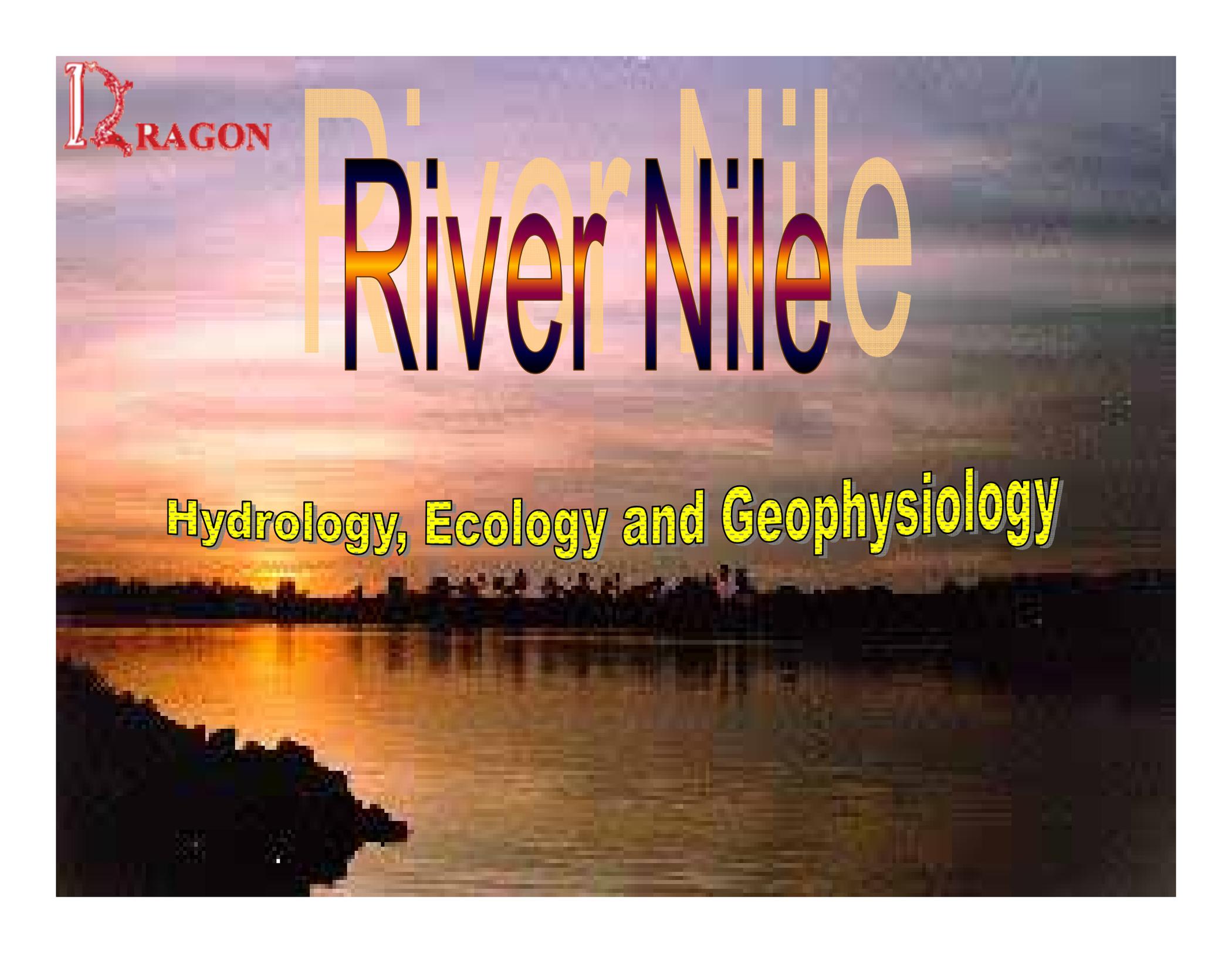




River Nile, History, Present and Future Prosperity

**Dr. Mary Ghobrial
National Institute of
Oceanography &
Fisheries, Alexandria
Egypt**

The background of the slide is a photograph of a sunset over a large body of water. The sun is low on the horizon, creating a bright orange and yellow glow that reflects on the water's surface. In the distance, a city skyline is visible against the darkening sky. The overall mood is serene and atmospheric.

D DRAGON

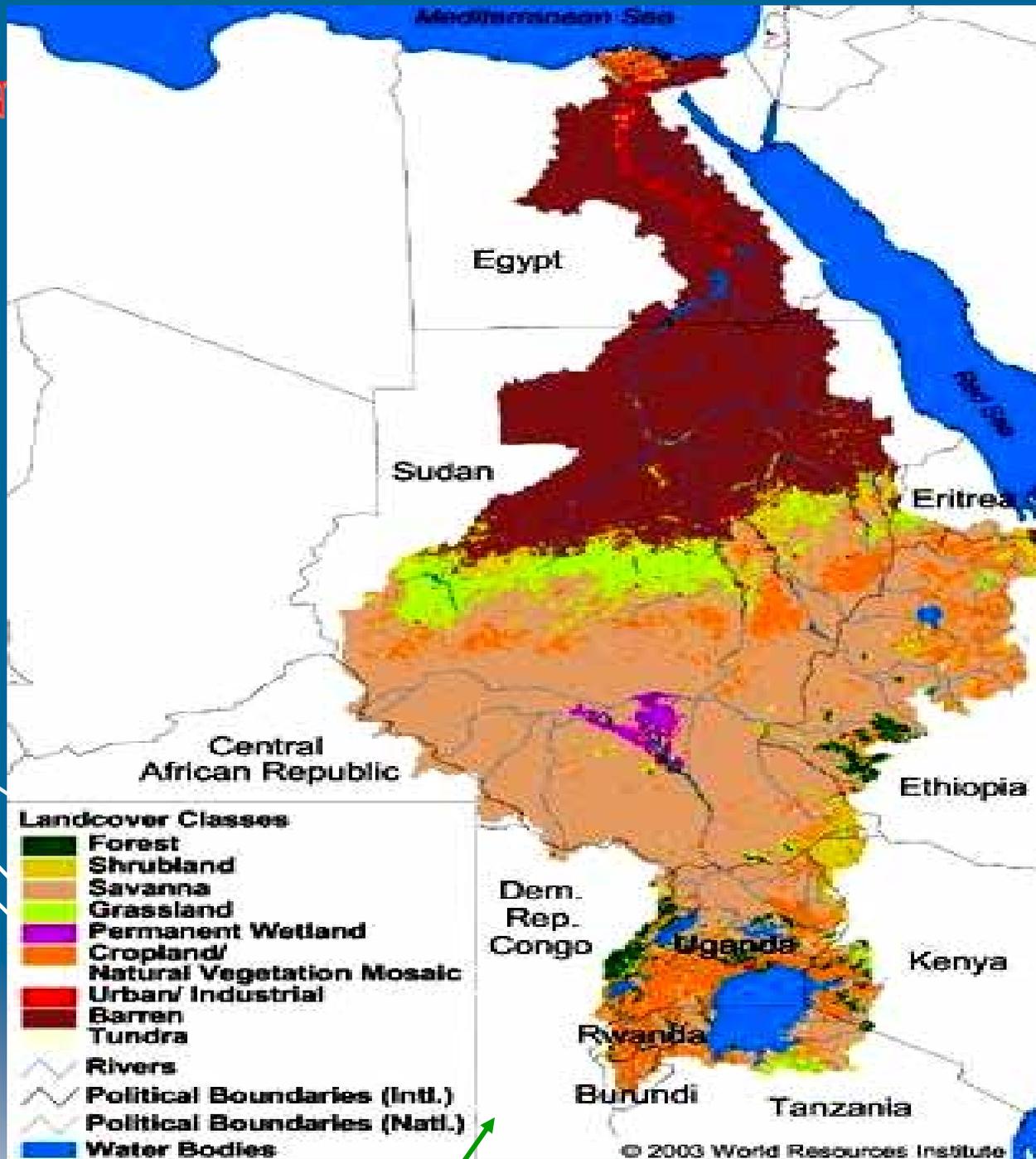
River Nile

Hydrology, Ecology and Geophysiology



River Nile Basin

- ◆ **Longest** river in the World (6,695 Km)
- ◆ **Location:** Africa latitude 4⁰S to 31⁰N
- ◆ Total length of the **river and its tributaries:** 37,205 Km²
- ◆ River **catchment's** area: 2,9 million Km²
- ◆ Shared among ten **countries:** Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Eritrea, Kenya, Rwanda, Sudan, Tanzania and Uganda
- ◆ Total **population** of these countries: about 280 million
- ◆ Crosses several **climatic regions** of Africa: tropical rain forest to desert



NILE RIVER Watersheds

Watershed area : 3.3 million km² (one tenth of Africa)

The Nile River gets its water from three catchments :

- 1- The Plateau of Equatorial lakes (South)
- 2- Bahr EL Ghazal (Center)
- 3- Ethiopian high lands (East)



Eastern Main Watershed

Central Watershed

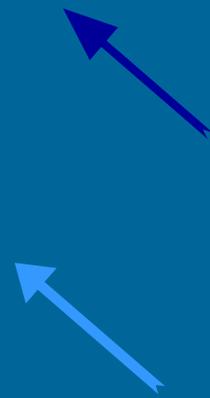
Southern Watershed

Main Watersheds of Nile River Basin

Water Sources of River Nile

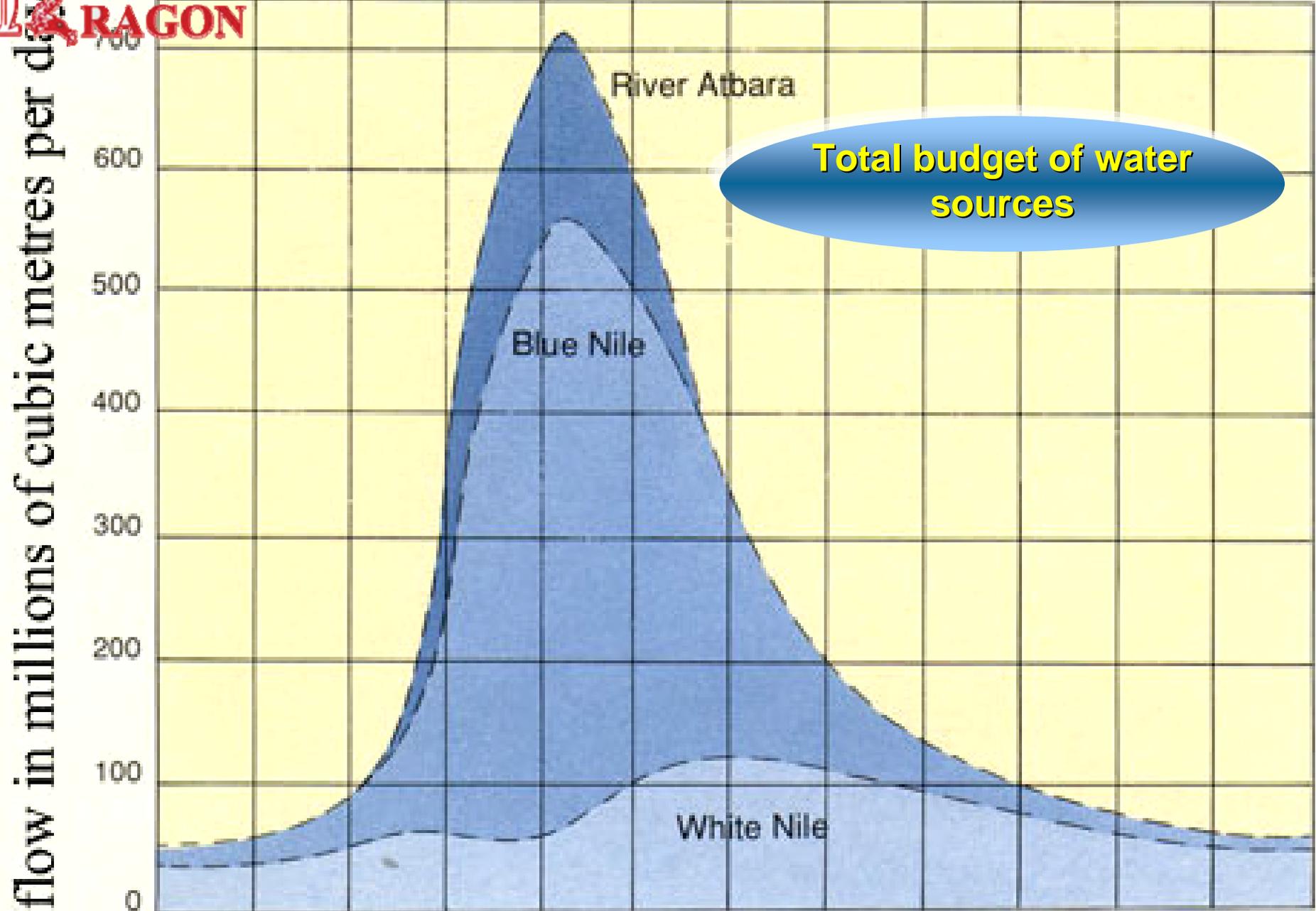
- ◆ The Nile is a combination of three long rivers whose sources are in central Africa: the **White Nile**, the **Blue Nile**, and the **Atbarah**.
- ◆ The **White Nile**, which begins at **Lake Victoria** in **Uganda**, supplies about **28%** of the Nile's waters in Egypt
- ◆ In southern and central Sudan, the White Nile passes through a wide, flat plain covered with **swamp vegetation** and slows almost to **stagnation**.
- ◆ The **Blue Nile**, which originates at **Lake Tana** in **Ethiopia**, provides an average of **58%** of the Nile's waters in Egypt.
- ◆ The much shorter **Atbarah** River, which also originates in Ethiopia, and provides about **14%** of the Nile's waters in Egypt.

DRAGON



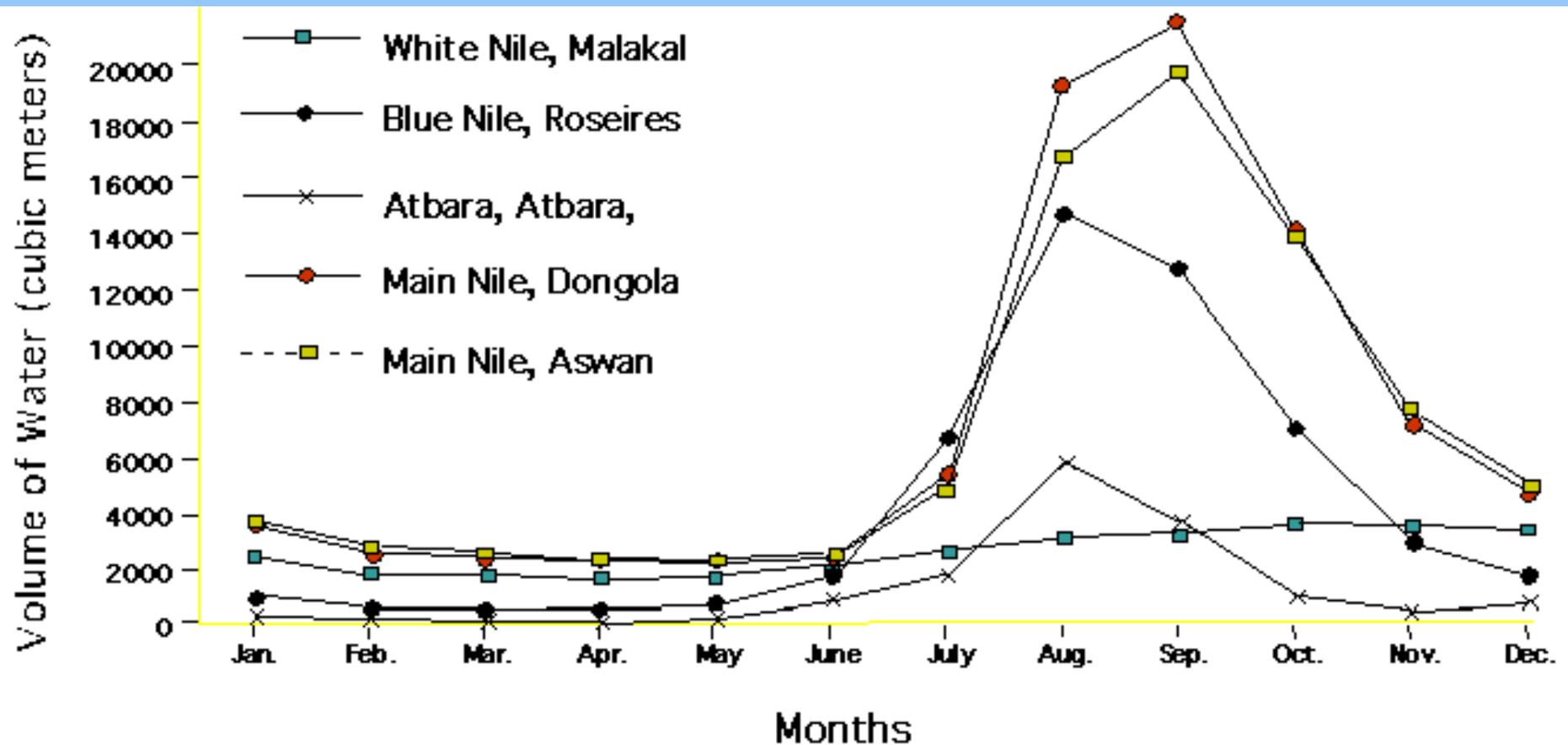


DRAGON





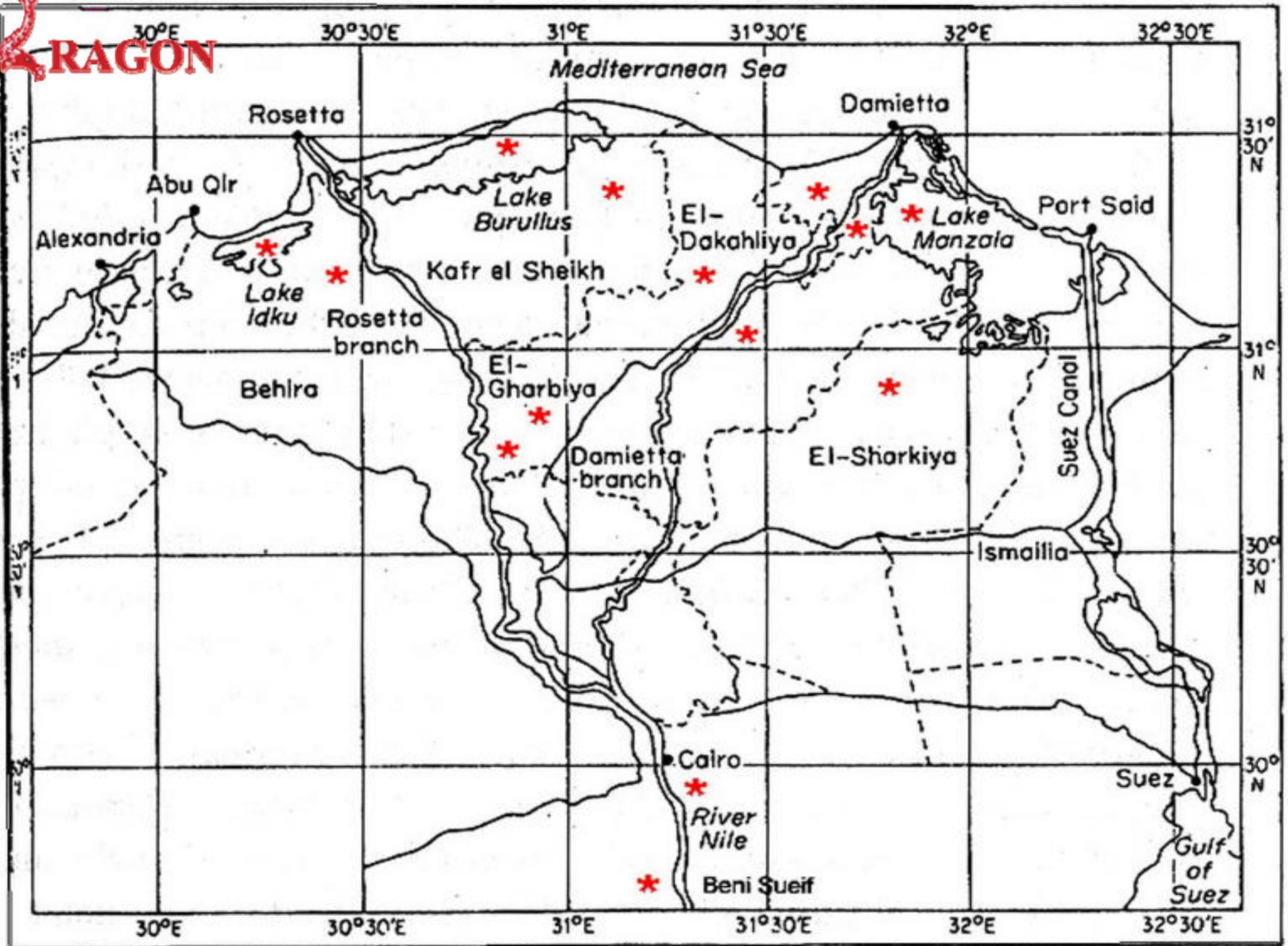
Water flow to River Nile (Egypt) (x10⁶)



Egypt's share of the Nile flow is 55.5 cubic kilometres per year (average flow is 84 cubic kilometres per year at Aswan)

Delta Branches

- ◆ The Nile Delta extends over approximately 22,000 square kilometers.
- ◆ The Nile in Egypt extends for 1200 km between **Aswan** and the Mediterranean Sea .
- ◆ At Cairo, the Nile spreads out over what was once a broad **estuary** that has been filled by silt deposits to form a fertile, fan-shape **delta** about 250 kilometers wide.
- ◆ According to historical accounts from the first century A.D., seven branches of the Nile once ran through the Delta.
- ◆ Nature and man have closed all but two main outlets: the east branch, **Damietta** (240 kilometers long), and the west branch, **Rosetta** (31.50°N, 30.35°E)(235 kilometers long).
- ◆ A network of **drainage** and **irrigation canals** supplements these remaining outlets.



Nile Valley Geology

- ◆ The **Nile Delta** has strong geological similarities with the desert to the west and the Nile Valley to the south.
- ◆ The **Nile Valley** consists of the broad floodplain which flows between steep **limestone** or **sandstone hills**.
- ◆ The valley **sediments** have been formed by the deposition of over bank deposits (**sands, silts, and clays**) when the Nile flooded. Silt is **50 to 75** feet deep.
- ◆ Much of the delta is dominated by **similar alluvial sediments** to those found in the Nile Valley.
- ◆ River regulation has stopped this annual sediment influx, and the flood plain is now dissected by a network of irrigation canals.
- ◆ At the coast there is a series of **saline lagoons** and salt flats trapped behind coastal sand bars.

DRAGON

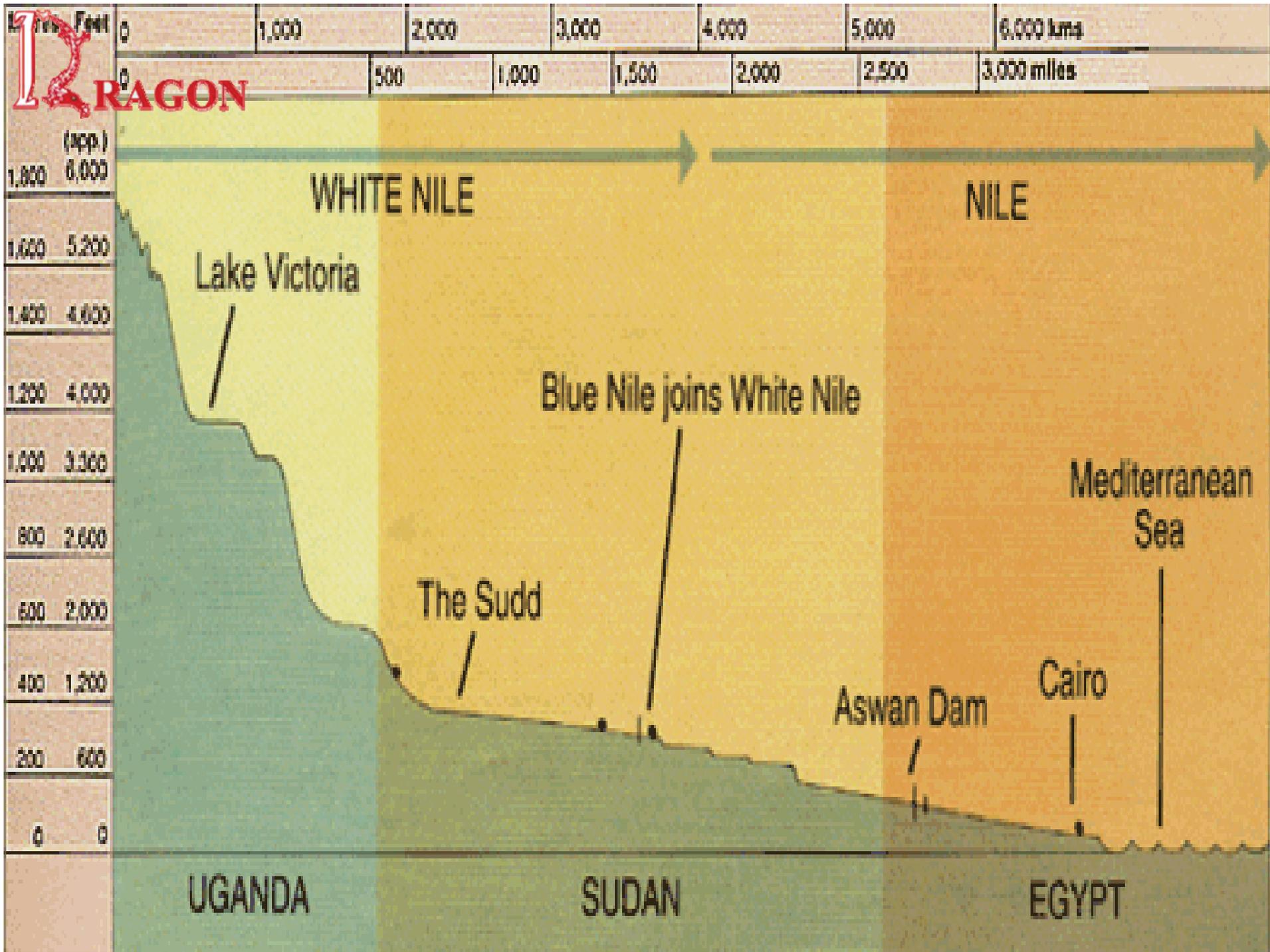


Population: 3 800 000
Cropland (Km²): 1 800



Sources of Nile Sediment

- ◆ Most of the sedimentation of the Nile (~ 90%), flows from the **Ethiopian highlands** through the **Blue Nile** and the **Atbara** during the flood .
- ◆ The **White Nile** and its tributaries lose most of its sediment load by spilling and deposition over flood plains, lakes, and marshlands.
- ◆ Mean annual sediment load to be approximately **134 million tons** at Aswan.
- ◆ North of Aswan, the river has a gentle gradient, dropping **1m in every 13 km**.



Nile Islands Protected Area

- ◆ Location: **144 Islands** along the main course of the Nile from Aswan to the Delta with an area of about 32,500 feddans.
- ◆ At **Rossetta** branch there are **30** isles of 3400 feddans. At **Damietta** branch, there are **19** isles of an area of about **1250** feddans.



D RAGON

Phaela



D RAGON

Elephantine

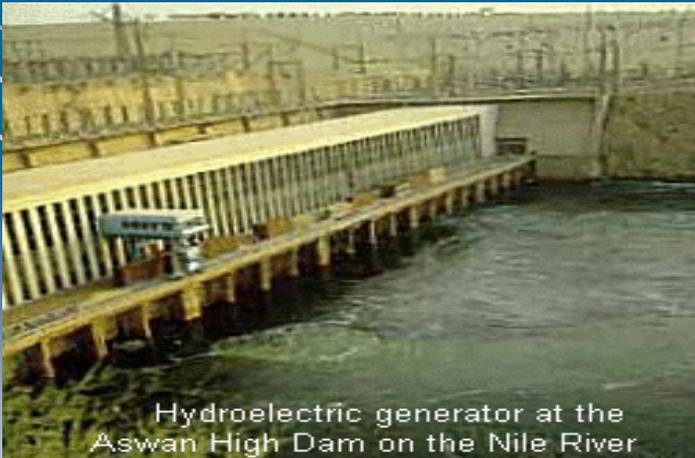


HYDROLOGY

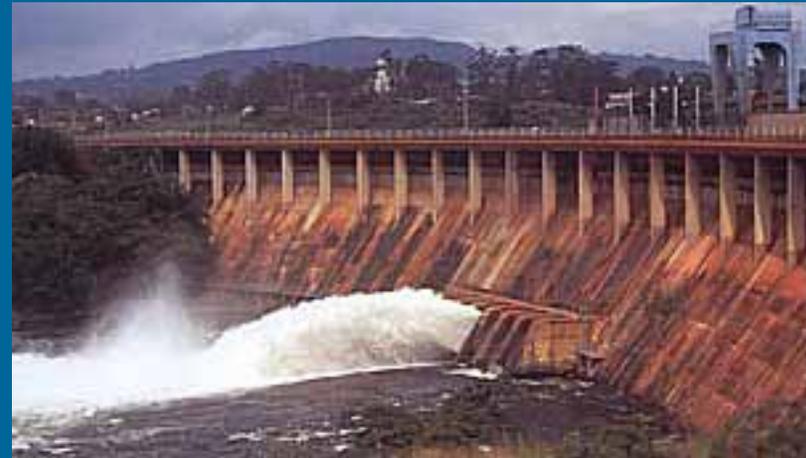
- ◆ Very low annual rainfall, **Annual rainfall ranges between a maximum of about 200 mm to a minimum of nearly zero**
- ◆ Therefore, The Nile becomes increasingly important the farther north it flows into Sudan and Egypt. This is because it brings water to regions which lie in Earth's greatest and **most desolate desert, the Sahara.**
- ◆ The scale of agriculture increases as the area of cultivatable land increases northward.

Aswan High Dam

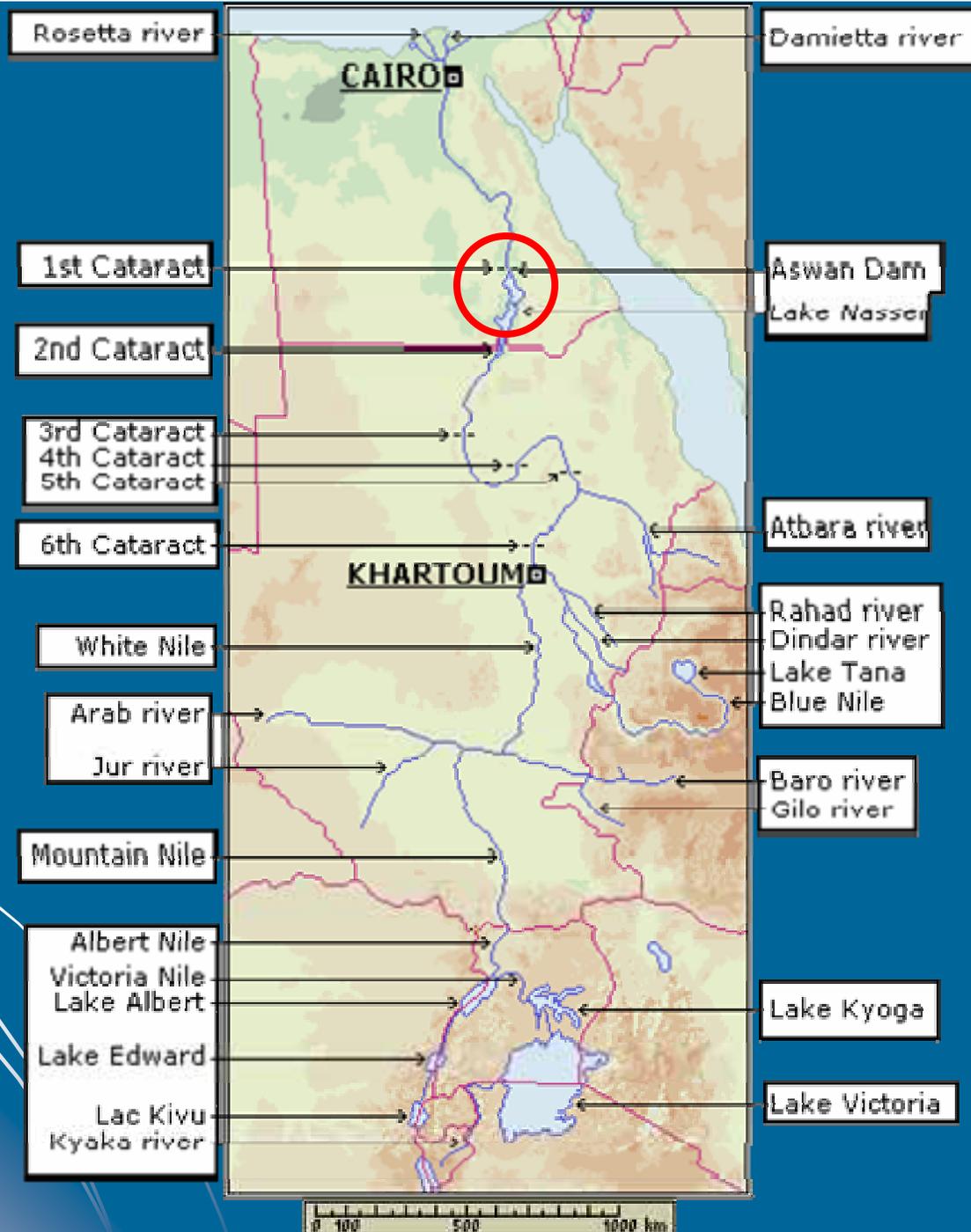
- ◆ The High Aswan Dam (HAD) is the most important structure to **regulate the flow of the river Nile** in Egypt and it is located near the border with Sudan.
- ◆ Captures the mighty Nile River in the world's third largest reservoir, Lake Nasser
- ◆ **Flood control, hydroelectric power, irrigation**



Hydroelectric generator at the Aswan High Dam on the Nile River



1 DRAGON



LAKE NASSER

- ◆ Lake Nasser, the world's largest artificial lake
- ◆ Lake Nasser (**180 sq km**), the dam's reservoir and, has a storage capacity of **157 billion cu m**.
- ◆ As a result of Aswan High Dam construction, the Nile actually begins its flow into Egypt as Lake Nasser.
- ◆ The amount of water in Lake Nasser is about **twice** the annual yield of the river in Aswan.

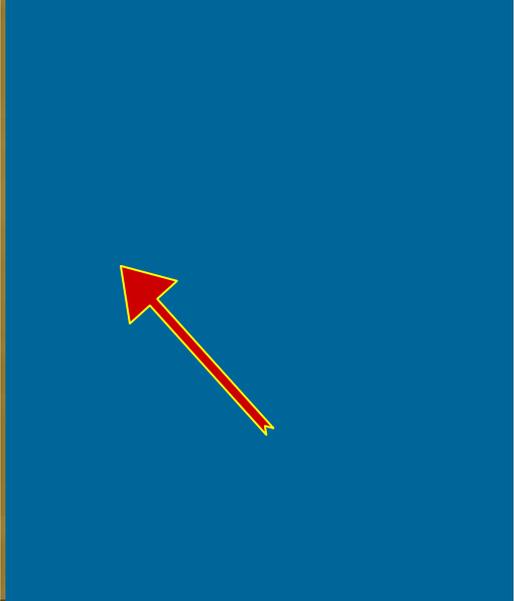
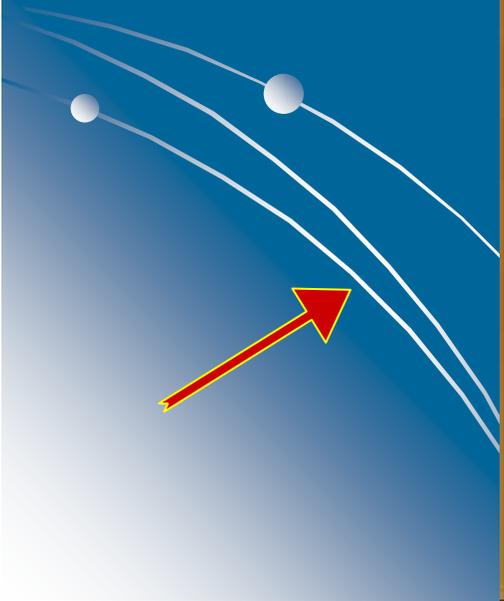




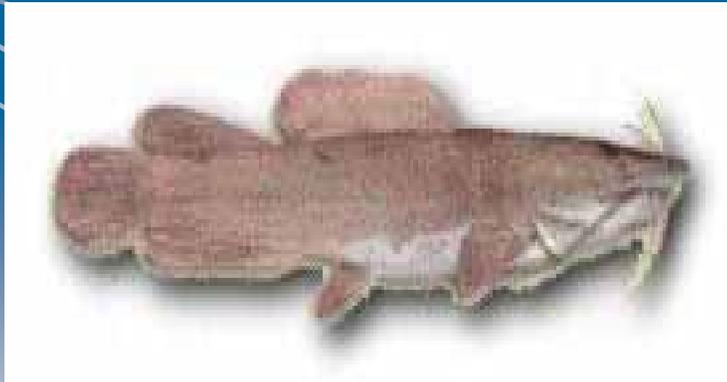
Lake Nasser Flood and Drought Control Project

- ◆ Since 1964, **4.95 billion cubic meters** (bcm) of sediments have deposited in Lake Nasser
- ◆ Studies indicate that up to **134 million cubic meters** a year end up in the lake, with **130 million** sediment and **4 million** passing through the Aswan High Dam to the valley north of Aswan.
- ◆ The current operation strategy is to keep the level of the lake as high as possible to secure sufficient release in case of consecutive dry years.
- ◆ In case of a large annual flood, surplus water has to be spilled into the desert through the **TOSHKA** spillway at the west side of the lake.
- ◆ This spillway was used in the last four years, with annual discharge equals **35%** .

DRAGON



Wildlife in Lake Nasser





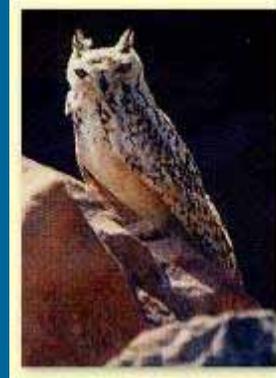
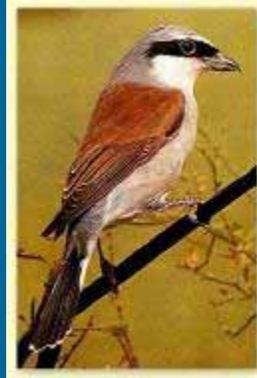
River Nile Ecoregion

- ◆ The region enjoys a Mediterranean climate, with average summer temperatures around **86° F (30° C)** and winter temperatures ranging between **41 and 50° F (5-10° C)**. Rainfall is scarce, falling mostly in the winter.

Wild Side

- ◆ The Nile Delta is part of one of the world's most important migration routes for birds. Every year, millions of birds pass through Europe and Africa along the "eastern African flyway." White storks, black storks, European cranes, and white pelicans all rely on the region during their annual migrations

Migratory Birds



DRAGON

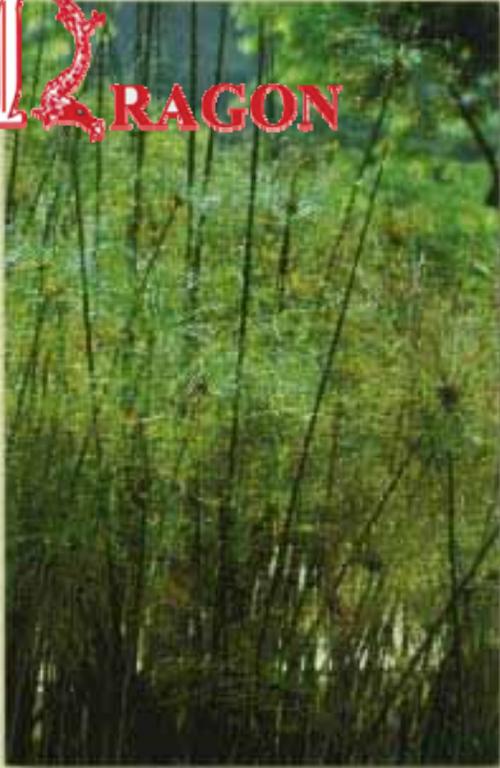


Major Birding Areas in Egypt

Vegetation

- ◆ The Nile Delta was once known for large papyrus (*Cyperus papyrus*) swamps, but papyrus is now largely absent from the delta.
- ◆ Vegetation consists of *Phragmites australis*, *Typha capensis*, and *Juncus maritimus*.
- ◆ The Nile has been connected to the Niger and Chad water systems, through a series of shallow lakes in the Sahara Desert. Therefore, the three river systems share a similar flora and fauna.
- ◆ The Nile River within Egypt has at least 553 plant species associated with it, of which at least 8 species are endemic

DRAGON



Phragmites



Papyrus



Juncus

River Nile Threat

The ecological balance of Nile and its surroundings has been badly affected by a host of factors such as:

- ◆ **The population explosion,**
- ◆ **Pollution**
- ◆ **Global warming.**
- ◆ **Salination caused by increased global warming**
- ◆ **The extinction of many native species of flora and fauna.**
- ◆ **Invasion of alien species**

DRAGON



DRAGON



River Nile - Polluted River

- ◆ Nile pollution in Egypt became a problem after 1970 and the completion of the Aswan High Dam.
- ◆ Only **10%** of River Nile water reaches Mediterranean.
- ◆ Before then, river pollutants were washed away with the annual flood.
- ◆ The dam has tamed the surging floodwaters that would annually flush pollutants out of the Nile system and into the Mediterranean

DRAGON

Key sources of pollution include:

- ◆ Farmers have been forced to use about one million tons of **artificial fertilizer** as a substitute for natural nutrients.
- ◆ Agricultural run-off from irrigation – chemical fertilizers are seeping back into the river – and, because more water evaporates in irrigation systems, it has higher **saline** levels.
- ◆ **Sewerage** from cities, towns and villages is dumped into it in untreated or partially treated form.
- ◆ **Industrial waste** from factories situated along the river.
- ◆ **Domestic** rubbish.
- ◆ **Fisheries**



River Basins Management Problems and issues (Nile River Case)

Soil erosion in the watershed area

Factors affecting soil erosion

- Vegetation Cover
- Loose Soil
- Urbanization
- Slopes

Problems

- Erosion of top fertile surface
- Decreased run off
- Damages of properties
- Increased sediment yield to River Nile

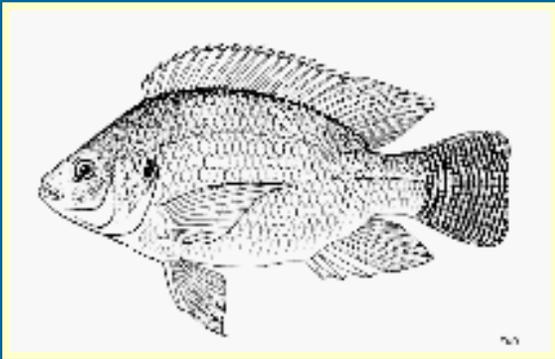


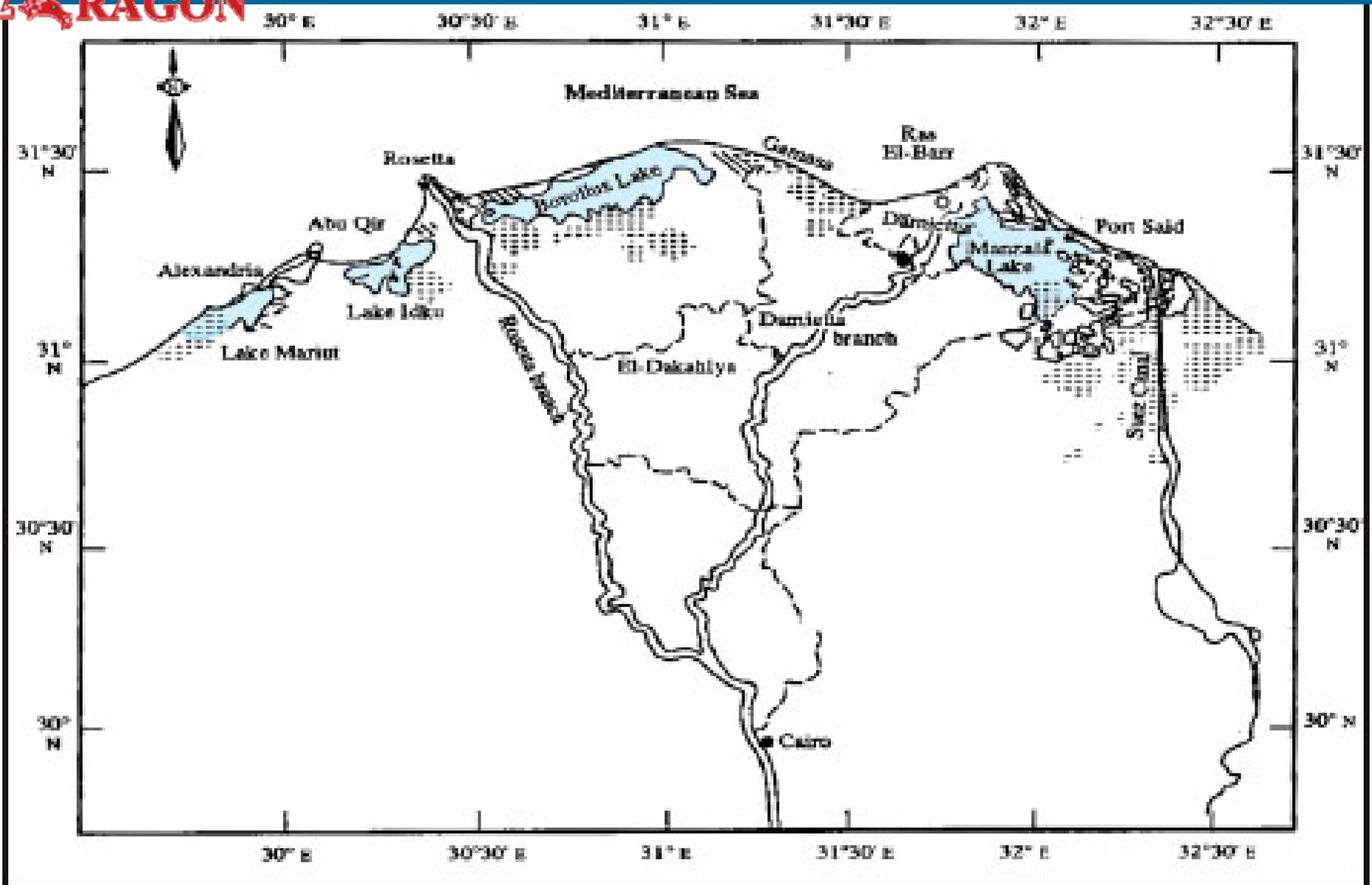
Coastal Delta Lakes Saltmarshes

- ◆ Coastal Delta lakes are transitional zones between land and sea.
- ◆ Over **25%** of all Mediterranean wetlands are found along The Medit. Coast of Egypt.
- ◆ The Nile Delta lakes are the most biologically diverse sites
- ◆ They are considered the **most productive** natural systems.
- ◆ Important fish species in the lakes and lagoons include ***Oreochromis niloticus*, *O. aureus*, *O. galilaeus*, *Tilapia zillii*** and ***Clarias sp.***
- ◆ Several problems affect the conservation of the Nile Delta lakes such as : pollution, land reclamation, intensive aquatic vegetation, over fishing, eutrophication, heavy metals and pesticides are of increasing concern.
- ◆ Levels of pollution in these lakes: **L.Mariut>L. Manzalah>L. Edku>L. Burullus.**

D RAGON

Tilapia spp.





Lake Burullus

- ◆ Lake Burullus Protected Area is located east of the Rosetta branch of the Nile.
- ◆ The lake is shallow and rather elongated with about **50 small islands** scattered through it.
- ◆ The **sand bar** separating the lake from the sea varies in width from a few hundred meters to 5km.
- ◆ The only **connection** with the sea is at the northeast corner and here the water is most saline.
- ◆ **Salinity** decreases to the south and the water is fresh near the canals and drains that enter the lake.
- ◆ Commercial **salt production** and fish farming are carried on to the south of the lake.

Hydrophytes in L. Burullus

- ◆ The southern shore of the lake is bordered by extensive stands of *Phragmites* and *Typha* reed swamps.
- ◆ In the lake, abundant aquatic vegetation such as: *Potamogeton* spp, *Ceratophyllum*, *Najas*, *Lemna*, *Ludwigia* and *Eichhornia*.
- ◆ Reed swamps: common reed *Phragmites australis* covers (6.972ha).
- ◆ Total standing crop of Lake Burullus is 239,040 tons.

□ Erase-r-plant
■ Rooted-plant

— Main-drains
— Drains

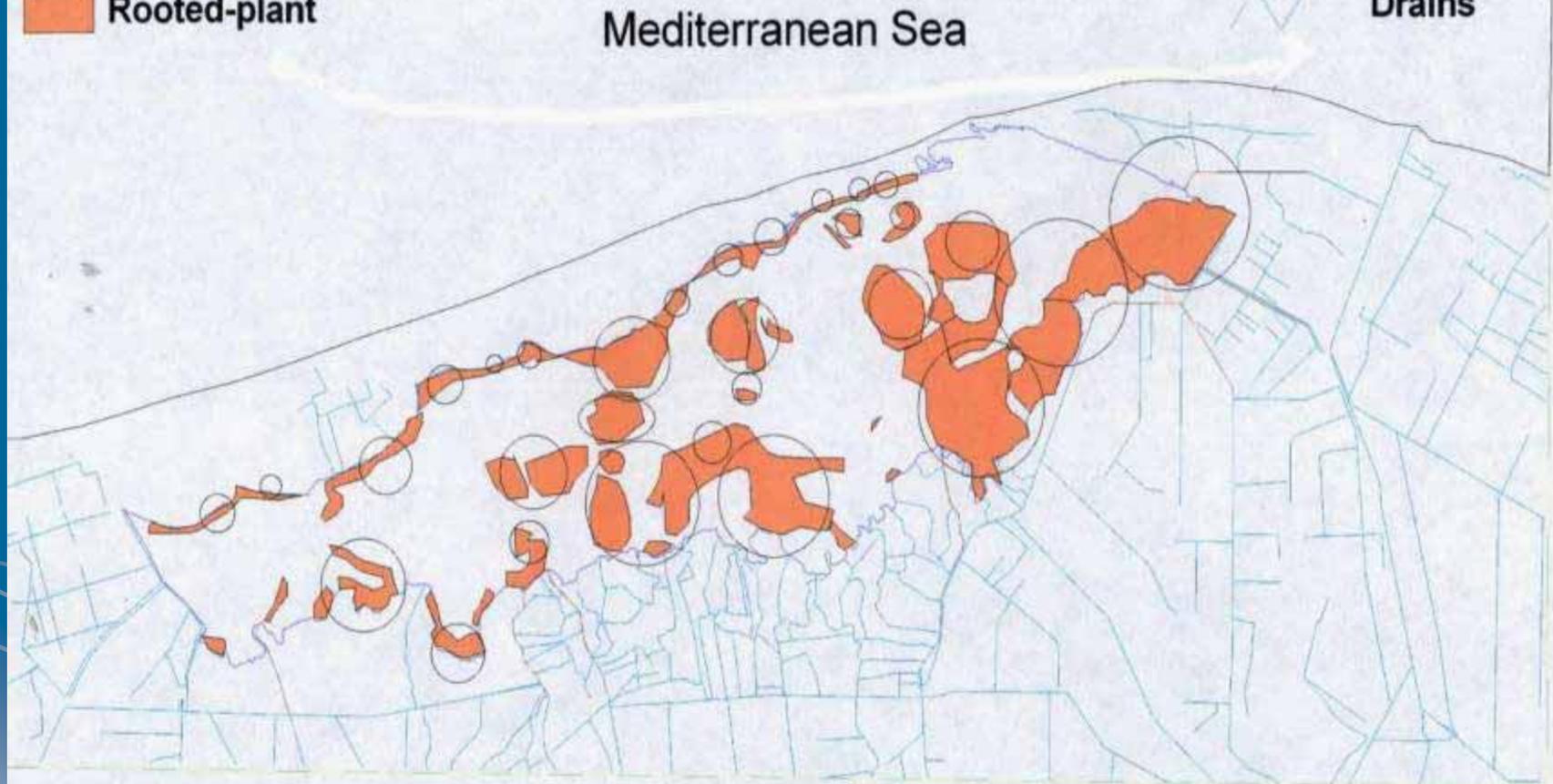


Figure (VI-17) Mechanical Scenario (4- Erase Rooted Plant)





L. Burullus continued Biological/Ecological notes

Flora

- ◆ Lower plants (phytoplankton) Species composition has changed drastically in a short period due to change in water chemistry
- ◆ The extensive *Phragmites* beds in the southern and eastern parts of the lake, covering about 20,000 ha, provide an important breeding habitat for *Ixobrychus minutus* and *Porphyrio porphyrio*

Wildlife

- ◆ The site is an important wetland for wintering and staging area for birds including; *Ardea cinerea*, *Casmerodius albus*, *Egretta garzetta*, *Ardeola ralloides*, *Ixobrychus minutus*, *Anas crecca*, *A. ferina*, *Circus aeruginosus*, *Fulica atra*, *Vanellus spinosus*, *Tringa stagnatilis*, *Calidris minuta* and *Larus cachinnans*
and
for the threatened Ferruginous Duck, *Aythya nyroca*. Purple Gallinule, *Porphyrio porphyrio*, and Little Tern, *Sterna albifrons*, breed in the area.



Lake Manzala

- ◆ Lake Manzala, the **largest (60 km long and 40 km wide)** of Egypt's Mediterranean wetlands and the most productive for fisheries.
- ◆ This huge shallow lake is suffering from **land reclamation, industrial and nutrient pollution, and overgrowth by water hyacinth.**
- ◆ Formerly saline or brackish, its salinity is reduced by year-round freshwater inflow and poor drainage to the sea, and **fish catches** are reduced.
- ◆ Extensive emergent reed beds, mainly of ***Phragmites***, help to localise pollution, but also prevent the circulation of saline water.

LAKE MANZALA

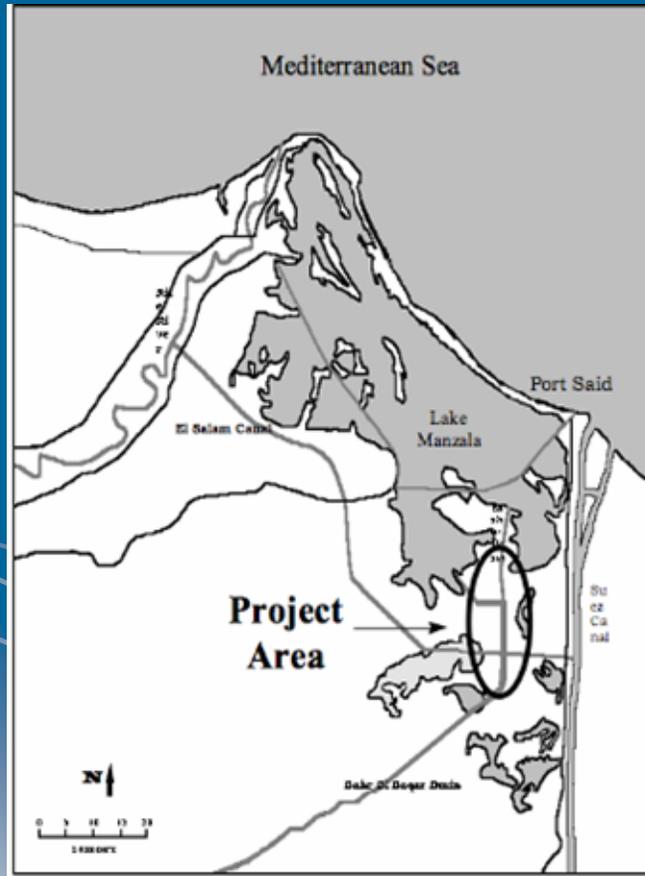


Figure 1. Project Area



RAGON

L. Manzala.....continued

Habitats vegetation

- ◆ The three main habitats are reed-swamps, saltmarshes and sandy areas.
- ◆ **reed-swamps** of *Phragmites* and *Typha*, with associated submerged water-plants (e.g. *Potamogeton* and *Najas*), are found extensively in the less saline portions of the lake in the south and west and fringing many islands.
- ◆ **Saltmarshes** of *Juncus* and *Halocnemum* occur on the northern (coastal) margins of the lakes and some islands.
- ◆ **Sand formations** are occupied by several plant communities, e.g. coastal dunes. Open water and mudflats are also important habitats for birds.
- ◆ Large areas in the north-west of the lake have been turned into fish-farms

Waterfowl of L. Manzala

- ◆ Manzala is by far the most important wetland for wintering waterbirds in Egypt, holding a total of **233,901 water birds** in winter. This represented **c.40% of all waterfowl** counted throughout Egypt's wetlands and included the **world's largest** concentrations of wintering ***Larus minutus*** and ***Chlidonias hybridus***.
- ◆ There were also up to **36,180 waders** present in spring especially of ***Recurvirostra avosetta*, *Calidris minuta*, *Calidris alpina* and *Philomachus pugnax***.
- ◆ Manzala is also of importance for a number of breeding waterbirds and wetland species. About 35 species are known to breed, including ***Ixobrychus minutus*, *Egretta garzetta*, *Ardeola ralloides*, *Porphyrio porphyrio*, *Sterna albifrons*, *Charadrius alexandrinus*, *Vanellus spinosus*, *Glareola pratincola*, *Caprimulgus aegyptius*, *Ceryle rudis* and *Acrocephalus stentoreus***.
- ◆ Highly organized bird-catching activities take several tens of thousands of waterfowl every year, mainly ducks, ***Fulica atra*, *Gallinula chloropus*** and waders



Conservation project of L. Manzala Constructed Wetland

- ◆ An artificial wetland that would prevent pollutants from Cairo from seeping through the Nile delta into the Mediterranean.
- ◆ It demonstrates the value of engineered wetlands as a cost-effective, ecologically sound method for trapping sediments and pollutants from municipal, industrial and agricultural sources.



- Fish production, which uses water cleansed by the wetland .
- After sediment. water is poured into cells with different flow, slope.
- Indigenous species of water reeds have been tested at the site, including Papyrus
- Huge screw pumps lift the drainage water from Bahr El Baqr and into sedimentation ponds .

Lake Edku



Lake Edku continued

- ◆ **Situated** at 30km NE of Alexandria
- ◆ It is **connected** with the Mediterranean sea through Boughaz El- maadyah.
- ◆ **Area:** 126 km²
- ◆ **Depth** range from 50-150 cm.
- ◆ This coastal lagoon is almost an agricultural drain
- ◆ 389x10 millions m³ **agricultural wastewater** are discharged through Boughaz abu-kir.
- ◆ Its salinity has been reduced by fresh-water overload from the Nile drains.
- ◆ Fish quality is reduced by eutrophication and the spread of **water hyacinth** and ***Azolla filiculoides*** on the water surface.
- ◆ Its size is being rapidly reduced by **land reclamation.**

Lake Edku



Lake Edku vegetation

- ◆ After the closure of the Aswan High Dam in 1964. Water weeds increased, including indicators of eutrophication such as *Ceratophyllum* (hornwort), *Lemna* (duckweed), *Eichhornia* (water hyacinth), and reed swamps grew up dominated by *Typha* (cattail).
- ◆ Meanwhile, molluscs and foraminifera typical of brackish lagoon conditions decreased as the water became fresher.
- ◆ *Azolla nilotica* thrived in the brackish and saline conditions early in the century, but became extinct after 1920 when nutrient levels began to increase.
- ◆ *Azolla filiculoides* was introduced to the delta as a green fertilizer and it spread across the lake in the 1990s.



Percentages of various types of vegetative cover
in the basins of lake Maryout in 1996

Category	Main Basin	Fishery Basin	Northwest Basin	Southwest Basin
<i>Phragmites</i>	46	21	14	50
Water Hyacinth	12	0	0	0
SAV ¹	0	62	74	43
Open Water	36	9	5	4
Other Cover	6	7	5	2
Total	100	99	100	99

1. Submerged aquatic vegetation



Restoration project (Alexandria Wastewater AWP)

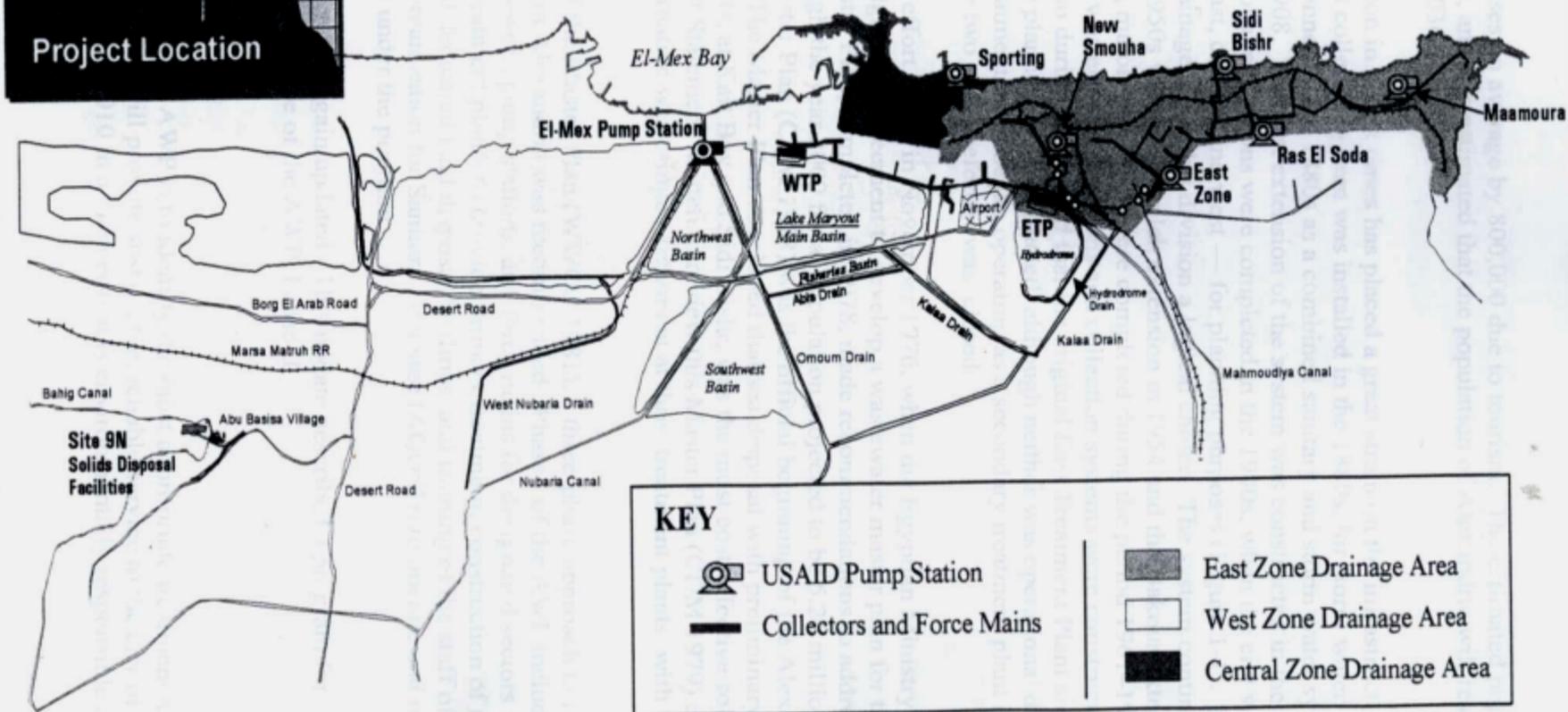
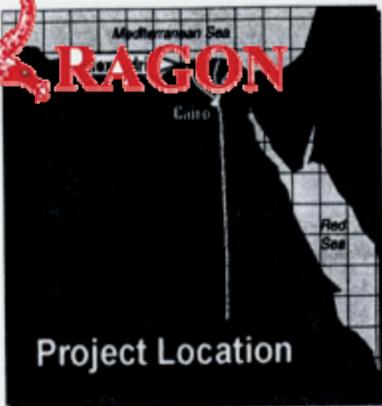


Figure 1-1. Location of the Alexandria Wastewater Project facilities, Alexandria, Egypt.



Change, stress, sustainability and aquatic ecosystem resilience in North Africa" (CASSARINA)

- ◆ **High alkalinities** with varying degrees of brackishness.
- ◆ The sites tend to be **eutrophic** and the phytoplankton is mainly dominated by green or blue-green algae.
- ◆ High growth rates of **fish**, in the Egyptian Delta lakes.
- ◆ Palaeoecological and littoral vegetation surveys show that **emergent macrophytes** are still extensive only in the Delta lakes where they are important in controlling water pollution.
- ◆ From sediment records of **diatoms, zooplankton, higher plants and benthic animals** major changes in species composition have taken place

Delta Threats

The reduction in annual silt deposits has contributed to:

- ◆ **Rising water tables** and increasing soil salinity in the Delta
- ◆ **Erosion** of the river's banks in Upper Egypt,
- ◆ **Erosion** of the alluvial fan along the shore of the Mediterranean Sea.

Cause for Concern

The major threats to the region's biodiversity are :

- ◆ **Fertilizers**, applied to the land because nutrient-rich sediments are no longer deposited through flooding;
- ◆ **Salinity** increased in the waters;
- ◆ **Hunting** increasing and trapping;
- ◆ **Rising sea levels** due to global warming could also drastically alter the region.
- ◆ **Loss in coastal fish catch**: the most spectacular case following impoundment of a flood river is the collapse of the Egyptian **sardine** fishery.
- ◆ **Invasive plants**: the introduction of the water hyacinth (***Eichhornia crassipes***) on life in the River Nile and the networks of irrigation and drainage canals throughout the country.

Conservation programs

- (i) the conservation and **sustainable** use of biodiversity and ecosystems.
- (ii) the promotion of **environmentally sound** and sustainable development in the areas adjacent to protected areas.
- (iii) the **maintenance of viable populations of species** in their natural surroundings.
- (iv) the **rehabilitation** and **restoration** of degraded ecosystems and the **recovery of threatened species**.
- (v) the **management of the risks** associated with the use and release of living modified organisms resulting from **biotechnology** with possible adverse impact on the environment.



Activities for Wildlife Service Egypt - Wild Bird Surveillance – 2007

- ◆ The sampling was conducted during January and February **2007**. Research teams were able to work with 40 different species of birds including a variety of migratory waterfowl.
- ◆ This work was jointly supported by **FAO** and **USAID** to:
- ◆ **Assess the current status** of wintering water birds in Egypt's major wetlands.
- ◆ **Collect representative** samples from wild water birds from a variety of locations in Egypt.
- ◆ **Describe condition** of wetlands visited.
- ◆ Complete **International Water bird Census** site and census forms for each site visited.

The fieldwork was performed in two missions: a- Lake Manzalla, Lake Elabasa, Lake Elbawa; Egypt, b- Cairo, Fayoum, Lake Burulous, Lake Manzalla, Sherqeya.

Conservation of the Delta-Mediterranean Wetlands:

- ◆ **Biotechnology** will contribute substantively to the improvement of **agriculture, fisheries, health** and **environment** in Egypt.
- ◆ Egypt has signed a number of international and regional agreements for the conservation of natural habitats and species.
 1. Rio (Biodiversity))
 2. - Ramsar (Wetland protection)
 3. - CITES (Trade in wildlife)
 4. - Bonn (Migratory species
 5. - Red Sea (marine and coastal)
 6. - Barcelona (marine and coastal)
 7. - Specially Protected Area Protocol
 8. - World Heritage (natural and cultural heritage)
 9. - Man in the Biosphere Programme
 - 10.- African-Eurasian Waterfowl Agreement



Potential impact of sea level rise: Nile Delta

Population: 3 800 000

Cropland (Km²): 1 800



Population: 6 100 000
Cropland (Km²): 4 500



GRID
Arendal



0 50 km



DRAGON

The impacts of Rising sea level would be very serious:

- ◆ It would destroy weak parts of the **sand belt**, which is essential for the protection of lagoons and the low-lying reclaimed lands.
- ◆ Destroy one third of Egypt's **fish catches** in the lagoons.
- ◆ Sea level rise would change the **water quality** and affect most fresh water fish.
- ◆ Valuable **agricultural** land would be **inundated**.
- ◆ Vital, **low-lying installations** in Alexandria and Port Said would be threatened.
- ◆ **Recreational tourism** beach facilities would be endangered.
- ◆ **Groundwater salination** and impacts on agriculture

DRAGON

Thank You





History

- ◆ The **delta** has been formed through deposits along tens of thousands of years by the Nile, being originally shallow sea bed.
- ◆ **Agriculture** in the region, thus forming the backbone of **Egyptian civilization**.
- ◆ The management of land and water resources in the Nile Valley and Delta led to the rise of the **unique** civilization.
- ◆ The Nile has been the source of civilization for more than **5,000 years**.
- ◆ People have lived in the Nile Delta region for thousands of years, and have been intensively farming. Communities of farmers, were cultivating wheat and barley and were herding sheep, goats and cattle.
- ◆ With the natural flooding and draining of the **floodplain**, the annual inundation permitted a single crop-season over two-thirds of the alluvial ground.

Fish, Plants, Birds



© THE METROPOLITAN MUSEUM OF ART

Papyrus

Papyrus was, and continues today to be made from the papyrus reed that grows in freshwater marshes along the River Nile ,though today this growth is .rare and controlled.



Papyrus

Besides its use for producing a medium for writing purposes, papyrus was also used for mattresses on beds, for building chairs, tables, and other furniture as well as for mats, baskets, boxes, sandals, utensils, rope and boats.

The papyrus root was a source of food, medicine and perfume.

A decorative graphic in the bottom-left corner consisting of three white curved lines with small white circles at their ends, set against a blue gradient background.

C. papyrus

- ◆ In July 2000, the author discovered a flourished *C. papyrus* L. stand at Sharabas, on the bank of Damietta Nile branch, 24 km south of Damietta (Serag, 2000).
- ◆ The capacity of papyrus to control water pollution and to treat wastewater (Abe *et al.*, 1997; Abe & Ozaki, 1998; Mizuta *et al.*, 1998; Okurut *et al.*, 1999; Azza *et al.*, 2000; Kansime & van Bruggen, 2001).



Inland open water

◆ Sparse mats of *Eichhornia crassipes* cover the open water. These mats are drifted due to fishing activities in the area. The most common associated species include:

- ◆ *Eichhornia crassipes* (60% cover).
- ◆ *Myriophyllum spicatum* (20% cover).
- ◆ *Ceratophyllum demersum* (20% cover).

Hydrophytic Vegetation in the Irrigation and Drainage Canal System of the River Nile in Egypt

- ◆ Various water ways, namely, drainage canals, irrigation canals, northern lakes (**Manzala**, **Borollus** and **Idku**), **Damietta** branch, **Rosetta** branch and **main stream** of the River Nile (*Mashaly and El-Ameir, 2007*)
- ◆ 70 plant species recorded in 80 sampled stands.
- ◆ Six vegetation groups dominated by:
Phragmites australis, *Eichhornia crassipes*, *Typha domingensis*, *Arthrocnemum macrostachyum* and *Echinochloa stagnina*.

The biodiversity of freshwater ecosystems

- ◆ **Threats to inland water biodiversity**
 - ◆ The main direct drivers of change include:
 - ◆ habitat change,
 - ◆ pollution,
 - ◆ over-exploitation,
 - ◆ invasive alien species and
 - ◆ climate change.
 - ◆ Due to over-hunting and fishing, the populations of many species are declining



Physiography and Agro-ecological Systems

Egypt can be divided into five main Physiographic units :

- (1) Western Desert
- (2) Nile Valley
- (3) Nile Delta
- (4) Eastern Desert
- (5) Sinai Peninsula.

Winter crop is wheat, which is cultivated along the whole length of the Nile Valley.

Summer cultivation , crops such as cotton, rice, sugar cane, and millet became important

Agroecosystem

- ◆ Most of irrigated land is used to produce cotton, rice, citrus fruits and potatoes.
- ◆ Egypt is self-sufficient in almost all agricultural commodities with the exception of cereals, oils and sugar



DRAGON

♦ Agriculture - products:

cotton, rice, corn, wheat, beans, fruits, vegetables;
cattle, water buffalo, sheep, goats

♦ Horticulture

Gardeners grew radishes , sesame , lentils, beans and chickpeas, (*Cicer arietinum*), lettuce, onions, leeks, dill (*Anethum graveolens*), grapes , melons, cucumbers and gourds.

♦ Crops Important crops :

barley (*Hordeum hexastichon*).
wheat (*Triticum aestivum*).



Agriculture Threat

- ◆ **The major challenge** facing the sustainable agricultural development in Egypt is the **limited water resources**. Surface irrigation accounts for more than **85%** of the total volume of water used for irrigation in the Nile Delta region.
- ◆ **Farmland urbanization** represents a serious threat to agriculture in Egypt.
- ◆ It is prohibited by law to construct any buildings on farmland



Water Management

Improving water resource use through:

- ◆ implementation of integrated irrigation and drainage water management,
- ◆ identification and correction of limitations of drainage water reuse for irrigation under normal and saline conditions,
- ◆ conjunctive use of ground water for irrigation,
- ◆ optimization of irrigation scheduling for different soil and plant conditions,
- ◆ designing and management of surface irrigation system, as well as improvement of the irrigation delivery system.



**Total Available Renewable Water Resources -
TARWR**

58km²/yr (2353 L/day/cap (

Renewed as:

Surface water produced internally

0.58km³/yr (1%)

Groundwater recharge

1.16km³/yr (2%)

Incoming waters

56.3km³/yr (97%)

Rainfall

100mm/year

Used by people

68.44km³/yr (118%)

Water Usage [2 [

68.44km³/yr (118%)

By Sector :

Agriculture

55.8 km³/yr (82%)

Industry

7.5 (%11)

Domestic

4.8km³/yr (7%)

Population without Safe Access to :

-an improved water source (2004) [3 [

%2 (1,467,800)

Average in Urban Areas

%1

Average in Rural Areas

%3

-improved sanitation (2004 (

%30 (22,017,000)

Average in Urban Areas

%14

Average in Rural Areas

%42



Conflict Management of Water Resources

Country	Per capita water availability 1990 (cubic meters)	Per capita water availability 2025 (cubic meters)
Egypt	1,123	630
Sudan	4,792	1,993
Ethiopia	2,207	842
Uganda	3,759	1,437