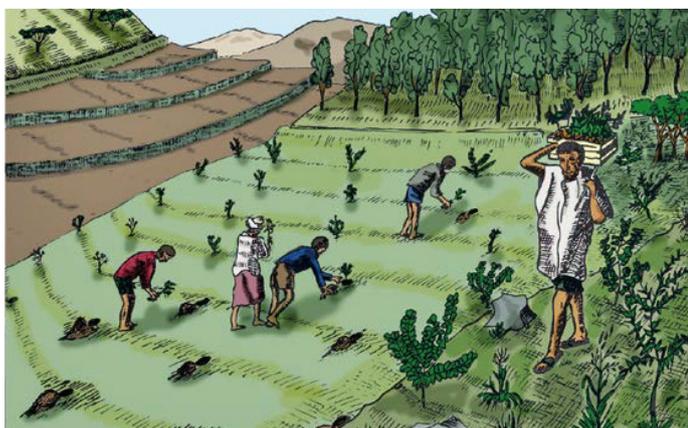


Figure 20. Model Tree planting
This drawing shows how tree planting is carried

out. In the foreground on the right, a man carries a box with well protected seedlings. Trees are planted in rows on the slope. Pits have been excavated months earlier. After the plastic sack is removed, tree seedlings are planted by putting soft earth around each one. A cut-off drain protects the field from run-off coming from the mature forest above.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

A trench:

Trench is a short ditch dug along the contour (i.e. across the slope) to trap run-off water in dry and moist areas. The trees will be planted in a planting pit in the centre of the trench. Trenches are particularly useful to help rehabilitate degraded lands.

A trench is normally 2 to 3 m long and 0.3 to 0.5 m deep, depending on soil depth. Trenches should be spaced about 1 m apart along the contour, and the rows should be staggered with a distance of 2 to 3 m so that overflow flows into the next trench below. The trenches trap water that would otherwise run down the slope and be lost. The trench allows the water to seep into the soil. Trenches are good places to plant trees, particularly in dry places, due to the water they collect.



Figure 21. Model Trenches
The sketch shows alternating trenches. Note that the level of the soil left in the centre of the planting hole is slightly lower than the trench!

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Revegetation:

Revegetation is a system of forage establishment on land with an unsatisfactory vegetation cover. Such land may be newly constructed bunds, cut-off drains, waterways, or degraded land and gullies. Forage includes grass, legumes, and selected trees and bushes.

Three steps are important for revegetation:

- Exclude all grazing animals throughout the year. Use Cut and carry instead.
- Regularly cut the weeds which grow during the rainy season, so that grass and legumes can develop.
- Plant sods of grasses and legumes. Such sods can be taken from good natural grassland nearby or from forage nurseries.

Revegetation is the most effective way to conserve soil and water. Grass reduces soil erosion greatly if established well. It also helps to stabilise bunds and other structures significantly if cattle are excluded from grazing all year. Revegetation provides forage which is essential for livestock.



Figure 22. Model for Revegetation

Revegetation is used here together with other conservation measures to stabilise a gully or Badland. Small pits are prepared, sods of grass and legumes are taken from nearby grassland or from nursery and planted on the bare land.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Grassland improvement:

Grassland improvement includes all activities aimed at improving the productivity of grassland whereby run-off and soil erosion are reduced. Activities include the introduction of better forage species, moisture conservation, removal of unpalatable species, the cutting of shrubs, regular weeding, and maintenance of fertilisation. Removal of unpalatable species is very important for grassland improvement. Fertilising with natural or artificial fertilisers can improve production and result in better conservation of the area. Grassland

improvement has two main effects: first, it increases the productivity of the area for fodder and second, it reduces run-off and soil erosion as there is better ground cover.

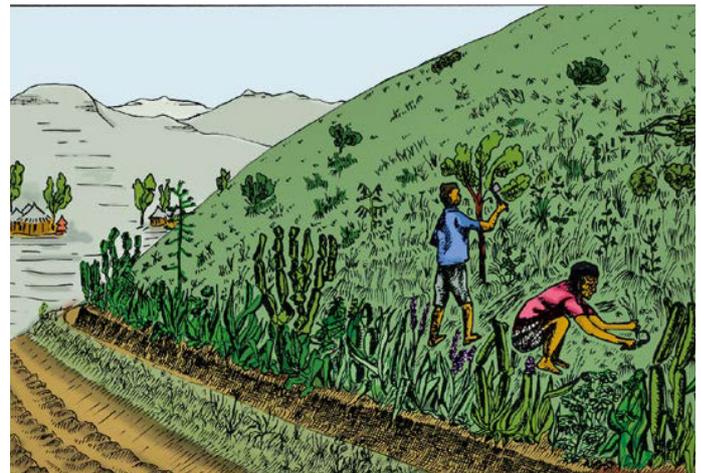


Figure 23. Model for Grassland improvement

Grassland improvement includes activities shown here, such as regular weeding and cutting of forage after the flowering stage, and removal of shrubs that prevent better growth of vegetation underneath. Improved grassland has to be protected from grazing as shown by the live fence. A cut-off drain below the area diverts surplus run-off safely.

(Source: MoA (2016). Guidelines for development agents on soil and water conservation in Ethiopia.)

Most of these technical measures are easy to apply, using locally available materials, with less human labour. These conservation measures must be taken place based on agro-ecological conditions. These efforts have resulted in many ecological benefits such as restoring farmlands, increasing soil depth, water holding capacity, and improved woodlot and pastureland. There was also an effort to minimise free grazing, as constructed structures can easily be damaged.

1.6. Ecosystem restoration

Ecological restoration is the process of assisting the recovery of ecosystems and their biological communities, interacting groups of various species in a common location, that have been destroyed, damaged, or degraded. It aims to eliminate or modify causes of ecological degradation and to re-establish natural processes, e.g. natural fires, floods, or predator-prey relationships.

(Source: https://www.biologicaldiversity.org/programs/public_lands/forests/ecosystem_restoration/index.html)

With these objectives, NABU has initiated ecosystem restoration pilot projects in the LTW.

NABU's 'Water for Life' - Project: Ecosystem restoration in the Lake Tana Watershed

Objective of ecosystem restoration

Restoration of degraded ecosystems in the respective districts of LTW is realised by planting seedlings, establish area closures, and conduct physical soil conservation based on type and status of the land.

The ecosystem restoration process has already begun with an assessment of the degraded sites in 29 Woredas. The sites are selected and approved by the community.

Planning, design and stakeholder engagement

Stakeholder engagement:

Stakeholder engagement is essential to the sustained success of the project. Meaningful engagement must be undertaken at the planning stage of a restoration project with all key stakeholders, including NGOs, CBOs, CSOs, the private sector, and government institutions working in the area. This is where Multi-stakeholder Partnerships (MSP) are practically applied and exercised. It is also good to organise stakeholder dialogues on how ecosystem restoration is carried out and who can contribute in which way.

Planning phase:

- In the planning process, necessary resources are already identified (such as funding, labour, equipment, plant materials, and technical knowledge). The planning activity should start by providing awareness creation to the community. The community must understand the benefits and all the activities to be undertaken, and they should also identify the community's contribution and responsibility.
- Awareness creation: The community should understand the whole technical and administrative process and procedures on ecosystem restoration.



- Establishing an ecosystem restoration association: The committee should be democratically elected by the members. The committee is responsible for running the project, coordinating resources, follow-up on planned activities, and organise meetings and present the progress report to the community members on a regular bases (if possible, every three months).
- Setting the objective of the restoration: The community can set their own objective based on their needs, such as forest tree restoration, pasture land, wildlife protection, wetland restoration, improving soil fertility, etc.
- Site selection: Site selection should be done by the community's active participation, to identify priority areas for restoration.
- Boundary definition: The restoration site's boundaries shall be defined, surveyed and mapped with the help of experts.
- Ecosystem baseline inventory: A list of all native and non-native species evidently persisting on the site should be developed, particularly noting any threatened species. This will help to measure changes after the intervention.
- Restrictions: Avoid free grazing, cutting trees, and encroachment, as this will be restricted by bylaw and endorsed by the community.
- Fencing: If need arises, fencing the pilot site is a good measure to minimise any pressure on the pilot project site.

Activities that must be implemented during the implementation phase on restoration pilot sites include:

- Developing a bylaw: The community should prevent any encroachment, such as grazing, hunting, ploughing, and firewood collection to the pilot project site. Fencing the site may be important to protect it from any damage.
- Treatments are undertaken in a manner that is responsive to natural processes and fosters and protects natural recovery. These include planting grass strips, shrubs strips, or plantations of indigenous, fruits

trees and forages trees. Conduct soil and water conservation suitable for the area, e.g. stone or soil bunds, bench terraces, water trenches, pits for seedling plantations, and construction of check dams for gully rehabilitation. These interventions are all very helpful to fasten the restoration process.

Reporting

Includes preparation and dissemination of progress reports to major stakeholders actively involved in the process of ecosystem restoration, planning, and implementation. Reporting can be done through newsletters or leaflets, and must clarify the level and details of monitoring upon which any evaluation of success is based.

Monitoring

Monitoring generally involves collecting and analysing data on the implementation process, strategies, results, and recommending corrective measures. Collect data regularly from the site, the progress made, the cost incurred (in terms of labour or cash), and also collect data on treatments made. Take pictures from time to time.

Applying all these technical measures is crucial to scale ecosystem restoration up to other areas, especially as other community leaders and experts will come to visit and learn.

Water resource management

Water:

Water is a chemical substance composed of hydrogen and oxygen existing in gaseous, liquid, and solid stages, and that is essential to all known forms of life. Water is a clear, colourless, odourless, tasteless liquid that freezes into ice below 0°C and boils above 100°C (Adedayo Babatunde, 2019).

Water is not just essential to our health, but also used for numerous household tasks such as cooking, bathing, cleaning, and drinking. But how often do we think about its source?

Where does our water come from? From which sources do we get water for different uses?

There are two major sources of water - Surface water and groundwater. Surface water is found in lakes, rivers, and reservoirs, whereas groundwater

lies under the surface of the land, where it flows and fills openings in rocks.

Groundwater:

Groundwater is water that is found underground within rocks. Its presence depends primarily on the type of rock. Permeable rocks have tiny spaces between the solid rock particles that allow water and other fluids to pass through and to be held within the rock structure. The layers of rock that hold groundwater are called aquifers. Groundwater in an aquifer is replenished by rain and other forms of precipitation (any form of water such as rain, snow, sleet, or hail). Deep and shallow wells are used to retrieve water from the ground.

Surface water:

Surface water is the most abundant supply of natural water. Surface water does play an important part in our daily lives and particularly as a source of drinking water. Surface water is also used for producing hydro-electric power and for irrigation. Surface water is supplied by precipitation, springs, and ice melting from higher elevations. Glaciers, lakes, and rivers are part of surface water. Rainwater is the source of water that comes from above the clouds. It is very pure until it encounters something on its way down. However, if stored properly it may relinquish clean drinking water.

Natural sources of water are constantly replenished through weather cycles, so we need to be conservative on how we use water. Fresh water is like a precious gift. We should use it sparingly and do everything in our power to share and protect it for future generations.

In areas where there is scarcity of water, rainwater harvesting is used. It simply means collecting, or harvesting, rainwater as it runs off from hard surfaces and storing it in a tank or cistern.

Rainwater harvesting:

The simplest way to effectively store moisture in the field is tie ridging, stopping the in-situ rainfall water from running off and allowing it to infiltrate into the soil instead. This is particularly suitable for row crops like maize and sorghum.

Run-off water harvesting:

This technology collects water from the ground, e.g. the farm compound or a road, from a rocky area or from roofs.

Do you have any experience on water harvesting? If so, for what purpose do you use it?

Challenges of water resources availability

- Climate change: Due to climate change, we are dealing with a variable climate. Many areas face a drier and warmer climate and thus potentially less water availability.
- Growing urban demand: The population of urban centres continues to grow, and urban areas continue to spread, thus placing greater pressure on water supply systems.
- Unrestricted extractions: In many areas, including LTW, there are no management plans or restrictions on water extractions (for example, pumping from rivers and groundwater extractions with deep or hand dug wells). This resulted in decreasing water availability or even mining of the resource.
- Expansion of irrigation: The expansion of farm dams in some areas also reduces the supply of water entering river systems.
- Land-use change: Clear-felling, expanding plantations, and the opening of new areas to agriculture all have impacts on the water resource.

Solutions for water resource challenges

- Address water supply through managing precipitation, humidity, and water storage, infiltration and transmission, so that improvements are made in the location, timing, and quantity of water available for human needs.
- Agriculture will need to meet projected increases in food demand and water is central to this need. Conservation agriculture is a flagship example approach to sustainably intensify production.
- Effectively manage surface and groundwater resources for domestic, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human and aquatic health and environmental quality, and contribute to wise physical and economic use of the area's resources for the benefit of present and future

generations.

- Protect source water to reduce water treatment costs for urban suppliers and contribute to improved access to safe drinking water in rural communities.

Natural resource conservation activities such as terracing and tree planting enrich the water resource supply and has a direct effect on water availability and security.

The main objective of the 'Water for Life' project is sustaining the functionality of the LTW as important supra-regional water supplier in the long term. This objective can only be achieved through active participation of the community in natural resource conservation measures. All actors, including the community, have to be actively involved for the success of the project to get sustainable clean water.



2. Sustainability

2.1. The concept of sustainability

The concept of sustainability is defined by different authors and organisations with different modifications. For the purpose of this manual, the following definition will be used:

Sustainable Development means attaining a balance between environmental protection and human economic development, and between present and future needs. It encompasses equity in development and sectoral actions across space and time, and requires an integration of economic, social and environmental approaches towards development (Frederick, 2016).

According to the UN's World Commission on Environment and Development and the Brundtland Commission Report, Sustainable Development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Basiago, 1999).

From these definitions, the three pillars of sustainability are economic, environmental, and social sustainability:

- **Economic sustainability:** Economic sustainability implies a system of production that satisfies present consumption levels without compromising future needs. A sustainable economy would provide a good quality of life for all residents without undermining the biological and physical processes of the environment upon which people depend, nor reduce the region's ability to ensure that the basic human needs of all its members are met.

- **Social sustainability:** In the most basic sense, social sustainability implies a system of social organisation that alleviates poverty without affecting the natural environment. It encompasses notions of equity, empowerment, accessibility, participation, sharing, cultural identity, and institutional stability. It seeks to preserve the environment through economic growth and the alleviation of poverty.

- **Environmental sustainability:** Environmental sustainability requires maintaining the natural capital as both a provider of economic inputs (sources) and an absorber (sinks) of economic outputs (waste). Resources must not be harvested faster than they can be regenerated, and waste must not be emitted faster than it can be assimilated by the environment. This involves ecosystem integrity, carrying capacity, and biodiversity.

2.2. Relationship with natural resource utilization

Natural resources are the backbone of the development of any country, and their proper utilisation is essential. Resources can be non-renewable and renewable.

Non-renewable resources are the result of millions of years of geological evolution and once used they can hardly be regained within a foreseeable period of time.

Renewable resources on the other hand only deplete when extraction exceeds renewal rates.

Therefore, to ensure sufficient resource supply for today's development demands, while also saving and transferring them to future generations, both resource types must be used in a sustainable way. The human demand for natural resources is increasing tremendously because of rapid population increase and a steadily rising resource use per person. Currently, natural resources are used faster than the planet can replace them. Furthermore, the technology to extract natural resources is continuously improving. However, resources are rare or scarce, and located unevenly around the globe, making the balancing of both serious issues promoting sustainability essential.

3. Waste Management

3.1. The concept of waste management

Solid waste (SW) can be defined as the unwanted products derived from different activities and discarded by society. It can be produced as a by-product of production processes or arise from domestic or commercial sectors, when discarded after use. The waste we produce can be described as liquid or solid waste, depending on its physical state. It can also be categorized as hazardous or non-hazardous. They can also be selected due to their raw materials, such as plastic, organic, aluminum, etc.

Refuse is introduced into the environment daily, and poses a big threat to the natural resources and public health. **Waste management** refers to the many methods and processes of dealing with waste at every stage, from generation and collection through to final disposal, further treatment and reutilization. The need to manage the waste aims mainly to prevent contact with humans or their immediate environment, since it is widely known that untreated and inappropriate waste disposal can lead into the spread of diseases. In addition, the aesthetic value of a better outlook and a clean physical environment is important for the emotional wellbeing.

On the whole, the increasing volume and complexity of waste associated with the modern economy has increased the need to find and adapt better management practices for the refuse, and avoid causing contamination and pollution in the environment, and diseases spreading.

3.2. Current situation in the Lake Tana Watershed

In the Bahir Dar region, the collection and transfer of solid waste from households, institutions and commercial areas is conducted by a private company, which operates together with the city administration, both practical and financially. The transportation of the waste to the final disposal is also done by this private company by the means of trucks, which take the collected material into a disposal area. By its term, the disposal facility is open, and the disposal site is close to rural settlements and about 3-4 km from the city centre.

About 70% of the generated municipal waste is collected, and disposed in the disposal area. About 2% of the collected waste is used to produce compost in the city service compost site. The remaining 29% of the waste, which is not collected by the company, is either burned, buried in their compound or disposed to lake sides or into the



river. Considering that burning and burring are costly, it can be assumed that a big proportion of the waste is being discarded directly in the natural environment, causing pollution.

There are numerous challenges when it comes to the management of the solid waste of the Bahir Dar city and region. For instance, during the transfer process from the collected garbage in the households to the landfill, there is the need for a transfer station which is appropriately isolated to protect the waste from spreading and polluting the natural resources. Also, the waste collection does not cover all solid waste generators, and therefore not knowing how to properly dispose their refuse, the originator eventually knows no better choice than discarding their waste in improper locations.

During the transport, another challenge that they face are the trucks, which are too small and not standardized for solid waste transportation purposes. Since they are not closed on top, the wind disperses refuse to the surrounding areas during transit. As mentioned before, the size of the trucks is also problematic, and therefore even the waste which was selected at the source, gets mixed up with other categories during transport.

Furthermore, the inexistence of any treatment facility for solid waste decreases the possibility to get the materials recycled, and increases the possibility for contamination of the region nearby the dumping area, not to mention the groundwater system. Besides, the disposal facility is too close to settlement areas. This poses big environmental and public health problems, and even farmers have reported that animals died by eating plastic bags.

The recycling of solid waste is lower as <1%. The private company which operates in the region sells paper to recycling industries, and the city administration makes compost out of the organic waste. There are also middlemen, who collect goods from the waste and resale.

Nevertheless, there is a new initiative to collect and process plastic bottles within the LTW, and this can be seen in the cities of Bahir Dar, Gondar and Woreta. The pressed or crushed plastic materials are then sent to Addis, where they get recycled.

The recycling is at its early stages in the region, and therefore it can be assumed that they lack

on technology and efficient machinery for such purposes. Moreover, the absence of waste segregation at the source, and the different materials that the bottles are made of, pose difficulties to those already developing companies. Moreover, they lack of resources for collection, transfer and transportation. Also important to mention is that, they are not strongly connected to the regional administrations, and this fact also hinders the process of collection (through the municipality waste collectors and waste collection associations).

3.3. Advantages of appropriate waste management

Numerous are the direct advantages of appropriate waste management, such as the conservation of the integrity of ecosystems services, increased public health and life quality, preservation of biodiversity, etc. Nevertheless, other indirect benefits also arrive from the activity, which are also relevant to improved livelihoods. Between them, the climate benefits can be cited.

The waste management sector offers an immediate, cost-effective, and fast-acting opportunity to achieve substantial cuts in global GHG emissions. Not only, the waste prevention, resource recovery, reuse and recycling can minimize environmental impacts, generate lower costs, and reduce potential risks and liabilities across supply chains and in product disposal.

As demand for raw materials directly extracted from nature intensifies and energy demand accelerates, the capacity to recover, reuse, and recycle key materials — as well as prevent waste in the first instance — is essential to promoting economic development and maintaining competitiveness. It is widely known that sustainable development is a necessary measure in the future, and by using existing technologies with lower energy consumption and reuse of processed residuals, waste management can be transformed into a carbon reducer. Countless examples across the world demonstrate that this is a strategy ready for scale-up.

Furthermore, the recovery of energy from waste processing and captured landfill gas, can also pose as alternative energy production, for uses such

as electricity, or in heating and cooling systems. Improved energy efficiency and fossil fuel avoidance represent an important and growing opportunity for indirect reduction of GHG emissions in sustainable long term waste strategies.

In summary, the waste management sector is well-positioned to promote sharing of technologies and to collaborate with all countries' governments to craft projects and initiatives capable of attracting public and private financial support. Implementing effective waste management systems can bring a wide range of environmental, economic and social benefits.

How can households contribute to a better management practice in waste management?

The most effective way to better address the waste, is to not produce it. There are many possible ways of reducing the amount of waste produced at home that could be suggested to householders. These include educating and encouraging them to:

- Buy products that use less packaging. Buying in bulk, for example, can reduce packaging and save money. Where households cannot afford to pay large sums of

money up front, it may be possible for neighbours to club together and buy a large quantity of a basic foodstuff between them.

- Make use of reusable rather than disposable items. For example, use refillable containers where possible; washable rather than disposable nappies; cotton handkerchiefs rather than paper tissues; rechargeable batteries and refillable ink pens.
- Use their own shopping bags, preferably made of cloth or other recycled material rather than plastic bags.
- Minimise food scraps or feed these scraps to animals, if appropriate.
- Repair and maintain items such as clothing so that they last longer.

Moreover, they can also:

- Separate their waste into categories to facilitate recycling
- Organize a collective gathering or recyclable goods in their community, such as plastic bottles, aluminium cans, glass, etc.



Figure 24. The concept of the 3 R's - Reduce - Reuse - Recycle

3.4. Selection at source

3.4.1. How does it work?

The solution, in the first place, is the minimization of waste. Where waste cannot be avoided, recovery of materials and energy from waste as well as remanufacturing and recycling waste into usable products should be the second option. Recycling leads to substantial resource savings, and also

direct alternative income, since the new processed materials can be bought and reutilized.

The need to separate the waste at its source arises from the difficulty to recycle materials once different types of wastes have been mixed together. Hence, the first stage of the recycling process is to separate the materials into different categories. This is called **waste segregation or separation at source** and should be done by the householder when the waste items are finished with and will be discarded. Waste

is separated by placing the different categories of waste into different bags or containers.

The degree of separation required will depend on the recycling opportunities that are available, but it is important to separate 'dry' and 'wet' materials. The simplest method of separation is to keep food waste separate from the remaining materials so that the food waste can be composted or used to make biogas. Also, plastic bottles and aluminium cans can be cleaned up and sold to processing middle men, who have connections to recycling centres.

If waste is not separated at the source, it ends up at a disposal site where all the waste is mixed up so separating the different types becomes much more difficult and hazardous. In many developing countries, including Ethiopia, collecting waste for recycling is often conducted by the informal sector. Such work can be done in a very labor-intensive, unsafe and polluting way, and for very low income. This could be avoided; once the materials have already been selected and taken to an appropriate destination once they were generated.

3.4.2. Advantages of waste selection at source

The selection at the source facilitates the process of recycling, since there are different types of treatment to each category of waste. Organic refuse, for instance, can be used directly as fertilizers or for the production of compost. The purer the material is, and the more controlled the content of the mass lead into better results when it comes to decomposition, and therefore a superior quality of compost is expected. This process can be done industrially, but also in individual or collective households.

On the other hand, plastic products are not so easily recycled. Even when it comes to plastic bottles, they are done in different colours and materials, not to mention that the lid is also composed of another sort of plastic. This all leads to difficulties in the process of reutilization for further purposes. In this manner, the importance of separating those goods from the rest of the household refuse is implicit. In addition to the fact that recycling those products supports the environmental protection, the selection of those materials could also generate a new source of income, since there are companies specializing in processing bottles for recycling, and

lack resources for their collection.

Last but not least, the differentiation of hazardous materials during the waste generation is of extreme importance not only to conserve the natural resources, but also to public health. Given that not all areas where the refuse is brought have a proper protection in the soil, combined with rain and lixiviation, there could be contamination of groundwater systems, soil and animals.

Another advantage of selecting the waste is the increased possibility of reuse. Reuse can be defined as using a waste product without further transformation and without changing its shape or original nature. Different types of solid wastes can be reused, such as bottles, old clothes, books and anything else that is used again for a similar purpose to that originally intended. Reuse means that less solid waste is produced, and therefore less pollution is generated in the environment. It brings other benefits by taking useful products discarded by those who no longer want them and passing them to those who do.

3.5. Recycling

Recycling waste means that the material is reprocessed, before being used to make new products. They become once again raw material, and can be reused mainly by the industry. Recycling means treating the materials as valuable resources rather than as waste. This is also a conscious thought, once those materials were made out of the region's treasured natural resources.

The options for recycling depend on the type of waste. For example, paper can be broken down to its fibres, while metals and glass can also be recycled by melting them down into new raw materials. Plastic bottles can be pressed and crushed, and used to make new bottles, plastic rope, foil, textiles, in the construction industry or plastic coating for electric wires. For some wastes, recycling involves complex technical processes and requires specialised machinery, but others can be recycled more simply and on a small scale.

4. Carbon footprint

4.1. The concept of the carbon footprint

According to the World Health Organization (WHO), a carbon footprint is a measure of the impact that activities have on the amount of carbon dioxide (CO₂) produced through the burning of fossil fuels, and is usually measured in equivalent tons of CO₂, during the period of a year. In other words, it corresponds to the whole amount of greenhouse gases (GHG) produced to, directly and indirectly, support an industrial activity, individual or collective lifestyles or commercial exercises.

The GHGs that result in a carbon footprint can come from the production and consumption of fossil fuels, food, manufactured goods, roads or transportation. And even though they are extremely important to address the protection of the environment, carbon footprints are difficult to calculate, due to poor knowledge and short data regarding the complex interactions between processes.

4.2. Strategies to minimize the CO₂ dispersion

Transportation

Examples of good and sustainable behaviour:

- Avoid polluting car journeys, and favor walking, cycling or using public transport, especially trains;
- If you are driving, share the ride with others and don't speed as it uses more petrol and therefore, emits more CO₂;
- Avoid flying, the world's fastest-growing source of CO₂ emissions. If you do it, consider offsetting your emissions.

Food

Examples of good and sustainable behaviour:

- Reduce the number of animal products consumed;

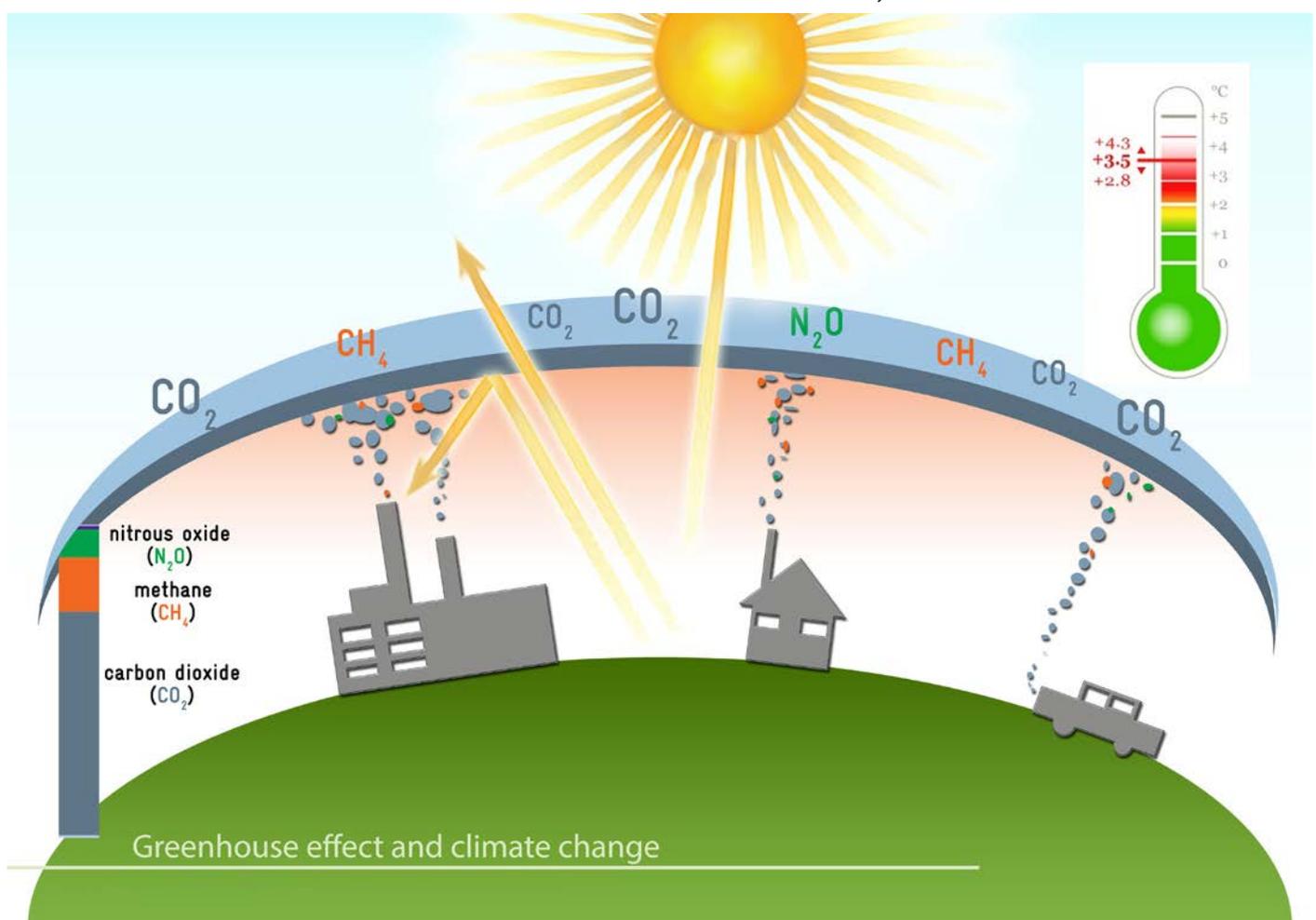


Figure 25. Greenhouse effect and climate change

- Eat local and seasonal produced food: short trips mean less pollution from transportation;
- Recycle/ compost organic waste. Otherwise, methane will be released by the decomposing biodegradable waste in landfills. In the EU, these emissions account for ~3% of GHG emissions.



Figure 26. Composting of degradable, organic waste

Water use

Examples of good and sustainable behaviour:

- Use the washing machine and dishwasher only when they are full;
- Boil only the water you will need and cover your pots while you cook: you'll save plenty of energy and the process will be faster;
- Collect the cold water from the first seconds of your shower to water your garden or plants;
- Harvest rainwater if you have access to a rooftop as an alternative to groundwater;
- Raise hand pumps to protect drinking-water from flood contamination.

Energy use

Examples of good and sustainable behaviour:

- Be mindful of the temperature of your house: just 1°C less reduce emissions (and your energy bill) by 5-10%;
- Turn down air-con for the cold – they are super energy expensive. Use a fan instead;
- Program your energy devices so that they're on only while you are (about to get) home;

- Improve your house's insulation so that less heat gets out when it's cold and less heat comes in when it's warm, reducing the need to use other devices;
- Mind the settings you choose: maybe your fridge doesn't have to be in the coolest setting and your water cylinder thermostat doesn't have to be set higher than 50°C;
- Unplug your cellphone's charger as it still drains electricity even when it is not connected to the cellphone;
- Switch off the lights when you don't need them and use energy-saving lights such as LED;
- Change your electricity supplier for a greener one, that provides energy from renewable sources.

Waste management

Examples of good and sustainable behaviour:

- Refuse what you don't need, reduce what you need; reuse it as many times as you can, re-purpose if you're not using it anymore and recycle or compost it and something reaches the end of its lifecycle;
- Avoid buying new bags to transport your shopping back home by reusing your shopping bag;
- Choose products with little/no packaging: this ultimately cuts down production costs.



Figure 27. Separation of waste

5. Behavioural Change to Conserve the Natural Resources of Lake Tana Watershed

Humans depend on natural resources directly or indirectly. While natural resources are limited in amount and/or volume, they are more and more demanded, threatening resources like water, trees, sand, soil, plants, animals, and minerals. For example, if water is being overused or wasted, lakes can run low on water, and not be able to provide enough water for plants and animals anymore. Hence, every individual should be involved in conservation activities and use resources in a sustainable way. Suppose you have a candy bar. You could eat the whole candy bar at once, or you could divide it into pieces to have some for later. Saving some for later would be an example for conservation, as it would last longer. Therefore, a mechanism is required to balance the limitation of resources and the huge demand towards them.

In this part of the manual, the following will be covered:

- Defining the concept of behavioural change,
- Human behaviour directly or indirectly affecting the natural resources of Lake Tana Watershed (LTW),
- Actors threatening the natural resources of LTW,
- Major techniques to change the behaviour of important actors.

5.1. The concept of behavioural change

In this manual, behavioural change focusses on the conservation of natural resources. Conservation of natural resources can be achieved by influencing the behaviour of key actors, as indicated in behavioural change models (Reddy, 2016). Therefore, to define behavioural change, there are two important concepts: behaviour and behavioural change.

Behaviour encompasses decisions, practices, and actions taken by the individual or groups (Byers, 2000) that are driven by knowledge, awareness, and concern. While people express concerns about

environmental issues, they continue to behave in ways that are harmful to the environment.

Behavioural change is the process of changing the behaviour of people who are ineffective in their conservation practices. Therefore, practitioners of natural resource conservation are working on enabling people to shift towards positive behaviours (Schmied, 2017). The existing trend indicates that those who changed their behaviour are actively participants in the conservation of natural resources and use natural resources in a sustainable way.



**TO Protect Nature
No Debate**

5.2. The need for behavioural change to protect the natural resources

Every individual, in many ways, affects the environment, depending on our behaviour. These behaviours represent the decisions, practices, and actions taken either by individuals or as members of a group. Whether we cut a branch or plant a tree, allow cattle to graze by a roadside or in the field, every action is a result of a decision we make based on the information we have and the influences affecting us. Based on environmental protection practitioners, individual behaviour may be pro-environmentalist (in favour of protection of natural resources) or anti-environmentalist (against protection of natural resources). By understanding peoples' behaviour, we can begin to identify the different social factors that influence their actions or change their behaviour from anti-environmentalist to pro-environmentalist. Promoting a sustainable natural resource management requires efforts to maintain certain behaviours and change others that deplete the environment. In order to change

behaviour towards using the resources wisely and sustainably, 'Training of Trainers' (ToT) trainees and local community members should be clear on the following issues:

- If used wisely and sustainably, the existing resources are enough for everybody and can be passed to the next generations.
- The existing resources are not limited to individuals but belong to the whole community, e.g. rivers, lakes, and mountains.
- The existing natural resources are a gift of God to the current community and for the next generations, so they shall be used but not depleted by everybody.

Therefore, to use the existing natural resources in a sustainable way, we need to change existing practices of individuals or groups through various techniques like awareness creation campaigns.



5.3. Types of behaviour that affect the environment

Individuals or groups are interacting with their environment through their behaviour and are called actors. These actors may behave as anti-conservationists instead of pro-conservationists. There are different reasons for behaving as anti-conservationist, especially **lack of awareness about the problem, non-conservation motivations (economic, social, intrinsic), and intuition, habit, decision context.**

Therefore, behaviour affecting the environment can be categorised as good and bad behaviour.

Good or desired behaviour to conserve natural resources:

- Minimise or stop cutting trees or clearing forests for fuelwood, charcoal, timber, house construction and household goods,
- Plant more indigenous trees at home gardens and communal lands,
- Reduce harvesting grasses for roof, animal feed, and basketry making,
- Reduce overgrazing on specific plots,
- Reduce overfishing and illegal fishing,
- Reuse resources such as compost making, reuse waste water,
- Recycle paper, glass, metal, and plastic, where possible,
- Reduce energy use, use renewable energy sources such as solar energy,
- Turn off water faucets while brushing teeth and when water is not needed,
- Minimise or stop use of pesticides and inorganic fertilisers,
- Stay out of sensitive landscapes and forests,
- Sustainably harvest forest products for food, medicine, etc.,
- No killing or hunting of wild animals,
- Buy organic products or eco-level products,

- Use public transport,
- Use better farming techniques, develop trace and other techniques that reduce soil erosion,
- Choose technological innovations with less impact on the environment such as energy efficient light bulbs, low-flow showerheads, and automatic water faucets,
- Focus on using washable glass, washable plates and other eating utensils, cloth towels and napkins, recycled bags,
- Turn off unused lights, televisions, radios, and other appliances when they are not in use,
- Put all trash in trash cans, do not litter.

Bad behaviour affecting natural resources negatively:

- Grazing a large number of cattle at a single spot,
- Making charcoal and timber for sale within the communal forest,
- Producing a lot of garbage and litter,
- Cutting of trees for fencing, firewood, craft-making, house building, and household goods without replacing,
- Hunting wild animals,
- Fishing with illegal fishnets and during non-fishing seasons,
- Harvesting of grasses such as papyrus, at wrong sites and during inappropriate seasons,
- Using private transport,
- Ploughing of wetlands and producing crops,
- Utilising more pesticides and inorganic fertiliser to increase productivity,
- Utilise many plastic bottles and plastic bags.

4.4. How humans activities and behaviour affect the environment

Behaviour is where the axe meets the tree, the hoe meets the soil, a tree is planted, a wild plant is gathered for traditional medicine, industrial chemicals are dumped into the lake, livestock is grazing on wetlands, etc. All such behaviour can be thought of as adaptations or responses to the social and ecological environment. And many of these behaviours affect or deplete natural resources or degrade the environment. These behaviours create economic or social problems or constraints, for some people today or for future generations. But natural resources can also be used sustainably, without degrading or depleting them.

List of activities that affect natural resources:

Common practices	Effects
Cutting of unripe fruits for self-consumption or for the market	Reduces the number of viable seeds needed for regeneration of plants in the local area
Cutting of various types of leaves for household consumption	If too many leaves are cut, it prevents the trees from growing or producing more leaves
Cutting of trees/forests for establishing crop fields	Decreases biodiversity and forests in the area
Cutting of trees/forests for household consumption and timber production	Decreases biodiversity, increases forest lost and fragmentation

Gathering medicinal plants in the forest	None if not overharvested
Building settlements close to natural resources	Potential to pollute the resources or clear the forest
Grazing livestock within forests/wetlands	Removal/decreasing biodiversity
Fishing in the lake	Overfishing threatens the fish populations
Collecting wild honey	Overuse threatens the wild bee colonies
Setting bush fires	Loss of biodiversity and other natural resources
Harvesting grasses for roof, animal feed, and basketry making	Overharvesting threatens biodiversity and other natural resources
Draining of water from the wetlands and drying wetlands through clearing vegetation for seasonal crop production	Alterations of land use or ecosystems
Ploughing of hilly land and areas close to river banks and lake shores	Increasing siltation in the lake and river banks, loss of natural resources
Littering of waste	Pollution of the surrounding environment including water bodies



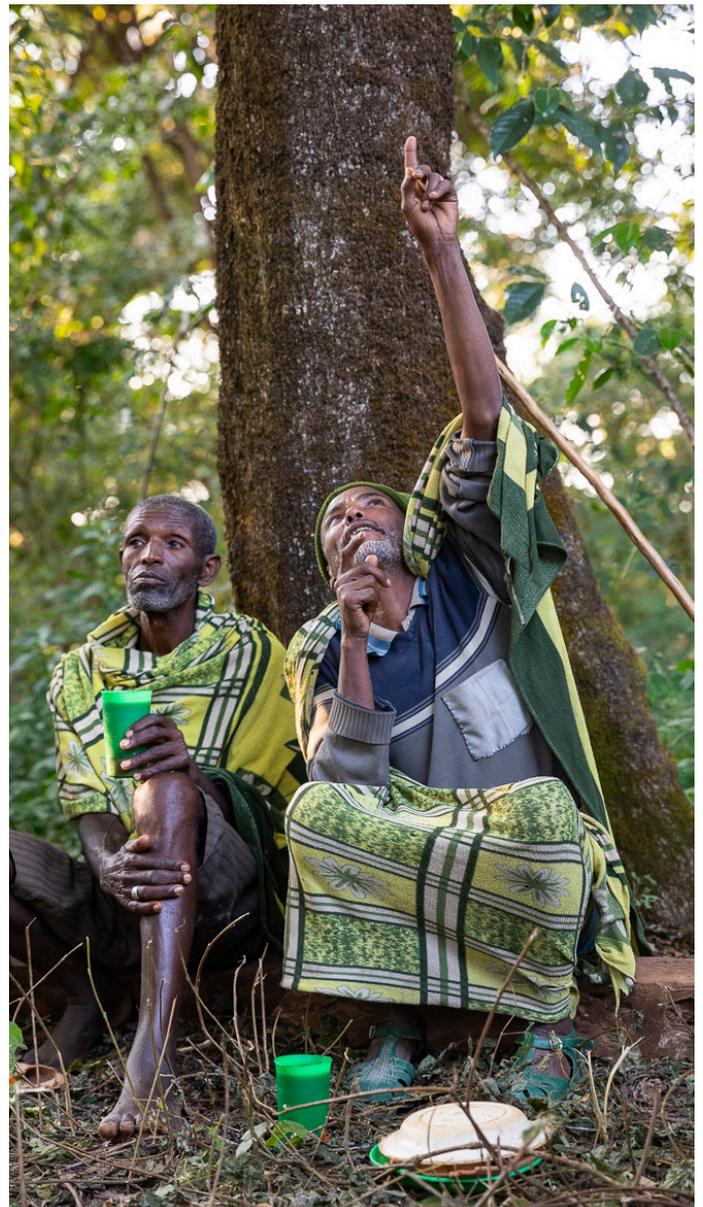


5.5. Methods or techniques to change the behaviour of important actors

As indicated above, there is pro-conservation and anti-conservation behaviour affecting natural resources. Before identifying and applying the right approach, the first step is to identify the target groups. Depending on the target group, it is possible to apply the right approach to change the behaviour of individuals or groups. Behavioural change is complex. There are many motivators and barriers to behaviour that vary based on the individual and the particular behaviour. Therefore, it is important to use multiple behaviour change strategies to target different motives.

There are a number of approaches that can be used to encourage pro-conservation (or discourage anti-conservation) behaviour, especially:

- Continuous awareness raising and communication activities: these will be done through continuous training of targeted groups, providing the right information through leaflets, posters, social media, electronic media, and signboards,
- Continuous dialogue and discussion to change values and attitudes,
- Develop local rules and regulations,
- Develop an agreed vision among local communities and start to realise this vision,
- Capacitate the targeted partners,
- Provide or develop incentives to change the behaviour.



More about games and how to enhance knowledge and change behaviour in Part Three of the manual.

Major Stakeholders involved: Trainers and workshop participants for awareness raising







PART TWO

1. Threats to the water resources of Lake Tana Watershed

The LTW is currently experiencing significant natural and socioeconomic changes attributed to water infrastructure development, urbanization, industrial expansion, land degradation and siltation, which are modifying the availability and demand of water resources. In addition, the stunning economic growth and population increases demand for good

quality water resources and give rise to prominent pollution problems. The functioning of the water management system in LTW (i.e., the conditions to establish who needs what, when and how) is thus affected by several factors – both physical, socio-economic and institutional (Asres et al., 2019). Between all the threats, the major are:



1.1. Inadequate hydro-climate data and operational plans

The lack of spatially and temporally monitored hydro-climate data, inconsideration of mathematic modelling as a planning tool, insufficient expert capacity, lack of mechanisms and operational standards for water allocation and growing water demands are major factors that limit the functioning

of the water management. This leads to undermine the socio-economic growth and create risks on the land and water resources.

Major Stakeholders involved: Government and regional authorities, universities etc.

1.2. Lack of coordination on water resources management

LTW is characterized by little integrated planning of sectors and different projects, so that water resources are being allocated in ways that neither consider competing demands nor are based on a systematic understanding of 'how much water' is available. This is already leading to instances of conflict, as demonstrated in the case of the Rib River and Chara Chara Weir regulation between upstream and downstream water users as well as between navigation and tourism and hydropower operators. Institutional roles are not sufficiently well-articulated, nor are coordination mechanisms for water resources management. For example, since the construction of Chara Chara weir in 1995, which controls Lake Tana water level, it became more difficult to know exactly whether lake level variation is induced by hydrologic process or not (Asres et al., 2019).

The alteration of river courses can also cause change in the lake water level. Those changes can be

humanly made as an effect of land relief alteration in the floodplain (due to flood events) and sometimes diverted intentionally by the community. Not only for those reasons, but when previous water courses are silted-up, they became a very fertile ground for crop production and became a permanent crop land. In this regard siltation has been found to be the cause for the conversion of significant wetlands to other uses. Moreover, when a river changes its path two conflicting situation may occur; in one side it destroys farmlands and induce conflicts, in the other side feeds water to the local community and benefit a certain group of people whereas others missed the advantage. For that reasons river course alteration has both negative and positive advantages. (Asres et al., 2019).

Major Stakeholders involved: Government, farmers

1.3. Excess Abstraction for Irrigation

Lake water level or the watershed water balance is also affected by excess and unregulated water abstraction from the upstream rivers. Diverting and pumping from rivers and digging shallow wells has become common practice in the floodplains of LTW. The excess abstraction is to the extent that big rivers such as Gumara and Rib become dry during the dry season because of excess abstraction. Even people dug the river course to get water. Moreover,

the water level of Lake Tana and the river systems will be expected to become uncertain and dynamic after the completion and operation of medium scale irrigation dams being constructed (Seraba pump irrigation, Megech and Rib reservoirs) (Asres et al., 2019).

Major Stakeholders involved: Farmers (both commercial and familiar)

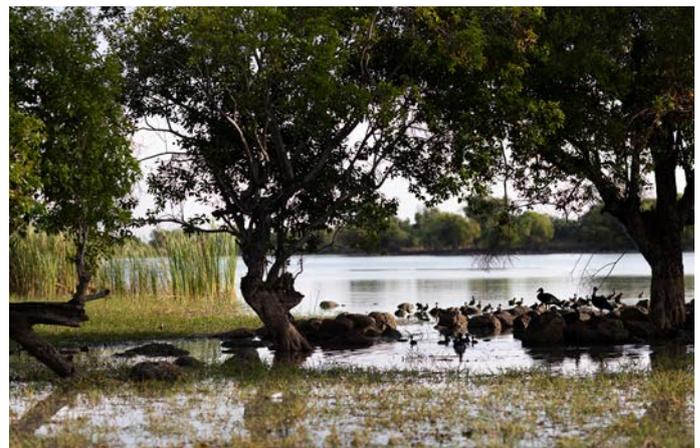


1.4. Threats to Wetlands and Aquatic Biodiversity in the LTW

The trends of shrinkage of wetland habitat due to anthropogenic activities and the growing number of threatened and endangered bird and fish species have indicated the threats of the wetlands and its biodiversity and the resulting negative impact on the livelihood and economic development of the watershed. Many interrelated factors lead to risk the wetland ecosystem. The threats and causes of aquatic and wetland ecosystems degradation are many and varied which need to understand them very well and need quick action to reduce their impacts.

Some of the major threats to the Lakes and wetlands include:

- Infestation by invasive species;
- Sedimentation arise from flooding;
- Conversion of wetlands to other land uses such as farm land, grazing land and settlement;
- Unwise utilization of aquatic and wetland resources such as unscheduled free grazing, unscheduled harvesting of papyrus plant, mining of sands beyond its carrying capacity;
- Free/over grazing which causes compaction, borehole and gully formation, that in turn, results in poor production and productivity of pasture



- Point and non-point source pollution affects aquatic and wetland ecosystems in decreasing water quality, declining biodiversity.

Major Stakeholders involved: Farmers (both commercial and familiar)

1.5. Illegal fishing practice / Overfishing

The use of motorboats and small size nets enables the fishermen easily catch in deeper offshore waters, distant river mounts. This development induced overfishing because they fished during spawning seasons.

Major Stakeholders involved: Fisherman, Fishing industry

1.6. Conversion of wetlands to crop farming

Large wetlands (like Shesher and Welela) are seriously threatened by conversion into farming by draining the swampy areas. Encroachment of wetlands for recession farming, livestock grazing, settlement, and reallocation to crop farming for

landless youths become a threat to the wetland ecosystem and aquatic biodiversity. As a resulting practice, the wetland vegetation population, especially the papyrus, are seriously declining and are mainly found in undisturbed pocket habitats

(shorelines and swamp areas). Furthermore, encroachment of wetlands for livestock grazing (mainly in bigger wetlands) of northern and eastern part of the lake become common practices by the farmers.

The growing demand for Khat production around Lake Tana has also threatened the local wetlands. Its increase has changed both the socio-cultural and biophysical landscape of the watershed. The huge water consumptive nature of rice and khat

1.7. Sand mining

Extensive sand mining in the northern and eastern part of Lake Tana (Delgi, Agid Kirigna, Kunzula and Mitraha Abawarka, nearby Arno-Garno River entry) is a serious threat for the wetlands along the shoreline. River-driven commercial sand mining sites can be found at the ephemeral rivers of War, Sege and Kimo (around Delgi) and upstream tributaries of Arno-

1.8. Pollution sources from urban and industrial areas

Lack of pollution control measures for both point and non-point sources including municipal drainage systems, industrial effluents, commercial and service centers and agrochemicals degrades water resources and aquatic biodiversity. Deteriorating water quality caused by pollution influences water usability downstream, threatens human health and

1.9. Vast expansion of invasive water hyacinth (*Eichhornia crassipes*)

The spread of the invasive species could constitute a serious threat. The weed spreads in the Lake and forms floating mats covering the important shoreline areas, and is suppressing the natural vegetation within some wetlands. The dense floating mats can impede water flow and the mats inhibit the diffusion of air into water, which leads to increase sediment accumulation rates and accelerate eutrophication processes.

Furthermore, the weed impacts lakeside communities due to the fact that accessibility to land and water are hindered, which affects cargo and human transportation and water quality of pumped water is lowered by blocking of the pump. Water hyacinth entangles the fishing nets and boats' propeller, making it difficult to fish and resulting in reduced fish catches. Artisanal fishers,

crops is negatively affecting the hydrology of floodplain. This unsustainable and unregulated wetland practices has led to the loss of habitat for important bird species, disturbance and low water level of river courses used for fish spawning (Asres et al., 2019).

Major Stakeholders involved: Livestock, Rice and khat farmers

Garno and Rib River. At the shoreline black sand is found and excavated on a grand scale for building purpose which is resulting in the total degradation of the shore and wetland areas and which can cause erosion and affect fishing activity.

Major Stakeholders involved: Mining companies

the functioning of aquatic ecosystems, especially the fish species, so reducing effective availability and increasing competition for water.

Major Stakeholders involved: Municipalities, government authorities, waste management associations, farmers, industry

who couldn't enter the pelagic area using reed boat, are highly vulnerable to the problems derived by water hyacinth.

Major Stakeholders involved: Municipalities, government authorities



2. The Role and Contribution of Major Stakeholders in Conserving the Resources of Lake Tana Watershed

The Multi-stakeholder Partnership (MSP) structure of the project is based on the active participation of the relevant stakeholder of LTW. Those numerous actors can be divided into different sectors, according to their main activity field. Their roles can be classified as individual and collective, and it is possible that one actor belongs to more than one sector at the same time.

With that in mind, it is also important to mention that each classification has different attributions, responsibilities and possibilities to address distinctively the conservation of natural resources. In this way, a customised approach during the awareness raising training is the most effective to create positive adapted behaviour among the different actors.

2.1. Government/public sector (regional, zonal and district level)

The government (including municipalities, kebele level, regional, zonal and district level) plays a big role in the conservation of the environment, since

it is the sector which manages and has contact to all others. Their biggest objective is to maintain the order, while attending every sector's expectations.

Even though the government can act as an important partner in the conservation of the resources, there are also actions which are not supportive, and should also be brought to attention, in order to be improved. Some of them consist in: not having clear regulations on environmental standards, not enforcing the law, delaying environmental protection measures, not participating in environmentally friendly projects, etc.

What can the government do to support the conservation of natural resources?

They can provide financial assistance to implement issues raised by the communities, technical expertise and know-how to throw environmentally friendly events, coordination of various stakeholders, capacity building activities for the local stakeholders, monitoring and evaluating the sustainability of economic activities in the watershed region, development of policies/guidelines/strategies favourable for environmentally friendly



actions and projects, facilitating and implementing adequate activities, participating actively as board members for different purposes, support documentation of data in the LTW, among others.

2.2. Civil society

Civil society is also very relevant to the protection of natural resources, since every single actor also belongs to this sector. In this category of stakeholders, the best approach is to direct the speech personally, and reinforce the idea that everyone can make a difference, and that the change of behaviour will affect directly the future generations.

The lack of environmental awareness is definitely the most critical point when it comes to civil society. The majority of times, in the absence of information on recycling, waste management, conscious use of natural resources, ecosystems of the region, the importance of sustainability, alternative income sources and other concepts, helps to perpetuate the same negative behaviour.

What can the civil society do to support the conservation of natural resources?

There are endless possibilities to the civil society to support the conservation of natural resources, and it is very positive to hear which suggestions the group has to propose. Between numerous possibilities, some can be cited, such as: the involvement in natural and cultural resource rehabilitation and protection activities, taking an active role in planning, developing, managing and implementing the biosphere reserve management plan, teaching the children at home the different concepts related to environment protection (sustainability, waste and water management, segregation of waste at the source, ecosystem services, recycling, etc.), segregating the waste at the source, using water wisely, collecting plastic bottles for recycling, etc.

2.3. Developmental organizations/local and international NGOs

This category has a special characteristic, which is the international connection and outreach. For this reason, they are able to compare what has been

done in the region with international standards, creating therefore positive energy to achieve more ambitious goals.

There are few manners in which an NGO or developmental organization can be harmful to the environment, once their main objective is to achieve positive change within a region. However, the lack of compromise and planning the sustainability of some projects can lead into abandoned structures and inappropriate technology implementation can end up into rotten equipments, from lack of use. Another negative characteristic of an NGO/DO is the inability to listen to the local community in order to address their specific needs, and not the international agenda. This can reduce the trust of the community into the projects they develop, and increase the chances that those changes will not be long lasting.

What can the NGOs and DOs do to support the conservation of natural resources?

There are plentiful of actions that NGOs and DOs can do to support the protection of the environment. For instance, by capacitating the local community and private sectors, by securing adequate funding and resources to implement management plans, by coordinating and facilitating the connection between the stakeholders, by assessing and promoting improved livelihood options dependent on natural resources, by supporting small businesses on using environmentally friendly technologies and protocols, by actively taking part of projects that are relevant to the local population, by supporting campaigns on environmental protection, etc.

2.4. Private sector/investors, including Lake Tana Fishery Association

It is well known that the industry and the private sector have a great impact in the environment, and are among the most polluting actors towards the environment. They can contribute with negative impact in all the natural resources, and therefore it is indispensable to have a proper sustainability plan in every one of their systems. In spite of this, the private sector doesn't have to be considered an antagonist to environmental protection. Their activities are needed for economic growth, and are



very positive for the development of the region they are settled in. By finding a compromise between industrial production, economic activity and natural resources conservation, the stakeholders can guarantee the sustainability of their businesses, and will function as allies on protecting the natural resources.

Industrial activities can harm the natural resources in different ways. Examples are:

- **Air pollution:** It happens due to the high proportion of poisonous gases in the air like carbon monoxide. Air-borne particulate matters, smoke, toxic gas leaks etc. cause pollution. It affects humans, animals, plants, and atmosphere as a whole too.
- **Water Pollution:** Organic and inorganic industrial wastes and affluent that are dumped into water bodies cause water pollution. Some main factories that cause it are paper, chemical, textile, tanneries, etc. Harmful substances include dyes, acids, fly ash, among others.
- **Thermal Pollution:** It happens when hot water is released into rivers and ponds without cooling. It adversely affects the aquatic life.
- **Land pollution:** Solid waste material like glass, packaging and renders reduce the quality of the soil. Rain water carries the chemicals underground and can pollute ground water as well.
- **Noise Pollution:** Industrial work,

construction process, machinery and various equipments create a lot of noise. It can be a cause of irritation and stress. It can also create health problems, and should not be underestimated.

How can the industry and the private sector support the environmental protection?

As mentioned before, the companies can also create positive change. Among the possibilities for this are: working with and supporting the local community to establish small sustainable firms, coordinating and facilitating the involvement of the stakeholders, supporting the implementation of environmental protection projects financially, supporting the local economic value chains, by actively taking part of projects that are relevant to the local population, by supporting campaigns on environmental protection, by implementing environmentally friendly protocols in their systems, by planning an adequate treatment of their by-products, waste and effluents, by undertaking constant scientific measurements of their impact on the natural resources, by being open to improvement interventions by other supporting actors, etc.

2.5. Academic institutes and Amhara Region Agricultural Research Institutes

Those academic institutes are consistent mainly of universities and research centres. They play an important role into identifying and measuring the impact of different activities into the environment,

and even though their acting is relatively passive, they hold the reason when it comes to taking decisions. It is utterly relevant to have an appropriate data base on environmental conditions, and therefore their activities are very supportive.

How can the academic and research institutes collaborate to the environmental protection?

As mentioned above, the research of different environmental parameters support the decision making processes, and builds a precise scenario where it is easier to identify the challenging points in the system. Other than that, they can contribute by providing trainings, conducting researches that improve the wellbeing of the local community and biodiversity, mobilise resources of environmental protection and development, support in proposals writing for fundraising and different projects, etc.

2.6. Media

It is widely known that the media is relevant for forming opinions, and can influence the population in both positive and negative ways. As a consequence, it can be a very powerful tool, which needs to be used carefully.

How can the media collaborate to the environmental protection?

The media can be used to promote and support projects, to create awareness for the local community and other actors in contributing to the conservation of natural resources in LTW,

to introduce policies, strategies and guidelines, to active participate in the board composition of different projects, to support and facilitate environmental protection campaigns, etc.

2.7. Religious institutes

The religious institutes are respected and one of the most relevant actors in the region. They are also interested in contributing to environmental protection, aiming on the wellbeing of all community members. Other than that, they can use their traditional bylaws and religious rules to speed up the awareness level of the local community to protect the natural resources.

How can the religious institutes collaborate to the environmental protection?

For instance, the Orthodox Christian followers are not cutting trees within the churches area, and this rule applies for any site belonging to the church. In the Muslim community, it is believed that planting trees and planted trees provide services such as shade, and those planted trees will get religious value even after death. And even the local communities themselves, have developed local regulations, which will “punish” those who inappropriately cut trees or harm the environmental on purpose.

Moreover, the church members can also offer support by actively participating in environmental protection groups, and into raising environmental awareness of their followers.



3. Gaps and targets in awareness raising with stakeholders of Lake Tana Watershed

Stakeholder's engagement, behavioural change and knowledge management working group

In order to identify gaps and targets in awareness raising to bring behavioural change to protect the natural resources of LTW, a study was made by NABU Bahir Dar together with the Environment, Forest and Wildlife Protection and Development Authority, the Bureau of Agriculture, the Amhara Muslim Affairs office, the Bureau of Women, Children and Youth and representatives of the Amhara mass media.

Aiming to attain the objectives of this study, a series of interviews were taken with 74 participants of six different Woredas within the project's region, to determine their level of environmental awareness, and what would be the most effective way to influence them into adopting an adapted behaviour.

3.1. Current scenario on environmental awareness in the LTW

To find out the understanding level of the community and other partners, a questionnaire was applied to the respondents, with questions related to natural resources degradation and their benefits. From the total respondents, 79.73% have answered that the natural resources are decreasing along time, and most of them are acquainted with the benefits of the natural resources.

The respondents listed down the following advantages of natural resources:

- To protect from the climate change (rain on right season, normal temperature),
- To get enough clean water,
- To guarantee the presence of plants and animals that are under threat,
- To increase the beauty of the city,
- To protect from soil erosion,

- To increase the productivity of the region,
- To restore ecosystem services,
- To increase the amount of raw materials for the manufacturing sector,
- To secure an appropriate environment for human life.



Are the natural resources being depredated or are they improving/being restored?

Respondents	Frequency	Percentage
depredated	59	79.73
Improving/ restored	15	20.27
Total	74	100

Another question asked was to appoint the mostly depredated natural resources among water, air, plants and soil. As indicated in table 3, 36.49% responded plants, 33.79% chose soils, 28.37% thought it was the water and 1.35% answered air. In addition, they were asked to identify the most polluted resource, and the majority with 45.95% answered water, followed by soil, air and plants respectively.

Which natural resource are mostly depredate/ lost in your area?

Respondents	Frequency	Percentage
water	21	28.37
Air	1	1.35
Plant	27	36.49
Soil	25	33.79
Total	74	100

Which natural resource are you worried about mostly regarding its quality?

Respondents	Frequency	Percentage
water	34	45.95
Air	13	17.57
Plants	8	10.81
Soil	19	25.67
Total	74	100

Besides, the participants were questioned about the level of knowledge of the local communities on ecosystem services, and 54.05% of the respondents answered they were familiar with the term, while 21.62% said they were not familiar. This implies that most of the local community are not familiar with ecosystem services, and could make good use of awareness raising trainings.

Moreover, the respondents that were familiar with ecosystem services reinforced that they had no alternative other than to plunder the resources, since their sole income was depending on it. This emphasizes the need to introduce the concepts of sustainability, and feasible measures to minimize their negative impact on the environment while undertaking economic activities.

Are you familiar with the ecosystem services of natural resources?

Respondents	Frequency	Percentage
Familiar	40	54.05
Not Familiar	16	21.62
partially familiar	18	24.33
Total	74	100

Furthermore, another question was about their familiarity with moral and legal responsibilities to protect the natural resources. Concerning the moral responsibility, 32.43 % said they were familiar with the terms, meanwhile 37.83 % said they were not familiar. Regarding the familiarity of legal responsibilities to protect the natural resources, 43.24 % said they were familiar, 37.83 % said not familiar and 18.91 % said partially familiar.

Eventhosewhoarefamiliarwithlegalresponsibilities are not protecting the resources, because of lack of follow up and enforcement from the law by the responsible institutions. Other than that, they expressed the need for a detailed guideline to implement the laws. In addition, the majority of the participants indicated that they would be interested in taking part of trainings which would suggest new approaches for dealing with those topics.

Are you familiar with the moral responsibility to protect the natural resources, to use in a sustainable way?

Respondents	Frequency	Percentage
Familiar	24	32.43
Not Familiar	28	37.83
Partially familiar	22	29.74
Total	74	100

Are you familiar with the legal responsibility to protect the natural resources, to use in a sustainable way?

Respondents	Frequency	Percentage
Familiar	32	43.24
Not Familiar	28	37.83
Partially familiar	14	18.91
Total	74	100

Equally important, is the concern to transfer knowledge to the next generation, so that they are aware of the benefits of having preserved natural resources, and that they can properly asses a situation when those are being depredated.

The respondents were asked to list down the consequences of environmental degradation, as topics that they would like to pass to the next generation:

- Decreasing of biodiversity and soil fertility,
- Decreasing of the productivity of agricultural sector and soil fertility
- Decreasing of surface and underground water that can be used for drinking and irrigation
- Due of climate change, there will be unusual diseases for plants and animals, decrease of life expectancy, appearing of drought and desertification, increasing of flooding, migration of locals from usual residence, increasing of temperature, increasing of poverty, increasing of unemployment and lack of peace and security.
- Increasing of environmental pollution and invasive weeds

The respondents were asked to identify the existing negative behaviour of the partners that can affect the natural resources. They identified the followings:

- Harvesting firewood from the forest and producing charcoal for income generation,
- Selling cow dung for income generation that can be used as organic fertilizer,
- Disposal of waste and defecation inappropriate site
- Urban community are less active in natural resource conservation activities (such as trace building)
- Deforestation, destruction of soil and water conservation activities
- Private organizations are not actively participate in the natural resources conservation,
- Free grazing and participate in illegal fishing activities.

3.2. Methods to raise the environmental awareness in LTW

Based on the type of community or partners, there are different methods of awareness raising that can be used to change the behaviour of partners in environmental protection and conservation. The respondents asked if they know any methods of awareness raising that can be appropriate to LTW to change the behaviour of partners in environmental protection and conservation. They propose the following methods of awareness rising:

- Face to face continuous presentation to local community and other partners for the purpose of awareness raising on the benefits of natural resources, the existing situation of the natural resources, the existing regulations, the effect of using chemical to increase productivity. It will be also supported by Training of Trainers (ToT) to eldering, influential local community members, religious leaders, DA and Health extension workers, organized youth/women association, Edir leaders to reach to wider partners,



- Training to the local community supported by practice and experience share visit,
- Distributing promotional materials such as leaflet and manual (supported by pictures),
- Installing poster and signboards that indicates the benefits of the natural resources at the appropriate site,
- Use social media and TV (to urban community) and radio/FM (to rural community)
- Street show using vehicle in urban centre
- Video show on the past and the current situations of the natural resources including Cinema (theatre or comedy).

3.3. Which stakeholders should be the focus of awareness raising trainings?

The respondents requested to identify partners/ community groups that needs a positive change in behaviour to protect the natural resources. The followings are identified partners to protect the natural resources.

- Rural Local community
- Urban local community
- Community level organizations (youth associations, women associations and Local watershed committee at kebele level)
- School community (Primary and secondary students, teachers, staffs)
- ToT (religious leaders Elderly community members, Kebele administration, Natural resources experts health workers at kebele level, Judiciary/ police staff and experts in Woreda including (political leaders))
- Private sectors

In addition, the respondents were asked to identify those partners that can be in challenge to adopt more environmentally friendly measures. These partners may be those highly depend on natural resources as source income, those private sectors more sensitive to profit making and those youth groups who have no agricultural land. To address these problems, the respondents proposed:

- The need of enough and continuous awareness raising to the local community, private sectors and others
- Promotion of sustainable energy and creating optional income sources such as beekeeping activities to landless youths
- Coordination and collaboration among the stakeholders
- Implementing the existing rules and regulations related to natural resources protection.

3.4. Gaps in awareness raising program so far in environmental protection

Based on the table below 56.76 % of the respondents have participated in previous environmental awareness campaign trainings and each of them asked why the previous efforts of the government and developmental organizations in awareness raising were not so efficient in protection of the natural resources and they list down the following:

- Lack of follow up on those conservation related activities,
- Concerned bodies are reluctant and are not enforcing regulations such as fishing that will contributed to the natural resource's protections
- There is no continuous training /awareness raising on different levels
- Awareness raising training was not focused to activities that bring behavioural change, the training was not provided on the right time and not supported by practical training
- Focusing to rehabilitate affected ecosystems, and failing to preserve the ones that are in a good situation
- Lack of adequate inputs that can be used to protect and preserve natural resources
- There are traditional laws and religious rules that can contribute to protect natural resources. The concerned are not fully implementing these laws and rules,
- Duplication of roles and responsibilities

between agricultural and environment offices

- Lack coordination and collaboration among stakeholders, not have incentives mechanism for those contributed to the natural protections
- Not using properly the existing sub watershed committee at kebele level and school communities,
- Not supported by incentive mechanism for those contributing to the natural resources contribution,

- Evaluation and monitoring mechanism/system not applied fully.

Participation in previous environmental awareness campaign training

Respondents	Frequency	Percentage
Participated	42	56.76
Not Participated	32	43.24
Total	74	100



3.5. Effective awareness creation materials for LTW partners

Based on the results of the interviews, the most useful materials to influence positive change in LTW towards the natural resources were mentioned, and they are:

- Leaflets, supported with visual content,
- ToT training manual,
- Banners,
- Posters,
- T-shirts and capes,
- Regional Newspapers,
- Video clips to show to rural community.

In addition to the above proposed, the following communication media will also be used to promote environmental awareness:

- Personal explanation: at churches and mosques, edir meeting, organize farmers day, using existing meeting/workshop by organizing special events. This can be done by youth associations, religious leaders, elderly, school teachers, natural resources experts at different level
- Broadcast using weekly radio program and TV to promote natural resource conservation
- Use open market /health centre and other public gathers to present video clip or music
- Social media.

The respondents recommended the following times of the year as optimal to make an awareness-raising campaign for rural and urban community:

- ToT training: from September to November
- Rural community: from January to April
- Urban community: Anytime of the year, with preference on Sundays.

3.6. Major stakeholders and recommendations for environmental protection

When asked which stakeholders played the most important roles towards the conservation of the natural resources of the LTW, the participants brought up the following actors:

- Woreda level sector offices: to facilitate the implementation and to use as ToT : Woreda Agriculture Office; Woreda Environment Protection and Land Administration office; Woreda women, Children and Youth office; Woreda Communication office; Woreda mining, energy and water office; Woreda and kebele administrative office; Woreda Fishery and Livestock office, Small and Micro Enterprise office, Judiciary and Police
- Community level ToT trainers: religious leaders, organized youth group, organized women group, elderly people , Kebele administrator
- School community
- Private sectors and developmental organizations to support financial and technically
- Mass media
- Research centres and universities
- Micro banks
- Ethiopian Electric and power authority

Last, but not least, the respondents were requested to give general recommendations for further improvement of the conservation of the natural resources in the LTW. Among them, the most cited were:

- Give continuous awareness raising training to the local community and partners
- Take the experience of Diredawa to plant trees on the main streets of urban centres
- Install permanent signboards that indicate the need of planting trees, and conserving natural resources, especially in urban centres
- Prepare appropriate waste disposal site in urban centres
- Focus on developing nursery sites owned by youth groups, plant seedlings and take care of planting trees
- Bring and promote alternative and environmentally friendly technology such as solar energy for cooking and pumping
- Identify the existing legal gaps on the law and its enforcement
- Encourage the private sector to actively participate in environmental protections activities
- After rehabilitated, the sites should pass the use right to private sectors or to local community to guarantee the preservation of the restored ecosystem
- Organize and support the local watershed committee
- Encourage the communities to benefit sustainably from the resources that are protected and conserved by them
- Develop a conservation plan with the participation of the beneficiaries
- Support environmental clubs in the school
- Encourage the private sector to contribute financially in environment protections activities
- Promote technologies that use water wisely
- Promote alternative income sources to decrease the economic dependency on agricultural activities
- Promote plantation around churches or sites owned by churches





PART THREE

1. Developing a plan for a sustainable use of the natural resources of Lake Tana Watershed

TARGET GROUP: children, young adults, families, civil society

1.1. Introduction of the practical exercise

After the trainer makes the presentation of the content of this manual, the participants are expected to be ready to put their recently acquired knowledge into practice.

An exercise should be proposed, where they will be able to reflect on their own impact in the environment, and to think about what they expect for the future of their region.

An overview of the time frame and structure suggested for this activity can be seen on page 74.

Before starting the actual exercise, a **“warm-up”** activity should be introduced. The trainer should hand on a paper with the questions proposed in Annex 1, and ask for the trainees to write down their reflections.

Their answers shall not be shared with the rest, and this shall be explained as the individual internal reflexion is the first step into creating physical change.

Before starting the exercise, the trainer can give a small introduction to the exercise, and present shortly an overview of steps 1 to 9 with their titles.

1.2. Description of the material needed

For the exercise, the following materials will be needed:

- Prepared papers with an information sheet about the project and the training, the warm-up questions, some sheets to write down notes (see Annexes)
- Pens, pencils and eraser should be provided (if possible, with the NABU logo)
- Big cardboards (in different colours)
- Tape for fixating the cardboards on the wall
- Adhesive note papers in different colours
- Markers/chalk for the trainer to write on blackboard/cardboard



- NABU T-shirts and caps for the trainers (if possible, with NABU and water for life logos)

1.3. The 9 steps of the sustainable use plan

Understand your role in the system

To better comprehend the complexity of the behaviour impact on the environment, firstly the participant has to understand which role he/she/or their work sector plays in the system. In order to do that, the trainer can suggest that the participants divide their selves in groups according to their main activity segment (agriculture, industry, government, community, etc.), or region (Kebeles). It is important to keep in mind to encourage women to take the lead into representing their communities.

The trainer should draw a rectangle on the blackboard (or bring a cardboard/something that can be written on, and hang in the wall) and make the following table.

Example of the board the trainer should present to the participants of the training:

Sector	Role (what I/we think)	Role (what others think)	Consensus
Agriculture	*Grow crops /produce food/etc.		
Community (civil sector)	*Assure the livelihood of the community/ etc.		
Industry	*Produce material goods/ products for the other sectors		

*Those are only examples, and should not be presented to the participants

Then, the participants should receive the adhesive note papers (the trainer should try to address different colours to each of the different sectors/groups), and should write three of the roles they develop. (This part should take max. 5 minutes)

After the groups are ready, the trainer should glue

their notes into their respective square in the board. Now, is the time for the others to assume roles to the other sectors. The trainer shall start with the firstly written sector on the board, and ask to the other groups to come up with three suggestions that were not mentioned by the group itself. He/she should act as a mediator, and if a suggestion arises in a rather aggressive/unfavourable way, it should be politely refused by the trainer (even if he/she feels it is relevant. There is no beneficial outcome when negative feelings are generated between the participants). The trainer should write three suggestions in adhesive notes himself, and glue it to the board (This part should take max. 10 minutes).

The third part consists of the trainer asking the sector group, which roles are they willing to assume, based on their suggestions and the ones proposed by the other groups. They should shortly discuss it internally (max. 5 minutes), and then present their last and final three main roles. The trainer should write them down and attach to the board. There will be no discussion about this theme after this point.

1.3.1. Step 1: Setting the vision

A vision statement provides a concrete way for the participants to understand the meaning and purpose of the campaign. Vision statement describes the desired long-term results of the programme's efforts, and it shows their highest hopes to be achieved in the long-term.

There are certain characteristics that most vision statements have in common. A good vision statement should be:

- Understood and shared by members of the community,
- Inspiring and uplifting to everyone involved in your effort,
- Easy to communicate - for example short, simple, specific to the intended programme or project, leaves nothing for interpretation.

This exercise can be done individually, and the trainer can hand over small blocks of paper that are self-adhesive, and everyone can add different concerns about the themes: nature, natural resources, economy, population, region development, etc. An example of a concern can be: "loss of wetland for agriculture", or "water hyacinth infestation" (this part should take max. 5 minutes).

After a “board” with all concerns is ready, the participants will build together more elaborated visions, such as: “Rehabilitated and well-managed wetland in _____ Kebele by the year 2025”, or “Significant reduction and control of water hyacinth in the region _____ by the year 2030” (this part should take max.15 minutes).

1.3.2. Step 2: Setting objectives

Objectives are specific and measurable statements of what you hope to achieve within your project time. It represents your assumption as to what you need to accomplish and as such, become the measuring stick against which you will gauge the progress of your project. Objectives can be stated in terms of reducing the status of a critical threat, enhancing or maintaining the status of key ecological attributes of focal targets, securing project resources, and/or the outcomes of specific conservation actions. Projects will have multiple objectives. Ideally, realisation of all the project's objectives should lead to fulfilment of the project goal. It is important to set good objectives, as they build the foundation for selecting strategic actions in which to invest and for determining the effectiveness of those actions.

A good objective meets the following criteria defining a “SMART” objective:

- Specific - What exactly does the sector/community want to achieve? The specific outcome to be accomplished needs to be described in clear enough terms that all people involved in the sector/community have the same understanding of what the terms mean.
- Measurable - Is it measurable? The objective needs to be defined in relation to some standard scale (e.g. numeric, percentage, fractions, or all/nothing states) to allow progress to be measured.
- Achievable - Can it be done in the proposed timeframe within the social and political context of the sector/community and with available funds? The objective or expectation of what will be accomplished must be realistic given the market conditions, time period, resources allocated, etc.
- Relevant - Will this objective lead to the desired results? The results need to be impact oriented and represent the necessary

changes in key ecological attributes, critical threat factors, or project resources to achieve the project goal.

- Time limit - When will the objective be reached? This means stating clearly when the objective will be achieved.

At this point, the participants could be divided into groups according to their most prominent sector/or community (5 persons in a group is the ideal). The trainer can suggest that each group come up with 5 objectives for their specific sector. The results shall then be shared with the other groups (this part should take max.10 minutes, when the extra activity is done).

-> An extra activity in this topic could be performed, depending on the time and relationship of the participants. After the presentation of the objectives, the groups should comment on each other's objectives. The goal with this exercise is to understand the point of view from other sectors about their priorities/real goals (this should take max.10 minutes).

1.3.3. Step 3: Assessing the natural resources of the region

The first part of this step will be to develop a natural resources inventory, which encompasses information that can be used to know about current conditions of the natural resources in the community. It is a meaningful record of all existing resources and essential to have baseline data for comparison after 2 to 3 years, to measure the result of the intervention.

The inventory will focus on identifying key plant and animal species, water resources, soil resources, landscape, wildlife habitats, minerals, etc. The participants should be handed out a paper (Annex 2), with different natural resources.

In groups, they should fill up so many characteristics as they can for each category (this part should take max. 10 minutes).

After that, they should write on the side which resources are directly affected by their activities (from sector, and individual) (this part should take max. 5 minutes). They will have 2 minutes each to present it to the other groups.

1.3.4. Step 4: Analyse the condition of each sector on natural resources using the SWOT analysis

Understanding the existing condition of the natural resources will help in designing the solution to the threats that are affecting the resources. The existing condition will be analysed using SWOT: Strength, Weakness, Opportunity, and Threat.

Each one of those categories should be applied by the different sectors present towards the environment, as illustrated in the figure below.

The Annex 3 could be used as a support for this activity.

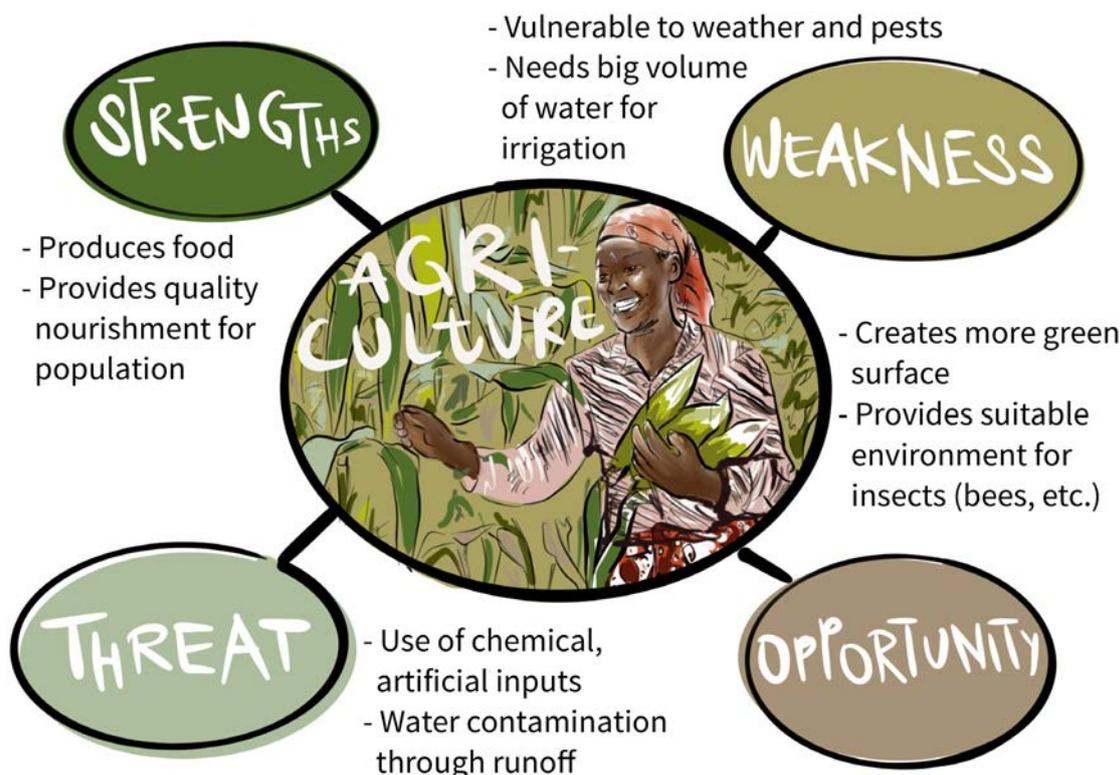


Figure 28. Example of SWOT analysis in agriculture

1.3.5. Step 5: Develop conservation strategies

Based on the SWOT analysis, major threats or strategic issues are identified. From that, conservation strategies are designed to conserve the natural resources, followed by specific actions to each of the strategic issues.

Using the same paper, the trainer should ask the participants to write on the rectangle on the bottom of the page what they would propose to improve their sustainability (it is important that the trainer uses this word, to train the concept that was introduced earlier).

1.3.6. Step 6: Develop an action plan

An organisation's action plan describes in great detail exactly how strategies will be implemented to accomplish the objectives developed earlier in this process. It lists all activities that will be implemented to accomplish the objectives or to conserve the natural resources of the Kebele.

The action plan is typically developed by the planning core team, which may be community representatives, and agricultural and natural resource experts of the Kebele. The plan should include the following:

- List of activities that should be done to accomplish the objectives.

- Define who will be responsible to do specific activities.
- Determine when specific activities will take place.
- Estimate resources required by specific activities.

This activity should be made in the same groups, and the participants can use the table in Annex 5 to fill up the plans.

-> Before giving the participants time to work on the activity, the trainer should read out the guiding principles and values described in Annex 4, and invite the participants to take a moment to reflect on them.

1.3.7. Step 7: Generating a spreading network or monitoring and evaluation – should be applied differently

This step should be applied differently depending on the number of trainings the participants have taken/or on their previous knowledge about environmental conservation.

In case it is the first time/contact:

The participants should create together a message that will be taken on forward to other colleagues, family, friends, etc. This should be done through a democratic procedure, and the trainer shall act as a mediator. Example of a message: “sustainability is not only advantageous for the environment, but also for saving money and resources, while guaranteeing that the future generations will be able to profit from nature”.

After the message is created, the participants should divide their selves again in groups, and create a network for broadcasting the message they just developed together. They could use the document in Annex 6 for support.

In case this is not the first time:

Monitoring means continuous checking if the activities are exercised according to plan, and learning from successes or identifying and addressing problems. If this is not done in time, a problem can just grow and eventually prevent reaching the desired objectives. Successes on the other hand can be used to make things better in the

future and may even be helpful in addressing some problems. Participatory monitoring is used to:

- Check how far all stakeholders including communities implemented their plans,
- Learn from successes,
- Identify and address problems/issues on time, and
- Use the successes to learn how to do things better in the future.

While evaluation is more common at the end of a certain programme, or after certain periods, it may be monthly, quarterly, or annually. During evaluation, partners will be participating. During project period, outputs will be similar to monitoring.

Based on the outputs of monitoring and evaluation, there are lessons learned and successes, as well as outputs and outcomes of the intervention. Each result of the project or intervention should be documented. This will be used to share with others and to do things better in the future.

The participants can use the support document in Annex 7 to answer some relevant questions about their change of behaviour, and should share with the other participants.

1.3.8. Step 8: Final Discussion

The trainer should present the main goals of the campaign again, and ask the participants if they have completely understood the main concepts presented in the training, if they feel like they can change some actions that can be harmful to the environment, and how, and what did they think of the training in general. If they have questions, this is the most appropriate moment to be asked.

At this point, the trainer can thank the participants for coming, and support the engagement of the stakeholders in a friendly discussion about the content of the training.

Overview of the main training activity

# Step	Time (minutes)	Material	Structure of participation
Warm-up	10	Print out of Annex 1 , pens/pencils/eraser	Individual
Understand your role	20	Blackboard/Cardboard, Chalk/Marker, Adhesive paper notes, pens/pencils/eraser	Groups/All together
1	20	Blackboard/Cardboard, Chalk/Marker, Adhesive paper notes, pens/pencils/eraser	Individual/All together
2	10 (+10 optional)	Nothing	Groups/All together (optional)
3	25	Print out of Annex 2 , pens/pencils/eraser	Groups
4	20	Print out of Annex 3 , pens/pencils/eraser	Groups
5	10	Same as Step 4	Groups
6	10	Print out of Annex 5 , pens/pencils/eraser	Groups
7 a)	10	Print out of Annex 6 , pens/pencils/eraser	Individual/All Together/ Groups
7 b)	10	Print out of Annex 7 , pens/pencils/eraser	Individual/All together
8	20	Paper for taking notes	All together
Total	165 minutes (2h45min)		

1.4. NABU Monitoring of the training outcome

It is important that the outcomes of the behaviour change campaign are measurable. A structured list of the main sectors from the LTW stakeholders can be seen in the Table below. As an indicator for the repercussion of the campaign, it is expected that at

least 75% representatives of the sector groups use their communication channels until the end of the project (2022) to inform the inhabitants of the LTW on their sustainability improvement measures, and report them at the Water for Life annual conference.

Main sectors of the LTW stakeholders and their influence in the region and its natural resources/interest in environmental conservation

Sector	Influence/Interest
National administration	
Regional administration	
Zone administration	
Woreda administration	
Kebele administration	
Local communities	
Civil society	
Private sector	
Religious authorities	
Research institutions	

2. Games to Raise Awareness about Decreasing Natural Resources

Adapted from the "Lake Tana Biosphere Reserve day manual".

TARGET GROUP: children, young adults, families, civil society

2.1. Decrease of Biodiversity - Insect search/tree shaking game

Background

Insects are very important for a functioning ecosystem. They pollinate crops and fruit trees and serve as food for birds and other animals.

Different tree species are inhabited by different insect species. Most times, exotic tree species are inhabited by much fewer species than native species.

Preparation

- Looking for an area with at least three different tree species, at least one should be native to Ethiopia (non-ornamental tree)
- White cloth of about 1 m x 1 m
- Paper and a pen for the team leader

Method

- Take your group of participants to a tree.
- Let two members of the group hold the cloth spread out under a branch of the tree.
- Let everyone/groups estimate how many insects and spiders will be found on the cloth. Write down the estimated numbers.
- Let someone shake the branch. Let one or two group members count the number of animals on the cloth, while two others hinder the animals to creep off the cloth.
- Write down the number and compare it with the estimated numbers. Declare the group member(s) as winner(s) who have estimated best.
- You can also not only count the numbers of animals, but also the number of species, the members of the group can differentiate. This



will give them a feeling what biodiversity means.

- Then go to the next tree species and do the same. Repeat it with the third tree species.
- Discuss the results:

Are there differences between the tree species?

Tell them which tree species are native and which are not native. Let them discover the difference concerning the insect number found.

Tell them about the importance of insect species for crops and fruit trees.

Tell them about the importance of insects as food for birds, and that Lake Tana is a biosphere reserve and major tourist destination because of its many bird species.



Learning outcome

Getting a feeling for how many insects live in the surrounding.

Seeing the importance of trees for insects.

If there are native and exotic species: learning about the importance of native tree species.

Learning what biodiversity is and why it is important.



2.2. Decrease of Biodiversity - Leaf collecting game

Background

Plants are the base of food webs, animals depend on plants. Many animals feed on a single or on few plant species, therefore plant diversity is the reason for animal diversity. Many plant species also have functions for humans: As food, medicine, fuel, carving wood, nutrition for bees, home for helpful birds and insects, etc. Plant species richness also means a beauty to look at. Overall, there are many reasons why biodiversity of plant species is desirable.

Preparation

- Look for one or two areas you want the group members to explore. That may be communal land, a roadside greenery nearby, church forest (ask priest first!), or some other kind of public area. Make sure that there is no extremely poisonous plant in the area (otherwise mark it and explain to the students not to touch this one).
- A paper and a pen for the group leader, a clock or mobile phone to take the time.
- If needed, something to mark the limits of the chosen area.

Method

- Divide the group members into groups of two to six each. Show them the boundaries of the game.
- The aim is to find as many plant species as possible, but to respect plants and only take one leaf as a proof of their finding. Each species counts one point, each species brought twice in one group counts minus two points, exceeding the boundary of the marked grounds counts minus five points. That means that the group members within one group have to compare within the group if they have already taken this species before picking a leaf!
- Give them a time limit of six to ten minutes, depending on the size of the marked grounds. Let them start in the middle of the area (otherwise groups will follow each

other).

- When the time runs out each group spreads its findings on an open piece of ground. The group leader, or one of the other groups, looks for duplicated species and counts the points. Write down the winner and the number of species found.
- If the aim is to compare two different areas, repeat the game at the second area
- Discuss the results:

Would the students have thought that the number of plant species is that high (or low) in the explored area?

What does the result mean for them? Are there nutritional plants among the species found? Flowering plants with insects (e.g. bees)? Tree or grass species preventing soil erosion? Plants looking nice or interesting?

If two areas were compared: Which area is more diverse? Which area do the group members like more and why?

Let the group members wash their hands after the game (in case of poisonous plants)!

Learning outcome

Training observation skills and team work.

Getting a feeling for how many plant species live in the surrounding.

Different plant species serve for different purposes in nature.

If you have compared two areas: getting an impression of how areas with different plant species diversity look like.



Things to remember

If two or more areas are compared, you can also play the game in a more scientific way: If the explored area has the same size each time (e.g. 50 m x 50 m), the number of species found can be taken to characterise the habitat. By this, group members can find out the most and the least diverse kind of habitat in their surrounding and discuss the

reasons of the species number. This might also lead to the protection of the most diverse habitat by the group members (keep in mind that there are also some habitats like wetlands which are not rich in plant species, but nevertheless very important for nature conservation because of their animals or their special features).



2.3. Decrease of Biodiversity - Food web game

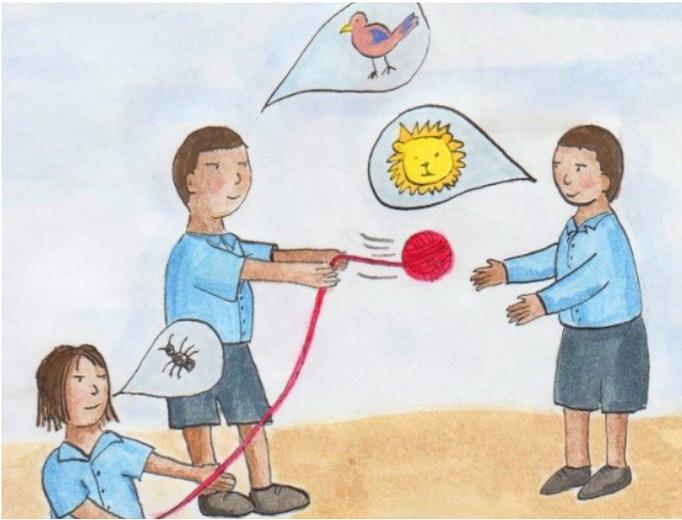


Figure 29. Food web game

Background

Everything is connected in nature! We all eat and live in the same space. This game helps children to think of how the plants and animals are connected and depend on one another.

Preparation

- A ball of string
- A piece of paper for each member of the group (optional)

Method

- Ask the members of the group to make a list of animals and plants that can be found around them and ask them to choose one each. The members of the group can either write or draw their chosen species on a piece of paper. If you have no paper, the students can just say the name of the species (or act it out).
- Ask the members of the group to think of ways their species might be connected with each other. Producers like plants need the nutrition that is provided by the bacteria. Herbivores eat plants. Carnivores eat other animals as prey.
- Have the members of the group stand and hold the piece of paper with their species on it. Have one student read the species on his/her piece of paper and then toss a ball of string to plants another member of the

group, keep on holding the end of the string. Have the member of the group (that was throwing the ball of string) state how his/her species is connected to the one holding the ball of string now (e.g. the leopard is connected to the grivet monkey because it is its prey). The member of the group holding the string tosses the ball now to someone else, still holding onto a piece of it. Continue the exercise until everyone has caught the ball of string and is now holding a piece of it. Have the last student throw the ball of string back to you.

- You should now have a representative 'web' of strings with every member of the group holding a species and a piece of the web. Have everyone pull the string so the web is taut. Tug on your piece of the string and ask if anyone felt the tug. Have some others tug on the string and see who else feels it. Ask what that tug might stand for. The tug can stand for disturbances like deforestation activities by humans or more heavy weather due to climate change. You can ask some members of the group to sit down, representing that the species has gone extinct. Ask what impact this has on the other species. Ask the members of the group where humans should go in the web.

Learning outcome

In nature everything is connected and depends on everything else. If one species is lost, the web will become unstable and at one point even collapse. We are a part of that net and need it for our survival. It is therefore important to conserve biodiversity and ecosystems for us and for future generations.



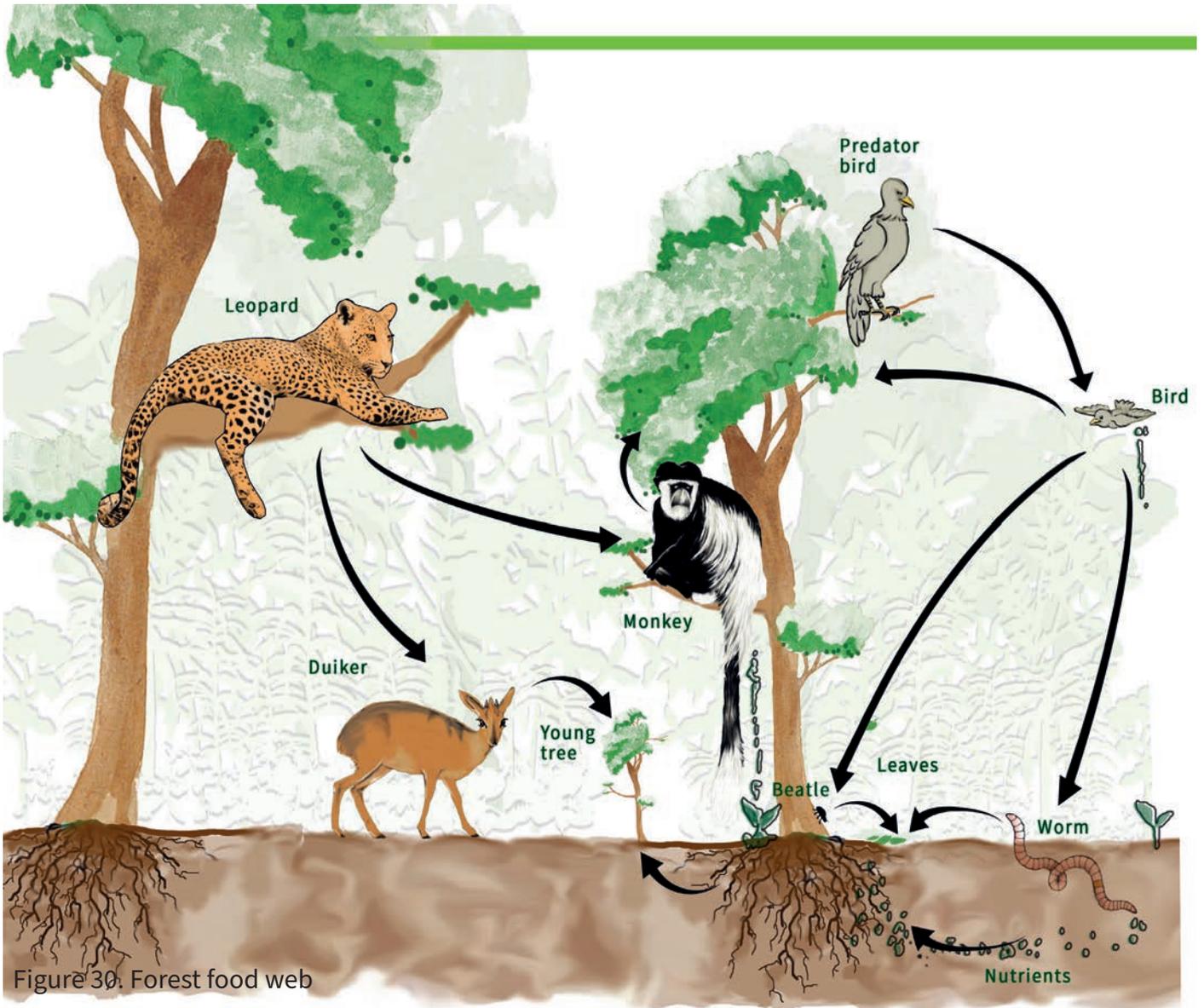


Figure 30. Forest food web



2.4. Overgrazing - Area closure game



Figure 31: Area closure game

Background

Overgrazing occurs when plants (e.g. grass) are disturbed in their growth by cattle. When there are too many animals on a small area, the plants cannot recover fast enough after they got eaten. The dying of plants has a big impact on the ecosystem, overgrazing reduces biodiversity and productivity and is one cause for desertification and erosion.

Preparation

- Find an area (communal land) that the local community often walk on.
- Fence in a small area on communal land.

Method

- Let the local community mark another area that the local community often walk on, but do not fence it!
- After 3 to 4 weeks, let the local community compare the different areas and the impacts on the plants (in the fenced area the plants will be probably grown and recovered).
- Discuss the results:

You could also fence a larger part of the communal land permanently and document the progress with different groups of the local community. How long does it take until the first trees grow?

Learning outcome

The local community learns that restricted areas have a positive impact on plants. For a sustainable agriculture it is very important to have restricted areas to let the plants grow and recover.



2.5. Soil erosion - Experiment on soil erosion



Figure 32: Experiment on soil erosion

Background

Soil erosion is a massive challenge for the Lake Tana Watershed (LTW) as rain on bare earth washes away the top layer of the soil. With this simple experiment you can show your local community members the different effect rain has on bare soil and on soil which is covered by vegetation. Thus, your local community members can learn why vegetation is important to prevent soil erosion.

Preparation

- Provide the materials before starting the experiment. You will need dry soil, a bucket of water/watering can and litter/straw.
- Find a place to conduct the experiment, like a table, so every member of the local community can see properly

Method

- Let the local community make two hills of dry soil.
- Cover one of the hills with the litter or straw, let the other one bare.
- Let another student pour water first over the hill with bare soil, then over the covered hill.
- Discuss the results:

What was the difference between the two hills? And why?

Learning outcome

Open soil results through overgrazing.

Rain can easily wash away open soil which leads to erosion.

Through erosion the fertile soil gets lost which leads to problems for the farmers.

The rain washes the soil into Lake Tana, where it causes negative effects for plants and animals.

Plants hold the soil with their roots and therefore prevent it from erosion.

Things to remember

The experiment can also be conducted with existing hills on the school ground. Keep eyes open for hills with and without plant cover.



2.6. Siltation - Water bottle experiment

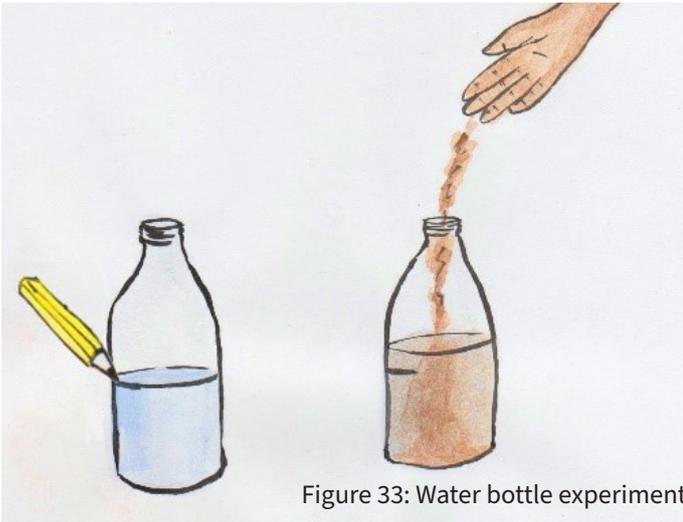


Figure 33: Water bottle experiment

Background

Siltation or silification describes the pollution of water by dissolved soil and is often caused by soil erosion.

As a result of deforestation and intensive agriculture, the soil loses its stability and is floated away by rain. Rivers and lakes fill up with soil which has a significant impact on the ecosystem. Muddy water does not let enough sunlight through and the plants cannot grow. Therefore, the food for fish is missing, causing a decrease of fish population. The water level increases and farmers next to the lake lose their land. Lakes become shallow and can dry up completely.



Preparation

- Dry soil
- Two water bottles (transparent)
- Pen/marker
- Water

Method

- One member of the local community fills both water bottles with the same amount of water and marks the water level.
- Another member of the local community puts a handful of soil in one of the bottles.
- Now the members of the local community can compare the clean water and the water containing soil.
- Let the members of the local community develop a chain of siltation effects.
- Discuss the results:

What are the consequences of siltation?

Learning outcome

The members of the local community see how water becomes cloudy and is displaced through the addition of soil, which symbolises the effect of siltation.

Through discussion they learn that siltation is often caused by soil erosion and has negative consequences for the environment.

These consequences can be serious and include the loss of fish and farming land next to the lake and the drying up of the lake itself.

To prevent siltation, it is necessary to reduce soil erosion by planting trees and exercising sustainable agriculture with less cattle and protected areas.

2.7. Overfishing - Running game



Figure 34: Overfishing - Running Game

Background

Fish stocks in Lake Tana are rapidly declining. Unfortunately, there is a threat that in a few years no (edible) fish will be left, although people still have to live from Lake Tana's resources in the future. There are many reasons for the decline of fish population. Apart from the increasing silting caused by sediment input and eutrophication, illegal fishing is an important factor. Traditional nets catch too many small fish and interfere with reproduction. This game clearly illustrates how the fish population in Lake Tana develops under different conditions.

Preparation

- Select the site (area) to race and play tag
- The game has two to three different phases, each 10 to 15 minutes: Phase 1, Phase 2, Discussion

Method

- Mark a limited playing field.
- Two of the members of the local community are the fishermen, the others the fish (ratio 1:10).
- The fishermen try to catch the fish. Whoever has been ticked must stand still and count to 30, during this time he/she is out of the game. After that, he/she may play again (symbolising the reproduction of fish).

- The game can be continued forever with only two catchers, since all fish may play again after a certain time.
- In Phase 2 the number of fishermen is massively increased, e.g. to 10 (minimum ratio 5:10).
- The fishermen try to catch the fish again and they have to stand still again for 30 seconds when ticked. Most likely there will be no fish left to tick after a short time.
- Discuss the results:

What are the consequences of catching too many fishes?

It is important to have a short discussion about the consequences after both phases of the game, so students can find out for themselves what happens when the pressure from fishing is too massive (no fish left!).

Learning outcome

The game makes it quite easy for local community members to learn how sustainable fishing works and which consequences a high hunting pressure can have on fish stocks. By moderating the game, the local community members realise that the fruits of the lake must be used sustainably if they want to continue to benefit from them in the future. They learn that every fisherman also has a responsibility to ensure that he/she (or his/her children) will still be able to catch fish from the lake a few years later.



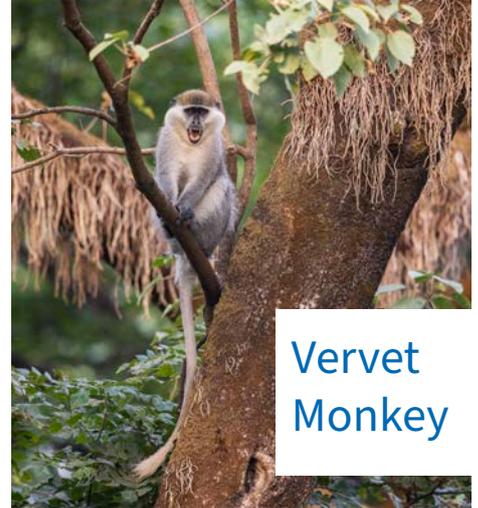
3. Knowing the Regional Biodiversity - Species Guessing Game

TARGET GROUP: children, young adults, adults, families, civil society

Silvery-cheeked Hornbill



Vervet Monkey



Yellow Fronted Parrot



African Fish Eagle



Duiker



Hyrax



Annex 1

Print-out for activity (1.1 Warm-up)

Kebele: _____

Name: _____

Date: ____/____/____

Questions for individual reflexion

1. What do you know about the situation of the natural resources in your area in the past?

2. What is the situation of the natural resources in your area like today?

3. What are the reasons for these differences?

4. What do you expected from the local community and other partners to rehabilitate the resources and pass them to the next generations?

5. What are your main concerns about the natural resources in your area? Who has a direct influence on it?

Annex 2

Print-out for activity (1.3.3. Step 3)

Kebele: _____

Group: _____

Date: ____/____/____

Soils

- o Types of soil

- o Condition of soil erosion and gully sites

Plants

- o Existing types and amounts of plant species

Animals

- o Existing types and amounts of animal species (mammals, fish, birds, amphibians, reptiles, insects)

Water resources and related data

- o Groundwater amount and quality

- o Lists and amounts of surface water (streams, lakes, ponds, rivers)

- o The quality of water bodies

- o Wetlands

- o Flood plains

- o Watersheds

Wildlife habitats

- o Significant biodiversity areas

- o Forests

- o Grasslands

- o Shorelines

Landscapes

- o Condition and amount of landscapes

Minerals and construction materials

- o Condition and types of existing minerals and construction materials

Annex 3

Print-out for activity (1.3.4. Step 4)



Print-out for activity (1.3.5. Step 5)

How to increase your sustainability?

By strengths: _____

By weakness: _____

By opportunity: _____

By threats: _____

Annex 4

Supporting document for activity (1.3.6. Step 6)

Guiding principles

- Involve all relevant stakeholders including marginalised groups within the community.
- Create local ownership by ensuring the process is understood by all stakeholders.
- Develop a common vision based on consensus by all relevant stakeholders.
- Be aware of policies and laws that might impact on the process positively and negatively.
- Use and build on existing structures and institutions, e.g. appropriate government structures.
- Be sensitive to the community's seasonal and daily calendar.
- Seek to enhance traditional natural resource management systems by building on local indigenous knowledge.
- Encourage active community participation and ownership.
- The process should promote the culture of learning by doing.
- Ensure the process is empowering and devolves power to the people.
- The process should aim at providing added value to the community by responding to natural resource management and livelihoods.
- Be able to incorporate quick actions for quick benefits.

Guiding values

- Practice fairness with all stakeholders.
- Have respect for others by being tolerant to other people and their views.
- Be open, transparent, and credible.
- Be sensitive to culture and gender.
- Be simple yet professional.
- Have fun in the process.
- Be committed to the completion of the planning phase.
- Take responsibility for furthering the process.

Annex 5

Table for developing an action plan (1.3.6. Step 6)

Kebele: _____

Group: _____

Date: ____/____/____

#	List of activities/actions	People responsible	Schedule	Required resources
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Annex 6

Supporting document for activity (1.3.7. Step 7a)

Kebele: _____

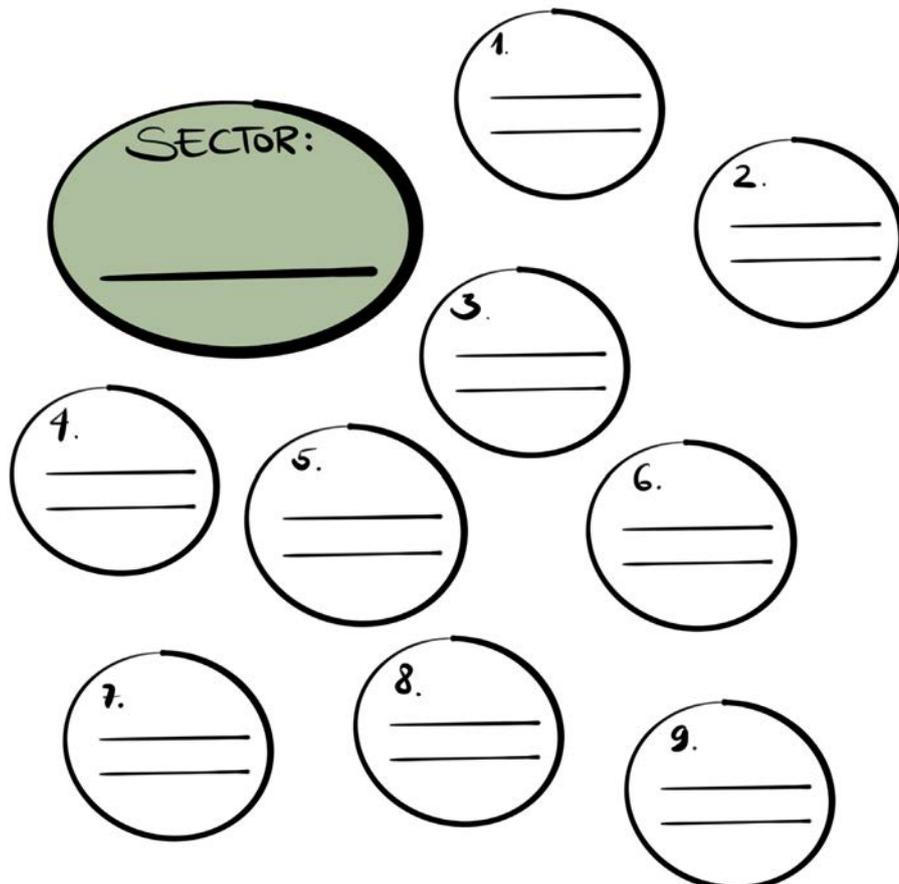
Group: _____

Date: ____/____/____

Step 7.a) Creating resonance

Message to be passed on:

To whom? How are they connected? Can you make a concrete suggestion on how they can increase their sustainability?



Annex 7

Supporting questions for activity (1.3.7. Step 7b)

Monitoring and Evaluating

1. Which actions did have a positive outcome? How would you explain the success of the implementation?

2. Which actions did have a negative outcome? Why?

3. Were there any surprises by implementing the planned actions? Were they positive or negative?

3.1. If they were negative, what could have been done differently to make it work?

4. Would you suggest new actions to be implemented for increasing the sustainability of your sector?

4.1. Which ones?

5. What kind of repercussions did your actions generate among other colleagues of the sector?
Were they mostly positive, or negative?

5.1. Would you recommend your colleagues to implement the same actions as you?

6. Which natural resources were mostly affected by the change in your actions?

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