LECTURE-24+25(L24-L25)

Environmental impacts of various Civil Engineering Projects.

1.Irrigation

The environmental impacts of irrigation relate to the changes in quantity and quality of soil and water as a result of irrigation and the effects on natural and social conditions in river basins and downstream of an irrigation scheme. The impacts stem from the altered hydrological conditions caused by the installation and operation of the irrigation scheme.

Direct effects (General)

An irrigation scheme draws water from groundwater, rivers, lakes or overland flow, and distributes it over an area. Hydrological, or direct effects are those which show their effect immediately.

Indirect Effects

Indirect effects are those that have consequences that take longer to develop and may also be longer-lasting. The indirect effects of irrigation include the following:

Waterlogging
Soil salination
Ecological damage
Socioeconomic impacts

The indirect effects of waterlogging and soil salination occur directly on the land being irrigated. The ecological and socioeconomic consequences take longer to happen but can be more far-reaching.

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Some irrigation schemes use water wells for irrigation. As a result, the overall water level decreases. This may cause water mining, land/soil subsidence, and, along the coast, saltwater intrusion.

Irrigated land area worldwide occupies about 16% of the total agricultural area and the crop yield of irrigated land is roughly 40% of the total yield. In other words, irrigated land produces 2.5 times more product than non-irrigated land.

Negative impacts of Irrigation

(1) Reduced river flow

The reduced downstream river flow may cause:

* **Reduced downstream flooding**

* **Disappearance** of ecologically and economically important wetlands or flood forests ,reduced availability of industrial, municipal, household, and drinking water

* **Reduced shipping routes**. Water withdrawal poses a serious threat to the Ganges. In India, barrages control all of the tributaries to the Ganges and divert a large percent of river flow to irrigation

* **Reduced fishing opportunities**. The Indus River faces scarcity due to over-extraction of water for agriculture. The Indus is inhabited by 25 amphibian species and 147 fish species of which 22 are found nowhere else in the world. It harbors the endangered Indus River dolphin, one of the world's rarest mammals. Fish populations, the main source of protein and overall life support systems for many communities, are also being threatened.

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***Reduced discharge into the sea**, which may have various consequences like coastal erosion (e.g. in Ghana and salt water intrusion in delta's and estuaries (e.g. in Egypt) Current water withdrawal from the river Nile for irrigation is so high that, despite its size, in dry periods the river does not reach the sea. The Aral Sea has suffered an "environmental catastrophe" due to the interception of river water for irrigation purposes.

* **Increased groundwater recharge**, waterlogging, soil salinity

Although fairly high irrigation efficiencies of 70% or more (i.e. losses of 30% or less) can occur with sophisticated techniques like sprinkler irrigation and drip irrigation, or by well managed surface irrigation, in practice the losses are commonly in the order of 40% to 60%.

(2) **Rising water tables**

Increased storage of groundwater that may be used for irrigation, municipal, household and drinking water by pumping from wells causes waterlogging and drainage problems in villages, agricultural lands, and along roads - with mostly negative consequences. The increased level of the water table can lead to reduced agricultural production.
shallow water tables - a sign that the aquifer is unable to cope with the groundwater recharge stemming from the deep percolation losses
where water tables are shallow, the irrigation applications are reduced. As a result, the soil is no longer leached and soil salinity problems develop.

Stagnant water tables at the soil surface are known to increase the incidence of water-borne diseases like malaria, filariasis, yellow fever, dengue, and schistosomiasis in many areas

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Mitigation

To mitigate the adverse effects of shallow water tables and soil salinization, some form of watertable control, soil salinity control, drainage and drainage system is needed

As drainage water moves through the soil profile it may dissolve nutrients (either fertilizer-based or naturally occurring) such as nitrates, leading to a buildup of those nutrients in the ground-water aquifer. High nitrate levels in drinking water can be harmful to humans, particularly infants under 6 months, where it is linked to "blue-baby syndrome"

(3) **Reduced downstream river water quality :**

Owing to drainage of surface and groundwater in the project area, which waters may be salinized and polluted by agricultural chemicals like biocides and fertilizers, the quality of the river water below the project area can deteriorate, which makes it less fit for industrial, municipal and household use. It may lead to reduced public health.

Polluted river water entering the sea may adversely affect the ecology along the sea shore

The natural build up of sediments can reduce downstream river flows due to the installation of irrigation systems. Sedimentation is an essential part of the ecosystem that requires the natural flux of the river flow. This natural cycle of sediment dispersion replenishes the nutrients in the soil, that will in turn, determine the livelihood of the plants and animals that rely on the sediments carried downstream. The benefits of heavy deposits of sedimentation can be seen in large rivers like the **Nile River**. The sediment from the delta has built up to form a giant aquifer during flood season, and retains water in the wetlands. The wetlands that are created and sustained due to built up sediment at the basin of the river is a habitat for numerous species of birds However, heavy sedimentation can reduce downstream river water quality and can exacerbate floods up stream. This has been known to happen in the Sanmenxia reservoir in China.

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(4) **Effect on downstream water users:**

Downstream water users often have no legal water rights and may fall victim of the development of irrigation.

Pastoralists and nomadic tribes may find their land and water resources blocked by new irrigation developments without having a legal recourse.

Flood-recession cropping may be seriously affected by the upstream interception of river water for irrigation purposes.

After the closure of the Kainji dam, Nigeria, 50 to 70 per cent of the downstream area of flood-recession cropping was lost.

(5) **Lost land use opportunities:**

Irrigation projects may reduce the fishing opportunities of the original population and the grazing opportunities for cattle. The livestock pressure on the remaining lands may increase considerably, because the traditional pastoralist tribes will have to find their subsistence and existence elsewhere, overgrazing may increase, followed by serious soil erosion and the loss of natural resources.

(6) **Groundwater mining with wells, land subsidence:**

Flooding as a consequence of land subsidence

When more groundwater is pumped from wells than replenished, storage of water in the aquifer is being mined and the use of that water is no longer sustainable. As levels fail, it becomes more difficult to extract water and pumps will struggle to maintain the design flowrate and consume more energy per unit of water. Eventually it may become so difficult to extract groundwater that farmers may be forced to abandon irrigated agriculture. Some notable examples include:

The hundreds of tubewells installed in the state of Uttar Pradesh, India, with World Bank funding have operating periods of 1.4 to 4.7 hours/day, whereas they were designed to operate 16 hours/day

(7) **Reduced downstream drainage and groundwater quality:**

The downstream drainage water quality may deteriorate owing to leaching of salts, nutrients, herbicides and pesticides with high salinity and alkalinity. There is threat of soils converting into saline or alkali soils. This may negatively affect the health of the population at the tail-end of the river basin and downstream of the irrigation scheme, as well as the ecological balance.

The **Aral Sea**, for example, is seriously polluted by drainage water. The downstream quality of the groundwater may deteriorate in a similar way as the downstream drainage water and have similar consequences

Mitigation of adverse effects

Irrigation can have a variety of negative impacts on ecology and socioeconomy, which may be mitigated in a number of ways. These include siting the irrigation project in a location which minimises negative impacts. The efficiency of existing projects can be improved and existing degraded croplands can be improved rather than establishing a new irrigation project

Developing small-scale, individually owned irrigation systems as an alternative to large-scale, publicly owned and managed schemes The use of sprinkler irrigation and micro-irrigation systems decrease the risk of water logging and erosion.