RESEARCHERID
THOMSON REUTERS
[Gupta, 4(9): September 2017] ISSN 2348 – 8034
DOI- Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

ENVIRONMENTAL ASPECTS OF HYDROPOWERS

Subrat Gupta[*1], Nitin Mishra[2] & Sanjeev Kumar[3]
[*1]U.G.Student, Dept. of Civil Engineering, Graphic Era University, Dehradun
[2]Assistant Professor, Dept. of Civil Engineering, Graphic Era University, Dehradun
[3]Professor, Dept. of Civil Engineering, Graphic Era University, Dehradun

ABSTRACT

Hydropower is the most efficient way to generate electricity. Hydro power does not contaminate the air or the water. Modern hydro power turbines are capable of converting maximum of 90% of the available energy into electricity. However, facilities given by hydropower can have huge ecological effects by changing and influencing land utilize, regular natural surroundings, water quality and homes in the dam area. The objective of this paper is to give a overview on various environmental aspects by hydropower plants. These large structures may affect ecosystem, obstruct fish migration and affect their populations, change the water temperature and the waterway's stream. Building dams may also require relocating people. Greenhouse gases, may likewise form in a few reservoirs and be transmitted to the environment. Quality of the water discharged from turbines and especially by the low dissolved oxygen level that may have an unfavourable impact over environment and can endanger the aquatic life

I. INTRODUCTION

Hydropower energy is one of the most renewable and economic energy with low running cost. In hydroelectric power, water falling because of gravity making dynamic vitality to be changed over into mechanical vitality, which thusly is changed over into electrical power through turbines.(Castaldi, Duane, et al.)

Hydropower is electric power produced by consuming the energy of streaming water, precipitation and melting snow which originate from mountains, create streams that are running to the ocean. Today hydropower has turned into the least expensive approach to create power. That is on the grounds that once a dam has been developed and the hardware is introduced, the vitality source that is the streaming water is costless. It is a perfect source of fuel that is re-useable yearly by precipitation and snow. Hydropower is likewise promptly accessible; engineers can control the stream of water with the help of dams and turbines to create power based on requirement. Furthermore, reservoirs may offer recreational open doors, for example, jumping and drifting. Today many countries are looking hydropower as a way to their future development.

Hydro power comprising of significant parts like dam, canal, intake, fore bay, desander basin, penstock, tail race, powerhouse, transmission line and so forth is the fundamental wellspring of electrical vitality. The hydro power is a green one if some measures for protecting the environment are taken when a new power plant is built. In the sustainable development context, the ecological degradation of the rivers when implementing a power plant is not accepted. The amount of water stored and amount of area covered have great impact on the natural habitats and living beings. The quality of the water released from hydropower plants have high impact on the aquatic habitat which are continuous concern for a hydropower project. The paper aims at the various aspects which have impacts on environment due to hydropower.

II. LAND USAGE

The area of the reservoir occupied by a hydropower project can change broadly, depending to a great extent on the topography of the land and the span of the hydropower generators. Hydroelectric plants in level ranges have a tendency to require considerably more land than those in high terrain whereas deeper reservoirs in hilly terrain

whereas deeper reservoirs in high region can store more capacity of water in a less area. The physical condition is influenced rather essentially by development of hydro power stations. Both stream and biological system of the encompassing area zone will be changed when dam development starts. Once the obstruction is set up, the free stream of water will stop and water will start to amass behind the new reservoir. The same land may have been utilized for various purposes, for example, horticulture, ranger service, and even living arrangements, yet it is presently unusable. The loss of territory may not appear to be serious but rather if this region was home to a debilitated.(Castaldi, Duane, et al.)

For a hydropower or reservoir project, flooding land has an outrageous ecological effect as it demolishes wildlife life living space, horticultural land, forest, and grand grounds.[5] One of the primary components of Land Administration is land use which plays very crucial role for the environment sustainability of the and hydropower projects itself. Upstream land use affects water quality and quantity, quality such as sediment levels and flow rate, for example requiring controls during clearance of land. Downstream land must be available for the pipes, powerhouse, access plants and electricity lines.

In many occurrences, for example, In China, the Three Gorges Dam, whole community have additionally must be moved to clear a path for the reservoir. Due to the development of dams around 400,000 km of land area in the world has been sub-merged because of the (A report by Mohit Sanguri,2013).

Forest land that is known for 4193.813 ha. was occupied for development of Tehri Dam Project and in the downstream of Tehri Project i.e Koteshwar Project. This forest area incorporated the land utilized as a part of development of Project, land utilized as a part of Project and resettlement provinces and filling of reservoir. Also against this, Project has finished the compensatory destruction of forest in an range of 4586.07 ha. in Lalitpur and Jhansi District. Also, for 1358.20 ha. forestland occupied in second stage for rustic resettlement, the compensatory afforestation has been done in an area of 2716.40 ha. of debased timberland place that is known for Khanpur woodland run in Haridwar District. (Water for Welfare Secretariat IITR Feb.2008).

During the development of Tehri dam entire Tehri town and 109 villages were influenced and the inhabitants were to abandon their hereditary homes and horticultural fields, in spite of the fact that a plan was pepared, to resettle these individuals, with the thought to enhance their expectation for everyday comforts, keeping their social bonds in place however a resettlement prompts a high aggravation and expands the cost of the project.(S.C.Sharma)

III. WILDLIFE

In plain basins, large dams cause floods in extensive range of land, obliterating nearby creatures and their environments. Dammed stores are utilized for numerous reasons, for example, flood control, farming water system and diversion, so all wild life affects are not related with dams can be specifically allocated to hydro power. Be that as it may, hydroelectric facilities can in any case majorly affect oceanic biological systems. There can likewise wildlife affects both downstream from the facility and inside the dammed reservoirs, aside from direct contact. Storage water is typically more dormant than ordinary river water. Thus the amounts of sediments and nutrients will be greater in reservoir as compared to normal conditions, which can develop an overabundance of green growth and many more oceanic weeds. The weeds developed can swarm out other river creature and vegetation, which ought to be controlled by presenting fish that eat these plants or through manual gathering. Also, in dammed reservoirs water misfortune through vanishing is considerably higher as compared to flowing rivers.

Additionally, the portions of the stream downstream from the repository dry out when an excessive amount of water is stored behind the dam. In this manner, maximum hydropower reservoir administrators are needed to discharge a base measure of water at specific circumstances yearly. In the event that a specific measure of water is not discharged properly, water levels downstream will drop and accordingly it will hurt creature and vegetation. Likewise, reservoir water generally low in DO and much colder as compared to typical stream river water. At the point when it is discharged, it may adversely affect downstream plants and creatures. In this manner to moderate

these effects, circulating air through turbines can be introduced for increment of DO and multi-level water admissions may help to guarantee that the water discharged from the store originates from all the levels of reservoir, instead of just its bottom, as bottom most water is coolest and has the least amount dissolved oxygen.

IV. WATER QUALITY

The hydraulic energy is a *green* one if measures for protecting the environment are taken when new power plants are built. The water quality, especially the amount of dissolved oxygen, is part of these measures. The *fish friendly* concept became a necessity for a continuous development of the hydraulic energy field. In the sustainable development context, the ecological degradation of the rivers when implementing a power plant is not accepted. For high heads, with intakes arranged at the base of the reservoir, the water is low oxygenated; besides, when water goes through the turbine the amount of dissolved oxygen is reducing.

Diverse techniques for upgrading the amount of disintegrated oxygen(DO) in the hydropower plants releases have been tested at international level. Until now, the air volume injected inside the turbine was considered the main parameter affecting the aeration efficiency.

The hydro plants water intake is generally located at the bottom of the reservoir. In this area, especially during the hot summer months, the water is depleted in oxygen; by passing through turbines, the DO amount diminishes furthermore if no aeration systems are implemented. (Florentina Bunea, et al.)

V. GREENHOUSE GASES AND GLOBAL WARMING EMISSIONS

A lot of vegetation are submerged and without oxygen they decay anaerobically creating greenhouse gases such as methane etc. It has been assessed that a hydro power plant produce 3.5 times the measure of greenhouse gases in comparison to thermal power plant which use to burn fossil fuels .

Emission of global warming mainly occurs during the establishment and dismantling of hydro power plants. However a portion of the current research proposes that the emissions during the operation of facility's can be critical. These emission fluctuate significantly relying upon the topography of the land that was overflowed by the reservoir and the size of the reservoir.

Carbon dioxide emitted by small run-of-the-river plants is in the vicinity of 0.01 and 0.03 pounds proportional for each kilowatt-hour. Emanations of life cycle from large hydropower project worked in semi-arid areas are additionally unobtrusive, i.e roughly it is 0.06 pounds of CO_2 proportionate per kwh. In tropical territories estimates for life-cycle global warming outflows from hydropower plants are essentially higher. The vegetation and soil submerged in these regions breaks down and emits both CO_2 and methane, after the area is flooded. The correct measure of emission depends significantly on location particular qualities. According to current evaluations recommend that life-cycle emissions can be more than 0.5 pounds of CO_2 proportional per Kwh.

VI. CHANGES IN THE ECOSYSTEM

Some specific ecosystem affects caused by a hydropower project majorly depend upon the following factors:

1) Flow rate and size of the river where the project is located.
2) Existing habitat and climatic conditions.
3) Size, type, design and operation of the project.
4) Cumulative impact because of the other projects located to its upstream or downstream.

The initial two factors depends on geographic, geologic and climate conditions. Engineers typically determine the size, type, design, and operation of a project based on these natural dynamics. The two common hydropower facilities are run of the river projects and storage projects.

When the requirement for electricity is high the storage projects hold water in a reservoir to change the pattern of river's natural flow and to release water. However, water falling from larger height over a turbine produces more energy than from lower height falling water. This tallness is known as "head" .Thus, hydropower plants produces the most power have the largest reservoirs and the tallest dams.

Run of the river projects permits water to go about a similar rate that the river is flowing.
For most of the part, the water level upstream of the project is genuinely steady, with every day vacillations restricted to just 3 to 5 feet at the biggest activities. These are the biological system changes that may occur because of the presence of storage or run of the river projects.

VII. STRATIFICATION

When storage projects are to be built reservoirs are made. These reservoirs can slowdown the rate of the water streaming to d/s. Slower moving or slack water absorbs heat from the sun therefore it increases the surface temperature. Due to higher density, colder water starts sinking towards the bottom. Now this causes a layering effect which is known as stratification. Therefore the top layer becomes hottest and base layer becomes coldest.

At the point when stratification happens, there is likewise a ecosystem impact i.e the colder water with decreased oxygen levels sinks toward the bottom. Moreover, at some sites when water is discharged towards downstream then the habitat conditions changes because of the reduced oxygen level present in the water.

VIII. SUPER SATURATION

One of the main ecological risks due to construction of high dam for fish living downstream of dams is the effect of total dissolved gas (TDG) i.e super saturation (J Zhejiang) . Super saturation happens when turbulence is made because of the catching of air in water overflowed a dam as it hits the pool beneath. As 78% of air consists of nitrogen, therefore the level of nitrogen dissolved in the water can increase dramatically and the affected water does not lose the excess nitrogen quickly. This supersaturated water can enter tissues of fish and other species. If a fish swims to a lower pressure area from an area supersaturated with nitrogen, a condition of decompression sickness similar as "the bends" in scuba diving can occur. This effect can causes injury and even cause death of fish.

IX. CHANGING OF WATER LEVELS

Construction of a storage project can raise the water level behind a dam from a couple of feet to a few hundred feet. Inundation occurs at the point when stream banks and riparian territories wind up plainly secured by the reservoir's higher water level. Environment conditions changes and a new equilibrium rises. As this happens, an alternate arrangement of dynamics begin affecting species that traditionally grow, nest, feed, or spawn in these areas.

Once constructed, storage projects raise and lower the level of water in a reservoir on a every day, week by week or regular premise to deliver power. The process of "power peaking" happens when, for example, more water is discharged in the morning since power requests increment as individuals wake up and start scrubbing down, utilizing kitchen machines, and so forth. In a riparian zone, this may bring about shoreline vegetation not being adequately restablished.

X. SEDIMENTATION

The reservoir that has been quickly topping off with water instantly starts topping off with residue also. Clearly when more silt fill in the base of the store, the utilization of reservoir is hindered by silt sedimentation and less water can be put away. Less power is produced as the reservoir's ability contracts which is a designing issue with sedimentation. Clean water stripped of its silt load is streams downstream of the dam. This perfect water has more constrain and speed then water conveying a high silt load and along these lines disintegration of the river bed and banks becomes an issue. As it is not natural and is a form of "forced erosion" it happens at a significantly quicker

rate than caused by natural river process to which the nearby biological community would have the capacity to adjust. (Castaldi, Duane, et al.)

Additionally, small rocks can be caught behind a dam in an indistinguishable path from sediment. Spawning areas for fish, important habitat conditions can be affected where movement of gravel is a part of their habitat.

XI. EROSION

One of the issue the sedimentation creates is disintegration of the delta at the mouth of the river(Castaldi, Duane, et al.). Accelerated soil disintegration is a serious issue around the world, with high financial and environmental effects on account of its magnitude, rate, extent and complex procedures. Various human-induced activities, for example, mining, development, and agricultural activities, disturb land surfaces, consequently bringing erosion. Different issues brought on by soil disintegration incorporate loss of soil supplements, declining crop yields, diminishment in soil efficiency . Besides, soil moved by disintegration conveys supplements, pesticides and other destructive farm chemicals into waterways, streams, and ground water resources and subsequently, shielding soils from disintegration is important to maintain human life (Florentina Bunea, et al.). Water level changes and an absence of stream side vegetation can likewise prompt expanded disintegration. This can bring about more extent transformation to a riparian zone and the species supported by it. Increments in disintegration can likewise build the amount of sedimentation behind a dam.

Water streaming rivers carry sediments and silt disintegrated from the rocks and soils. Dams and reservoirs trap some sediments, particularly cobbles and heavy gravels, and hence keep the downstream flow of its normal sediment load. More than 90 percent, and sometimes almost 100 per cent, of approaching sediment is trapped in case of large reservoirs and dams which do not have low level outlets. The clear water underneath a dam is called as 'hungry': it will look to recover its sediment load by dissolving the quaint little inn of the stream. The residue got by this hungry stream might be deposited downstream further, and disintegration of the riverbed underneath the dam will then supplanted by its raising further downstream.

After sometime all the effectively erodible material on the riverbed beneath the dam will eventually be removed, and the bed will become "armoured" with rocks. A shielded riverbed underneath a dam does not have the gravels required for producing of fish, for example, salmon and as living space for river-bottom invertebrate, for example, molluscs ,insects and shellfish. These animals are a critical sustenance hotspot for fish and waterfowl. In the mean time channel aggradation may likewise diminish the territory of gravels by covering them in sediment. (Patrick McCully)

XII. EARTHQUAKE

Among all, the most debated and less studied physical effects of dam development is the likelihood of generating quakes. Seismic action can be ascribed to the making of reservoir and their nearby stockpiling reservoirs, according to few researchers. According to the theory additional powers of the dam along non active faults appear to free considerably more grounded orogenic tensions. Early research demonstrates that the profundity of the water section might be more essential to actuating tremors rather than aggregate volume of water in the reservoir. While more research is required regarding this matter a few catastrophes, for example, the Koyna Dam in India appear to give some truth to this hypothesis. (Castaldi, Duane, et al.)

The dam has withstood numerous earthquakes in the recent past, including the staggering 1967 Koynanagar seismic tremor, bringing about the dam building up a few breaks. After the catastrophe grouting of the cracks was finished. Additionally inward gaps were penetrated to calm the hydrostatic weights in the body of the dam. Indian logical foundation has figured a driven venture to bore a profound borehole in the district and strongly concentrate the seismic tremor movement. This would help in better understanding and conceivable figure of seismic tremors. The proposition is to penetrate up to 7 km and study the physical, topographical and chemical processes and properties of the reservoir activated seismic tremor zone progressively.

ISSN 2348 – 8034
Impact Factor- 4.022

XIII. CONCLUSION

Hydropower Setup leads to both good and bad aspects. Hydropower becomes a cheapest form of electricity. Although it leads to flooding and clearance of large amount of area, resettlement of colonies which largely affects the local communities near the sites. Building of reservoirs in hilly region is a way to conserve natural form of energy. Therefore hydropower becomes the best form for generating electricity and reservoir becomes the best form for saving natural resource i.e water and using it irrigation and other purposes when these large structures built under taking care of nature and environment.

REFERENCES

1. *Berhanu F. Alemaw, et al. (2013) "Journal of Water Resource and Protection", Vol.5 No.12, 1127-1131, December2013, http://dx.doi.org/10.4236/jwarp.2013.512118*
2. *Castaldi, Duane, et al. "A study of hydroelectric power: from a global perspective to a local application." The Pennsylvania State University, The Pennsylvania State University (2003)*
3. *Florentina Bunea, et al." Hydropower Impact On Water Quality", November 2010, Vol.9, No. 11, 1459-1464, http://omicron.ch.tuiasi.ro/EEMJ*
4. *J Zhejiang , "Effect of total dissolved gas supersaturated water on early life of David's schizothoracin", Journals of Zhejiang University Science B, 2013 Jul; 14(7): 632–639. DOI: 10.1631/jzus.B1200364, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3709068*
5. *Patrick McCully, Silenced Rivers: The Ecology and Politics of Large Dams, https://www.internationalrivers.org/dams-and-geology*
6. *S.C.Sharma, Former General Manager,THDC Ltd., "Effects (Impacts) Of Tehri Dam"*
7. *Water for Welfare Secretariat IIT Roorkee, "Impact Of Tehri Dam Lessons Learnt", February 2008*
8. *http://fwee.org/environment/howahydroelectricprojectcanaffectariver/howahydroprojectaffectsariverprint*
9. *http://www.emedicinehealth.com/decompression_syndromes_the_bends/article_em.htmscuba*
10. *http://environment.nationalgeographic.com/environment/global-warming/hydropowerprofile*
11. *http://www.thehindubusinessline.com/economy/economy/article1559091.ece*
12. *http://www.ucsusa.org/clean_energy*
13. *http://www.wvic.com/Content/Facts_About_Hydropower.cfm*
14. *https://en.wikipedia.org/wiki/Koyna_Dam.*