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Environmental Impacts of Hydropower Plants

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The impact of hydroelectric power plant on the environment is varied and depends upon the size and type of the project. Although hydropower generation does not burn any fuel to produce power and hence does not emit greenhouse gases, there are definite negative effects that arise from the creation of reservoir and alteration of natural water flow. It is a fact that dams, inter-basin transfers and diversion of water for irrigation purposes have resulted in the fragmentation of 60% of the world's rivers.

ENVIRONMENTAL IMPACT

The physical environment is affected rather significantly by the construction of a hydroelectric power station. Both the river and ecosystem of the surrounding land area will be altered as soon as dam construction begins.

1. Impact of Size and Type of Hydropower Plant

It is difficult to correlate the damage caused by dams to their size or type, as the impacts depend on local conditions. Generally plants with smaller dams are considered less environmentally damaging than those with larger dams. Also, run-of-river (ROR) hydropower plants are generally less damaging than reservoir power plants, because it is not necessary to flood large areas upstream of the project for storage. Yet in some cases run of river impacts can also be severe due to river diversion over long stretches of the river.

2. Impact of River Diversion

While both ROR and reservoir types of hydropower dams may divert water, this is always the case with ROR plants, since they seek to increase kinetic energy with an increased head. The length of diversion can range from a few meters or less to kilometers (km). For example, the Teesta-V ROR dam in northeasternIndiadiverts water for a 23 km long stretch of the river. Eventually the diverted water is returned to the river.

Often downstream flows are reduced considerably or even completely stopped during certain periods of time with sudden intervals of high flows. Such drastic variability in water flow impacts the structure of aquatic ecosystems often leading to a loss of biodiversity. Also, under normal conditions, increased sediment transport from low to intermediate flows provides a warning to aquatic organisms that high flows may follow. Abrupt changes from low to high flows obliterate this cue, making it difficult for organisms to respond to impending environmental changes. A decrease in fish populations has been observed in dewatered reaches below diversions. After long periods of little to no flow some species may not be able to recover and go extinct.

3. Impact of the Reservoir

Dams have major impacts on the physical, chemical and geo-morphological properties of a river. Environmental impacts of dams have largely been negative. Worldwide, at least 400,000 square kilometers have been flooded by reservoirs.

Once the barrier is put in place, the free flow of water stops and water will begin to accumulate behind the dam in the new reservoir. This land may have been used for other things such as agriculture, forestry, and even residences, but it is now unusable. The loss of habitat may not seem severe but if this area was home to a threatened or endangered species, the dam construction could further threaten that species risk of extinction.

3.1 Sedimentation

Large dams with reservoirs significantly alter the timing, amount and pattern of river flow. This changes erosion patterns and the quantity and type of sediments transported by the river. Sedimentation rate is primarily related to the ratio of the size of the river to the flux of sediments. The reservoir that has been rapidly filling up with water immediately begins filling up with sediment as well. The trapping of sediments behind the dam is a major problem. Every year it is estimated that 0.5 to 1% of reservoir storage capacity is lost due to sedimentation. The engineering problem with sedimentation is that less power is generated as the reservoir's capacity shrinks.

3.2 Downstream Erosion

Trapping of sediments at the dam also has downstream impacts by reducing the flux of sediments downstream which can lead to the gradual loss of soil fertility in floodplain soils. Clean water stripped of its sediment load is now flowing downstream of the dam. This clean water has more force and velocity then water carrying a high sediment load and thus erosion of the riverbed and banks becomes problematic. Since this is unnatural and a form of "forced erosion" it occurs at a much faster rate then natural river process erosion to which the local ecosystem would be able to adapt.

3.3 Impact on Local Climate

Another often-ignored environmental effect of the reservoir is the impact on the micro-climate level. Studies indicate that man-made lakes in tropical climates tend to reduce convection and thus limit cloud cover. Temperate regions are also impacted with "steam-fog" in the time period before freezing. Since water cools and warms slower then land, coastal regions tend to be much more moderate then land-locked regions in terms of temperature. Therefore, large dams have a slight moderating effect on the local climate.

3.4 Greenhouse Gas Emission from Dams

Freshwater reservoirs can emit substantial amounts of the greenhouse gases methane and carbon dioxide as organic matter submerged in a reservoir decays under anaerobic and aerobic conditions, respectively. Studies indicate that GHG emissions from hydropower reservoirs in boreal and temperate region are low relative to the emissions from fossil fuel power plants, but higher relative to life cycle emissions from wind and solar power.

Tropical reservoirs with high levels of organic matter and shallow reservoirs have higher emission levels. A recent compilation of greenhouse gas emissions from reservoirs found a correlation between the age of the reservoir and latitude. Younger reservoirs and those in low latitudes are the highest emitters. For example, of four Brazilian

dams in the Amazon, showed that the GHG emissions factor of the electricity produced by those hydropower dams exceed those from a coal-fired power plant.

3.5 Dams Inducing Earthquakes?

Finally, a least studied and most disputed physical impact of reservoirs is the possibility of inducing earthquakes. Many scientists believe that seismic activity can be attributed to the creation of dams and their adjacent storage reservoirs. They postulate that the added forces of the dam along inactive faults seem to free much stronger orogenic tensions. Early research indicates that the depth of the water column may be more important to inducing earthquakes rather then total volume of water in the reservoir. While more research is needed on this subject several disasters such as the Koyna Dam inIndiaseem to provide some truth to this theory. While these impacts can be quite severe often they do not receive the attention of the biological impacts that people tend to associate more with animals like fish.

3.6 Impact on Fisheries

Dams and river diversion can impact freshwater, as well as marine fisheries. Estuarine and marine fisheries are dependent on estuaries and rivers as spawning grounds and the transport of nutrients from the river to the sea. Migratory fish are especially vulnerable to the impacts of dam construction. Dams can prevent migrating fish such as salmon and eel to reach their spawn grounds.

A survey of 125 dams by the World Commission on Dams (WCD) reported that blocking the passage of migratory fish species has been identified as a major reason for freshwater species extinction in North America. Lower catch is a common side effect of dams and has been reported worldwide. There have been cases where fishery production below a dam has increased due to controlled discharge of the sediments.

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About Goodpal

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One Response to *Environmental Impacts of Hydropower Plants*

Pekyom Ringu *says:*
December 31, 2011 at 10:42 am

As a wildlifer, I do agree with the EI of large HEP both on social and environment. However, it is the best bet vis-a-vis thermal and nuclear power projects. India cannot afford to have fossil fuel powered power projects. Wind and solar power enery plants are also economically viable. So the best bet is to go for ROR HEP which don't have serious impact on the environment and shall fulfill the enery need of the country and economic needs of smaller himalayan states. With proper environmental and wildlife management plans imlemented, the environmental loss can be minimized. Feel free to write to me.
P Ringu, DCF (Wildlife & Biodiversity), Itanagar, Arunachal Pradesh

Reply

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