Environmental impacts of Civil Engineering projects(continued)

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(2) HYDRO ELECTRIC PLANTS

Hydroelectric power includes both massive hydroelectric dams and small run-of-the-river plants. Large-scale hydroelectric dams continue to be built in many parts of the world (including China and Brazil).

The future of hydroelectric power in, say, the United States will likely involve increased capacity at current dams and new run-of-the-river projects. There are environmental impacts at both types of plants.

For more on the benefits of hydroelectric power and other renewable energy technologies, we should see Benefits of Renewable Energy Use.

Land Use

The size of the reservoir created by a hydroelectric project can vary widely, depending largely on the size of the hydroelectric generators and the topography of the land. Hydroelectric plants in flat areas tend to require much more land than those in hilly areas or canyons where deeper reservoirs can hold more volume of water in a smaller space.

At one extreme, the large Balbina hydroelectric plant, which was built in a flat area of Brazil, flooded 2,360 square kilometers—an area the size of Delaware—and it only provides 250 MW of power generating capacity (equal to more than 2,000 acres per MW) In contrast, a small 10 MW run-of-the-rive plant in a hilly location can use as little as 2.5 acres (equal to a quarter of an acre per MW)

NEGATIVE EFFECTS

(1) Flooding Land

Flooding land for a hydroelectric reservoir has an extreme environmental impact: it destroys forest, wildlife habitat, agricultural land, and scenic lands. In many instances, such as the Three Gorges Dam in China, entire communities have also had to be relocated to make way for reservoirs

(2) Wildlife Impacts

Dammed reservoirs are used for multiple purposes, such as agricultural irrigation, flood control, and recreation, so not all wildlife impacts associated with dams can be directly attributed to hydroelectric power. However, hydroelectric facilities can still have a major impact on aquatic ecosystems. For example, though there are a variety of methods to minimize the impact (including fish ladders and in-take screens), fish and other organisms can be injured by turbine blades.

Apart from direct contact, there can also be wildlife impacts both within the dammed reservoirs and downstream from the facility. Reservoir water is usually more stagnant than normal river water. As a result, the reservoir will have higher than normal amounts of sediments and nutrients, which can cultivate an excess of algae and other aquatic weeds. These weeds can crowd out other river animal and plant-life, and they must be controlled through manual harvesting or by introducing fish that eat these plants. In addition, water is lost through evaporation in dammed reservoirs at a much higher rate than in flowing rivers.

In addition, if too much water is stored behind the reservoir, segments of the river downstream from the reservoir can dry out. Thus, most hydroelectric operators are required to release a minimum amount of water at certain times

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of year. If not released appropriately, water levels downstream will drop and animal and plant life can be harmed. In addition, reservoir water is typically low in dissolved oxygen and colder than normal river water.

When this water is released, it could have negative impacts on downstream plants and animals.

Mitigation

To mitigate these impacts, aerating turbines can be installed to increase dissolved oxygen and multi-level water intakes can help ensure that water released from the reservoir comes from all levels of the reservoir, rather than just the bottom (which is the coldest and has the lowest dissolved oxygen).

(3) Global Warming Emissions

Global warming emissions are produced during the installation and dismantling of hydroelectric power plants, but recent research suggests that emissions during a facility's operation can also be significant. Such emissions vary greatly depending on the size of the reservoir and the nature of the land that was flooded by the reservoir.

Small run-of-the-river plants emit between **0.01** and **0.03 pounds** of carbon dioxide equivalent per **kilowatt-hour**. Life-cycle emissions from large-scale hydroelectric plants built in semi-arid regions are also modest: approximately **0.06** pounds of carbon dioxide equivalent per kilowatt-hour. However, estimates for life-cycle global warming emissions from hydroelectric plants built in tropical areas or temperate peatlands are much higher. After the area is flooded, the vegetation and soil in these areas decomposes and releases both **carbon dioxide** and **methane.**

The exact amount of emissions depends greatly on site-specific characteristics. However, current estimates suggest that life-cycle emissions can be over **0.5 pounds** of carbon dioxide equivalent per **kilowatt-hour** .

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To put this into context, estimates of life-cycle global warming emissions for natural gas generated electricity are between **0.6** and **2** pounds of carbon dioxide equivalent **per kilowatt-hour** and estimates for coal-generated electricity are **1.4** and **3.6** pounds of carbon dioxide equivalent **per kilowatt-hour.**

(3) Flood Control

NEGATIVE EFFECTS ON ENVIRONMENT

(1) **Reduction of nutrients** derived from flood-prone sediments, hence reduced availability of soil nutrients and thus increased dependence on chemical fertilizer inputs of which overuse is very much harmful for our environment.

(2) **Loss** of natural flood-induced pest control and increased dependence on pesticides.

(3) **Crop loss** with greater flood and failure of embankment. This has occurred to the Meghna-Dhonagoda embankment twice - in both the disastrous floods in 1987 and 1988,

(4) **Agrochemical runoff** from fields into water bodies causes water pollution in both surface and groundwater, and can lead to eutrophication due to low oxygen content in stagnant water. Because the existing environment and ecological balance is altered, losses in wildlife diversity can be expected.

(5) **Increased depth** of flooding, higher flood velocities and erosion of char and other unprotected active flood plains.

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(5) **Livestock grazing** areas are reducing due to the stagnant water inside the embankment.

(6) **Increase** in the incidence of diseases, such as cholera and malaria, as a result reduced flushing of polluted water sources.

Most flood control and drainage projects prior to 1988 were justified in terms of increased crop cereal production but undermine the need for water by industry, fisheries, inland navigation and environment.

(7) **Siltation**, or the gradual deposition of soil, becomes another major problem on river beds as this is no longer washed away by floods. Furthermore, when the fields aren't drained due to poor designed/or maintenance of the embankment (a common problem in Bangladesh) water logging results, which can be devastating by increasing soil salinity, rotting crops and altering the whole social structure of that particular area.

Some of these Flood projects have given rise to social problems and public reaction. A case of negative effect of a Flood project is documented in Beel Dakatia, a deltaic plain. The project's aim was to protect the area from daily tidal saline waters and from seasonal floods. Although it did initially help to raise agricultural production but the pitfall of this project was poor operation and maintenance resulting in siltation problems, severe drainage congestion, water logging and salinization. Moreover, it brought a profound change in the socioeconomic situation with complete break down of agriculture structure, forestry, fisheries, livestock and social infrastructure, including educational and health facilities.

One of the richest wetland areas is now almost ruined by water projects. Due to construction of ill conceived embankments & regulators, drainage has been impeded and water logging has become a serious problem in the drainage basin. There is one more area, which is submerged into floodwater

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due to the Flood projects since last two years. Approximately one hundred thousand people live in this water clogged area. Habitat has been changed, and livelihood opportunities is gradually decreasing. So it is very clear that, due to the long term environmental and social impact these Flood projects have became a big challenge

As with most human interventions in nature, there are both beneficial as well as detrimental effects associated with embankments. Often the benefits are reaped almost immediately while the negative effects take time to eventually become apparent. This applies to the effects of embankments as well as to any other `controlled' environment. The following steps can be taken to improve the present and future condition in Flood projects area.

Control Measures

(a) **To eradicate** drainage congestion in any further Flood projects, the project design should be qualified enough to minimize its harmful impact on environment.

(b) For the **protection** of human lives, houses and livestock, alternative solutions such as shelters and pile foundation houses should be investigated.

(c) **To create** the livelihood opportunities, promotion of culture fisheries is necessary.

(d) **Integrated management** of land and water is necessary to extract the positive outcome from Flood projects without hampering the environment. There is no doubt that all Flood projects with its reduction in seasonal flooding and hydro logically controlled environment, has resulted in a major ecological change. This change appears to have enabled the primary objective of increasing rice production.

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However, this change has also been the primary cause for further environmental, social and economic changes within the Project area.

Secondary changes are affecting natural resources, soil, water regime, farming systems, fisheries. The environmental sustainability of these Flood project remains questionable. The effects of intensive rice cultivation are becoming more apparent. The people of the Flood project's area are now committed to living within the realms of a new artificial environment. The benefits of this environment are now also being readily reflected in the diversity of negative effects resulting from the ecological change. It is easy

to find the parties always interested in structural solutions to the flood problems that involve huge costs. Expensive projects have always been preferred probably because expensive projects ensure a good return.

However, the Flood Action Plan was virtually abandoned in the face of criticism from home and abroad. But it was later replaced by the Water Resources Planning Organization (WARPO), which was basically the same program under a new name.

Conclusion

Despite all that has been done to make a country free from flowing abundant water into an area that is water logged, it seems that the water sector becomes an increasingly more interesting field for corporate bodies and scientists. The ultimate value of Flood projects, a reduction in the risk of flooding to households and property, including crop damage, is very difficult to measure against these long-term negative impacts.

NEGATIVE EFFECTS OF A DAM CONSTRUCTED FOR FLOOD CONTROL.(Figure shows the river/water quality condition before and after construction of the Dam)