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**Impacts of Dams and their Development projects**

INTRODUCTION: A BRIEF OVERVIEW OF DAMS AND DEVELOPMENT There is nothing new about dams: for thousands of years people have been building them to manage flood waters and supply water for drinking, irrigation and, more recently, industry. By the 1950s, as national economies and populations expanded, dams were increasingly viewed as a means of meeting water and energy needs, and since then, at least 45 000 large dams have been constructed. Nearly half of the rivers in the world now house at least one large dam, and hydropower produces over 50% of the electricity in a third of countries across the world, with large dams generating 19% of electricity overall. Half of the world's large dams were built exclusively or primarily for irrigation, and some 30-40% of the 271 million hectares irrigated worldwide rely on these constructions. Dams have been promoted as an important means of meeting water and energy needs, and as a long-term, strategic investment with the ability to deliver multiple benefits, some of which are typical of all large infrastructure projects, while others are unique to dams and specific to particular projects. Regional development, job creation and fostering an industrial base with export capability are often cited as additional considerations when building large dams, while other goals include the generation of income from export earnings, either through direct sales of electricity or by selling cash crops or processed products from electricity-intensive industries. However, such benefits need to be weighed up against the social and environmental impacts of large dams, which have become increasingly Issue Paper 108, Drylands Programme, IIED 2 obvious over the last fifty years. Rivers have been fragmented and transformed, and worldwide, an estimated 40-80 million people have been displaced by reservoirs. The enormous investment required to build large dams, and their huge social, environmental and economic impact, have fuelled opposition to them. As decision-making processes in many countries have become more open and transparent, the future of large dams is increasingly being called into question.

**The Ecology of Dams**

Ecology meaning:-is the scientific analysis and study of interactions among organisms and their environment. It is an interdisciplinary field that includes biology, geography, and Earth science.

Rivers possess a delicate ecology that depends on a regular cycle of disturbance within certain tolerances. The plant and animal communities that inhabit the river and river margins have evolved to adapt to their river's own peculiar pattern of flood and drought, slow and fast current. Dams disrupt this ecology.

     There are several types of dams. **Check dams** are small dams that help control erosion or flooding or, in the dry West, capture runoff to provide water for cattle. **Diversion dams** divert river water to irrigate crops. Large dams may be built for flood control, irrigation, and/or electrical generation. **Flood control dams** are often **earth dams**--made of huge mounds of clay, sand, gravel, and rock--but may instead be made of concrete.**Hydroelectric dams** are concrete marvels of engineering. This section will examine mostly the large dams: flood control and hydroelectric dams.

***Interrupting Natural Cycles***

 The first effect of a dam is to alter the pattern of disturbances on which the plants and animals of a river depend. Many aquatic animals coordinate their reproductive cycles with annual flood seasons. Every flood is valuable in that it takes nutrients from the land and deposits them in the river, providing food for the stream's residents. Floods also provide shallow backwater areas on vegetated and shaded riversides; the young of many animals depend on these backwaters to protect them from predators too large to swim in these shallow waters.

     As an example, a fish on a certain river may only reproduce during April of every year so that its offspring will have abundant food and places to hide. If the normal spring flood never comes because a dam holds the river back, the offspring will be produced during a time when they cannot possibly survive. If the fish breed during the next flood, which may be in July or may be in October, its young will be born during the wrong time of year and will have to contend with the absence of their normal food supply and temperatures for which they are not prepared.

     Vegetation, too, depends upon these regular cycles of flood. Quite often, people will decide that they can spare no water at all and no flooding at all will occur in the stream. Or they may have built the dams specifically to stop flooding so they can build houses in the floodplains. When this happens, **riparian** vegetation, the vegetation bordering the river, changes forever. An example of this may be found in much of the Southwest United States, where enormous floodplains of cottonwood, marsh and grasses have been replaced by dry, barren areas of tamarisk.

***Armoring the Riverbed***

 If the dam is allowed to release water from its reservoir, it will often do so only once in awhile, rather than in the frequent, small floods as are seen in nature. This leads to **scouring** and **armoring** of the riverbed. The higher energy of the sudden floods picks up and removes smaller sediments like silt, sand, and gravel, as well as aquatic plants and animals, leafy debris, and large woody debris. Complex sets of habitats are erased. The riverbed below the dam becomes like a pavement of cobbles and loses its value as habitat for plants, macroinvertebrates, and fish.

     Another reason that riverbeds become scoured and armored is that dams remove sediment from the river. The river, which now has no sediment, has improved carrying capacity and will pick up sediment from the streambed below the dam. It is much as though the river has been "starved" of its sediment. As in everything else in nature, balance will be achieved one way or the other.

***Changing Temperatures***

   Temperature is another problem. Rivers tend to be fairly homogenous in temperature. Reservoirs, on the other hand, are **layered**. They are warm at the top and cold at the bottom. If water is released downstream, it is usually released from the bottom of the dam, which means the water in the river is now colder than it should be. Many macroinvertebrates depend on a regular cycle of temperatures throughout the year. When we change that, we compromise their survival. For instance, a stonefly may feel the cold temperatures and delay its metamorphosis. This may mean that at a critical lifestage it will be living in the depth of winter rather than in autumn as it should have been.

***Stopping Fish Migration***

  Fish passage is a concern with dams. Many fishes must move upstream and downstream to complete their lifecycles. Dams are often built without **fish ladders**. When fish ladders are provided, they seldom work as needed. If enough adult fishes do manage to climb above a dam, there remains the issue of their young: how will they get back downstream? Many are killed by predators while they wander in the slow waters of the reservoir above the dam. Many are killed in their fall downward through the dam to the river below. They aren't killed by the fall itself, but by the high levels of nitrogen gas at the base of the dam. In other words, like divers who go too deep, they get the "bends."

     There are many fishes that cannot climb dam ladders or leap over low dams. Some of these fishes swim upstream every year to breed, then let the water carry them back downstream. The eggs of **pelagic spawners**float downstream, too, which is why the adults must swim far upriver to breed. Otherwise, the baby fish would soon end up out to sea.

***Erosion***

 Perhaps deadliest of all to salmon and steelhead species is the typical hydropower practice of releasing large amounts of water in powerful **surges** during the day in order to provide electricity when demand and prices are highest, and cutting down flow during the night in order to replenish reservoirs for the next day. The **cyclic floods** caused by this popular practice contribute to the extinction of salmon by flushing away their spawning gravels during the day and leaving them high and dry at night. Riverbeds become scoured, stripped of their organic materials, sediment, vegetation, and macroinvertebrates.

     The practice at the Three Gorges Dam of periodically "sluicing" massive amounts of water in the hopes of washing away sediments behind the dam is an extreme version of this problem. It contributes to erosion downstream.

**Other Problems**

The Three Gorges Dam may be an extreme case in several ways; it is an enormous dam, set on two fault lines in a mountainous region that is subject to high levels of erosion--and it is surrounded by an unusually dense human population. Even so, it may serve as a cautionary tale. The reservoir behind the dam is leading to landslides, doubtless adding to the sediment load but also making more of the land uninhabitable. The reservoir is serving as a catchment basin for enormous amounts of garbage and pollution. Another effect is controversial: earthquakes in the region have increased 30-fold. Many critics claim that the sheer weight of the reservoir on the faults below is causing this increased earthquake activity. This is called "Reservoir-induced Seismicity (RIS).

**Why We Always Seem to Need More Dams**

The government of a country will often encourage and fund the construction of dams in order to generate electrical power (decreasing pollution by coal plants), control flooding, enable irrigation, increase shipping, or a combination of these. Developers and speculators will campaign for dams in order to dry up large areas of floodplain, creating new real estate. Government institutions (such as the United States's Army Corps of Engineers and Bureau of Reclamation in the United States) that are accustomed to being in the business of damming have historically campaigned for new dams as well. They do this because they their very mission is to build and maintain dams as well as other water-conserving projects. In the final analysis, though, the reason we always seem to need more dams is that we always have more people; growths in population are followed by growing needs for electricity and water.

     This is where the irony lies. Once a dam is built and its reservoir is formed, the region that is served by the dam will be developed. In other words, it will be filled with cities, roads, parking lots, and houses. This, unfortunately, lowers the water table due to water **extraction** and **urban runoff**. And that lowers the river even further. Eventually, the new human populace will run out of water--but developers and politicians will still want to "grow" their cities. At this point, they will demand yet another dam.

The findings presented in Dams and Development are aimed at everyone involved in dams, from governments and the private sector, developers and owners, to civil society groups, international organisations and affected communities. The challenge now is to use the insights and proposals made in the report to reassess established procedures and involve all stakeholders - from the most powerful international players to the smallest communities - in making and implementing decisions about fundamental water and energy development choices. The Commission proposes a number of entry points to help organisations start to act on the report, by:

• Carefully reviewing and actively disseminating the report.

• Issuing public statements of support for the approach taken.

•Using WCD WORLD COMMISSION ON DAMS criteria and guidelines to review dams currently being developed

•Supporting investment in building capacity, particularly in developing countries, for options assessment and improved decision-making.

A new approach to improving the outcomes of dams and water development projects

Top of Form

Like any development project, dams and their alternatives must respond to a wide range of needs, expectations, objectives and constraints. This can only be achieved by transforming the development process, so that it includes all relevant stakeholders and is based on negotiation and consensual decisionmaking. For this radically different approach to work, participants need to have a clear understanding of and agreement about the shared objectives and goals of development, which should be underpinned by five core values identified by the Commission:

Bottom of Form

Equity

Efficiency

Participatory decision-making

Sustainability

Accountability