



TEACHING BIODIVERSITY

MODULE FOR THE INTEGRATION OF BIODIVERSITY, NATURE
CONSERVATION AND CLIMATE CHANGE IN SCHOOL CURRICULA
IN THE KAFA BIOSPHERE RESERVE, ETHIOPIA



Imprint

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Key notes



Kafa Zone Department of Education
Akililu Woldemichael Bulleto
Head of Department

Dear ladies and gentlemen,

Our students in Kafa as upcoming generation have to play a vital role in all aspects of sustainable development. In order to implement, realise and achieve the intended goal of sustainable development, educational material for all school levels needs to be enriched with additional and reference resources.

NABU, as partner of the Kafa Zone Department of Education, developed this valuable booklet on biodiversity, conservation and climate change particularly for school curricula.

Ethiopia is experiencing the effects of climate change. Besides the direct effects such as an increase in average temperature or a change in rainfall patterns, climate change also presents the necessity and opportunity to switch to a new, sustainable development model.

The Department of Education finds NABU's module very important and wants to see students of Kafa Zone well equipped with knowledge on community-based conservation management and sustainable development concepts for our unique forest landscape. The booklet shall be distributed to sample primary schools and hence uniform information sharing in terms of topics, issues and extent for teachers and students.

Thank you for cooperation!



The Nature and Biodiversity Conservation Union - NABU
Svane Bender-Kaphengst
Head of Africa Program

Dear teachers, dear students,

What does biodiversity have to do with your school? Isn't it more important to learn about maths, and how to read and write?

Well, we are all part of the global biodiversity and depend on a functioning environment providing us with air to breathe, water to drink, and food to survive. Each and every tiny plant, animal or other organism takes a place in this system. When it disappears, the whole system will deteriorate until it might collapse, leaving us without water and without food... Doesn't it therefore sound logical that we need the essential knowledge in order to care about our environment and its fascination diversity? Shouldn't we make sure not to destroy what has been given to us as the basis of our life?

For over a hundred years, NABU (The Nature and Biodiversity Conservation Union) has been promoting the interests of people and nature, drawing on its unwavering commitment, specialised know-how, and the backing of about 600,000 members and supporters. One of NABU's major aims is conducting environmental education, which is why it runs more than 70 environmental education centres in Germany. It also hosts its own youth organization, NAJU, bringing together 80,000 children and youngsters. NABU is the German partner of BirdLife International and closely cooperates with its BirdLife partners around the world.

This manual is designed to provide you with an overview of the complexity of biodiversity, nature conservation, and climate change. It will assist you in understanding each subject and in passing your knowledge. A wide range of formal and non-formal teaching material is at offer for your use. In teaching biodiversity and related matters, you will become an ambassador for the environment!

I would like to thank all teachers and students, our partners at Kafa Zone's Department of Education, our NABU team in Bonga and Ms Stefanie Gendera for contributing to the development of this wonderful Manual.

Enjoy and make use of it!



Introduction

Ethiopia is one of the most species-rich countries in the world. The montane cloud forests of the Kafa Biosphere Reserve in southwest Ethiopia are considered to be the origin and centre of *Coffea arabica*'s genetic diversity. They are also home to many rare species. Together with the area's numerous wetlands, they form a carbon sink of nationwide importance. However, studies have shown that their habitats are threatened by overexploitation and climate change.

NABU is supporting Kafa Zone for the conservation of the natural environment and beautiful biodiversity with financial support from the German government since 2006. The module has been developed with NABU's project 'Biodiversity under climate change: Community-based conservation, management development concept for the wild coffee forests'. The project aims to conserve and restore the Afromontane cloud forests and wetlands in order to preserve the ecosystem's resilience and unique biodiversity. It also intends to avoid carbon dioxide emissions and secure ecosystem services for the local population. In collaboration with the local population, ecosystems are being explored and restored, secured and transferred to sustainable, participatory community management. In order to simultaneously create awareness for the effects of global warming on biodiversity and in order to promote regional development, targeted development programmes for crafts, ecotourism and regional products as well as educational programs for children and youths and energy-efficient stoves will be introduced.

Education and communication are among the key instruments of NABU's work in Ethiopia. As a new generation of inhabitants of the Kafa Biosphere Reserve, students play a particularly important role for future nature conservation and sustainable development.

Therefore, this module shall raise the general awareness and create a long-term understanding of a healthy environment as a source of human life, ecological interactions and opportunities for a sustainable development.

The module has been developed by NABU in a participatory process involving 50 teachers and 50 students during a series of workshops in Bonga in June 2016 (see pictures). Teachers took time to discuss and adjust example lesson plans for the grades five to eight and elaborated the teaching contents. The students were asked to test topic related games. As a result, three different group games addressing the principles of UNESCO's Global Action Programme on Education for Sustainable Development were adjusted and selected.

Impressions of the participatory scoping workshop



How to use the manual

This module booklet ‘Teaching biodiversity’ is designed as standard school material for lecturing and working on the topic of biodiversity and nature conservation in class.

The first part addresses important topics such as sustainability, biodiversity, ecosystems, climate change and waste management, that play a role in the students’ life. Each topic provides the teacher with a broad overview. A set of related questions for teachers’ and students’ is available, highlighted in grey.

In each topic section you will find a guideline for group work, highlighted again in grey.

Annex I provides you with lessons plans according to topic and grade, whereas Annex II offers a set of teaching aids. These can be easily copied as a handout to the students or as a poster which can be pinned to the classroom’s walls.

At the end of the booklet you will find a glossary explaining you the used terms. The section “More to read” may inspire you for further reading; most of these references can be found in the worldwide web.

We wish you successful teaching!

Although the module booklet provides a wealth of information, it is not exhaustive. Please feel free to add material and/or alter it as it suits your needs.

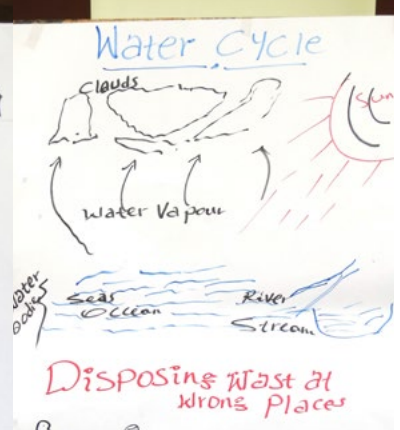
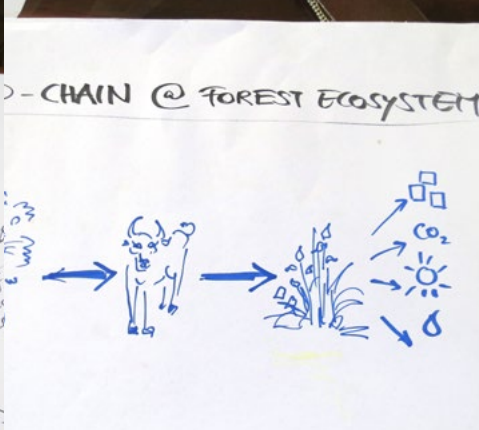
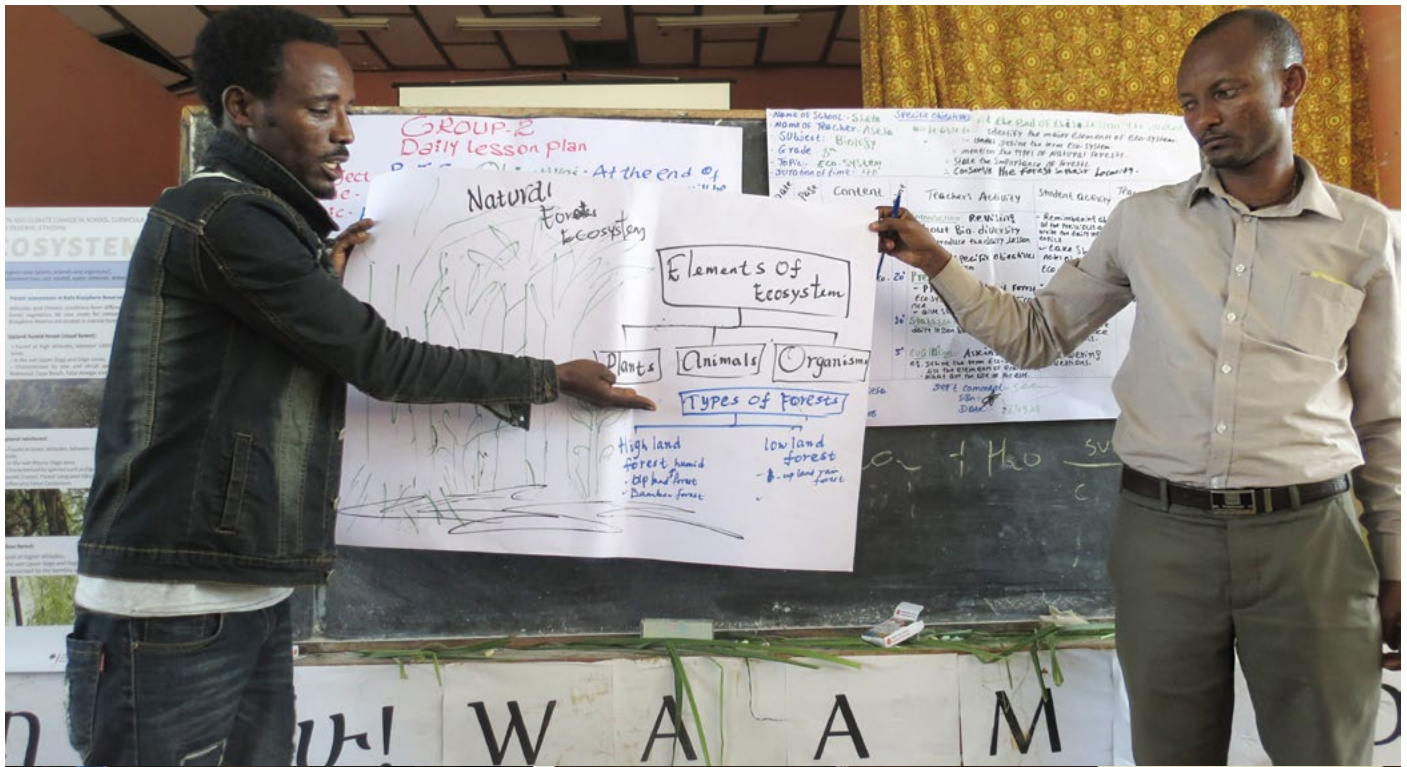
We appreciate your comments and ideas!

The Nature and Biodiversity Conservation Union (NABU)

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Impressions of the participatory scoping workshop



Topic 1: Sustainability

Poster in Annex II "Effects of overpopulation"

"Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland Commission, 1987)

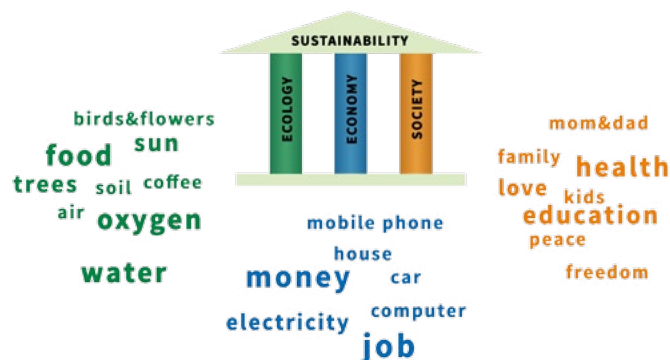
Explain the concept of sustainability to the class: Sustainability is more than concern for the environment; it includes environmental components but also considers economic viability and social equity.

Sustainability describes systems that:

- Keep our environment healthy,
- Make our living economically viable,
- Assure that we enjoy social equity.

Ask the students: What do you need for a happy and content life now and in future?

Allocate the answers to the three columns. Underline the essential necessities of the ecological column for the student's wellbeing.



Everything that we need in life can be found in the three columns of sustainability.

Energy can not be created, nor be destroyed. It can be converted from one form to the other. Energy converted into electricity can power our homes, schools and community.

Ask the students: Which things that you are using every day need electricity to work?

Many things that we are using, like light, computers, cars and mobile phones, need electricity.

Do you know where our electricity comes from?

Group the answers in renewable and non-renewable energy:

Renewable energy:

- Sun
- Wind
- Water
- Biogas
- Wood

Non-renewable energy:

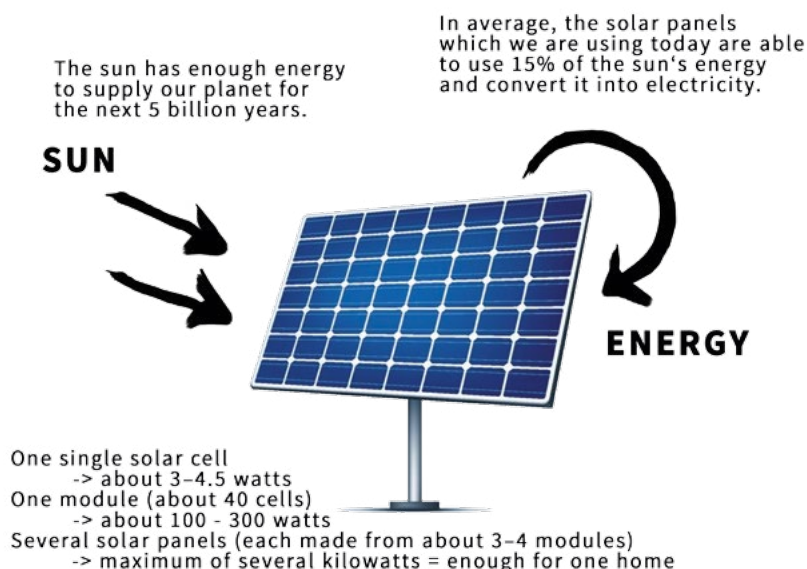
- Gas
- Oil
- Coal
- Nuclear energy

Raise the question: How long do you think it takes for oil to form naturally?

Oil and gas take between tens of millions and hundreds of millions of years to develop naturally. About 70% of current oil deposits date back to the Mesozoic period, 65 million years to 150 million years ago. Once we have used it, it is gone. That means, oil and gas are **non-renewable**.

On the other hand, sun and wind cannot be exhausted and can also be converted into energy. That is why they are called **renewable** energy sources.

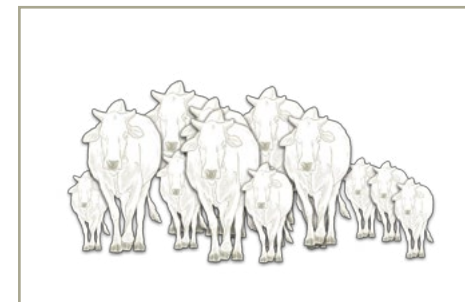
Do you know how sunlight is used to generate energy?



Benefits:

Once a solar panel or a wind turbine is installed there are no cost for the basic resources wind or sun, compared to gas or oil which have to be bought from big companies. Using renewable energies is also better for our health and the environment because they don't produce harmful greenhouse gases which pollute the air.

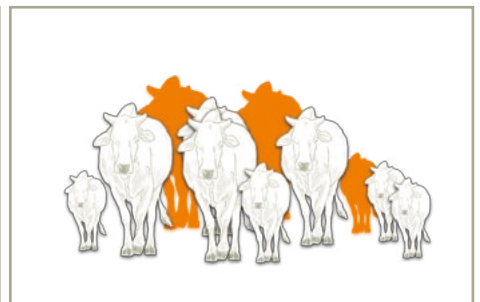
Sustainable management means that we do not overuse our resources. We can only use as much in a given time as it can replenish. The following example uses a herd of cows to explain the concept:



Picture 1: A herd consisting of many bulls and cows can reproduce and grow. The herd is stable, even if some animals are taken out for human needs.



Picture 2: The number of animals taken out has to be in balance with the ability to maintain reproduction. If there are not enough adult individuals left, the herd will shrink.



Picture 3: If the outtake is in balance, the herd can replenish sufficiently. Sustainable management ensures a continuous outtake of animals now and in future.



Many of the most essential things which we need for our wellbeing are provided by nature, for example food medicine or fire wood.

All of them are **renewable resources**. They are provided by nature through ecological processes and need time to grow until we can use them. Like the herd of cows, if the outtake is in balance with the natural rate of recovery, the continuous use of renewable resources is possible. This way of using natural resources is called **sustainable**.

Ask the students: Can you imagine what sustainable use means in regard to our food resources?

Imagine a teff plant. There is a certain number of small grains on one plant. If we use all of them for making Injera, there will be no grain left to grow a new Teff plant.

Challenges:

Up to now there is no perfect solution for storing alternative energies. It is necessary though because there is no guarantee for the wind to blow and the sun doesn't shine in the night or on cloudy days.

Students: Think about more examples to explain the concept of sustainable use of resources:

- Fruits
- Fire wood
- Coffee



☺ How about your mother's affection after you played a trick on her? She will need time to recover. Is your mother's affection a renewable or a non-renewable resource?

GROUP WORK

Sustainability game - Coffee bean distribution

This game aims to improve students' understanding of sustainability in the context of present and future generations. The increasing number of humans on our planet is the biggest challenge in future and a wise management of renewable resources is crucial.

With the help of a limited number of coffee beans that challenge will be addressed. Prior to the game, the students need to have a basic understanding of population pressure and overuse of natural resources (Teaching aid "Effects of overpopulation" can be used to explain the conflict).

Step 1:

Divide the students into two groups. One will represent the present generation and the other one the future generation. The second group needs to be four times larger than the first, as the population of Ethiopia is currently increasing by factor 4 (2016).

Step 2:

Hand out the exact amount of coffee beans equal to the total number of students. Make the first group take as much as they like. The left over will be given to the second group. There will be confusion in the second group because they won't have enough beans for all students.

Step 3:

Discuss the result of the first round of the game. What went wrong and why does only one group have enough coffee beans and the other doesn't? What can be done differently to prevent this happening again?

Step 4:

Repeat the game and define the rule that everybody is allowed to have only one bean. Explain that you (teacher) are now in the role of the biosphere management authority. The taking out of coffee beans will be limited in order to save the resources for future generations.

Step 5:

Discuss the result of the second round of the game. Underline the importance of rules and regulations in order to defend the right for future generations and the environment.

Step 6:

Coffee is a renewable resource. Ask the students: How would it be possible to increase the number of beans per person in future? Give the students time to think and discuss, together. The right answer would be that some of the beans can be used to replant coffee trees in the present in order to have more beans in the future. It has to be underlined that new coffee trees in the Kafa Biosphere Reserve can only be planted around your house or in your home gardens and in the transition zone - not in the core zones.

Lesson learnt

It is necessary that the students understand the conflict between economic growth and the protection of nature. Both need space and this is limited on our planet. We have to balance our needs with the needs of wild animals and plants.



Topic 2: Biosphere reserves

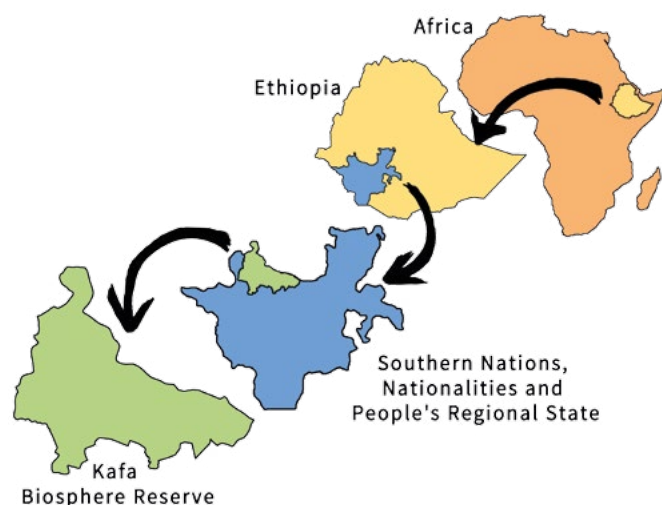
Poster in Annex II “Forest cover in the Biosphere Reserve“

Biosphere reserves are part of the Man and the Biosphere (MAB) Programme by the United Nations Educational, Scientific, and Cultural Organization (UNESCO).



What is a biosphere reserve?

- An area created to conserve biological and cultural diversity while promoting sustainable economic and social development,
- A place for people and nature to co-exist and interact with each other for their mutual benefit,
- Use of natural resources in a sustainable way,
- Conserving precious habitats.



Zonation of a biosphere reserve:

Every biosphere reserve must contain one or more **core zones**. These have strong legal protection and serve as a refuge for wild plants and animals free from human disturbances.

Buffer zones, as their name suggests, buffer, i.e. surround and protect the core areas from the impact of human activity. They function as essential ecological corridors, connecting the core areas to allow the movement of wildlife.

The **transition zone** has a central role in enabling sustainable development. It is a place where people live and make a living. It accommodates more high-impact and economic land uses and may contain a variety of agricultural activity, settlements and other land use types.



The Kafa Biosphere Reserve

- **Size:** 760,144 ha in total
- **District administration:** Kafa Zone, 10 Woreda administrations (Adiyo, Bitu, Chena, Chetta, Decha, Gesha, Gewata, Gimbo, Saylem and Tello), 250 rural Kebele administrations, 25 urban settlements
- **Core zones:** within 11 protected forests with statutory conservation status: 41,391 ha
- **Buffer zones:** surrounding the core areas to protect them from negative impacts of human activities: 161,427 ha
- **Transition zones:** mainly consists of urban areas (e.g. villages) and cultivated agricultural land: 337,885 ha

Test your students: Knowing that a biosphere reserve serves the purposes of nature conservation alongside a sustainable economic development, what would you prohibit in the core zones if you would be in charge of the management? Compare the students' ideas with the following list.

Prohibited in the core zones (as proposed in the official application for the Kafa Biosphere Reserve, 2009):

- Farming
- Mining
- Road construction
- Water well drilling
- Irrigation and dam works
- Other infrastructural development
- Deforestation or settlement
- Hunting
- Cutting of trees
- Grazing domestic animals
- Beekeeping



GROUP WORK

Human activities in the biosphere reserve

Group the students into farmers, honey producers, coffee collectors, tourist guides and scientists. Ask the students to have a look at the map of the biosphere reserve (map of the Kafa Biosphere Reserve on the following double page). The task is to identify areas in which they are allowed to conduct their income generating activities.

Farmers and honey producers

- Prohibited in the core zone
- Allowed in an extensive way in the buffer zone
- Allowed in the transition zone

Coffee collectors

- Prohibited in the core zone
- Allowed in a traditional, extensive way in the buffer zone
- Allowed in the transition zone

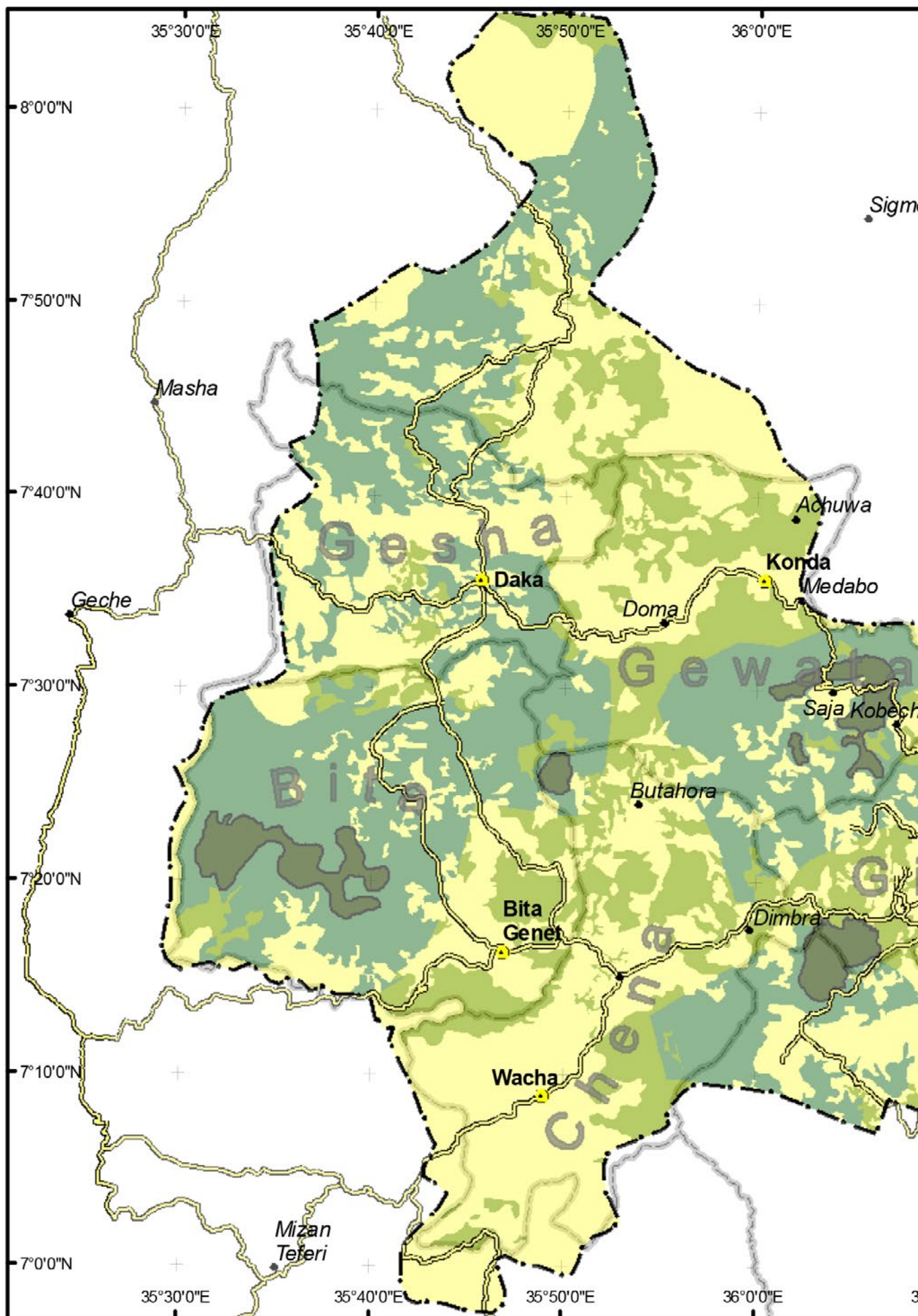
Tourist guides

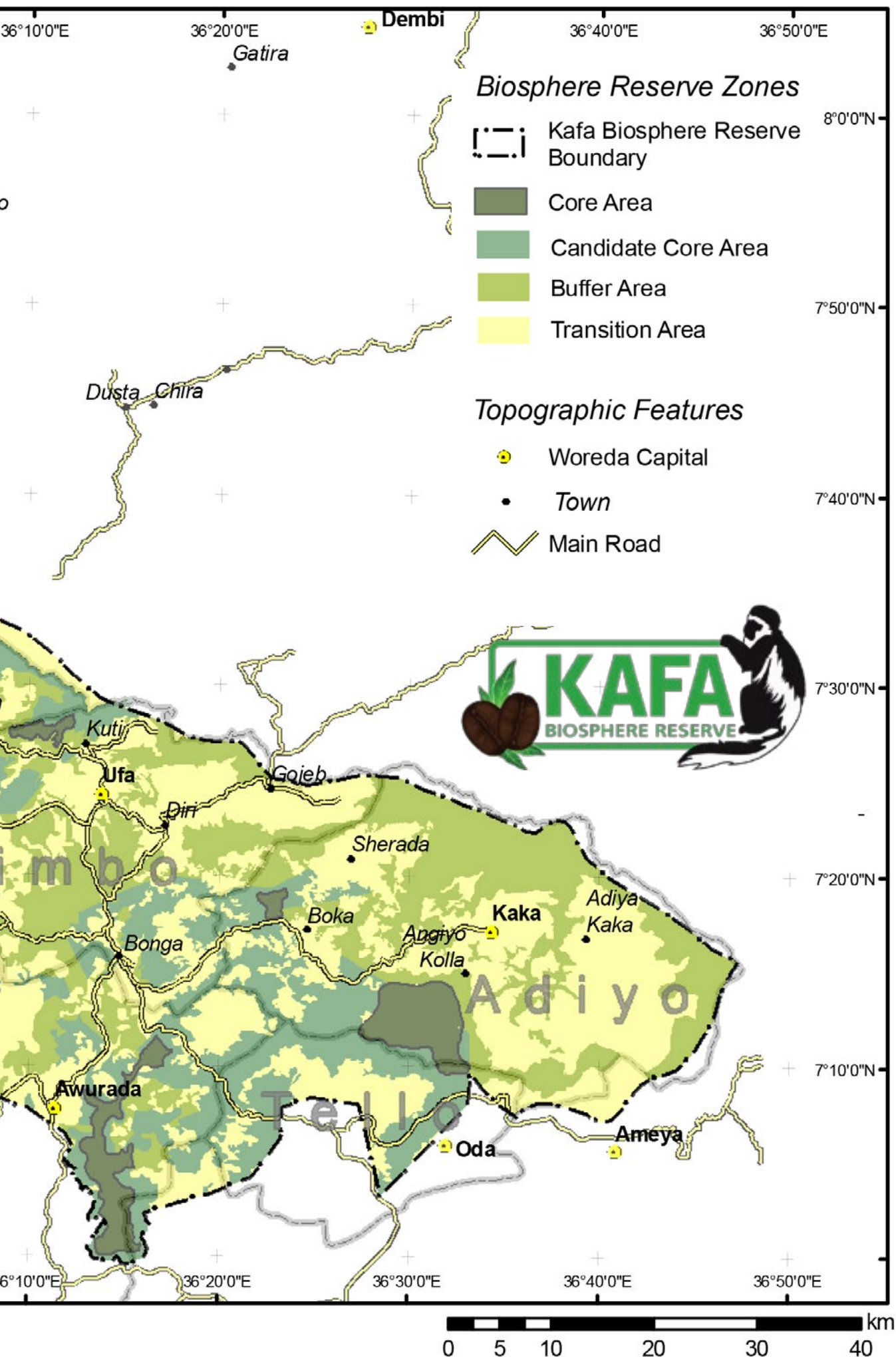
- Prohibited in the core zone
- Allowed in the buffer zone
- Allowed in the transition zone

Scientists

- Allowed in the core zone
- Allowed in the buffer zone
- Allowed in the transition zone

Discuss about the findings and expand the train of thoughts towards own family members and their jobs. Are there restrictions to their usual ways of income which are connected to the installed biosphere reserve? Where do the students see benefits concerning the biosphere reserve for themselves?





Topic 3: Biodiversity

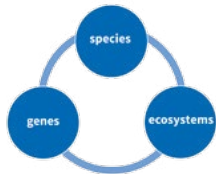
Poster in Annex II „Importance of wild animals“

“Biological diversity or biodiversity is the variety of life on Earth and the natural patterns it forms.”
(Convention on Biological Diversity, 1992)

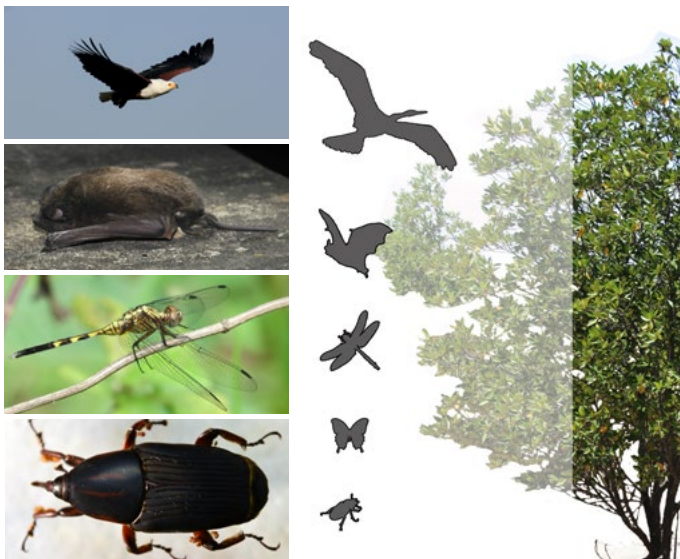
The **biodiversity** of today has developed over billions of years of evolution. It forms the web of life. We are an integral part of it and have to protect it now and for future generations.

There are different types of biodiversity:

- Diversity of species
- Genetic diversity
- Diversity of ecosystems



In nature, every creature has its place. From the top of the trees to the bottom of the oceans, **species** adapt to their surrounding and form communities based on the natural conditions and the interaction between each other.



Diversity of species and of genes appears in a wide variety of forms and colors, which for example can be observed in the different flowers growing around us.



Genetic diversity can be observed in many different physical compositions of humans around the world. We are all one species but we look very different.



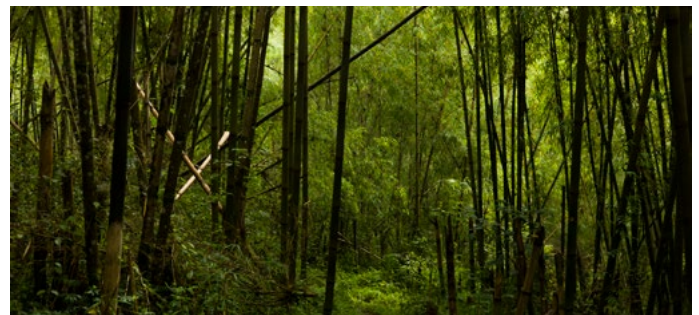
Ask the students: What is biodiversity? Can you see something diverse in your class room?

Genetic diversity results in all kind of physical variations. Let the students compare for example the form of their hands, toes or noses.

The **Kafa Biosphere Reserve** is rich in every aspect of biodiversity. Starting from genetic variety, over species diversity up to its many different **ecosystems** (mostly wetlands and forest ecosystems).

Forest ecosystems found in the Kafa Biosphere Reserve are:

- Upland humid forest (cloud forest)
- Upland rain forest
- Bamboo forest
- Montane forest



Approximately 5% of the Kafa Biosphere Reserve is covered by **wetland ecosystems**:

- Freshwater marshes
- River floodplains
- Swamps
- Peatlands



Benefits of biodiversity for humans:

- Source for food, water and oxygen
- Basis for medicine
- Energy from renewable and non-renewable resources
- Income based on natural resources and tourism
- Inspiration and recreation value

Major threats of biodiversity:

- Deforestation and habitat loss (e. g. cutting down natural forest, drying out of wetlands)
- Climate change
- Overexploitation (overhunting, overfishing and over-harvesting)
- Invasive species
- Pollution

Some animals and plants can only be found in Ethiopia. Those species, which are only found in a certain area and nowhere else, are called **endemic**.

Can you imagine what endemic means in regard to the vulnerability of species?

They only occur in Ethiopia and nowhere else in the world. If we don't protect them they are lost forever. This is why we have to take good care of them. Examples of endemic animal species in Ethiopia are:

Wattled ibis
Bostrychia carunculata



Blue monkey
Cercopithecus mitis



Rouget's rail
Rougetius rougetii



Yellow fronted parrot
Poicephalus flavifrons



Mountain nyala
Tragelaphus buxtoni



Abyssinian longclaw
Macronyx flavicollis



Topic 4: Ecosystems

Poster in Annex II “Forest Food chains“, “Benefits of forest“, “The water cycle“

An **ecosystem** includes all living things in a given area (plants, animals and organisms), interacting with each other and with their non-living environment (sun, soil, rainfall, water, minerals, atmosphere).

The Kafa Biosphere Reserve is rich in different valuable ecosystems. Most of them are wetlands and forests, which are part of the core and buffer zones of the reserve.

Many **natural forests** in the tropics have a similar structure. Trees and plants of different heights form vegetation layers. Different types of plants and animals can be found in the different layers.



Layers of a natural tropical forest.

Why are forests important for our planet?

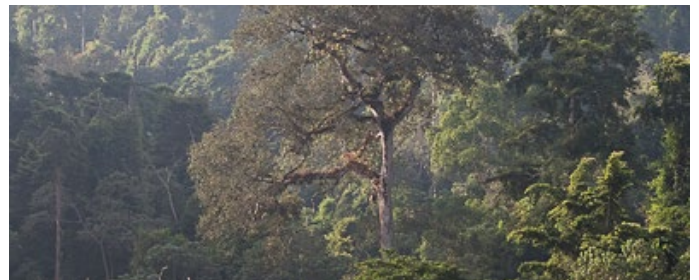
- Forests keep the moisture from clouds and are important for maintaining the hydrological cycle,
- The root system of forests prevents the soil from being washed away (erosion),
- All trees and plants store carbon dioxide through photosynthesis (important for our climate) and at the same time produce oxygen (vital for humans and animals),
- Forests are home (habitat) for many plants and animals,
- Forests provide humans with renewable resources for example wood, fruits, honey or animal feed.
- Forests are appreciated for their aesthetic and spiritual values, and are attractive for tourism.

Forest ecosystems in Kafa Biosphere Reserve

Altitudes and climatic conditions form different types of natural forest vegetation. All core zones of the Kafa Biosphere Reserve are located in natural forests.

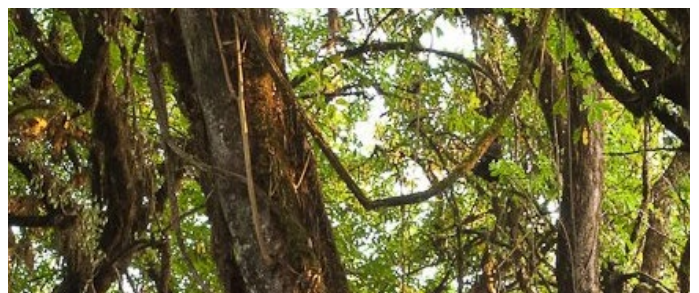
Upland humid forest (cloud forest):

- Found at high altitudes, between 1800m - 2600m above sea level,
- In the wet Upper Dega and Dega zones,
- Characterized by tree and shrub species such as African Redwood, Cape Beech, False Assegai and Winged Bersama.



Upland rainforest:

- Found at lower altitudes, between 1500m - 1800m above sea level,
- In the wet Weyna Dega zone,
- Characterized by species such as Elgon Olive, Euphorbia, Broad-leaved Croton, Forest Long-pod Albizia, Red Stinkwood, Arabica Coffee and False Cardamom.



Bamboo forest:

- Found at higher altitudes,
- In the wet Upper Dega and Dega zones (e.g. Boka Forest),
- Characterized by the bamboo species *Arundinaria alpina*.



Natural forests are in danger of being cut down for farmland. Can you imagine a way to save the forest and still harvest agricultural products?

There is a practice called **agroforestry**. Fruits, coffee and other crops are planted under the bigger canopy trees. That practice is criticized because it tends to be managed in an unsustainable way. More natural trees are cut down compared to their ability to regrowth. However, if a sustainable management is applied, the system of Agroforestry can be an option.

Besides forests, other types of ecosystems are also found in the reserve - **wetlands**.

Some examples are:

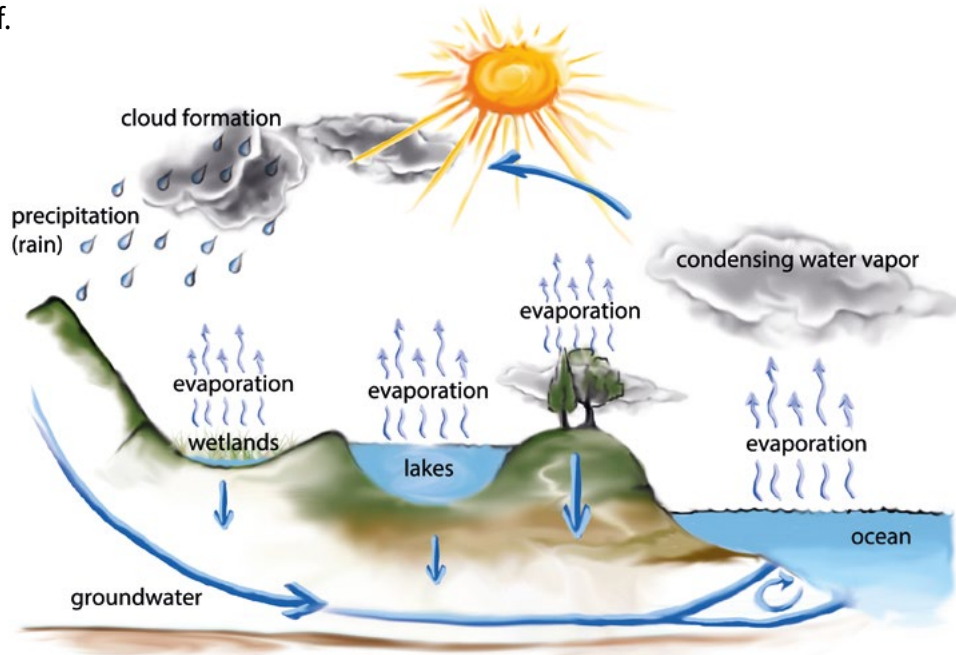
- Freshwater marshes
- Wet meadows
- Swamps
- Peatlands – bogs and fens

Due to its varied landscape and high rainfall, the Kafa BR has a wide range of wetland systems. Approximately 5% of the Kafa BR is covered by wetlands, the primary ones being the Gojjeb, Ghibe and Alemgono wetlands.

In many cultures wetlands, like swamps and peatlands, are inspiration for poems and myths. Ask your grandparents if they know old tales in which wetlands play a role.

Wetlands are areas where the ground is saturated with water, and/or covered with shallow water, for all or part of the year. Do you know the water cycle and can you explain how it is possible that sometimes a wetland is full of water and sometimes it dries out?

The earth has a limited amount of water. That water keeps going around and around in what we call the **water cycle**. This cycle is made up of several main parts: evaporation, condensation, precipitation and collection or runoff.



Evaporation is when the sun heats up water in rivers or lakes or the ocean and turns it into vapor or steam. The water vapor or steam leaves the river, lake or ocean and goes into the air. Transpiration is the process by which plants lose water out of their leaves. Transpiration gives evaporation a bit of a hand in getting the water vapor back up into the air.

Water vapor in the air gets cold and changes back into liquid, forming clouds. This is called **condensation**.

Precipitation occurs when so much water has condensed that the air cannot hold it anymore. The clouds get heavy and water falls back to the earth in the form of rain, hail, sleet or snow.

When water falls back to earth as precipitation, it may fall back into the oceans, lakes or rivers or it may end up on land. When it ends up on land, it will either soak into the earth and become part of the groundwater that plants and animals use to drink or it may run over the soil and **collect** in the oceans, lakes or rivers where the cycle starts all over again.

GROUP WORK

Ecosystem game - The food web

With this interactive game you can explain that every simple food chain needs producers, consumers and decomposers. You can demonstrate the complexity and interlinkages in a food web and the relations between the species. In order to explain the game and create a basic understanding the poster „Forest food chains“ can be used.

Step 1:

Have the students brainstorm a list of animals and plants that can be found around them and make them choose one each. Depending on the time you have in class, the students can either write or draw their chosen species on a piece of paper. You (teacher) can also prepare the exercise and print out photos of different species.

Step 2:

Plants are **producers** as they make their own food. They use the sunlight to convert carbon dioxide from the air and water from the soil into sugar and oxygen. This process is called photosynthesis.

Animals are **consumers** as they cannot produce their own food and need to eat plants or other animals to survive. Within the consumers there are **herbivores**, that only eat plants (e.g. cows), **carnivores**, that only eat meat (e.g. leopard) and **omnivores**, that eat both plants and animals (e.g. humans). **Decomposers** are small creatures that break down the dead material and turn it into nutrients in the soil, which plants use to grow (e.g. Fungi, bacteria, earth worms, beetles or ants).

Ask the students to identify one of the following categories for the species that they represent:

Producers, Herbivores, Carnivores, Omnivores, Decomposers

If there are no decomposers, explain their importance and make some students represent them.

Step 3:

Ask the students to think of ways their species might be connected with each other. Producers, like plants, need the nutrition that are provided by the bacteria. Herbivores need plant to feed on. Carnivores need plants because their prey feeds on them. Carnivores also make use of other carnivores, omnivores and herbivores as prey.

Step 4:

Have the students 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 yarn to another student, keep on holding the end of the yarn. Have the student (that was throwing the ball of yarn) state how his/her species is connected to the one holding the ball of yarn now (i.e. the De Brazza's Monkey is connected to the coffee plant because it eats and spreads the seeds of the plant). The student holding the yarn tosses the ball now to someone else but still holds onto a piece of it. Continue the exercise until everyone has caught the ball of yarn and is now holding a piece of it. Have the last student throw the ball of yarn back to you.

Step 5:

You should now have a representative 'web' of yarn with every student 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 yarn and ask if anyone felt the tug. Have some others tug on the yarn 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 weathers due to climate change.

Lesson learnt:

In nature every thing is connected and somehow depends on another. If one species is lost the web will become instable 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 to come.



Topic 5: Climate change

Poster in Annex II “Greenhouse effect and climate change”

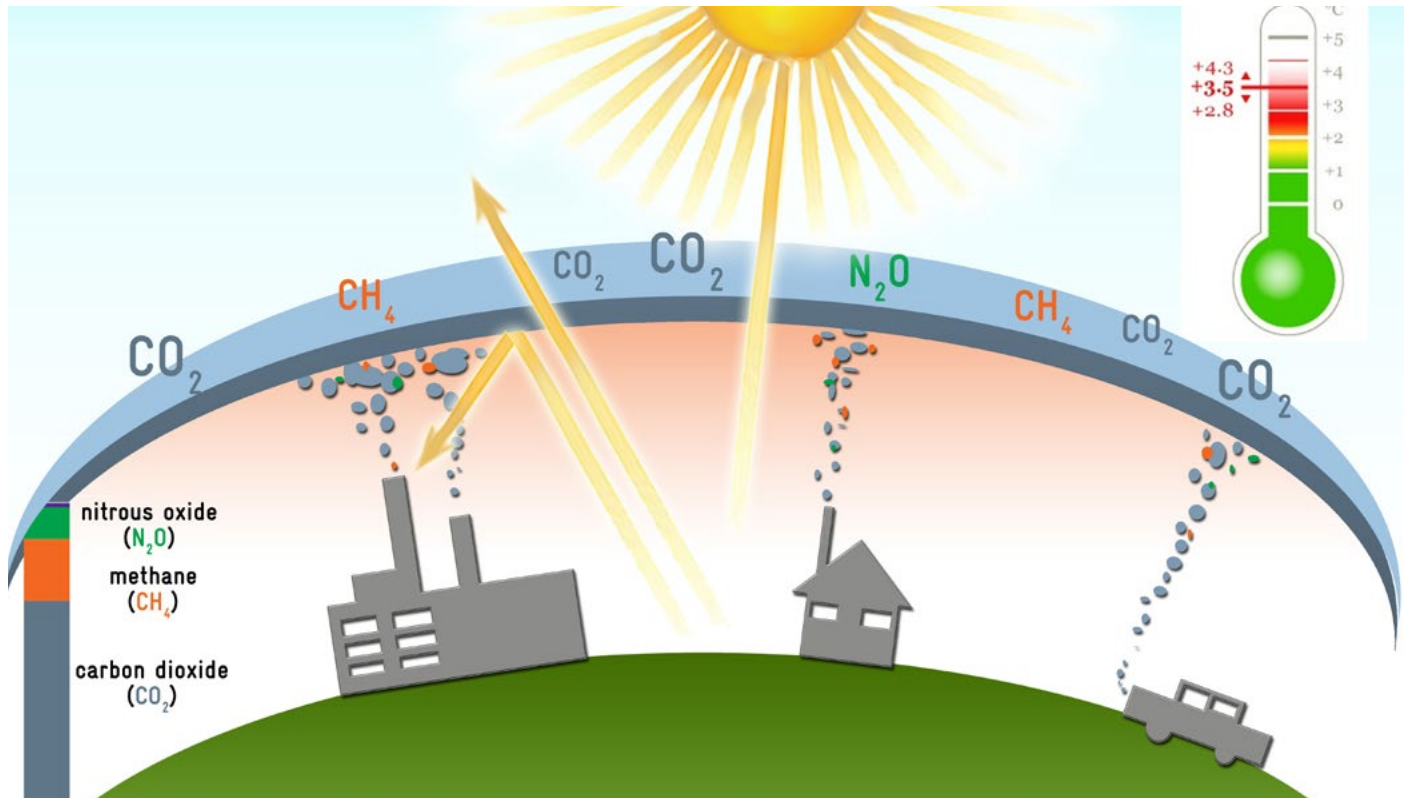
Climate refers to the average weather conditions that an area usually experiences over a long period of time. **Climate change** is the term used when the climate of an area, or the planet, starts to change.

How does climate change happen?

The Earth’s atmosphere contains different gases,

known as greenhouse gases, which trap the heat from solar radiation and keep the planet warm. Human activities have increased the amount of greenhouse gases in the atmosphere above the normal amounts. This has resulted in more heat being trapped in the atmosphere and the planet becoming warmer.

The main greenhouse gas is carbon dioxide. Others are nitrous oxide and methane. Especially the first one of those two is very harmful and affects our atmosphere already at a small amount.



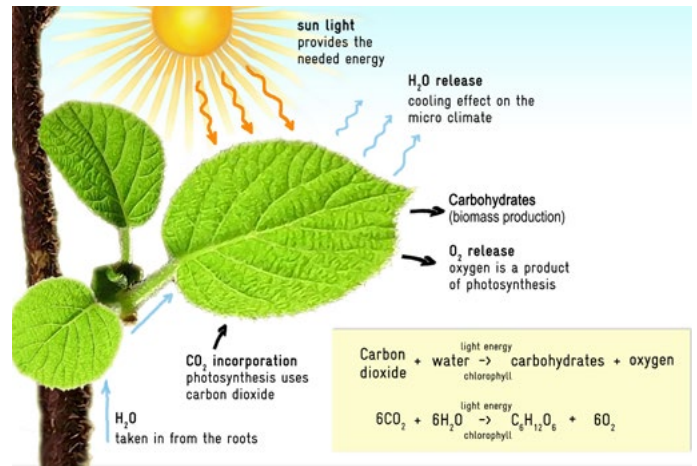
The greenhouse gas effect



Climate change is the reason for more extreme weather events, like storm (photo left), flood (photo middle) or drought (photo right).

The main human activities which lead to the release of carbon dioxide into the atmosphere are:

- Burning of petrol/diesel in motorbikes, cars, buses, trucks and factories,
- Burning of other fuels such as coal and oil (which are also burnt in power plants to make electricity), and wood,
- Cutting down forests and trees,
- Drying out wetlands, for example due to agricultural drainage systems.



The green parts of a plant are using carbon dioxide and convert it into oxygen. The process is called photosynthesis.



Climate change can be mitigated by carbon sinks* (photo left: wetland), trees (photo middle) and avoiding greenhouse gases (photos right: bicycle riding and solar energy).

What can be done locally to reduce the impact of climate change?

- Prevent deforestation,
- Plant new trees,
- Use energy-efficient stoves for cooking,
- Promote alternative energy like solar power,
- Protect wetlands as carbon sinks*,
- Use land sustainably, e.g. home gardens,
- Plant local food species,
- Raise awareness for climate change.

Many countries around the world are trying to reduce the amount of greenhouse gases they release into the atmosphere through:

- Improving and using renewable, environmentally friendly energy sources,
- Developing more energy efficient technology,
- Offering better and affordable public transport,
- Reducing deforestation and increasing tree replanting,
- Improving environmental standards and reducing carbon emitting production,
- Creating a greater awareness through green capacity building.

*A carbon sink is anything that absorbs more carbon compared to what it releases, e.g. oceans, healthy forests, soils and wetlands.

GROUP WORK

Climate change game - Map of change

Our global climate is changing. What does this mean in regard to our daily life? In order to find out how climate change affects our community, the students shall conduct interviews with local elders.

Step 1:

Explain the concept of climate change to the class. You can use the poster „Greenhouse effect and climate change“ in the annex of this manual. The students should know the main impacts of climate change - like more extreme weather events, drought and storm.

Step 2:

Prepare a set of questions and a map of the local community. Example questions:

- *Are there any changes in the weather patterns now, compared to your childhood?*
- *Can you remember your parents or grand parents complaining/talking about a change in regular weather patterns?*
- *Has the environment surrounding our community changed, compared to your childhood?*
- *Are you affected by the changes, compared to the past?*

Step 3:

The students are asked to conduct interviews with their parents, grandparents and community elders.

Step 4:

Visualize the observed changes mentioned in the interviews in the map, i.e. more (or less) rain, less harvest, more wildfires.

Compare and discuss the findings.

Step 5:

Try to imagine the situation in the future and give an outlook for your community.

Step 6:

The students elaborated the effects of a changing climate in their community through the interviews and the discussions in class. It is important to show that there are ways to mitigate climate change on the local as well as on the global scale.

Step 7:

Make a list of things that all students could do in order to help mitigate climate change.

Some examples are:

- *Use the bicycle to come to school rather than motorbike or bus.*
- *Plant new trees and avoid to destroy green plants.*
- *Help to raise awareness for the topic and support others in fighting climate change.*
- *Save energy in school and at home and promote alternative energy like wind or solar power.*
- *Choose local products over others to avoid long transport routes in the production chain*

Lesson learnt:

Climate change is caused by too many greenhouse gases in the atmosphere. Those gases are created by human interference in natural systems and result from the unsustainable management of natural resources. Climate change can only be tackled by a sustainable use of resources and the protection of nature for its recovery.



Topic 6: Waste management

Poster in Annex II "Waste and environment", "Label for waste separation"

Waste is material that humans do not want to use any more and therefore discard; or excess material generated during manufacturing, catering and other human activities.

The term "waste" is actually very subjective, because some things may have no value for their owner, but could be of value for others, as the saying goes "One man's trash is another man's treasure".

There are **different types of waste**, depending on what it is made of and each type has a different way of being treated. There are three main types of waste classification:

Organic waste

- Consists of plant or animal matters,
- Decomposes easily through natural processes in the environment
- Should be collected and composted.



Inorganic waste

- Consists of materials like plastic, glass or metal
- Does not decompose easily, stays in the environment for up to 1,000 years
- Some of it can be recycled or reused.



Hazardous waste

- Can be toxic, radioactive or infectious for humans and environment
- Has to be treated in a special way and should not be thrown into the nature or a normal dustbin.
- Even households generate toxic waste (pesticides, paints, old batteries, engine oil, etc.).



Waste can contaminate the soil, the air and the water and is dangerous for humans if it is not treated in the right way!

Waste shouldn't be thrown away in natural areas. Even the organic matter that would decompose naturally becomes problematic, if it is dumped in high amounts. It will attract insects or rodents which can carry diseases.



A common problem nowadays is waste from plastic bags, a big threat to the environment due to its durability. Plastic bags buried in the soil does not decompose and will prevent oxygen ventilation and the activity of soil bacteria. This will lead to degradation of the soil and limit the development of plants.

When released into water, plastic bags will clog drainage systems, limit flow and impede waterway transport, as well as polluted habitats that affect aquatic organisms.



Transported by wind or water, most of our plastic waste ends up in the oceans. Do you know how long it takes for a single plastic bag to be decomposed in the ocean?



600 years -> a fishing wire and hook

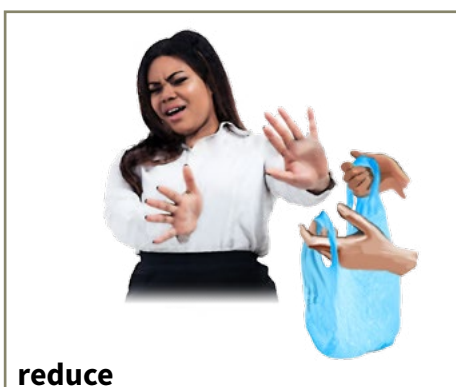
50 years -> metal can (for example for beer or tuna)

10 - 20 years -> plastic bag

1 - 5 years -> left overs from cigarettes

2 month -> organic residues from apples or bananas

The concept of the 3 R's describes ways of how to minimize our waste.



Recycling codes

In order to simplify the recycling of waste, recycling codes are used to identify the material from which an item is made. The overall symbol looks like three chasing arrows.



Waste can become fertilizer - build your own compost at school and start gardening

Through composting organic materials, such as leaves, grass and vegetable scraps, we can make organic fertilizer, which can be used to improve soil quality. Bacteria and chemical processes convert the organic material back into natural components, such as nitrates. The decomposing process can be enhanced by either shredding the material, watering it, turning it over regularly or through good ventilation.



After time the organic waste will become fertilizer.

Example questions and exercises for students:

- Brainstorm about the waste that you produce during one normal day. You can write down a list and compare with the others in your class.
- Discuss ways to reduce, reuse or recycle your waste.
- Discuss waste and its consequences for humans and nature.
- Develop a strategy of how to raise awareness in your community.
- Organize a clean-up day in your village together with friends and family.



The photos are examples for reuse and recycle of waste materials (photo left: bag out of stay-on-tabs, photo middle: lamp out of used bottles, photo right: seating out of old wheels).

Annex I: Lesson plans

Subject: Biology**Grade: 5****Topic: Forests**

Objective: At the end of the lesson the students will be able to explain the importance of forests and define the term forest.

Ref. page	Contents	Time	Teachers' activities	Students' activities	Teaching method	Teaching aids	Remarks
74	Importance of forests	5'	Introduction: <ul style="list-style-type: none">Introducing the lesson to the class	<ul style="list-style-type: none">Listening	<ul style="list-style-type: none">BrainstormingGroup discussionLecturingQuestions and answers	<ul style="list-style-type: none">Poster "Benefits of Forest"Poster "Forest food chains"	
		20'	Presentation: <ul style="list-style-type: none">Asking the students "What is good about forests?"Arranging the students to sit in groupsProviding activities for each group	<ul style="list-style-type: none">Form groups and participate in group discussionPresentation of group work			
		10'	Stabilization: <ul style="list-style-type: none">Discussion about the daily topicGuiding the students through the discussionSummarizing the main pointsGiving short notes	<ul style="list-style-type: none">Paying attention			
		5'	Evaluation: <ul style="list-style-type: none">Asking question about the importance of forests	<ul style="list-style-type: none">Answering questions			

Subject: Biology**Grade: 8****Topic: Ecosystems**

Objective: At the end of the lesson the students will be able to identify the major elements of ecosystems; define the term ecosystem; identify the types of natural forests; state the importance of forests; know how to conserve the forests in their locality.

Ref. page	Contents	Time	Teachers' activities	Students' activities	Teaching method	Teaching aids	Remarks
81	Elements of forest ecosystems	5'	Introduction: <ul style="list-style-type: none"> Revising the topic of biodiversity and introducing the daily lesson topics Tell the specific objectives of the lesson 	<ul style="list-style-type: none"> Remember about the previous Write down the topic of the daily lesson 	<ul style="list-style-type: none"> Group discussion Lecturing Asking and answering 	<ul style="list-style-type: none"> Poster "Benefits of Forest" Poster "Forest food chains" Poster "Forest cover in the Kafa Biosphere Reserve" 	
		20'	Presentation: <ul style="list-style-type: none"> Presentation about forest ecosystems and their significance Give short notes 	<ul style="list-style-type: none"> Take short notes about forest ecosystems Participate actively in group discussion 			
		10'	Stabilization: <ul style="list-style-type: none"> Summarizing the daily lesson briefly 	<ul style="list-style-type: none"> Listening carefully and add or make corrections in the notes 			
		5'	Evaluation: <ul style="list-style-type: none"> Ask questions like "What is an ecosystem?", "List the elements of ecosystems.", "What are the ecosystem services of forests?" 	<ul style="list-style-type: none"> Answering questions 			

Subject: Social studies

Objective: At the end of the lesson the students will know about and be able to explain the relations between living and non-living things.

Grade: 8

Topic: Environment (Human interaction with natural resources)

Ref. page	Contents	Time	Teachers activities	Students activities	Teaching method	Teaching aids	Remarks
77	Elements of the ecosystems and their interdependences						
		5'	Introduction: <ul style="list-style-type: none"> Recapturing last lesson 	<ul style="list-style-type: none"> Remembering 			
		20'	Presentation: <ul style="list-style-type: none"> Explaining about ecosystems Living things depend on non-living things, e.g. plants grow on soil 	<ul style="list-style-type: none"> Discussing with their partners 			
		5'	Stabilization: <ul style="list-style-type: none"> Summarizing about elements of ecosystems 	<ul style="list-style-type: none"> Reclaiming 	<ul style="list-style-type: none"> Group discussion Explanation 	<ul style="list-style-type: none"> Poster "Waste and environment" Poster "Effects of overpopulation" Poster "Forest food chains" 	
		10'	Evaluation: <ul style="list-style-type: none"> Giving class work, e.g. "Explain the relation between living and non-living things." 	<ul style="list-style-type: none"> Doing class work 			

Subject: Social studies**Grade: 5****Unit: 3****Topic: Environment**

Objective: At the end of the units the students will be able to know different types and understand the importance of natural vegetation and wild animals, recognize the effects of rapid population growth on vegetation and wild animals, know the conservation measure to protect natural resources and wild animals.

Semester	Month	Week	Date	Ref. page	Contents (Unit 3 - Environment)	Specific objectives At the end of the lessons the students will be able to:	Teaching method	Teaching aids	Remarks
2nd Semester	September	1	1-5.9.08EC	68-72	<ul style="list-style-type: none"> Importance of natural vegetation 	<ul style="list-style-type: none"> Explain the importance of natural vegetation 	<ul style="list-style-type: none"> Discussion Question and answers 	<ul style="list-style-type: none"> Poster “Benefits of Forest” Poster “Forest cover in the Kafa Biosphere Reserve” 	
		2	8-12-9-08EC	73-77	<ul style="list-style-type: none"> Types and importance of wild animals 	<ul style="list-style-type: none"> Identify the types and importance of wild animals 		<ul style="list-style-type: none"> Poster “Importance of wild animals” 	
		3	15-19-9-08EC	78-84	<ul style="list-style-type: none"> The effects of rapid population growth on wild animals and natural vegetation (climate change, deforestation, global warming) 	<ul style="list-style-type: none"> Analyze the effects of rapid population growth on wild animals and natural vegetation Define the terms climate change and deforestation and their effects 		<ul style="list-style-type: none"> Poster “Forest food chains” 	
		4	22-26.9.08EC	85-89	<ul style="list-style-type: none"> Conservation of wild animals and natural vegetation (afforestation, reforestation) 	<ul style="list-style-type: none"> List the ways of conservation of wild animals and natural vegetation Apply the way of conservation of wild animals and natural vegetation in their localities Differentiate between the terms afforestation and reforestation 			

Subject: Social studies**Grade: 6****Unit: 2****Topic: Water**

Objective: At the end of the units the students will be able to understand the water cycle and know the water borne diseases

Semester	Month	Week	Date	Ref. page	Contents (Unit 2 - Water)	Specific objectives At the end of the lessons the students will be able to:	Teaching method	Teaching aids	Remarks
1st Semester	February	1	7-11.10.08EC	31	<ul style="list-style-type: none">Water cycle	<ul style="list-style-type: none">Explain the water cycle	<ul style="list-style-type: none">DemonstrationQuestion and answers	<ul style="list-style-type: none">Poster “Water cycle“Poster “Waste and environment“	
		2	14-18.10.08EC	57	<ul style="list-style-type: none">Water born diseasesDisposing waste at wrong places	<ul style="list-style-type: none">List the water borne diseases			

Annex II: Selected teaching aids

Importance of wild animals



Bees are responsible for pollinating about one-sixth of the flowering plant species worldwide and approximately 400 different agricultural types of plant. Many seeds, fruits and berries eaten by birds and small mammals come from plants that are pollinated by bees, making them the provider of food and preserver of the biodiversity of our species. Nectar and pollen from flowering plants are the only food source for bees and are a delicious food source for humans in form of honey.

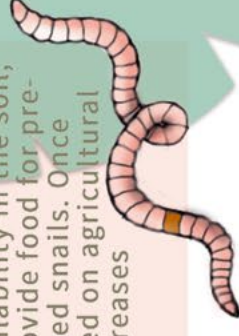
The **Colobus monkey** or primates in general play key roles in ecology as seed dispersers for many important tree and shrub species. Colobuses are important for seed dispersal through their sloppy eating habits, as well as through their digestive systems. They are prey for many forest predators and a valuable tourist attraction.



African **buffaloes** are widespread in Sub-Saharan Africa and play a pivotal ecological role, being bulk feeders in the food chain. They are the main prey of lions and their presence prevents losses of cattle as they are preferred by the large predators. Also the buffalo is a highlight for tourists.

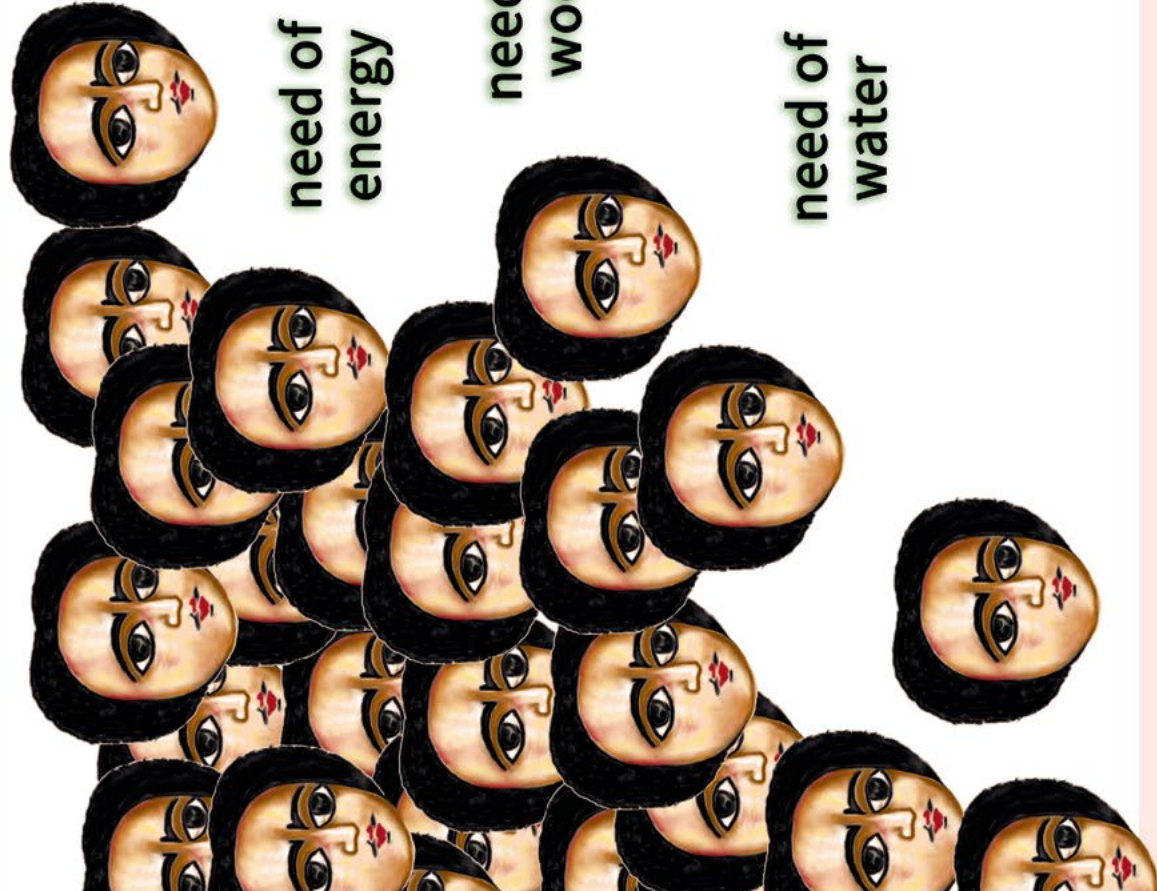


Earthworms, along with bacteria and fungi, decompose organic material. They increase the nutrient availability in the soil, improve soil structure, and provide food for predators, like birds and specialized snails. Once earthworms become established on agricultural land, pastoral productivity increases by 25–30%.



Lions play an important role in the food chain, helping to regulate numbers of some herbivore species, such as zebra and buffalo. Without lions to control them, these species can out-compete other animals, causing their extinction and reducing biodiversity. Lions are one of the biggest attraction for tourists and can therefore be perceived as a valuable economic asset.

Effects of overpopulation



need of
energy

need of
wood

need of
water

need for
recreation

need of
land

need of
air

need of
food

overuse
land

threaten
biodiversity

destroy
forests

poisoning
rivers

seal
soil

contaminate
oceans

pollute
air

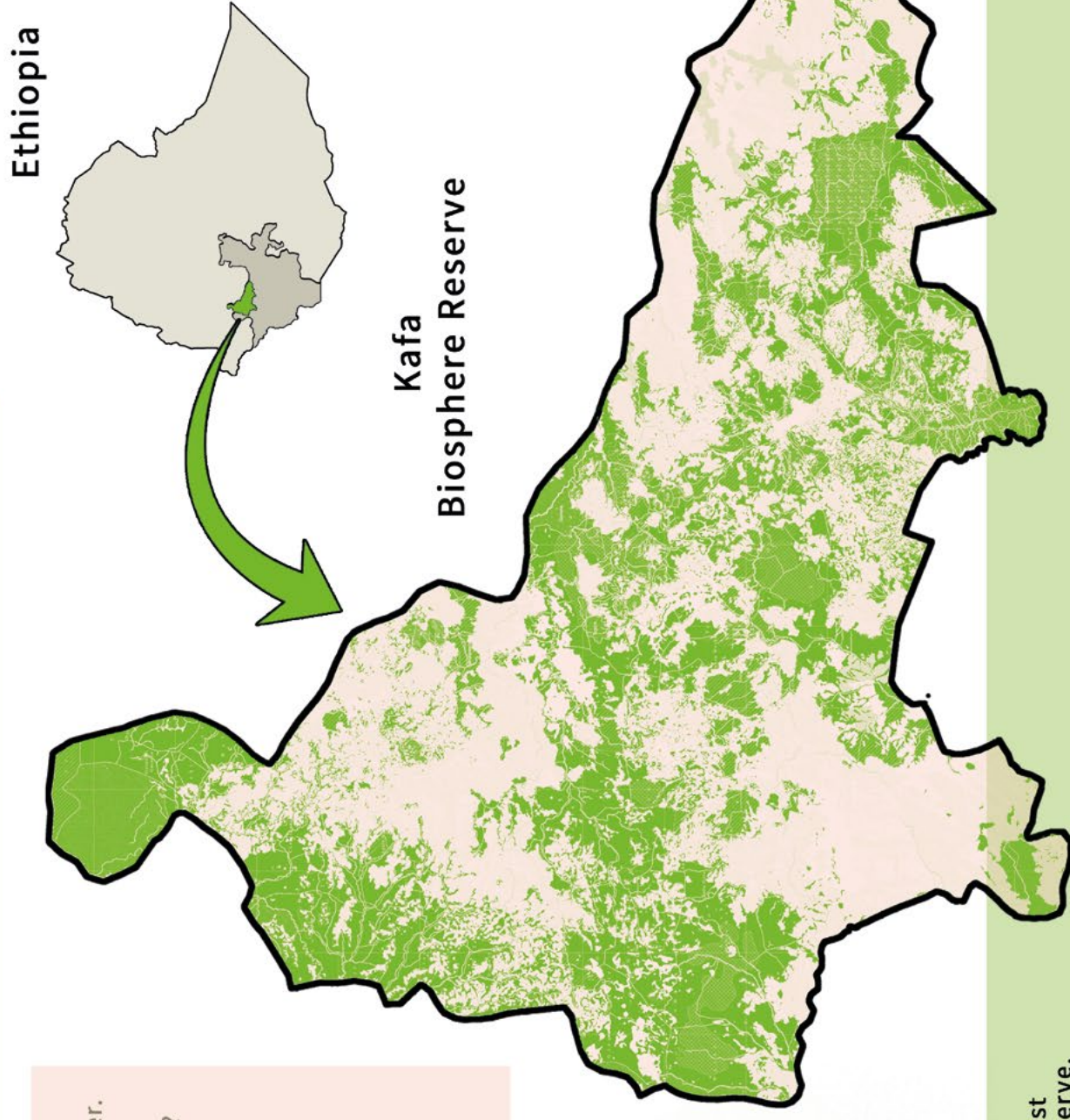
Humans and nature have lived in a balanced system of interaction over thousands of years. Whatever we need - out planet provides it. With our global population continuously growing, this balance is disturbed.

Forest cover in the Kafa Biosphere Reserve

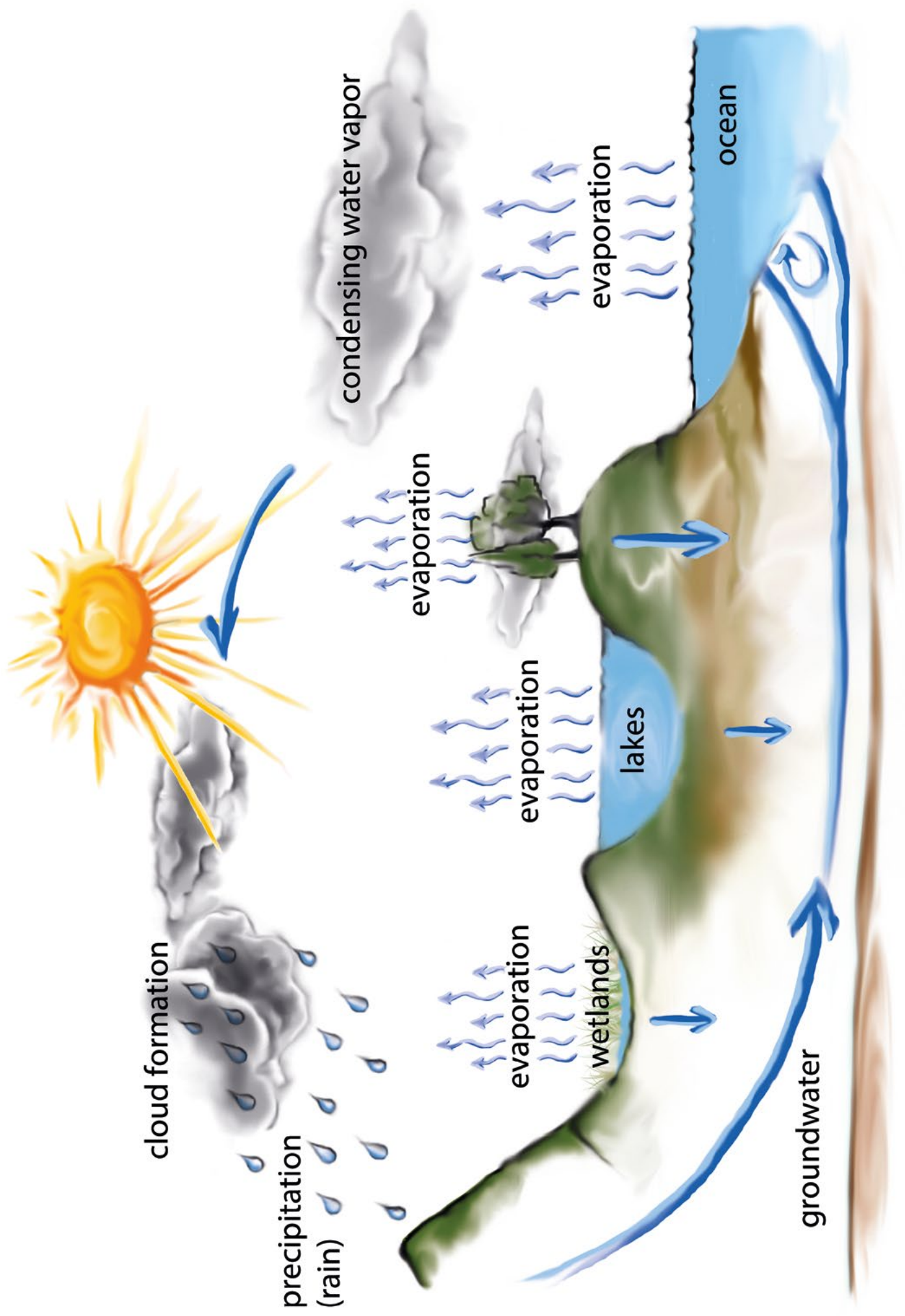
Recent estimates show that nowadays **Ethiopia** has **less than 3.6%** of its original natural forest cover. ("Forest status of Kafa Biosphere Reserve", NABU, 2011)

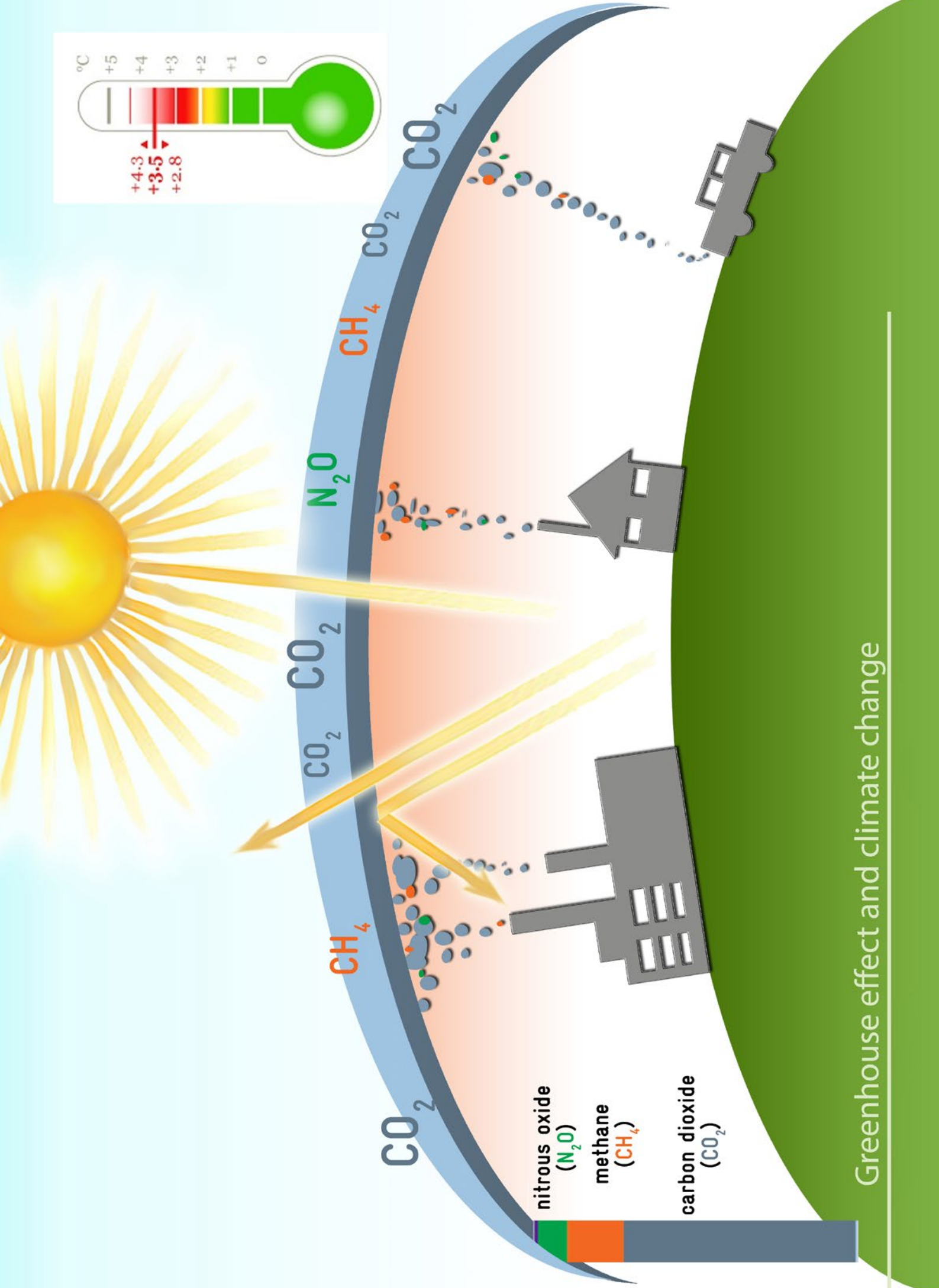
What leads to deforestation and forest degradation?

- Agriculture expansion,
- Population pressure,
- Resettlement,
- Concessions (.g. coffee plantations),
- Insufficient land property rights,
- Unsustainable use of forest resources.



Based on the data analyses from 2011, natural forest covers **47%** or 349,641ha of the **Kafa Biosphere Reserve**. This means that more than 45% of all forest found in Southern Nations, Nationalities and People's Regional State is located in the Kafa Biosphere Reserve.





A stylized illustration of a village scene. On the left, a large, gnarled tree with many branches and small leaves stands prominently. To its right are two small, square huts with conical, thatched roofs. A small figure of a person is visible near the base of the tree. The background is a light, textured grey.

Bad waste management practices can result in soil and air **pollution** that can cause respiratory problems and other adverse health effects as contaminants are absorbed from the lungs into other parts of the body. Especially when burning non-degradable waste like plastic or rubber, our health can be affected seriously.

Waste that ends up in water bodies negatively changes the chemical composition of the water - this is called **water pollution**. It can also cause harm to humans and animals that drink from such polluted water.

Too much washing detergent is changing the chemical composition of water and is harmful for aquatic organisms.

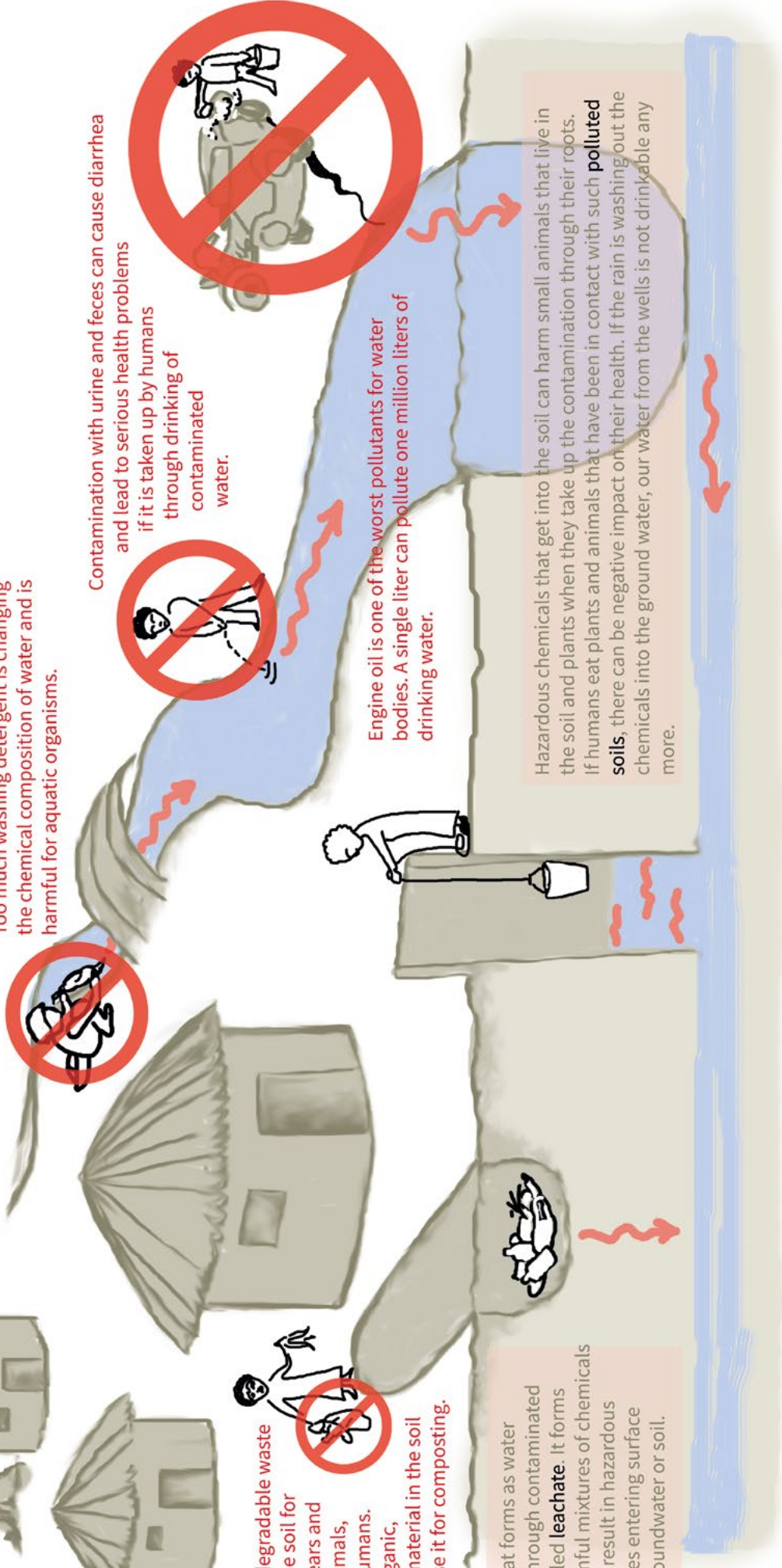
Contamination with urine and feces can cause diarrhea and lead to serious health problems if it is taken up by humans through drinking of contaminated water.

Buried non-degradable waste will stay in the soil for millions of years and can harm animals, plants and humans. Only bury organic,

Engine oil is one of the worst pollutants for water bodies. A single liter can pollute one million liters of drinking water.

Liquid that forms as water trickles through contaminated soil is called **leachate**. It forms very harmful mixtures of chemicals that may result in hazardous substances entering surface water, groundwater or soil.

Hazardous chemicals that get into the soil can harm small animals that live in the soil and plants when they take up the contamination through their roots. If humans eat plants and animals that have been in contact with such **polluted soils**, there can be negative impact on their health. If the rain is washing out the chemicals into the ground water, our water from the wells is not drinkable any more.



Forest food chains

Energy moves through an ecosystem though what we call a **food chain**. The food chain consists of three categories of living creatures that produce or consume food in different ways. This chain is actually not a chain but a cycle.

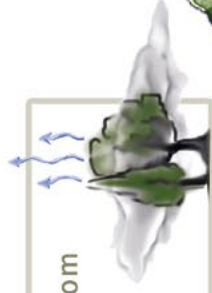
Producer – A living thing which is able to generate its own food from air, sunlight and nutrients in the soil. Green plants are producers.

Consumer – Animals that get their energy from eating food like plants or other animals.

Decomposer – Fungi, bacteria and small animals that get their energy from breaking down dead plants and animals. Decomposer turn dead material into nutrition for good soil fertility from which plants (producers) can grow again.



• Forests keep the moisture from clouds and are important for maintaining the hydrological cycle.



• Forests are home (habitat) for many plants and animals.



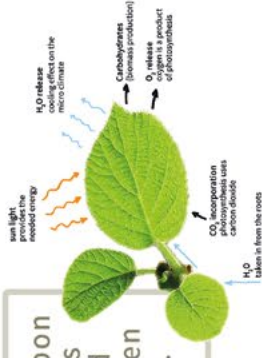
• Forests provide humans with renewable resources for example wood, fruits, honey or coffee.



• Forests are appreciated for their aesthetic and spiritual values, and are attractive for tourism.



• All trees and plants store carbon dioxide through photosynthesis (important for our climate) and at the same time produce oxygen (vital for humans and animals).



• The root system of forests prevents the soil from being washed away (erosion).



Benefits of forest

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Glossary

Agroforestry - A system where trees or shrubs are grown deliberately alongside with other crops and/or livestock farming.

Biodiversity - Biological diversity is the variety of life on Earth and the natural patterns it forms.

Biosphere reserve - A biosphere reserve is a protected area created to conserve the biological and cultural diversity of a region while promoting sustainable economic and social development.

Buffer zone - The area between the core zone and the transition zone in a biosphere reserve.

Carbon dioxide - A colourless gas that is responsible for the greenhouse effect.

Carnivore - An animal that eats meat.

Climate - The average weather conditions that an area usually experiences over a long period of time.

Climate change - The term used when the climate of an area, or the planet, starts to change.

Consumer - Animals that get their energy from eating food like plants or other animals.

Core zone - The central most protected area in a biosphere reserve.

Decomposers - Small creatures (e.g. Fungi, bacteria, earth worms, beetles or ants) that break down the dead material and turn it into nutrients in the soil, which plants use to grow.

Deforestation - The cutting down and removal of most or all of the trees in a forested area.

Ecosystem - An ecological community with its environment, functioning as one unit.

Endemic - An animal or plant only and nowhere else found in to a certain region.

Food chain - A system of living beings that are consumed by each other.

Food web - A system of interlocking food chains.

Forest - A continuous area covered with and dense trees, shrubs and undergrowth.

Greenhouse effect - The trapping of heat from the sun by atmospheric gases.

Habitat - An area where a plant or animal usually lives and grows.

Herbivore - An animal that only eats plants.

Mitigation - The reduction of or compensation for an environmental harm.

NABU - The Nature and Biodiversity Conservation Union.

Omnivore - An animal that eats both meat and plants.

Photosynthesis - A process carried out by plants during which carbon dioxide and sunlight are converted into sugars which the plants use to grow.

Producer - A living thing which is able to generate its own food from air, sunlight and nutrients in the soil. Green plants are producers.

Sustainability - Describes a system in which development meets the needs of the present generation, without compromising the ability of future generations to meet their own needs.

Transition zone - A place where people live and make a living in a biosphere reserve.

Waste - Material that human no longer use or do not want to use any more and therefore discard them; or excess material generated during manufacturing, catering and other human activities.

Water cycle - The way water, in its different forms, moves through our ecosystems. From the liquid (rain, rivers, lakes, oceans and groundwater) to the gaseous state (cloud formation) and even solid in form of ice and snow.

Wetland - An area where the land is saturated with water. Wetlands are very sensitive, valuable ecosystems which are very important for water storage.

Wildlife - Animals that have not been domesticated.

Zonation - The division of an area into zones according to some criteria.

Take care of your environment!

