UNDERSTANDING OUR WETLANDS

A RESOURCE BOOK FOR PRIMARY SCHOOLS

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Nile Transboundary Environmental Action Project
Nile Basin Initiative

August 2009

This publication was made possible with the financial support from the Canadian International Development Agency, The Netherlands Government provided through the Nile Basin Trust Fund, Managed by the World Bank and Nile Basin Initiative Member countries.

Published by: Nile Basin Initiative – Nile Trans boundary Environmental Action Project

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Citation: Oonyu J. C, (2009) Understanding our Wetlands – A Resource Book for Secondary Schools. Edited by Henry Busulwa, Wetlands and Biodiversity Component of the Nile Basin Initiative, Entebbe, Uganda

Printed by: LA Consult Ltd
P.O. Box 40025 Kampala Uganda
Tel: 0414 380 114, 0712 100199, 0772 374030
email: laconsult2009@yahoo.com

Available from: Nile Basin Initiative Secretariat
P.O. Box 192 Entebbe Uganda
www.nilebasin.org

ISBN:
9789970167043

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FOREWORD

The Nile Basin Initiative (NBI) is a partnership between riparian countries of the Nile; namely Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda. The NBI's shared vision is to "achieve sustainable socioeconomic development through the equitable utilization of, and benefit from the common Nile Basin water resources". To translate this shared vision into action, there are two complimentary programs: the Shared Vision Program (SVP) which creates a basin wide enabling environment for sustainable development; and the Subsidiary Action Programs (SAPs) engaged in concrete activities for long term sustainable development, economic growth and regional integration of the Nile Basin countries.

The Nile Trans boundary Environmental Action Project (NTEAP), one of the projects under the Nile Basin Initiative's (NBI) Shared Vision Program, was mandated to provide a strategic environmental framework for the management of the trans boundary waters and environmental challenges in the Nile River Basin. One of the ways NTEAP met this objective was to develop wetlands education, training and awareness materials for use at five stakeholder levels as follows:

a) Understanding our Wetlands – A Resource Book for Primary Schools;
b) Understanding our Wetlands – A Resource Book for Secondary Schools;
c) Understanding our Wetlands – A Resource Book for Tertiary Institutions;
d) Wetlands Awareness resource book for Communities;
e) Wetlands Awareness resource book for Policy Makers.

This Resource Book for Primary Schools pupils, has been produced through a consultative interactive process with the Regional Working Group Members of the Nile Basin Wetlands and Biodiversity Component and the Environmental Education and Awareness Component. This book has been designed to guide teachers to confidently address wetlands education issues while conducting classes for environmental education as an efforts to address the challenges of wetlands degradation and promote their wise use.

This book is reference for enhancing wetlands education and awareness in Primary schools in the Nile basin countries, with a long term goal of motivating professionalism for wetlands and biodiversity management from lower levels of education through to secondary and tertiary institutions. It is user friendly, designed for the extra curriculum education systems prevailing in each of the Nile basin countries. Awareness, learning and outreach materials such as brochures, handouts, charts, radio and TV programmes, cartoons, drama, role plays, and songs can be prepared using this resource book.

We hope that this book will be useful to any organisation or practitioner wishing children to learn about wetlands and their importance as an efforts towards their sustainable conservation.

Gedion Asfaw
Regional Project Manager
Nile Trans boundary Environmental Action Project

HOW TO USE THIS BOOK

Wetlands are very important ecological, social-economic and cultural resources. Despite this, awareness and understanding of their services, functions and use remains low amongst a large proportion of the people in the Nile basin region. This challenge stems from the fact that wetland functions and values that contribute to people's livelihoods are less visible and inadequately appreciated, yet they are resources that reduce poverty in Africa.

This book is designed to improve the understanding and appreciation of wetland functions and values. It is a generic Resource book, consisting of several units that can be adapted or modified to suit the various learning needs and the curriculum of a particular country in the Nile Basin region. This Resource book has been prepared to provide an interactive practical approach to learning and may be used by both teachers and learners at the Upper primary school level. The main aim is to enhance the understanding of wetland issues and in simple ways while mitigating their rapid degradation which is a threat to them in the Nile Basin.

This resource book provides an invaluable source of information and activities that take learners through experiences that awaken their interest in the proper care and use of wetlands. In preparation of this Resource book, effort was made to show the teachers the potential for learning about, in and for wetlands. The concepts have been presented chronologically to enable the learners move from the known to unknown through hands-on activities and self-reflection, which is the basis for experiential learning.

The Resource book contains five units, namely Unit 1: Wetlands and their formation; Unit 2: Wetland benefits; Unit 3: Living things in the wetland; Unit 4: How our actions damage wetlands; and Unit 5: Proper care and use of wetlands. Each unit is introduced and this is followed by Unit objectives, exposition of the key concepts and a presentation of activities, exercises and questions to support learning. The numerous illustrations in the form of pictures or photographs are meant to make learning easy and the teacher is encouraged to formulate other relevant questions that will help the learners to develop the essential process skills such as observation and communication.

In this resource book the teacher is a facilitator who guides an interactive process to learning. A wetland near a school would be appropriate as additional learning aid to encourage the learners to appreciate the efforts of the Nile Basin Countries in managing wetlands. The teacher is also encouraged to choose or design other activities, questions or exercises that are relevant to the learners that can be carried out and monitored over a period of time. Furthermore, the teacher is encouraged to seek other periodical sources of information or resources that may be locally available to supplement the information available in the Resource book. Although some of activities can be done inside the classroom, it is recommended that much of the interactions be carried out the classroom in conjunction with established environmental or science clubs.

ACKNOWLEDGEMENT

The Nile Trans boundary Environmental Action Project (NTEAP) is particularly grateful to the Project Management Unit (PMU) and National Project Coordinators for facilitating the production of this Resource book. The NTEAP worked with the Wetland and Biodiversity Working Group, and the Environmental Education Working Group who are all acknowledged for their constructive criticisms during the preparation of the resource book.

Thanks go to the Consultant, Dr. Joseph Oonyu for the time and ingenuity he displayed during preparation of this publication together with his team Ms. Josephine Esaete, Ms. Aiden Asekenye, Ms Betty Kituyi, Mr. Najib Bateganya, Mr. Moses Odongo, Mr. Gabriel Obbo-Katandi and Mr. Umar Tumwine of Makerere University, Uganda who assisted during the preparation of this resource book.

Special thanks also go to working group members: Mr. Messele Fisseha from Ethiopia, Dr. Khalid Riak from Sudan, Mr. Jean Marie Bukuru from Burundi, Mr. Crispin Sedeke from DR Congo and, Mr. Fred Omego Mr. Paul Mafabi from Uganda, and Mr. Dalmus Oyugi from Kenya for their continued inputs during preparations. Thanks also go to Ms. Grace Bithum Pacutho for the artwork. All those who provided photographs including the excerpts of student project activities that have been reproduced in this publication are acknowledged.

Special gratitude is also extended to Ms. Beatrice Adimola and Ms. Lucy Iyango for reviewing the final version of this print. The Nile Basin Initiative NTEAP is grateful for the financial support from UNDP, GEF, the World Bank, Nile Basin Trust Fund, and UNOPS.

The Nile Basin Initiative - Nile Trans boundary Action Project

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UNIT 1: WETLANDS AND THEIR FORMATION

1.1 INTRODUCTION

This is the first unit on wetlands. It will help you understand the meaning, forms and types of wetlands. You will read about how we benefit from wetlands. It will also prepare you to do some activities in a nearby wetland. In this Unit therefore, we shall learn:

- What wetlands are;
- Wetlands and their surroundings;
- Location of major wetlands in the Nile Basin;
- Types of wetlands.

Learning Objectives

By the end of this Unit, the pupils should be able to:

- Understand wetlands and the relationship with their surroundings"
- Classify wetlands
- Give examples of wetlands in the Nile Basin Region

1.2 What is a wetland?

Study the picture below about a wetland

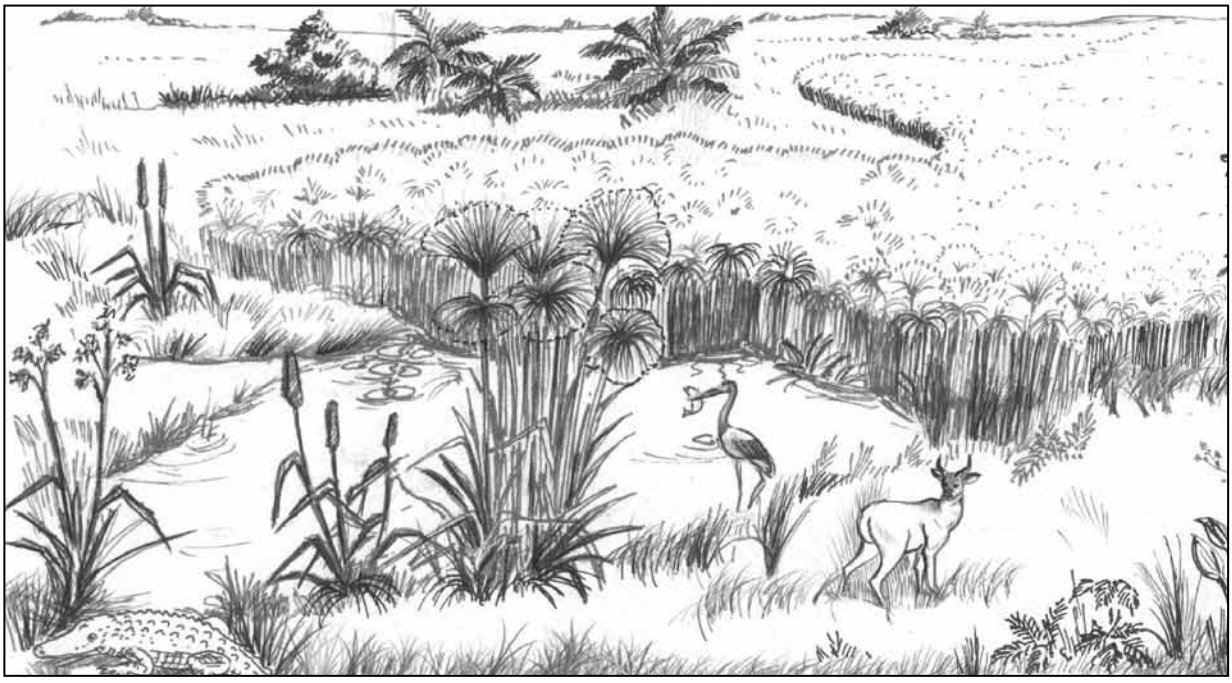


Figure 1: A wetland showing plants, animals and use

ACTIVITY 1.1

What is a Wetland?

Study the picture *(Figure 1)* and give answers to the questions in Exercise 1 and 2. After answering the questions, they should show you their answers which you can use to guide the discussion on what the features of a wetland are. The discussion is required to answer exercise 1.1 to 1.3. The major skill to be developed is observation and interpretation.

Exercise 1.1:

Write the answers, in your exercise book, to the following questions and show them to your teacher

- What plants can use you see in the picture?
- What animals can you see in the picture?
- What other things can you name you name in the picture?

Exercise 1.2:

- Discuss with your classmates what you see in this picture.
- Name a place which looks like this, found near your school.
- Make an outline of the main characteristics of wetlands

The place you have named and the one shown in the picture is called a Wetland.

"Wetlands are areas of land that are wet, flooded either permanently or seasonally, and where the land keeps water for long enough to allow the development of characteristic soils, plants and animals"

You should know that:

- In a wetland, you can have surface water or water within the soil
- Water in a wetland is shallow (less than 6 meters deep)
- Wetlands have a unique sol condition, usually with clay ad sand.
- There are specially adapted plants and animals in wetlands.
- Wetlands trap dead plants and animals and these decay in water logged conditions

These are things that make wetlands different from other lands.

They are called the characteristics of wetlands.

1.

Exercise 1.3:

- In your own words, tell your discussion group what a wetland is?
- Draw one plant and one animal found in wetlands, which interest you. Display your drawing. Move around to see what others have displayed.

1.3 How wetlands are formed

In your area, rain may fall frequently or occasionally. Here is an activity for you to do on an occasion when rain has fallen heavily. Choose a place you know that collects stagnant water near your school

ACTIVITY 1.2:

Make observations on the rain and surface run-off and note the following

- The direction in which the water flows
- The colour of the water
- What you see carried in the water?
- Where do the water stops flowing?.
- You may notice water flowing from other directions into the same area
- What happens to the soil where the water collects?

The water that flows from the different directions is called run-off. It gathers in an gently sloping area or depression such as a valley. The soil becomes water soaked and is water logged. The plants and animals which live here become used to water logged conditions. An area, with such conditions, plants and animals, is known as a Wetland. The run-offs carry water mixed with soil particles. The movement of the particles may be stopped by plants in the wetland, after which clearer water will continue to flow from the valley.

In your Social Studies or Geography lessons, you have learnt about rivers. Some rivers are fast moving, but when they reach the valleys, they slow down; water movement gets delayed. This causes conditions of a wetland because the soil becomes water logged. The plants and animals that adapt to living in these conditions, helps to spread the water. This causes it to deposit the eroded soil that it came with. The plants also trap other rubbish, which the water brings as it flows. As explained earlier, places where water logs for long time, and which have plants and animals are called wetlands. The water stays in the same place for a long time; it could be a week, months or even years. In deserts, where flowing water is rare, there are places where water logs; these are called oases. These are also wetlands. Oases are formed when the water table which is close to the surface is exposed by the removal of sand by the action of wind.

- *Wetlands are formed when water collects or logs in a flat low lying area.*
- *Wetlands are also formed at points where streams or river flow is slowed in flat plains; where water becomes logged for long.*
- *Wetlands can also be formed by the exposure of the water table, when sand is removed.*

ACTIVITY 1.3

Illustrations for understanding wetlands formation.

Help the pupils to understand how wetlands are formed by explaining the different ways in which wetlands come about. Give them an exercise which will require them to name the streams and rivers in their locality. This knowledge should then be extended to the major rivers in the country.

Exercise 1.4

1. Mention

a) Other ways in which wetlands can be formed and used.

b) How wetlands in your locality could have been formed.

2. Draw a diagram which shows how water runoff in your area has formed a wetland near your home or school.

3. With knowledge of rivers in your country. Name the places were the rivers start and end.

1.4 Wetlands and their surroundings

Wetlands are formed when water movement is retained or delayed at locations within the catchments. This may be on a gently sloping land, depression or basin. Some wetlands (oases) may also be formed by the exposure of the water table which is close to the surface. Therefore, important things for the formation of wetland are:

- The area from which the wetland collects its water as run off.
- The streams and rivers that are in the catchment.
- The slope of the area where water collects; it could be a flat area or valleys.
- The soil beneath becomes water logged.
- The water table is very near the ground surface.
- The natural actions expose the water table.

A wetland catchment area must be looked after well so that soil erosion is reduced and to allow water to flow at its pace. Wetlands also reduce water pollution; they ensure that water is cleaned. A clean or healthy wetland will provide products or benefits such as grass for domestic animals, water, reeds and fish.

Figure 2: A Diagram of a typical catchment

Exercise 1.5

1. Mention the
a) Advantages of protecting wetland catchment areas.
b) Ways of protecting these catchment areas.
2. Make a list of the things you would include in a plan to protect the catchment of the wetland near your school. The list should include the local communities and their leaders.
3. Discuss your list with your class teacher so that you come-up with one list for the class.

A wetland catchment refers to the area where wetland collects its water or furthest point on land where water collects and flows into the wetland.

ACTIVITY 1.4

Preparations for Field Trip

Having been exposed to wetlands and their surrounding a field exercise to take a class to a nearby wetland in order to consolidate this knowledge is necessary.

(i) Preparations for the field visit should include:

- Develop objectives of the field visit and what is required.
- Consultation with your head teacher, who will help you with clearances.
- Insist with the leaders in charge of the wetland that you intend to have preliminary visit to the area.
- Explanation to the pupils on the objectives of the visit and what is expected of them, including questions to be answered.

(ii) Try and encourage pupils to note the characteristic land forms of the area, drainage and peoples' activities in the wetland and its catchment.

(iii) Show the pupils the boundaries of the catchment area for the wetland and encourage them to discuss the importance of its protection. The major skills to be developed are observation, drawing, taking down notes and interpretation.

ACTIVITY 1.5

Field tour of the area surrounding the wetland near your school.

During the field tour to the area surrounding the wetland near the school. The following should be recorded

- The nature of rainfall (how frequent) in the area.
- The run off path of the area into the wetland.
- Land forms of the area (hills, valleys and flatland).
- Communities' activities in the area.
- The boundaries of the wetland (Catchment area) and the activities taking place in it.
- Compiling case studies and making notes or writing a report.

Which of the above noted aspects affects the size of a wetland?. This in turn influences the type and number of different plants and animals in the wetland.

Did you know that?

- The patterns of rainfall will determine the amount of water into the wetland?
- The drainage systems of the land around, directs the flow of water to the wetland?
- Land forms will influence the spread of rain water runoffs?
- People's activities in the catchment area will influence what materials the rain run-off will carry into the wetland?

1.5: Wetlands in the Nile Basin Countries:

Revise the names and location of wetlands of your country. The factors discussed in previous sections of this Unit are important because they affect the distribution of wetlands in your country. Let us look at wetlands in the Nile Basin Region. This may include your country.

Nile Basin is covered in Ten Countries written in red colour

1. Egypt
2. Sudan
3. Eritrea
4. Ethiopia
5. Uganda
6. Kenya
7. DR Congo
8. Rwanda
9. Burundi
10. Tanzania

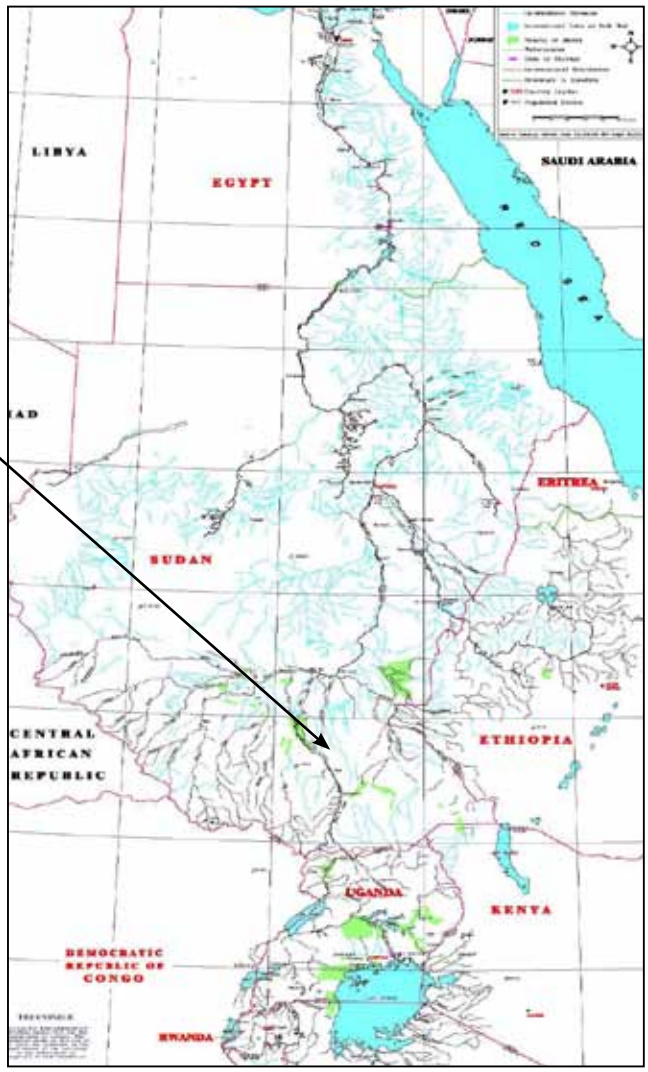


Figure 3: Map showing Nile Basin countries. Wetlands are associated with major rivers and lakes.

Find information, about the area covered by wetlands in the countries indicated in the table below.

Country	Area covered with wetland	% of the total land
Burundi		
Democratic Republic of Congo		
Egypt		
Ethiopia		
Kenya		
Rwanda		
Uganda		
Sudan		
Tanzania		

From the above table most countries have most of their land being covered with wetlands. Find out the names of major wetlands in each country and prepare a table that shows names of wetlands in at least four countries.

Show their sizes and make use of table as below:

Area Covered by Nile Basin	Names of Wetlands	Size of land covered by wetland

Most of the wetlands in the Nile Basin are found at shores of lakes and at river banks, or low lying basins of rivers, for example, Sudd in the Sudan. Some wetlands are found at points where rivers or streams enter major water bodies. There are also many wetlands formed at points where two rivers or streams meet. Can you give examples of these wetlands?

1.6 Types of wetlands in the Nile Basin

As mentioned above, the distribution of wetlands in the Nile Basin countries show some wetlands found around lakes, while others are around rivers. Wetlands associated with lakes are called lacustrine wetlands while those associated with rivers are called riverine wetlands. From the atlas we can find examples of lake (lacustrine) and riverine wetlands. Using the table below is a prepare a summary of lake wetlands in the Nile Basin.

1.6.1 Lake or lacustrine wetlands

Exercise 1.6:

Lake wetlands in the Nile Basin region

a) Complete the following table

b) Are there any other examples of lake wetlands that you can give about your country?

1.6.2 Riverine wetlands

Exercise 1.7:

Riverine Wetlands in the Nile Basin Referring to lessons in Geography, Social Studies or others related to rivers.

Name of Country	Examples of wetlands with lakes (Lacustrine)
Burundi	
Democratic Republic of Congo	
Ethiopia	
Kenya	
Rwanda	
Sudan	
Tanzania	
Uganda	

Photograph 1 Nakivubo wetlands in Uganda protecting Lake Victoria (Photo by Wetlands department in Uganda)

1. Referring to lessons in Geography, Social Studies or other subjects on rivers.

a) Name the rivers in your country.

b) Name the rivers within the Nile Basin, which are in more than one country.

2. Study the map of the Nile Basin in the Atlas. Read about Riverine Wetlands in the Nile Basin.

3. Use the information to complete the table on Riverine Wetlands and use the information to complete the table.

Table of Riverine Wetlands in the Nile Basin

Name of Country	Wetlands associated with Rivers (Riverine)
Burundi	
DR Congo	
Egypt	
Ethiopia	
Kenya	
Rwanda	
Sudan	
Tanzania	
Uganda	

Compare the table of the results with your classmates

Photograph 2: An example of riverine wetlands in South Sudan (Photo by Dr Khalid Riak-Sudan

1.6.3 High altitude Wetlands

Wetlands can be classified based on altitude or the height above sea level at which they are found. On this basis we can have low altitude, medium and high altitude wetlands.

Figure:2 shows different vegetation found in wetlands at different heights and should help you to answer exercise 1.8

Exercise 1.8

1) Draw the diagram in the exercise book.
2) Give examples of wetlands at different levels (altitudes) in your country.
3) Name the mountain or highlands where the wetlands are found.
4) Find out the names of highlands and wetlands in each of them, from your Geography or Social Studies teacher, .

The Wetland types are also named by the most dominant or common plant.

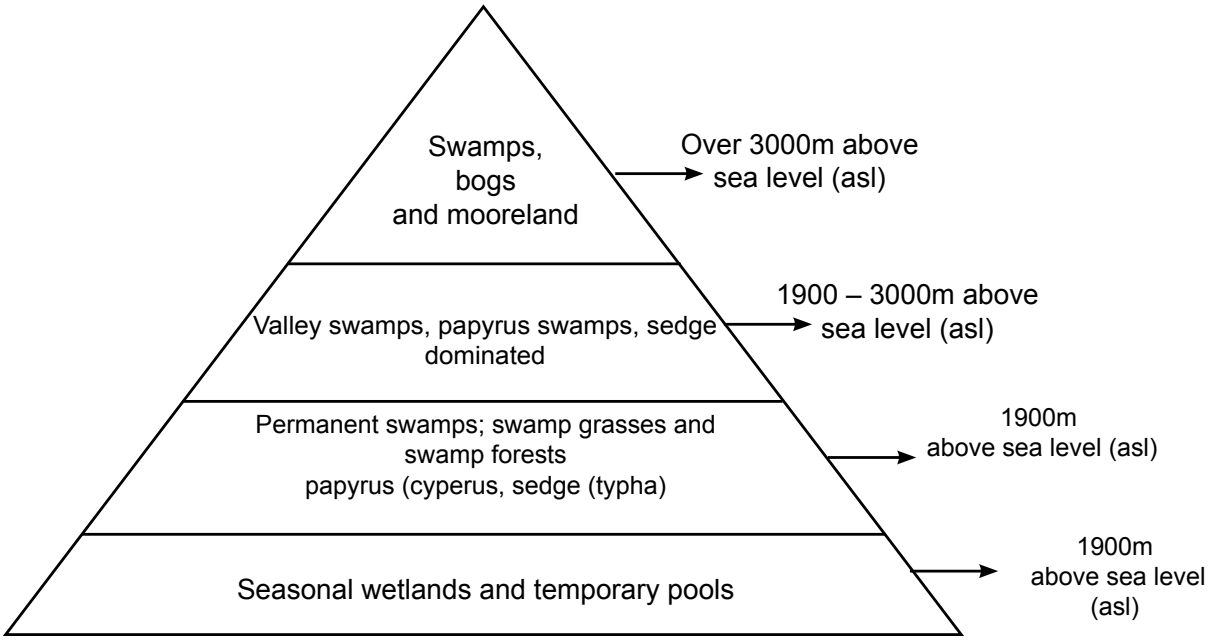


Figure 4: Different vegetations types found in wetlands at different altitudes

1.6.4 Oases (Wetlands in deserts)

In deserts, examples of wetlands created by the action of removal of sand and the subsequent exposure of the water.

An Oasis in the desert

ACTIVITY 1.6

Provide examples of different types of wetlands that are not found in the Nile Basin countries. The idea is to ensure that pupils are able to recognise other types of wetlands beyond what they are familiar with in their immediate neighborhood. Encourage them to use other text books. The major skills to be developed are observation, interpretation and communication.

1.7 UNIT SUMMARY

You have just completed one the five units that will help you understand wetlands better. You have dealt with:

- What wetlands are
- How wetlands are formed
- The different types of wetlands, and
- Where they are found.

How to classify and group wetlands

1.8 FURTHER READING

Wetland Inspection Division (WID). 2004. Wetlands Resource Book. Ministry of Lands, Water and Environment, Uganda. Kampala: MOWLE Publications.

United Nations Development Programme (UNDP). 2005. State of World Environment Report. Nairobi: UNDP Publications.

http//:www.nilebasin.org

www.wetlands.org

www.ramsar.org

UNIT 2: WETLANDS BENEFITS

2.1 INTRODUCTION

In the previous chapter, we studied wetlands and how they are formed. We also looked at the different types of wetlands. We now know some of the names and the location of different wetlands in the Nile Basin and in our areas.

Materials extracted from wetlands are known as products and benefits. Products include goods such as sand, clay, plants and animal resources and many others. Those that cannot be extracted are services we enjoy. The services include storing water, filtering water, home for animals and plants, and keeping the climate healthy. Therefore, wetlands benefits include products that are harvested and services that we enjoy.

Learning objectives

By the end of this Unit, the pupils should be able to:

- Give examples of wetlands goods and their uses
- Give examples of wetlands services in your locality or country
- Explain the role of wetlands in making water clean, storing it and releasing it
- Carry out a project in your community to make the people aware of the importance of wetlands to them

Photograph 4. Some of the goods and products from wetlands.

ACTIVITY 2.1

Having completed the first unit of this Resource Book, familiarise pupils with the various wetland products and services.

- One of the most effective approaches is to use pictures and to help pupils to interpret them. The illustrations presented here are simply examples. The teacher can look for other pictures and photographs that can be used.
- The teacher should also take the class to a nearby wetland in order to consolidate pupils' knowledge on benefits of wetlands. Prepare a series of questions for your class to respond to, on wetland benefits
- Encourage pupils to note the various uses of wetlands in the area that they are visiting and to quantify the goods.
- It should then become easier for pupils to answer questions posed in exercises 1-8, and to discuss their answers with class mates. You as the teacher should clarify these responses where necessary.

The major skills to be developed among the pupils are observation, drawing, taking down notes, interpretation and communication.

Exercise 2.1:

1) Name the products shown in Figure 5. What wetlands goods are they made of?
2) What other goods and products are got from wetlands in your country that are not shown here?
3) Write down what can go wrong when we over harvest goods from wetlands.

2.2 Products of Wetlands

The goods people get from wetlands either occur naturally or are harvested for use. When goods from wetlands are processed, they form wetland products. Some are cultivated by the people living near the wetlands. Most wetlands goods harvested are plants and animals. In some wetlands, we get mineral goods such as sand and clay. When processed, the goods can be used to make products like thatching material, medicine, bricks, fodder for cows. Let us now look at the different wetlands goods.

Exercise 2.2

- In your own words tell your discussion group the main wetland goods.
- List some of products made from wetlands goods.
- List some of the plants found in wetlands. Use the local or common names.
- Compare your answer with what other groups have given.
- Draw one plant and animal found in wetlands in your area. Display your drawing. Move around to see what others have displayed.

Does your answer include any of the following?

- Water, sand and clay.
- Wetland plants such as Papyrus, Nile cabbage, and Water lily, grass
- Wetland animals such as otters, sitatunga, fish and others that go to drink water, such as the water buck, camels, cattle, sheep and goats
- Some animals are domestic while others are wild.

Water

Water is an important product from wetlands. Without water, wetlands would not exist. Wetlands work like sponges. They store and retain water for long periods and release it slowly into rivers, springs or lakes.

Wetland plants and soil help to filter the water. We must not disturb or remove the plants too much because that would affect the function of wetlands in purifying water. The water supplied from wetlands is generally clean and can be used by living things and people for domestic and industrial purposes. The water supply can be seasonal or permanent. When it is permanent, it can also be used for irrigation.

Exercise 2.3.

- Name the wetland which supplies water to the spring.
- Find out the wetlands from which your community and other communities get water.
- What would happen to the spring water if the wetland dried up?
- What does a community need to do to keep the water supply clean?

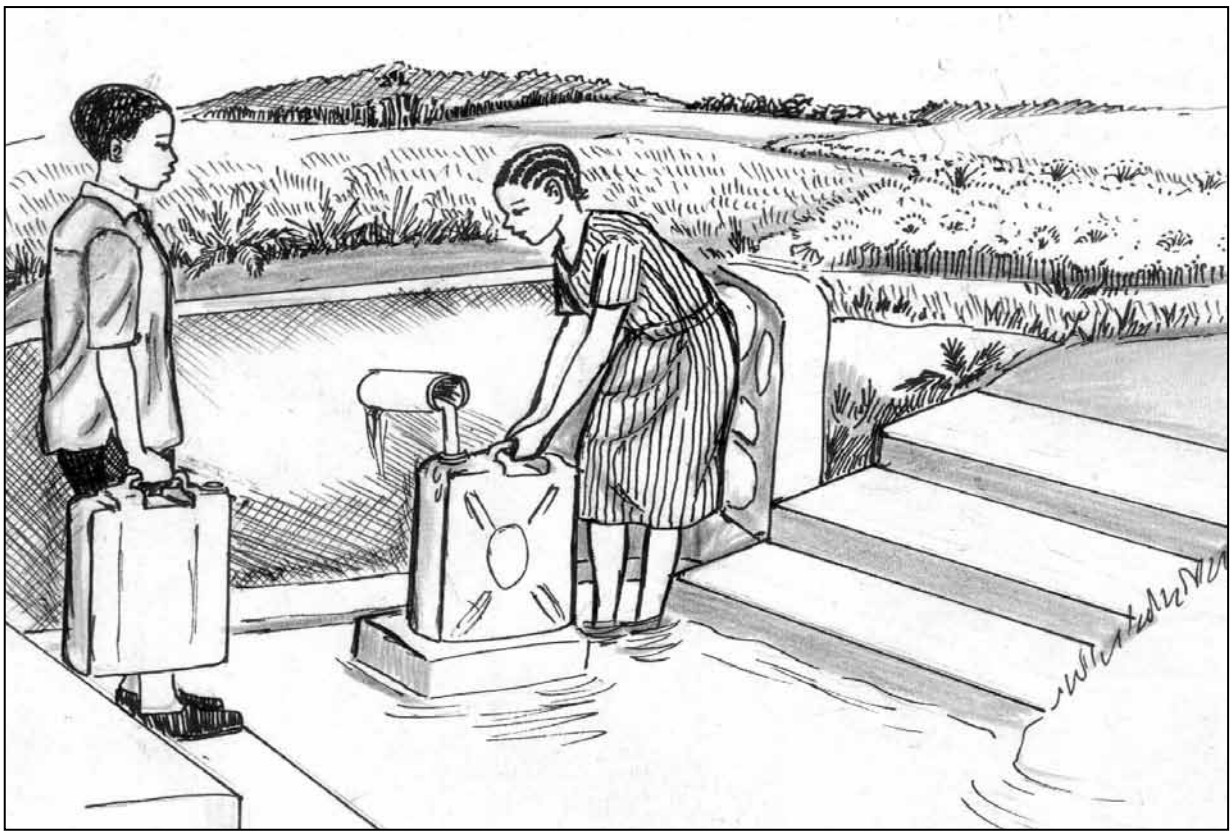


Figure 5. Wetlands if wisely used and sustainably used can be a good source of income for communities

Do you know?

- The water supply for town or rural area is supplied by a wetland?
- What the name of the wetland from which the water supplying your town or village is obtained?
- The importance of water as a resource from wetlands?

2.2.2 Wetland plant resources

We harvest plant resources directly from wetlands. The plant resources can be used for making crafts, medicine, wood, timber, building, food and fuel. Other plant resources like reeds, grasses and papyrus are commonly used for hatching, mulching and craft work. A large proportion of these resources is used directly by harvesters. Some are sold and provide financial benefit to the local people. In a later chapter, we shall look at names of different plants from wetlands and what they are useful for. The picture below shows some plant materials being used.

Some of the wetland plants harvested are directly used while others are sold; they hence have economic value. This demonstrates that wetlands are wealth lands since they provide financial benefit to local people and communities.

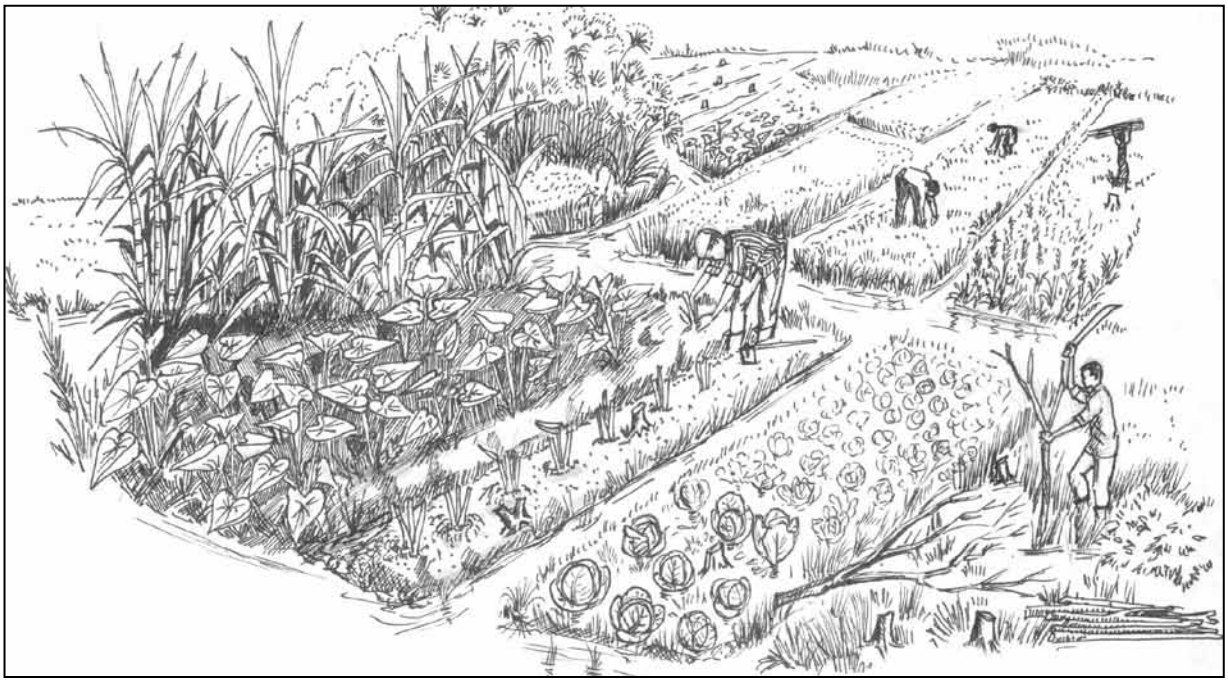


Figure 6: Wetlands wisely used for agriculture are a major source of income.

Exercise 2.4

- Name some plant resources found in wetlands in your local area.
- What are the different plants used for?
- Which of the plant resources are used directly by harvesters? And which ones are sold for money?
- Which of the plant resources are sold?

ACTIVITY 2.2

- With the help of your teacher, give local names of the edible wetland plants to complete the following table.

Plant	Local Name	Edible Part

- Find out edible plant products and their local names.
- Find out what people in other countries call them.
- Make a list of wetland plants which are used for craft materials.
- Name the crafts that are commonly made out of these materials.
- Give the name of the wetland resource from which the particular craft is made.

2.2.3 Wetlands animals resources

Wetlands are habitants for a wide range of plants and animals. Wetland animal resources can be grouped as:

- Fisheries
- Wild life
- Frogs, crocodiles,

a) Fisheries

Figure 8: People in a wetland fishing, while others hold out fish for sale.

Wetlands provide different types of fish; both big and small. Examples of fish we get from wetlands in the Nile Basin Region include:

- Catfish *(Clarias spp)*
- Lungfish *(Protopterus aethiopicus)*
- Nile perch *(Lates niloticus)*
- Tilapia *(Oreochromis spp)*

Photograph 3: Fish from River Nile at Bor in Sudan (Photo by H. Busulwa)

Did you know that?

- Many types of fish live and breed in wetlands?
- Some fish can only breed in wetlands?
- Fish from wetlands is an important source of food for many communities living near wetlands?
- Fish is a good source of protein, iodine and other food values (nutrients)?
- Fish from wetlands can be sold to earn money?

When wetlands are drained or polluted, the available fish stock is disturbed. We need to care for the wetlands in order to keep getting fish from them.

Exercise 2.5

- Name fish found in your local wetlands.
- Find out from the fishermen, what their monthly incomes are from fish.
- Write a composition for your school magazine on how to conserve wetlands for fish.

b) Wildlife in wetlands

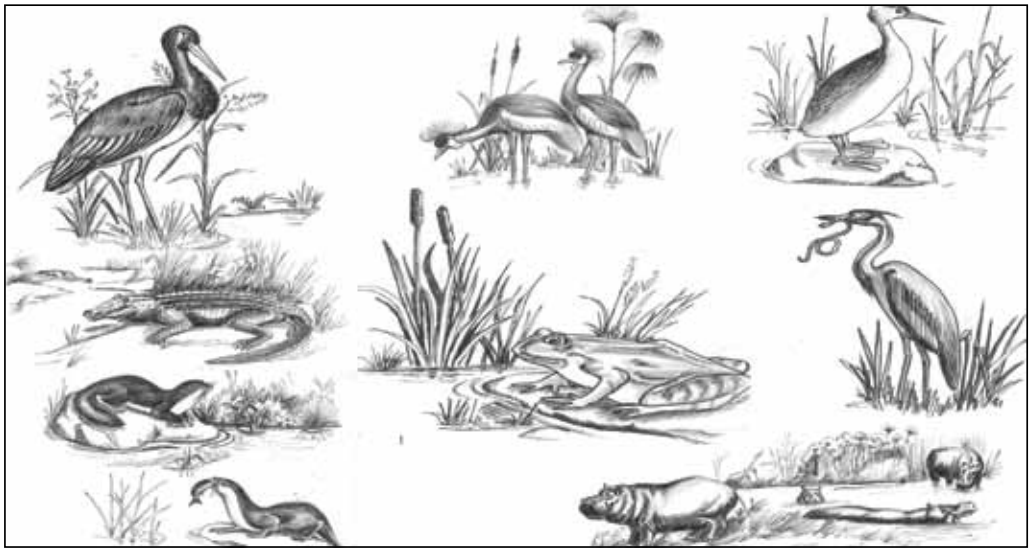


Figure 8: Different examples of wildlife found in wetlands, name them

ACTIVITY 2.3.

Figure 9 shows a variety of wildlife.

- Name the animals.
- What other animals are found in your local wetlands?
- Give three ways we benefit from these animals.

Wetlands wildlife resources include animals and plants. We have already looked at plant resources. Animals found in wetlands include: sitatunga, water bucks, hippopotamus, otters, amphibians and birds. The bird species vary from location to location. Some of the birds migrate with seasons. They move within Africa, and also to and from Europe and Asia. All wildlife animals depend on one form of wetland or another.

Some animals are usually hunted for their meat, skins, horns and feathers. Other animal products include; honey from bees, eggs and feathers from birds. These resources are used directly by the local people. Others are sold. Wild life in wetlands also attracts tourists.

Photograph 6: Tourists on River Nile (Photo by Dr Khalid Riak from Sudan).

ACTIVITY 2.4

- Discuss the importance of wild animals to local communities living adjacent to wetlands near your school.
- Make a visit to the area with a wetland and list the number and types of wild animals that you can see.
- How do communities use such animals to improve their way of living?

Note: Even in dry areas, wetlands are the only places where wildlife can get water. In the desert and dry area conditions, oasis are places where wildlife and livestock obtain water .

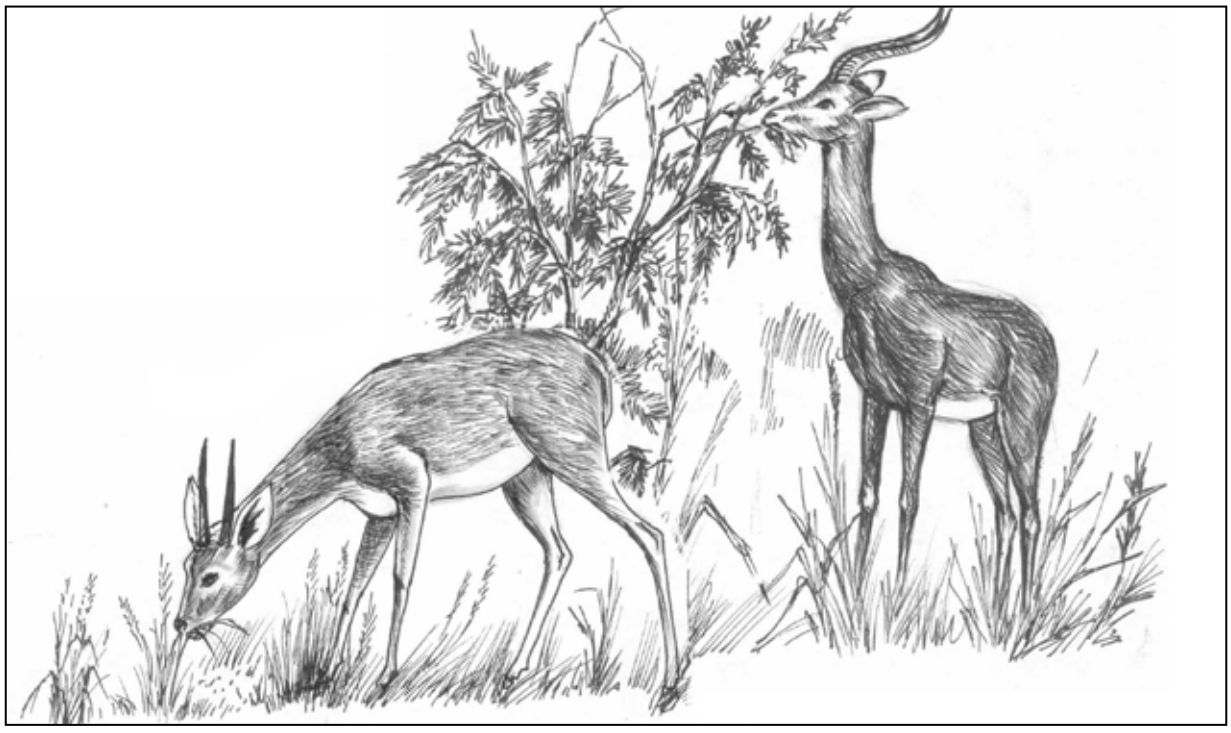
Exercise 2.6

- Name wetlands that are protected in your county.
- Find out, from your atlas, the names of water points and oasis in other countries of the Nile Basin.
- Name National Parks or game reserves near these water points or oasis.

2.3 Wetlands for Grazing and Foraging

Grazing is the consumption of grass and soft vegetation/by animals growing at ground level. Forage is material which animals get from woody plants (trees, bushes and shrubs). These are usually well above the ground.

The pictures below show (a) Animals grazing (b) Animals browsing



(a) (b) *Figure 9 .(a) Animals grazing, and (b) browsing in a Wetland*

In all the Nile Basin countries, domestic and wild animals graze in wetlands, especially during the dry season.

Exercise 2.7

- Name the common grazing areas of your country.
- Which animals graze in the wetlands?
- What are the advantages of grazing animals in wetlands?
- How is overgrazing dangerous to the wetlands?

Photograph 7. Livestock grazing at a wetland edge on River Nile - Photo by Henry Busulwa on River Nile

Grazing animals on the vegetation at wetland edges, especially of permanent wetland, is very useful. It makes use of grass available during the rainy seasons while the seasonal wetlands over grow with grass to be used in the dry season. Grazing on wetland edge needs to be done carefully. We should avoid overgrazing and actions which can destroy wetlands by planning the use of wetland edges for grazing.

Photograph 8: Making channels in a wetland for agriculture purposes has to be done carefully - Photo by Joseph Oonyu

2.4 Agriculture in Wetlands

Wetlands are important for agricultural development. For example, the Nile Delta, areas around lakes such as Victoria, Tanganyika, Turkana, Tana, Cyohoha, George and Kyoga.

Wetlands edges and seasonal wetlands are useful for growing crops. They are useful in times of drought or hardship. Wetlands edges are popular for the growing vegetables and yams but other wetlands can be used to grow crops like rice and sugarcane which tolerate waterlogged conditions. Seasonal wetlands in the highlands of Ethiopia are important for wheat growing. Wetland crops can grow well without need for significant drainage. However, drainage changes the natural set up of the wetland and can not grow upland crops for a long time. The wise use of wetlands will also involve constant assessment of the crop harvest.

It is dangerous to cultivate food crops in polluted wetlands, especially those receiving waste water from industries. This is because the crops may take in and store dangerous chemicals like heavy metals which may affect human health.

Exercise 2.8

- Name crops which are grown in wetlands in your country.
- Find out what proportion of each wetland is used for growing the various crops.
- Find out, from farmers of each wetland, the changes in their harvest in the last five years.
- Write a composition on the use of wetland edges in your community.
- Study the graph and answer the questions below:

(a) In which year was the harvest highest?

(b) Which year had the lowest harvest?

(c) What are some of the possible reasons for the differences in production over the years?

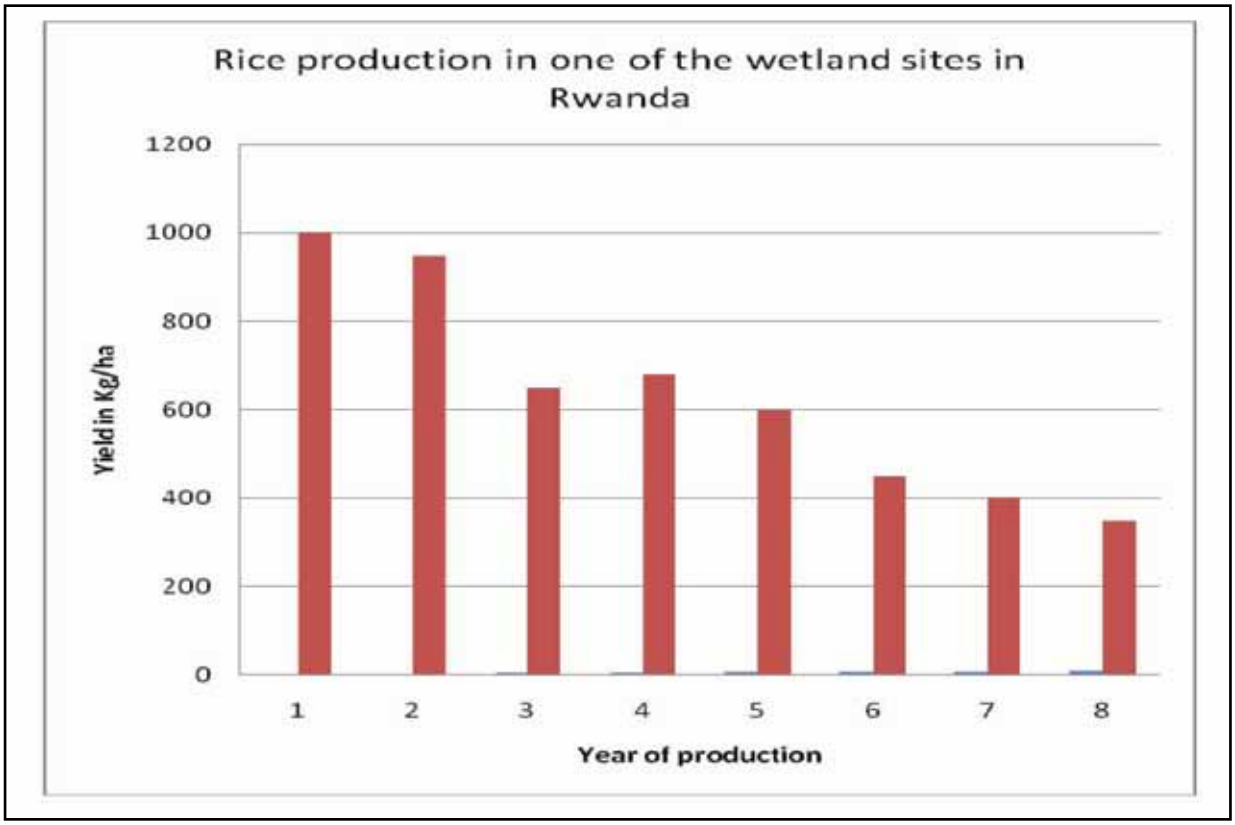


Figure 10: Graph showing rice production at one of the agricultural sites on a wetland in Rwanda for the last 8 years.

When we over use our wetland for agriculture, the soil becomes poorer and crop yield becomes lower, as years pass. This situation sometimes makes farmers want to use fertilisers, which may consist of chemicals that may pollute water and wetlands, and may affect biodiversity. For example, the fish and other organisms that live in the wetland may die.

2.5 Wetland Services

The services that wetlands give us are all indirect benefits. They are not readily recognised until wetlands fail to produce these services. The services include:-

- Flood control
- Water storage and supply
- Ground water re-charge and discharge;
- Water quality control and Sediment retention;
- Waste water treatment;
- Nutrient recycle and Climate modification;
- Wildlife habitat-centres of living things (biological diversity);
- Transport and communication;
- Recreation and eco-tourism;
- Cultural attachments.

ACTIVITY 2.5

This section is important for pupils to understand the ability of wetlands to store and discharge water. Your role as a teacher is to give them clear and simple explanations of how wetlands perform these functions and the importance of maintaining clean water free of pollution.

- Prepare your pupils to learn how to carry out simple tests such as Ph and turbidity (suspended solids).
- Take the class to a nearby stream or river to consolidate their knowledge on water quality. Prepare a series of questions for your class to respond to.
- Encourage pupils to note down their observations.
- The teacher should clarify the responses where necessary.

The major skills to be developed are observation, investigation, note taking and interpretation.

a) Flood control

Wetlands reduce floods by:

- Slowing down the speed of run-off from rain.
- Spreading out water; this reduces the force of storm-water.
- Wetlands vegetation offering resistance to water flow.

Characteristics which enable wetlands to reduce floods are:

- The size of the wetland; the more there is area available for flood water storage and reduction of spread of flow, the better it becomes.
- The location within the drainage basin; the most effective is at the foot hills and upper regions of the main valley of the wetland system.
- The type and thickness of vegetation in the wetland.

b) Water storage and supply

Water is retained within the wetland when the flow is slowed down. There is much more water retention in the man-made reservoirs.

- Wetlands work like dams. They store and release water slowly. They release water often, which they stored during the rainy season.
- Water from wetlands is redistributed to streams, wells and bore holes.
- Wetlands help to maintain the base flow of rivers throughout the year.
- Wetlands provide a cooling affect during a hot or drought season.
- Water from wetlands is important for
- Domestic supply
- Agriculture
- Livestock watering
- Industrial purposes
- Wildlife watering points
- Surface and ground water distribution.

The water which leaves wetland water is often clean because the pollutants (things which contaminate it) coming from agricultural, residential areas, and factories will have been reduced. The stored water is used as to supply many towns. Even in drier parts of the region, the seasonal wetlands usually provide the needed water.

c) Ground water recharge and discharge

Water from the wetland infiltrates or percolates into the ground. In this way, surface water bodies connect to ground water systems and keep feeding into them. This is called replenishing or recharging. This process is usually slow and goes on throughout the year.

Wetlands allow water to move into the ground to join ground water and adjoining water bodies. This process is known as discharging.

Water discharge is important in maintaining the ground water table and levels in water bodies.

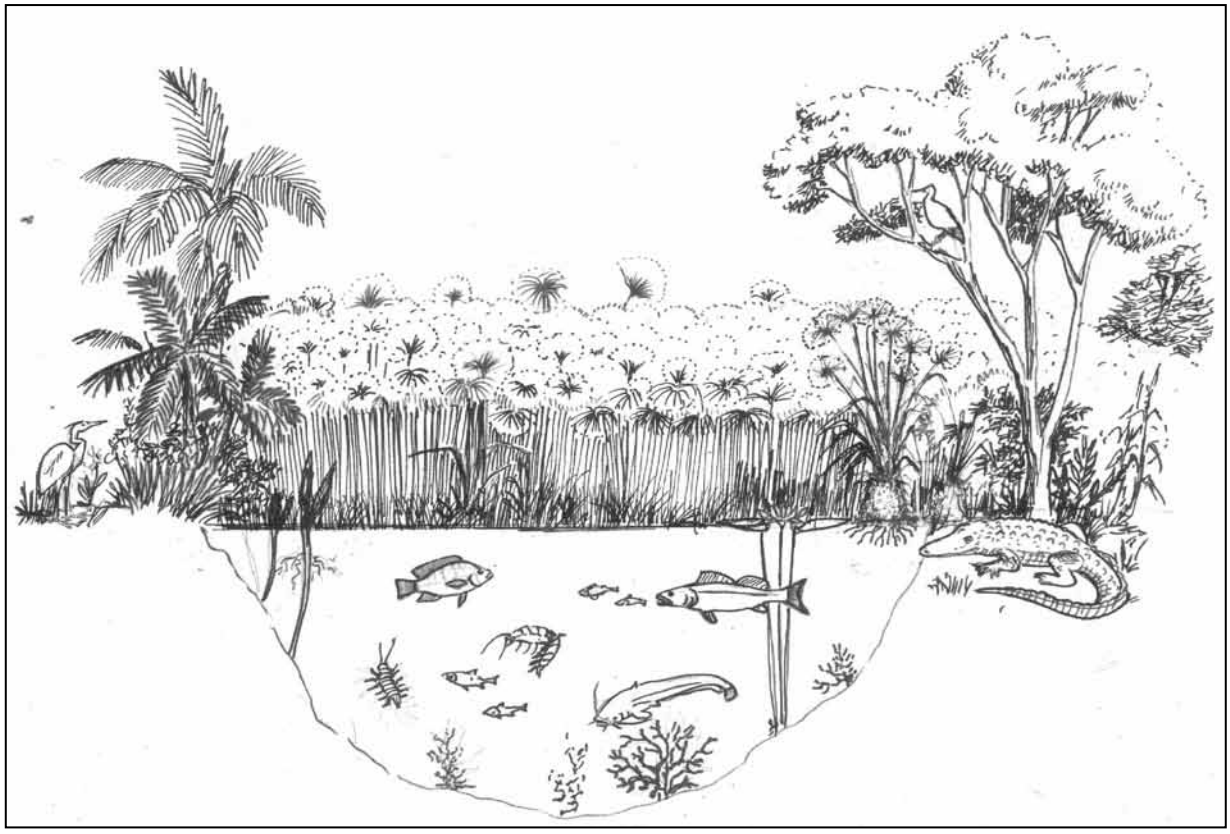


Figure 11: Wetlands store recharge and discharge water. The water quality has to be monitored regularly

d) Water Quality control and sediment removal

We have seen that wetlands act as sponges. They absorb water, store it and discharge it steadily. Wetlands also act as filters; they remove pollutants and sediments from water that passes through them. The quality of water passing through a wetland is able to become better because:

- As water enters the wetland, the rate at which it moves is reduced. This causes solid particles to settle at the bottom of the wetland;
- The spreading of the water gives opportunity for removal of suspended matter that comes with water.
- There are many chemical processes that take place in wetland water and soils. This helps to remove pollutants e.g. nitrates are converted to nitrogen gas;
- Organic substances (solids or liquid) are slowly decomposed by the micro-organisms in wetlands;
- Some nutrients are taken up by plants or animals e.g. phosphorus and nitrates are taken up by growing wetland plants;
- The abundance of organic debris (small particles) in wetland sediments provide suitable surfaces for the attachment and trapping of some pollutants such as heavy metals;
- Other pollutants become strongly attached to clay particals in the bottom sediment, thereby rendering them harmless.

When all these happen to the water passing through the wetland, the water that is obtained as a result is of improved quality. (See photograph 6)

ACTIVITY 2.6

Water quality monitoring

The teacher will give you water testing instruments for pH, temperature, colour, suspended solids, turbidity and others depending on availability.

- Use them to test water at two different points about 1 km from each other; one up stream and the other down stream. Record your observations at the two different points and share your findings with your classmates.
- Discuss the differences that were observed in the water at the two points. What can you conclude from this experiment?

Sediment retention

The process by which water quality is cleaned up is important. For example, soil particles carried from surrounding catchment area are removed. Particles are trapped by wetland vegetation and settle at the bottom. This filtration or settlement of particles is known as the sedimentation process. Constant sedimentation leads to accumulation of silt or soil particles. The Wetland vegetation or plants assists in getting the silt removed from the water.

Exercise 2.8

- Name a wetland in your country which is known for trapping silt
- Can you remember the colour of the water going into and coming out of the wetland?
- What environmental problem is faced in the area you have named?

e) Waste water treatment

Wetlands receive water from the catchment area, but they also get used water from residential and areas of human activities in the catchment area. The water flowing into the wetland is contaminated by industrial wastes, agro-chemicals and domestic wastes. The water carrying wastes is referred to as waste-water. Waste-water flowing into wetlands may contain toxic substances and germs.

The wetland removes waste from waste water free of charge. The quality of the water that comes out of the wetlands is much better than the one that goes in. Therefore wetlands treat waste water by removing contaminants. The water that comes out of

the wetlands can be used for other purposes. The treatment of waste waste depends on the following:

- Presence of the wetland plants which remove and use excess nutrients.
- The suspended solids which come from the catchment; if it is not well looked after.
- The size of the wetland.
- The gradient or slope of the wetland which determines the time water stays while it is getting treated.
- The availability of micro organisms such as protozoa, bacteria and fungi (decomposers) to convert some pollutants to less harmful forms.

Waste water contains the following:

(i) Nutrients

- Nitrates and phosphates, when simplified and are removed from water by plant up take.
- Wetlands function with varying degrees of efficiency as nutrient traps. This depends on the plants to trap it, and speed at which water moves.

(ii) Toxic substances

- Heavy metals, pesticides, herbicides and hospital wastes are all examples of toxic substances.
- Through complex chemical and biological process, many of these substances can either be changed to a harmless non-toxic or rendered harmless by being buried at the bottom (sediments) of the wetland.

(iii) Pathogens

- Pathogens are organisms which are harmful and can cause death. They may come from human waste, livestock and wildlife wastes. They get into the wetland system through sewage (effluent) waste.
- When water is retained in a wetland for a long time, the environment in the wetlands does not allow growth of such organisms; so they die-off.
- Wetlands help us to eliminate waterborne pathogens like cholera, dysentery, typhoid, polio, intestinal worms and diseases.

f) Nutrient Recycling

Conditions in wetlands require use of available oxygen. So there is not enough oxygen for all functions in wetlands. Functions in wetlands take place in conditions of little or no oxygen. This is known as an anaerobic condition. Without oxygen, rotting or decomposition of organic matter is made difficult. Sometimes it is partially done, leading to formation of preserved organic matter such as Peat or Coal. Wetlands help to remove carbon dioxide from the atmosphere; it is used to make organic matter. More organic matter is trapped from water that goes into the wetland. This is a very important role in nutrient cycling.

When wetlands are drained, or peat deposits are mined and burnt, carbon is released into the air. This can also contribute to global warming if no proper guidelines are put in place.

Climate Modification

Apart from retaining carbon dioxide, wetlands also act as local air conditioners. When water from wetlands evaporates, air temperature is reduced. The water vapour increases humidity, reduces dust and cleans the quality of air.

The presence of wetlands modifies the rainfall and temperature pattern of an area. Therefore, the presence of wetlands is important to the amount and quality of rainfall we receive.

g) Wildlife habitats and centre for living things

We have already seen that wetlands are home to many animals and plants. They adapt to the conditions of water logged soils. Some animals completely depend on wetlands for food, protection, resting area, reproduction sites, and for hiding away from predators. Some animals only live in wetlands for part of their lives, while others only stay in wetlands during a particular period. Some of them, like Sitatunga, however, live entirely in wetlands.

h) Other benefits of wetlands

Some wetlands are important for transport and communication because they connect different dry areas. Many people travel from one dry area to another by boat or canoes for business and other activities. Permanent wetlands are useful for transporting people and produce from one place to another. The rich plants and animals that live in wetlands attract tourism. Wetlands can also be developed for recreation purposes. Generally, we can benefit a lot from our wetlands. We get resources from wetlands; direct and indirect benefits. We therefore need to protect the wetlands in order to get all these benefits.

ACTIVITY 2.7

Role of wetlands in water purification

- Visit a nearby wetland and look at plants that grow in it. List the different plant types that grow in it. Why doesn't the water run fast in the wetland?
- Can you explain how wetlands store water, improve its quality or purity and control flooding?
- Your teacher will help arrange for you to visit a water treatment plant in your country and try to understand how water is made safe to drink.

ACTIVITY 2.8

Understanding how wetlands purify water. Visit to a nearby water treatment plant.

- Preparations for the field visit as described earlier in Unit 1:
- Prepare a series of questions for your class to respond to.
- Encourage pupils to note down their observations.
- You as the teacher should clarify these responses where necessary.
- Help pupils to understand the water cycle.

The major skills to be developed are observation, drawing, taking down notes and interpretation

Do you know that?

- The water works in your home area benefits from the presence of wetlands?
- What is the nearest wetland from which the water supplying your town or village is obtained?
- What other resources come from this wetland?
- How do wetlands help in rain formation? Ask your teacher to help you with this question if you do not know the answer.

Exercise 2.9

Plant	Local name	Edible part

- Give local names of edible plants to complete this the above table
- Find out more edible plants, and their local names
- Find out what other people in other countries call them
- Make a list of wetland plants used for craft materials
- Make a survey of wetland in your country and a list of crops grown in different wetlands.
- Does growing such crops interfere with the water quality and general functions of the wetland? Discuss this aspect with your teacher.

2.5 Functions and summary of values of wetland resources

Wetland Resource	Value
Source of water	Domestic, industrial, livestock consumption.
Bio-diversity, conservation of plants and animals	Recreation and wildlife, tourism development, habitat for rare species like Crested crane and Sitatunga.
Habitat for fish	Fish as food.
Nutrient retention	Bio-filters (Nutrient filters)
Source of raw materials	Handicrafts e.g. Mats from Leaves of Palm trees,or papyrus
Agricultural zones	Food production for local consumption.

Case Study for Sudan and Egypt

The Gezira irrigation scheme situated between Blue Nile and White Nile north of Sennar dam and South of Khartoum is a wetland managed by Gezira Board but owned by Sudan Government. The scheme is comprised of three areas; Gezira Scheme, Managil Scheme and Kenana Scheme. Crops like cotton, beans, sorghum, finger millet and maize are grown. The wetland makes use of the silting caused by periodic flooding in the area and has been used for production of food for a long period of time. The crops have played a big role in trapping silt thus controlling floods that used to be a menace in the area.

2.6 UNIT SUMMARY

You have just completed Unit 2 of the five units that will help you to understand wetlands better. You have dealt with:

- Goods and products from wetlands
- Wetlands Plants resources
- Wetlands Animals animal resources
- Wetlands as habitats for wildlife
- Wetlands benefits and services
- Case studies from Sudan and Egypt

2.7 FURTHER READING

Wetland Inspection Division (WID). 2004. Wetlands Resource Book. Ministry of Lands, Water and Environment, Uganda. Kampala: MOWLE Publications.

United Nations Development Programme (UNDP). 2005. State of World Environment Report. Nairobi: UNDP Publications.

UNIT 3: LIVING THINGS IN THE WETLAND

3.1 Introduction

We have already learnt about what wetlands and their benefits to us. In this unit we are going to learn more about living things in the wetlands. The variety of animals and plants is known as biodiversity.

We shall be able to learn about different examples of living things and how they adapt to conditions in the wetlands. We shall also study the role of different living things and their inter-dependence within the wetland. In this way therefore, be able to cover the following topics:

- Living things in wetlands
- How living things adapt to wetland conditions
- The roles of living things in wetland
- Inter-dependence of living things in wetlands.

Learning Objectives

By the end of this Unit, the pupils should be able to:

- List examples of living things in wetlands;
- Explain how living things are adapted to wetland conditions;
- Explain the roles of living things in wetlands;
- Describe how living things in wetlands are dependent on one another (Inter-dependence).

3.2 Classification of living and non-living things

Do the following activities. Your teacher will guide you on how to go about them.

Exercise 3.1:

Living and non-living things in and around our school

- Look around the school compound
- List all things you see
- Which of them are living things?
- Which of them are non-living things?
- What is the difference between the living and non-living things

Exercise 3.2:

Living and non-living things in the classroom

- Look at things in the classroom.
- How are they different from those outside the classroom?
- Which of them are living things?
- Give reasons why you think they are living things.
- What helped you to group them?

ACTIVITY 3. 1

Figure 12. Some of the living things in Wetlands

Study the picture above of living things in wetlands

- List all the living things you can see in the picture.
- What kinds of plants do you see?
- Name the kinds of animals you see
- What helped you group them as plants or animals?
- Which of them do you find in a wetland near your village?

ACTIVITY 3.2

Various plants, animals living in wetlands.

- One of the most effective approaches is to take pupils around the school so that they can not only see the wide variety of living things, but also learn how to classify them.
- Prepare a list of guiding questions for the class to respond to classification of living and non-living things in the wetland
- Encourage pupils to note the various things that they come across in and out of their classrooms and to develop the criteria for classifying them.
- It should then become easier for pupils to transfer this knowledge to the identification and classification of living and non-living things in wetlands.

The major skills to be developed are observation, drawing, taking notes and interpretation Wetlands commonly known as swamps are different in features or characteristics. They vary in detail depending on the period of flooding, depth of water altitude and fertility of the surrounding soil. They however have distinctive plants and animals which are adapted to flooding. The many types or diversity of living things (plants, animals and other organisms) is referred to as Biodiversity. These living things interact together and with the non-living things to form what is known as the ecosystem. When the interaction is in the wetlands, it is called Wetlands ecosystem.

Exercise 3.3:

Plants and Animals interactions in wetlands.

Think for a moment about the things which make up a wetland ecosystem.

- List all the living things you can see in the picture.
- List the non-living things.
- Discuss how living things and non-living things interact. Your teacher will help you during your discussion.

3.3 Wetland animals

Wetlands provide varied habitats for many animals. Wild life species including sitatunga, water buck, hippopotamus, camels and birds are common in wetlands of the Nile Basin.

ACTIVITY 3.3

Look at Figure 8 and 9 showing animals such as hippopotamus, and birds common in the wetlands of the Nile Basin. Ask your pupils to carefully look at them and to point out the various adaptations that these animals have to wetland conditions.

- Ask pupils to note down these adaptations and to discuss them in groups.
- The pupils should then list the adaptations of each wetland animal and explain the importance of each adaptation.
- Guide them to clarify their views.

The major skills to be developed are observation, drawing, note taking and interpretation.

3.4 Wetland plants

Besides the common papyrus and reeds, lower plants are common living things that grow in the wetlands. Lower plants are commonly characterised by their lack of vascular tissues which is the transport system for water and nutrients in higher plants. Examples of lower plants are the ferns, mosses and algae. Other plants can be used as food for both man and animals and others have medicinal value, while they are those that are traditional used as water purifiers like the Nile Cabbage

The water hyacinth (Eichornia crassipes) is a water weed that survives in fresh water and wetlands. The water hyacinth was introduced in Lake Victoria and Lake Kyoga in Uganda and is found all along the River Nile Basin. The weed is distributed in two distinct forms: as stationary fringes along the shore line and as mobile mats and it has become one of the wetlands plants together with papyrus, and hippo grass.

Figure 13 Examples of Wetland Plants, can you name them?

FACT SHEET: STUDIES CARRIED OUT IN LATE TANA CATCHMENT SHOW THAT.

- There are 17 species of amphibians and 35 species of reptiles recorded in the Lake Tana sub basin wetlands. Of these only 3 amphibians and 2 reptiles are endemic to the area.
- Crocodiles and monitor lizards are other wetland reptiles that may live both in fresh water and swampy areas.
- Amphibians are the other class of animals that live in wetlands. About 100 species of amphibians are known to occur in Uganda of which 48% live in wetlands common examples of these are frogs and toads.
- Birds are also common class of animals that live in wetlands. Over 287 species of birds are reported to exist in Lake Tana Sub Basin of which 224 are seasonal migrants, 176 move between Africa and Europe, and 43 Africa and Asia migrants. Birds improve on eco-balance in food webs and food chains to make the eco-system survive.

- Fish is another group of animal's species that live in wetlands. Mud fish and lung fish are common species of fish that live most of their lives in wetlands. In Cyohoha sub basin wetlands at the Rwanda – Burundi border, about 20 species of fish have been recorded. Of these 2 are endemic, 6 are native, 9 were introduced, 2 are probably extinct and 1 is surviving in one of the rivers near to the wetlands.

- Mammals are other animal species that live in wetlands. There are about 338 species of mammals in East Africa and 18 of which are documented as wetland mammals. Examples of these are otters and hippopotami.

- Lower animals especially micro-organisms are aquatic and the majority of these live in wetlands, except for corals, sea wasps and jellies that are marine. Mollusces are also common wetlands particularly the large water snails and octopuses.

ACTIVITY 3.4

Help pupils to design a project to conduct an inventory of wetland animals and plants, and investigate the growth of wetland animals and plants.

- Using waste water from the school, Help pupils to construct a wetland.
- Ask pupils to note down the growth rates and characteristics of wetland plants and animals.
- The pupils should keep a record of these changes over time.
- Guide them to clarify their views by explaining the observed patterns in growth.

The major skills to be developed are observation, drawing, taking down notes and interpretation.

ACTIVITY 3.5

Inventory of Wetland Plants and Animals

Your teacher will guide you to do this activity

- Visit a nearby wetland.
- List all plants and animals you can see.
- Write them in your local language and find out scientific names.
- Compare your answers with those of your friends.

Project work

- Prepare a small project at school.
- Grow papyrus or any other wetland plant and introduce frogs and fish.
- Observe their distinct / roots, leaves and pseudo-stems.
- Compare their leaves with those of upland plants.
- Make records on their breathing roots i.e. their growth and tropisms.
- Record the mode of reproduction in toads and fish in comparison with those of animals that live on land.

Record chart on growth of tadpoles

Make a growth graph on the growth of tadpoles you have studied. Describe how your chart looks like?

- From your graph/chart, how long do eggs of a frog take to hatch?
- Observe changes in growth of the tadpoles.
- How long do the tadpoles take to:-

(i) Use the gills for breathing?
(ii) Lose their tails?
(iii) Become mature frogs?
(iv) Start moving out from water to the land and vice-versa?

3.5 How plants and animals adapt (live) in wetland conditions

Exercise 3.4

Adaptations of wetland plants

Observe wetland plants and their adaptation to these conditions.

- Tabulate your observations.
- Share your observations with those of other pupils.
- Discuss your observations with the teacher.

Does your answer include any of the following?

Plants

- The wetland plants have reduced roots; if present they are not branched and do not have root hairs. Papyruses have breathing roots that come out of water to breathe fresh air.
- Some of wetland plant stems may be modified into Rhizomes.

- Their leaves are usually thin, narrow with a long leaf stalk and in some cases the leaves are large and are without wax.
- Mechanical tissues that keep the plants upright and vascular bundles (Phloem and Xylem) are generally lacking.
- The stomata are usually absent on the upper surface of the leaf.
- Many wetlands plants have the ability to float on water

Exercise 3.5

Adaptations of wetland animals

Observe wetland animals and observe their adaptations to these conditions

- Tabulate your observation
- Share your observations with those of other pupil
- Discuss your observations with the teacher

Does your answer include any of the following?

Animals

- The common wetland animals like frogs and toads have webbed feet that enable them to swim easily in water. The frog breathes through its skin and lungs when adult. The young of the of frog species; the tadpoles using gills.
- Fish and many lower animals carry out gaseous exchange from water but can also use other means like breathing using their skin when water dries up
- The tadpoles and fish are adapted to feeding on water weeds and prey in water.
- Presence of fins or modified limbs in fish helps them to swim in wetland water.

3.6 The role of wetland plants, animals and other organisms

3.6.1 Wetland plants

- **Nutrient and toxic retention:** Wetland vegetation use nutrients from the inflowing water. This protects the quality of water down stream.
- **Vegetation also acts as sediment traps:** Eroded materials from the surrounding catchments carried by rivers are deposited as sediments when the flow is slowed down on reaching the vegetation. This prevents down stream silting of dams, farmland and lakes. It creates good usable water to animals and humans.
- **Climate modification:** When wetland plants absorb carbon dioxide from the atmosphere for photosynthesis, its concentration decreases.

But plants also lose water into the atmosphere by transpiration, and this causes cooling of the atmosphere and reduction in temperature.

Exercise 3.6 Role of wetlands in rain formation

- Find out from your teacher why more rain falls and is often more evenly distribution in wetland areas compared to those far away from wetlands.
- Write brief notes on the wetland contribution to rain formation in an area (Refer to the Water cycle).

3.6.2 Wetland and other organisms

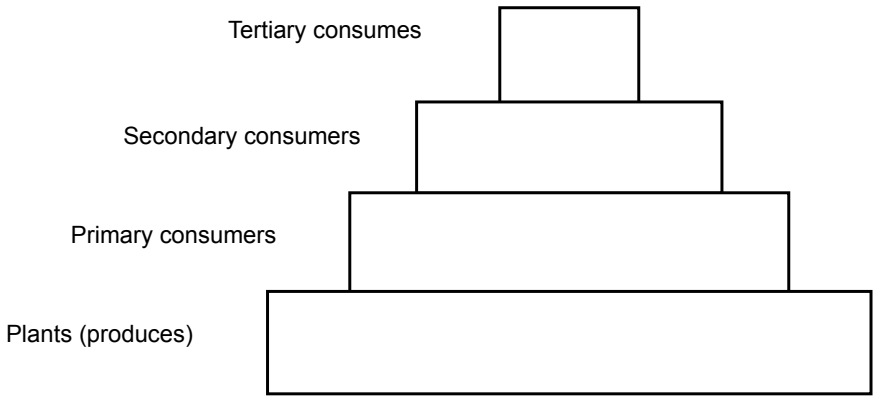
Water evaporates from wetlands into the atmosphere to form rain which will fall within the area. The evaporation process reduces air temperature and increases humidity. The water vapour in the atmosphere reduces dust and the air quality improves. The water that evaporates from wetland surfaces and plants increases humidity thus increasing rainfall in an area. Some pollutants are also consumed by plants e.g. phosphorous and nitrates are taken up by growing wetland plants.

Animals and other organisms also play a big role as living things in the wetlands.

- **They participate in eco-balance:** They facilitate energy flow in food chains and food webs.
- The biological functions of micro-organisms as primary, secondary and tertiary consumers are essential to the continual survival of both themselves and higher forms of living things.
- **Pest control:** Fish and most amphibians eat larvae of mosquitoes thus reducing spread of disease parasites to people.
- Large population of decomposers especially bacteria and fungi assist in the conversation of pollutants to less harmful forms.

3.7 Interdependence of living things in wetlands

All energy utilised by living organisms comes from the sun. Some of this energy, only less than 15%, is used by plants for photosynthesis. Plants have the wonderful ability to turn sunlight into food through this process. The pigment chlorophyll which makes wetland plants green captures the sun's energy. The green leaves put together water and gas called carbon dioxide from air to make food. This food gives plants energy to grow. This energy feeds plants and other animals like toads and frogs. Living things get energy from plants which are producers. Animals are referred to as consumers. Consumers can be primary as in herbivores and secondary consumers which are usually carnivores. In this way energy can flow from plants to carnivorous animals which do not eat grass. This is called a food chain and it helps the living things to

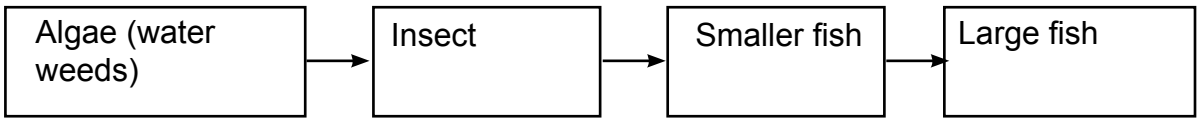


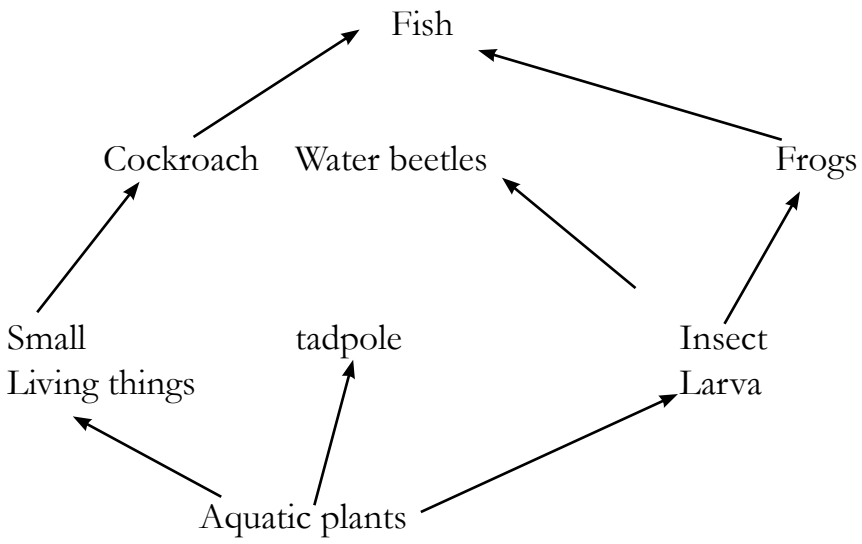
depend on each other so that the ecosystem can survive.

Ecosystem is more or less a self sufficient community comprised of a population of organisms in equilibrium with each other and with their environment. Energy and matter are exchanged between ecosystems and their surroundings. The activities of the community cause energy to flow through the ecosystem. The energy transferred to the next organism in a food chain keeps on reducing as can be illustrated in the following showing a decrease in the amount of energy transferred from producers to consumers

Example of a food chain in a wetland

A food web is a combination of many food chains. An example of a food web in a wetland is shown below:





Exercise 3.7

(1) Discuss in your groups, and:

- List ways how plants in the wetlands depend on animals for survival.
- In what ways do plants in the wetlands depend on other plants for growth?
- How do animals in wetlands depend on plants for survival?
- How do animals in wetlands depend on other animals for survival?

(2) Compare your findings with those of other groups. Make one list and put your answers in the nature corner.

(3) Discuss in your groups

- List ways in which plants in the wetlands depend on animals for survival.
- In what ways do plants in the wetlands depend on other plants for growth?
- How do animals in wetlands depend on plants for survival?
- How do animals in wetlands depend on other animals for survival?

Compare your findings with those of other groups. Make one list and put your answers in the Nature corner of your classroom.

Do you know?

- Wetlands have both water and land and that is why many living things are found there?
- Wetlands are home to a variety of living things.
- Wetlands are an important part of the Water or hydrological cycle.

3.8 UNIT SUMMARY

In this Unit, we have learnt about:

- Living things in wetlands.
- How living things adapt to wetland conditions.
- The roles of living things in wetland.
- Inter-dependence of living things in wetlands.
- Biodiversity includes a variety of things in the environment.
- It is important to conserve diversity in a wetland because of the different roles it plays
- Wetland animals and plants are interacting together with the non living part of the wetland to form a "Wetland ecosystem." They interact through feeding and in many other ways.

3.9 FURTHER READING

Dugan, P.J. (ed). 1990. Wetland Conservation: a Review of Current Issues and Required Action. IUCN, Gland, Switzerland.

State of Environment Report for your country.

UNIT 4: HUMAN ACTIONS THAT DAMAGE OUR WETLANDS

4.1 Introduction

We have already learnt about uses, roles and values of wetlands for example in controlling floods, local weather and maintaining water quality among others. In this unit, we are going to discuss human actions and natural occurrences that damage our wetlands. We shall learn of different ways in which human actions affect wetlands negatively.

Learning Objectives

By the end of this Unit, you should be able to:

- State the different ways in which humans abuse wetlands.
- Using examples, explain the effect of natural catastrophes on wetlands.

4.2 Actions that damage our wetlands

When we use wetlands, sometimes we damage them. These are some of the actions that may lead to damage our wetlands in the Nile Basin. The human actions that result in degradation of wetlands include the following:

- Drainage for different purposes like farming, industries and settlement.
- Unplanned Brick making.
- Unplanned Sand mining and mining of other minerals.
- Pollution from domestic and industrial wastes.
- Filling wetlands with soil to convert them to dry lands.
- Dumping garbage in wetlands

Damaged wetlands do not perform their roles and functions well. They show poor signs in vegetation, animals and water quality and quantity.

Exercise 4. 1:

Human actions that damage wetlands

Look at the pictures shown in *Photographs 7 - 11* Study them carefully, identify and discuss in your groups the following:

- Ways in which human activities can damage wetlands.
- What needs to be done to reduce the effects of harmful human activities on wetlands
- How else human actions harm wetlands
- How natural occurrences can cause harm to wetlands

Compare your findings with those of other groups. Make one list and put your answers in the Nature corner of your classroom.

ACTIVITY 4.1

Wetlands restoration

- Visit a degraded wetland and let them note the activities that damage the wetlands.
- Let the pupils also note the characteristics or features of degraded wetlands.
- Help the pupils to develop a plan for the restoration of the degraded wetland near the school and its implementation.
- The major skills to be developed are observation, drawing, down notes and interpretation.
- Do further reading about wetlands' restoration.

Photograph 9: Unplanned settlements on a wetland in Bwaise - Kampala, Uganda. - Photo by Joseph Oonyu

Photograph 10: Effects of unplanned settlements on a wetland include flooding and submergence of buildings - Photo by Joseph Oonyu

Photograph 11: Improper use of wetlands for disposal of plastic containers and other unwanted materials. - Photo by Joseph Oonyu

Photograph 12: An abused wetland: A wetland that is heavily mined for brick making: need proper plan for brick making. - Photo by Joseph Oonyu

Photograph 13: Brick making is lucrative business, but which has destroyed many wetlands in the Nile Basin. - Photo by Joseph Oonyu

Exercise 4.2:

Damage to wetlands

- List wetlands near your home.
- What activities do people do in any of the wetlands you named?
- Give ways in which these human activities damage the wetlands.
- What can be done to control the damage?

Discussion with pupils

- Effects of degraded to wetlands on their functions and roles.
- How degraded wetlands can be restored.
- Agencies in charge of protecting wetlands in your country.

Do answers to the above include the following?

- Grazing animals.
- Growing crops.
- Throwing rubbish and other wastes.
- Digging for sand.
- Harvesting fish or papyrus or clay or sand.
- Brick making.

4.2.1 Wetlands used for agriculture

Study the Figure below and answer the questions that follow.

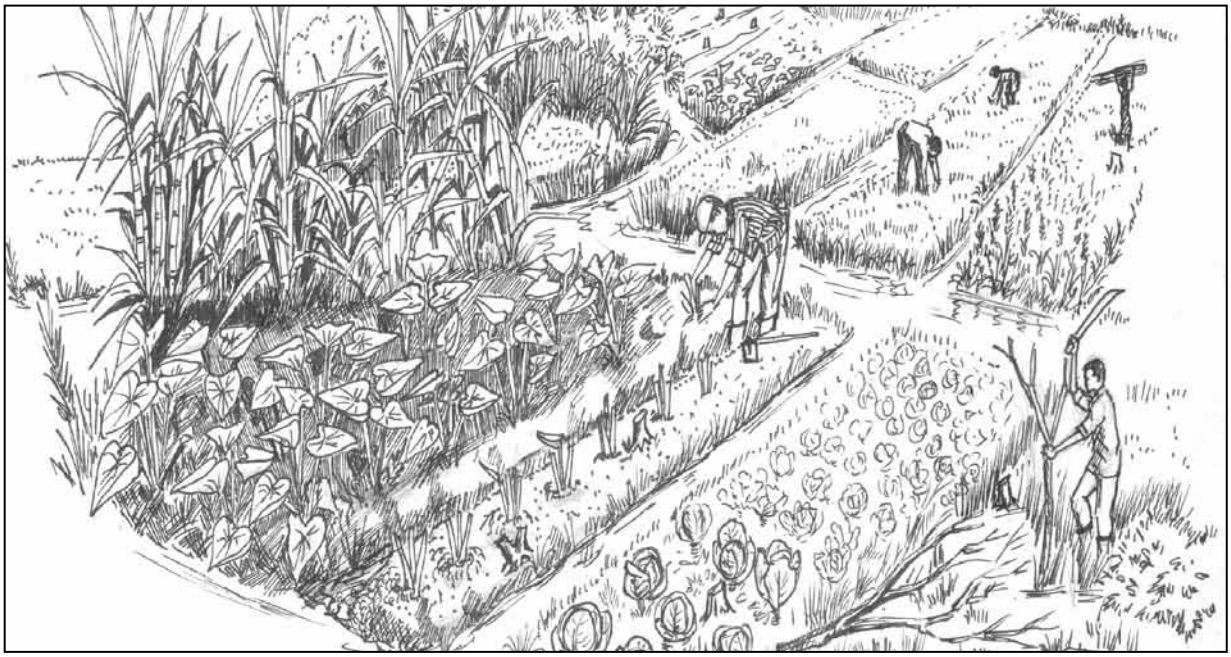


Figure 14. A wetland that is being used for agricultural activities.

Exercise 4.3.

- What activities are shown in the picture?
- What crops are being grown?
- Which crops do people grow in the wetlands near your school?
- What dangerous activities do you see in the picture?
- Discuss your answers with your classmates.

Examples of wetlands drained for agriculture are common in the Nile Basin Region. Activities include growing crops like cotton, sugar can, yams, rice, and vegetables. In Uganda, there is Doho Rice Scheme at Butaleja District, in Kenya there is Ahero Rice Scheme at Kisumu. Other examples of wetlands used for agriculture are in Ethiopia, for example people living adjacent to Lake Tana; and, the valleys of Rwanda and Burundi. It has been established that wetland edges may be good for gardening if guidelines are put in place for their use.

4.2.2 Wetland drainage for settlement and industrial development

Apart from wetlands being used for gardening, many places around major towns of countries in the Nile Basin are not wisely used for development purposes. Careful development requires guidelines from environment authorities in your country.

Exercise 4.4:

Wetlands degradation

Your teacher of SST or Geography will help you to:

- Name the industries near the major towns in your country.
- Identify and name wetlands that have been destroyed for industrial development.
- Suggest suitable sites where such industries could have been located.
- How do we ensure that wetlands are not destroyed, and yet continue to set up industries and other development activities?
- In groups of four, write out ways you think such wetland damage can be controlled.
- Discuss your answers with the teacher.

4.2.3 Activities that cause pollution to Wetlands

Exercise 4.4

- What is pollution? (Relate to what you study in science)
- What activities cause pollution in Wetlands?
- Discuss your answers with those of your classmates.

a) Pollution due to dumping

Many towns in the Nile Basin countries have real challenges in managing organic and inorganic wastes-generated as a result of human economic activities. Such wastes are usually dumped in wetlands such as those close to Lake Victoria in East Africa. Other dumping practices are done by Town Council authorities who dump household rubbish such as food wastes and crop residues in wetlands that would have otherwise been recycled. Such dumping sites are usually polluted *(see photograph 9)*.

b) Wetlands pollution by factory effluents

Wetlands in the Nile Basic did generally in many other African countries are heavily affected by factory effluents which are emptied in the streams leading to the wetlands or directly into the wetlands.

Some industries discharge waste water into the environment without pre treatment. This water can be dangerous to human health and animals in water such as fish.

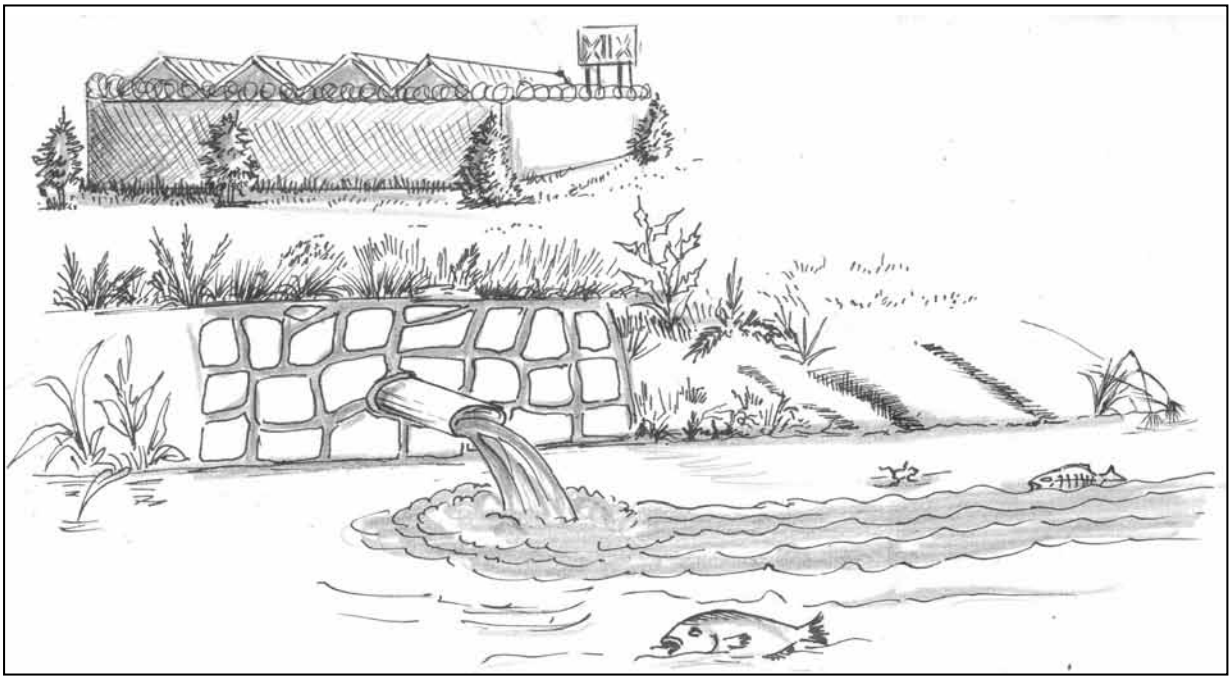


Figure 15. Presence of industries in the catchment can contaminate the wetland and water sources

4.2.4 Brick Making

Clay mining

We have learnt how wetlands get damaged by agriculture activities and deposition of wastes into the wetlands. Brick laying if not properly managed can also damage wetlands functions.

Photograph 14. A person making bricks from a wetland - Photo by Joseph Oonyu

Exercise 4.5

From the picture above

- What things do you see?
- What dangers can result from what you see?
- How can this situation be improved to avoid the dangers?
- Name places near your home/school where this kind of activity is done.
- Suggest ways people can use to harvest clay and carry out brick without damaging wetlands.
- Discuss your answers with your classmates.

Did you observe the following in the photo above?

- Excavations where clay was removed full of water
- Clay prepared for brick making
- A person still working on bricks
- The machine used for making bricks
- What else did you see?

When clay soil has been harvested for brick making, then the area should be marked and abandoned for sometime to allow the wetland to recover. The pools that fill with water should be clearly marked so that they do not cause danger to playing children. The pits which have been harvested for brick making, leaves holes which are filled with water. The abandoned pools of water will be restored and filled again with eroded clay, which with time and can be used again for making bricks.

4.2.5 Sand mining

Have you ever used or seen people use sand at home, school or community? What is sand commonly used for? Where do they harvest such sand from?

The sand we use at home (school and community) for building, is got from wetlands. Such wetlands are located at the entrance of streams and shores of lakes.

Mining sand also creates holes which hold water and interrupt the constant flow of water joining the main water body. Sand in wetlands help to filter the water before it joins the main water body.

When sand is removed, the water quality of streams of change. The water pollutants may join the main water body like a lake if the water does not go through the wetlands. The lakes may become polluted because filtration which was done by the sand was affected when the sand was removed

Exercise 4.6

- Name the sites of sand mining in your area.
- What dangers may such sand mining cause in a community?
- Write a short story as a message to people who mine sand in the wetlands.
- List some of crafts people make from papyrus.
- Name the types of wetland grass vegetation people harvest for thatching hours.
- What do you think is the effect of removing too much grass vegetation from wetlands?

Discuss your answers with the teacher

4.3 Signs of degraded wetlands

When a wetland is destroyed we say that it has been degraded. There are many human activities that cause wetland degradation. The effects of the damage may show in the surrounding areas. Examples of these signs include:

- Flooding down stream and the surrounding areas.
- Poor water purifying capacity.

- Excessive quantities of nitrogen and phosphorus.
- Change in the quality of water (seen in the colour) in the main water body and the areas surrounding the affected wetland.
- Changes in water regime of wetlands like or lowered water table.
- Changes in the wetland ecosystem mainly as a result of death of the original fauna and flora, or accumulation of heavy chemicals that upset the chemical composition of the nutrients.

ACTIVITY 4.2

Read the poem on wetlands

Read the poem below and answer questions that follow:

I am dead
I am dead
Man you have done it
Done it to me
Why? What wrong did I do to you?
You have dumped wastes,
Not spared rubbish on to me
You have burnt my vegetation.
My only blanket you have taken away,
I can no longer hold water,
You drain and drain!
What a mess you have done to me.
No cover,
I am dead,
Fish has died
Frogs have run away
Toads have done the same
Where will they go?
Please answer me,
I am dead. I am dead
Sweet dreams of rain formation
I can no longer
Now I am no longer
Please help
Restore me
I am dead
Bye, bye

Questions

- Who is telling the story?
- Why is the story teller saying that "I am dead?"
- Write a short story to explain what has happened to the story teller?

Exercise 4.7

Observe photograph 13

- What do you see in the photograph ?
- Suggest the causes of what you can see in the photograph
- What do you think can be done to change this kind of situation?

4.4 Monitoring general quality of wetlands

We can carefully make regular records of our observations in a particular or a number of wetlands in our area. This is called monitoring. When we have accumulated what is observed as changes and we record possible causes of the changes we refer to this as assessment. We can have activities to do as individual groups or even as a class or a club.

In order to do this we need to:

- Have a particular wetland we want to observe.
- Specify what we want to observe in the wetland.
- Prepare in advance how to record our observations.
- Decide on the period and duration within which to carry out the observation.
- Prepare how to share our results with others we have decided to do so.

ACTIVITY 4.3

Wetlands monitoring

- Select one wetland near your school or home and carry out a monitoring exercise.
- Make your assessment record and share the information with your classmates.
- What conservation activity can be done to improve the wetland you have monitored?
- What human activities were going on in the surrounding of the wetland?
- How did such an activity affect the wetland?
- The teacher will help you to be in an in an environment club in which you are a member.

- Write stories on wetland management and share them within the environment club.
- Display your work in the club's corner.
- The club may have a school made wetland, rear frogs, toads and fish in the wetland, and grow water plants / weeds in the wetland. List ways of how you would maintain the wetland without degradation.
- The school club may formulate a prayer, a poem or a story to promote wetlands in the locality.

Wetland Prayer

Thou shall NOT:

- *Drain it,*
- *Reclaim it or fill in,*
- *Build on it,*
- *Demolish anything in it ,*
- *Damp harmful wastes / silt in it,*
- *Disturb it in anywhere,*
- *Add any foreign species,*
- *Except with permission of the concerned Authority*
- *Amen.*

Do you remember that?

- Wetlands can be damaged through human and natural occurrences
- Damage to wetlands affects their roles and functions, as well their productivity
- Regular monitoring of wetlands is important in order to note the changes that are occurring as a result of our actions, and to design ways of protecting them

4.5 UNIT SUMMARY

In this Unit, we have learnt about:

- The different ways in which humans abuse wetlands.
- Using examples to explain the effect of using wetlands.
- Acquire skills of wetland restoration after abuse.
- Human activities impact on wetlands functions and at many times have resulted into wetland loss.
- Wetland degradation is the weakening of wetland functions as a result of human activities.
- When a wetland is affected, the whole ecosystem is aslo affected because its capacity to function normally will be reduced

4.6 FURTHER READING

National Wetlands Policies for Conservation of Wetlands in Nile Basin countries.

National Wetlands Action Plans

UNIT 5: PROPER CARE AND USE OF WETLANDS

5.1 Introduction

We now know what wetlands are and their benefits to us. We have also studied the living things in wetlands. We now know the actions which can damage our wetlands. We need to discuss how to care for the wetlands near us and others in the Nile Basin.

This unit will help us learn more on:

- What we can do to care for our wetlands.
- Why we need to care for wetlands.
- How we should care for and use our wetlands.
- What care we should take of areas surrounding wetlands.
- Institutions and organisations in Nile Basin concerned with wetlands.

Learning Objectives

By the end of this Unit, pupils should be able to:

- Explain why it is necessary to care and use our wetlands wisely.
- Describe the role played by various actors in the care of wetlands.
- Name the institutions and organisations that care for the wetlands and ensure their wise use
- Identify what conservation activity can be done to improve the wetland you have monitored

5.2 What we can do to care for our wetlands.

- Avoids actions that damage wetlands will help us to care for them.
- Promotes the use of wetlands with their water without draining them.
- Do activities which do not interfere with wetlands roles and functions will help us to care for the wetlands.

The next exercise therefore shall remind us of:

- Wetlands benefits to us and the entire environment.
- Actions we do and natural ones that damage our wetlands.

Exercise 5.1

- Make a list of wetland resources you get from your local wetlands.
- Write any ten services given to us and our environment by wetlands.
- Which action done by people can damage wetlands?
- What natural actions can interfere with natural services performed by wetlands

The following table shows actions that affect the wetlands and what can be done to care for them

Table 1: Actions that affect wetlands and what can be done to care for them

No.	Actions affectingwetlands	Fill in with Examples of affected wetlands	Correcting action
1	Drainage for agriculture	For example Nakivubo wetlands in Kampala Uganda	The Wetland can be left for tertiary treatment of waste water from Kampala
2	Encroachment		• Control hunting or stop human encroachment. Allow forregeneration • Follow laws and policies o wetlanduse.
3	Over-harvesting		• Selective harvesting. Harvest only mature goods.
4	Burning		• Avoid thiscompletely.
5	Uncontrolled brick making		• Refill holes from which clay has been got. • Avoid excessive use.
6	Uncontrolled sand and other mineral mining		• Use correct methods. • Avoid excessivemining.
7	Pollution		• Treat waste water that is drained into wetland. • Avoid or remove pollutants from wetlands.
8	Siltation		•Avoid actions which encourage soil erosion in catchment area

All human actions that affect wetlands should be avoided, because it is difficult to restore the wetlands and to recover its natural functions and status.

Exercise 5.2

- Complete the Table 1 by filling in the missing information. This may require you to read widely so that examples are from the whole Nile Basin Region
- Compare your answers with what other pupils have given.
- Discuss with the teacher and colleagues

ACTIVITY 5.1

Remedies for damage to wetlands

- Pupils to read and complete the tables by filling in the missing information. Distinguish the wetlands that can be found in other catchments and the Nile Basin Region

5.3 Why we need to care for our wetlands

The following table shows wetlands services and our actions that can promote wetlands to provide these services. Make suggestions of actions which promote these services.

Table 2: Suggestions of actions which promote wetland services

No.	Wetland services	Actions which promote the services	Case Studies
1	Flood reduction and constant water supply	Keep vegetation cover of the catchment area.	
2	Ground water recharge and discharge		
3	Sediment retention		
4	Waste water treatment		
5	Climate modification		
6	Wildlife habitat centre		
7	Transport and communication		
8	Recreation and eco-tourism		
9	Cultural values and attachments		

We care for wetlands so that we continue to get its services. Wetlands are sources of resources like water, timber, reeds, fish and animals whose meat we eat. If do not care for wetlands we shall not be able to get such resources.

Exercise 5.3:

- Fill in the missing information in Table 2
- Organise debate on topic: "Wetlands are the most important natural resources"
- Write down the points that came out of the debate on:

  (a) Wetlands

  (b) Other natural resources
- Use the points brought for wetland to write an article in your school's news letter.
- Use the points from the debate to talk to community on the importance of wetlands.

5.4 How we should care and use our wetlands

In taking care of our wetlands we need the participation of the different users and concerned people and institutions. Each may have or can play different roles according to their way of using wetlands. Proper care and use of our wetlands requires:

- Community participation in activities to put what has gone wrong right;
- Responsible use and access rights to communities using wetlands.
- Technology specification for equipment, tools and facilities to be used in wetlands.
- National Water Resources Master Plan known to all concerned;
- Constant water resources monitoring and assessment for comprehensive planning;
- Clear guidelines and advice on resource utilisation and management.
- A system that controls pollution by toxic effluent matter.
- Better co-ordination and consultations between concerned institutions.
- Better performance of staff and people involved in wetlands management through improved administration and support.

There are many ways in which we as pupils can take care of our wetlands. These include:

- Information gathering: The first thing that we need to do is to gather as much information as possible regarding the characteristics of the wetland. Such information may include its size, what it contains, what role it plays, who benefits from it and whether or not it is seasonal. This can be done from time to time and it is known as monitoring.
- We should also avoid draining the wetland when growing crops or trees on our wetlands as this will affect the amount, purity and flow of water within the wetland. You will recall that earlier, we noted that wetlands play an important role in controlling the release and uptake of water.
- We should also avoid dumping or throwing rubbish and other harmful things such as used oil from garages, plastic containers and other rubbish into wetlands as these will prevent the wetlands from performing their role and providing us with the goods or services that we need.
- We should also avoid infilling the wetland with soil in order to build factories or houses in wetlands.
- We should avoid over harvesting of wetland goods such as papyrus reeds, grass or building poles as this does not allow them to recover quickly enough in order to continue providing these materials. In addition, we should not encourage over mining of sand or stones and minerals.
- We can also report activities which harm our wetlands to the people concerned so that the laws which have been put in place to ensure their proper care and wise use can be put into action.
- As students we can also go to the communities and educate them about the importance of wetlands, and what they can do to take proper care while using the wetlands. We must remember that proper care of wetlands that are shared by the different administrative units or countries (Trans-boundary wetlands) is difficult because the people from either side of the wetland must agree to share information as well as to find ways of solving the problems being faced by people

ACTIVITY 5.2

- Ask pupils to read widely and guide them to learn more about what should be done to care for our wetlands.
- Elaborate in a simple manner each of the points given above
- Ask the pupils to summarise these points in their own language.
- Provide them with the necessary information or reference materials
- The major skills to be developed are research, taking down notes and communication

5.5 Care of areas surrounding wetlands

Often our wetlands are affected by human actions away from the wetlands themselves. This is known as off-site impacts.

Off-site impacts

What enters a wetland comes from the surrounding catchment. Some water enters the wetland directly from rainfall. Other wetlands receive water from rainfall that may have fallen some distance away. Such water may be brought in through larger water bodies such as rivers and lakes.

The quality of water in a wetland and the nature of the wetlands are influenced by the activities surrounding the catchment. These influences are experienced even when the activities occur at a great distance from the wetland itself. The influence of these activities affects the quality, quantity and timing of the water received into the wetland. In turn this affects the functioning and benefits of the wetland.

Exercise 5.4

Visit to a community living near a wetland.

- State five activities done in your community that can affect the water received by the wetland.
- Write in few sentences how the activity can affect the wetland.
- Make a list of community activities
- Indicate which activities directly affect the wetland
- Design message you can communicate to your community to address your findings.

Did your findings include the following?

- Sewage disposal from urban centres
- Agricultural effluent run-off from livestock rearing, abattoirs, coffee or sugar factories, and agro-chemicals from spray.
- Oil from nearby garages.
- Car and truck washing near the wetland
- Uncontrolled mining and brick making activities.
- Soil erosion caused by activities like road construction, overgrazing, deforestation.

The above activities may affect the quality of run-off into wetlands which can contaminate the whole water system. The water system of an area is known as its hydrology. Activities which affect water system (hydrology) influence the quantity and timing of water flow into the wetlands.

Examples of these activities include:

- Building of dams and diversion of water; this is usually done when water is needed for irrigation, industrial use and generation of hydro power.
- Deforestation affects the flow of water into the wetland because it increases the speed of flow. Water is not retained by the soil and instead it carries many unwanted materials into the wetland.

Exercise 5.5

- Organise yourselves into groups and carry out a study of the wetland that you have in your school. You should note its location, size, human activities in the surrounding areas, the flow of water, its colour and the amount upstream and downstream. You can also note the creatures that are found in the wetland plus many other interesting things that your teacher will ask you to do. Collect your information and then write a report with the help of your teacher.
- With the help of your teacher, organise a visit to a community that neighbours a wetland in order to make them aware of proper care and wise use of the wetland.
- Make a poster on wise use of wetlands. What messages does it give to the reader? Outline the steps that you took to prepare and how you plan to use your poster to provide communities with the message of proper care and wise use of our wetlands.

5.6 Institutions and organisation concerned with wetland conservation

All countries of the Nile Basin have institutions, organisations and agencies which help or are concerned with wetlands issues and management. Some have projects and activities on wetland conservation; wetlands restoration; wetlands resources and wise use; and researches on wetlands. Many organisations and agencies also work in more than one country. They have cross border projects and programmes.

In Uganda, for example, the following institutions, organisations and agencies have an active role in issues related to wetlands:

- National Wetlands Management agencies.
- Nile Basic Initiative.
- World Conservation Union (IUCN).
- National Environment Management Agencies (NEMA).
- Green Watch.

- Universities.
- Various Departments of related ministries.
- Wildlife Authority.
- Forestry Authority.
- Name the others

Exercise 5.6

- Name organisations, institutions, agencies concerned with wetlands issues in your country.
- State what each of them is concerned with.
- Which of them have wetlands programmes which are cross border?

5.7 UNIT SUMMARY

In this Unit, we have learnt about:

- The different ways in which humans abuse wetlands
- Explain the impact of floods on wetlands
- Using examples, explain the effect of natural catastrophes on wetlands
- Acquire skills of wetland restoration after abuse.

As we saw earlier, human activities impact on wetlands functions and often result into wetland loss or damage. Wetlands are both important and useful to us. We must care for them. We care for our wetlands when we avoid activities which damage them or reduce their abilities to perform their functions. The care for wetlands must involve all stakeholders and beneficiaries of wetlands resources. We must also follow guidance given to us by institutions, organisations and agencies concerned with resource use, wetlands management and conservation. Each individual or community needs to participate in wetlands conservation, restoration and protection.

5.8 FURTHER READING

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GLOSSARY

Adaptation: Ways in which living things have got used to staying in an area.

Amphibians: Frogs, toads and similar animals which breed in water and live on land as adults.

Aquatic: Living in water environments such as sea, lake or river.

Biodiversity. The variety of living organisms (plants and animals) in a given ecosystem or habitat e.g. wetlands, forests.

Browsing: feeding on leaves of trees.

Catchment: The furthest point from which a wetland collects its water.

Conserve: Proper care and wise use of environment.

Dissolved oxygen. Oxygen that is dissolved in water.

Eco balance: The balance between environmental and human needs.

Ecosystem: A place in which plants and animals live and relate to each other.

Effluents: Waste water that is released from industries and houses.

Endemic: Commonly found and originating in a particular area.

Energy flow: How energy moves from plants after photo synthesis to animals.

Extinction: To die away and disappear from earth.

Foraging: To move from place to place looking for plant food.

Food chain: Feeding on an organism (living thing) and in-turn being eaten by another.

Greenhouse effect: The increase in the earth's temperature, which results from the presence of carbon dioxide and other gases that trap heat in the atmosphere.

Ground water: Water beneath the earth's surface; often between the soil air spaces and

rocks. This water supplies wells and springs from which millions of people depend especially in rural areas.

Habitat: The specific area or environment in which a particular type of plant or animal live. An Organism's habitat must provide all the basic requirements for survival.

Heavy Metals: A group of elements that are present in the environment from natural sources and human activities (e.g. Mining) and can produce harmful effects to a variety of living organisms including man, examples include mercury, copper, cadmium, zinc, and arsenic.

Lower Plants: Non-flowering plants such as lichens and ferns.

Micro organisms: Very tiny living things that can only be seen with the help of a microscope, such as bacteria.

Precipitation: This occurs in form of rain, snow, or hails, all of which are formed by condensation of moisture in the atmosphere and fall to the ground/earth's surface.

Pathogen: Any organism, but particularly bacteria and viruses, that causes disease. Many pathogens are found in contaminated water causing diseases such as cholera, Diarrhoea, Typhoid e.t.c.

Rhizomes: A special type of stem of some plants which grows horizontally along or under the ground

Sewage: Wastewater containing liquid or solid wastes from a community, home an industry or an institution like a school.

Suspended Solids: Solid particles of different substances that are suspended in and carried by the water. They include; sand, mud, clay particles, human and animal wastes e.t.c.

Toxic: Something poisonous, or otherwise directly harmful to life (e.g. sewage, heavy metals, e.t.c)

Wetland encroachment: The act or process of changing a wetland to use that may destroy

its proper functioning.

Wetland Abuse: Any action that leads to loss, destruction or degradation of a wetland.

Wetland goods: Things or resources that are harvested directly from wetlands.

Wetland Inventory: To find out the size and what is in a wetland, namely the water, plants and animals.

Wetland restoration: To make a degraded wetlands to gain its natural status

Wetland degradation: A process by which the important uses, services, goods or

functions of a wetland are reduced or completely destroyed. Sub basin

Water pollution: Addition of excess harmful substances (e.g. sewage, fertilizers, chemicals from industries e.t.c.) to water that changes its general quality or normal characteristics. This destroys the intended uses of water; for example, drinking, cooking swimming, the consumption of fish, and the health of water/aquatic organisms.

Water surface runoff: The part of rain water that moves over the earth's surface (land surface) and normally washes away materials or substances into streams, wetlands or other receiving water bodies.

Wastewater: Water that is contaminated (or polluted) as a result of human activities (e.g. during washing) and is not used for any other purpose, but discharged (or poured away) as a waste.

Water table: The level beneath the earth's surface below which the soil or rock spaces are permanently filled with underground water. When you dig a hole below the water table, water normally comes out and slowly collects in the hole. A good example of underground water is the borehole water. The water table in wetlands is almost at the land surface and changes with the dry and rainy seasons.

Water cycle (Hydrological cycle): The cycle of processes or stages through which water moves from the atmosphere to the earth and returns back to the atmosphere. These processes or stages include; evaporation, transpiration, condensation, precipitation, surface runoff, e.t.c

Waterborne diseases: Diseases caused by harmful micro-organisms which are directly transmitted when contaminated drinking water is consumed. Contaminated drinking water, used in the preparation of food, can be the source of food borne diseases through consumption of the same micro-organisms. A waterborne disease can be caused by protozoa, viruses, bacteria, and intestinal parasites.(Examples of waterborne diseases include; Diarrhoea, Dysentry, Cholera,Trachoma,Typhoid e.t.c)

SPECIAL ACKNOWLEDGEMENT TO

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