CASE STUDIES OF ENVIRONMENTAL AND SOCIAL CONSEQUENCES OF ECONOMIC DEVELOPMENT AND CONSERVATION IN TROPICAL CLIMATE

The Nakdong River Basin in South Korea

RIVER BASIN DEVELOPMENT

- One of the most common types of river basin development is the **construction of man-made lakes or reservoirs.**


Bui dam project

RIVER BASIN DEVELOPMENT

- The reservoirs are usually built for some primary purposes:
  - ✓ hydropower generation
  - ✓ Irrigation
  - ✓ flood control
- An integrated series of benefits may often be projected that include other benefits:
  - ✓ fisheries
  - ✓ transportation
  - ✓ provision of domestic and industrial water supplies
  - ✓ recreation

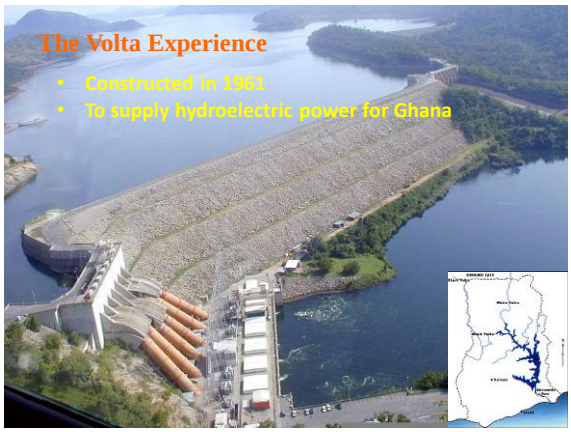
Limitation by Ecological Factors

- These development activities, like all others that take place within a natural ecosystem, are subject to the limitations of ecological factors which operate within the ecosystem.

Problems of River Basin Development

Impacts on fishes

- The creation of man-made lakes usually results in a **shift from riverine conditions and fish communities to lacustrine ones**.
- The lake waters will be colonised by riverine fishes
  - ✓ some of which will be able to exploit the changed conditions and flourish
  - ✓ others will vanish from the fauna as they cannot cope with the changed feeding or breeding conditions.



The Volta Experience

- After the construction of the Volta Lake
  - the mormyroid fishes were the first to disappear from the fauna as the lake filled, perhaps due to their benthic feeding habit and the fact that the bottom of the new lake was de-oxygenated.

The Volta Experience

- After the construction of the Volta Lake
  - Some characid fishes which had to move upstream to spawn vanished after some months.

The Volta Experience

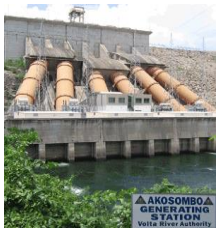
- After the construction of the Volta Lake .
  - **Cichlids** throve, as did **Schilbeid cat fishes** which changed from bottom-feeding to crop the burrowing *Ephemeroptera* nymphs which became abundant in the deadwood of tree downed by the rising river.

Cichlid fishes

Schilbeid cat fishes

The Volta Experience

- After the construction of the Volta Lake .
  - Another problem is the **shifts in salinity and turbidity or chemical changes in estuarine and adjacent marine areas** which have significant impacts on marine fish and shell fish.



The High Aswan Dam

The construction of this dam in 1964 brought about the collapse of a major sardine fishery which accounted for upwards of half of Egypt's total marine catch.

The High Aswan Dam

- Before the HAD was constructed, the annual flow of water from the River Nile (**Nile Stream**) stabilized the mediterranean ecosystem by continually supplying nutrient-rich sediments to these systems or water.

Nutrient-rich sediment from the Nile Stream was useful for agriculture

The High Aswan Dam

- However, this flow was cut after the construction of the dam, resulting in severe erosion along the Egyptian coast and decrease in fertility of the waters.

The High Aswan Dam

- The decrease in fertility in turn led to reduced primary productivity by the phytoplankton which provided sustenance to the sardines and other pelagic fishes.
- It also constituted a large source of detrital material, the products of organic decay, which forms a vital source of food for commerically valuable organisms such as shrimps.
- The fish industry in Egypt finally collapsed.

Spread of Aquatic Weeds

- Irrigation and hydropower projects may increase evapotranspiration loss due to invasion by water hyacinth (*Eichhornia crassipes*) and other weeds such as water lettuce (*Pistia stratiotes*).
- Besides the increase in evapotranspiration, blockage of navigation and damage to fisheries, *P. stratiotes* also poses a significant health threat.
  - the plant is a favourate habitat for the larvae of several mosquito species, which obtain oxygen from the water lettuce root and never have to surface.
  - control of the water weed is the only effective means of disease control.

Aquatic invasion of the Barekese dam

Lake Brokopondo Experience

Lake Brokopondo Experience

- A comprehensive study of the ecological impacts of water hyacinth on Surinam's Lake Brokopondo have been undertaken since its establishment in 1964.
- According to this study, water hyacinth was scarce in the river prior to inundation.
- By December, 1964, it covered 5000ha, 17900ha by June, 1965 and 41200ha by April 1966 (53% of the total lake area).

Lake Brokopondo Experience

- A control programme utilizing 2, 4 – D was initiated at an annual cost of $250, 000.
- In addition, there has been the cost of losses to water storage from evapo-transpiration and fishery having given a poor return in comparison with the previous riverine fishery.

Lake Brokopondo Experience

Table 2. Fish community parameters for Suriname River (pre-impoundment 1963-1964) and four different habitats in Brokopondo Reservoir in 1966-1967, 1978 and 2002-2005. Biomass of shore fish community in 1978 is given in kg per ha[1].

		Number of specimens	Biomass (kg)	Number of species	Species diversity *H* (numbers / biomass)	Evenness *J* (numbers / biomass)
Suriname River 1963-1964		12842	176.4	172	4.11 / 3.76	0.80 / 0.74
Brokopondo Reservoir 1966-1967		-	-	62	-	-
Brokopondo Reservoir 1978	Open water	301	67.9	11	1.49 / 0.46	0.62 / 0.19
	Shore	2540	26.0[1]	31	1.48 / 2.26	0.60 / 0.65
	Total	2841	-	35	1.82 / 2.04	0.75 / 0.61
Brokopondo Reservoir 2002-2005	Open water	1511	110.9	10	0.88 / 0.62	0.38 / 0. 27
	Shore	2308	20.5	27	2.29 / 2.43	0.70 / 0.74
	Bay	2020	110.5	23	1.58 / 1.51	0.51 / 0.48
	Beach	636	5.2	11	1.31 / 1.81	0.54 / 0.75
	Total	6475	247.1	41	2.17 / 1.53	0.60 / 0.42

Schistosomiasis

- Perhaps the greatest current problem of man-made lake and irrigation projects in the tropics stems from snail-borne infections.
- The WHO considers this disease as one of the largest public health threats in developing countries.
- Under earlier conditions, the ecological relationship between parasite, the primary host (snail) and the secondary host (man) was in relative balance, and relatively low levels of the disease prevailed.

Schistosomiasis

- More recently however, excellent conditions have been created for the fast spread of the snail host, through
  - ✓ rapid human population growth with poor sanitary facilities,
  - ✓ increased mobility of infected people
  - ✓ the ever more frequent construction of reservoirs and perennial irrigation projects

Case history of a schistosomiasis control in Egypt

- An excellent study of the relationship between schistosomiasis and the transmission from seasonal to perennial irrigation has been made by Henry *et al.* (1972).
- The report concluded:
  - ✓ *Egypt, over hundreds of years, has become unbelievably infested with bilharzias.*
  - ✓ *Life expectancy of women in Sindbis, near the Qalyub region, was 27 years and of men 25.*
  - ✓ *The countryside of the Delta is virtually rotten with the disease.*

Case history of a schistosomiasis control in Egypt

- ✓ *The overpopulation in horribly crowded villages, the lack of sanitation and the near impossibility of building proper facilities for potable water and waste disposal, the many unfortunate daily practices that allow for an amazing exposure to infection – all contributed to make conditions in the areas where perennial irrigation exists almost impossible to control.*

Cichlids: Parrot fish