Trans. Inst. Indian
Geographers

Environmental and Socio-Economic Impacts of the Khoupum Dam Project, Manipur

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Abstract

Construction of dams and reservoirs are to simply supply water for several proposes. However, adverse environmental and socio-economic impacts have been realized after construction of such many structures. The reservoir water spill out into the surrounding environment, this can lead to change the land use system of any region. Whether the dam projects are ultimately beneficial or determental to either the environment or surrounding human populations has been debated since the 1960s. There has been increasing recognition by both dam proponents and dam opponents that the social and environmental impacts of dams are complex, and can be far-reaching. The impacts can be positive or negative which can affect the environment and the socio economic life of the people of both upstream and downstream communities. In the same way Khoupum Dam Project, constructed in 1978, first dam in north-east India, giving trauma to the people of the region. Hence the present paper is attempted to find out the positive and negative impacts induces by the dam to the environment and socio economic life of surrounding communities and balance the positive and negative impacts and suggest for the future use of the dam.

Keywords: *Khoupum, dam, upstream, downstream, positive and negative impacts.*

Introduction

Khoupum Dam Project was constructed in 1978, during sixth plan under the Irrigation and Flood Control Department of the Government of Manipur with an outlay of Rs. 296 lakhs. This is the first dam in north-east India which is constructed in the hill areas. The project comprises of an Earth Dam of 17 meters height and around 600 square meter across the Mengchean River, tributary to Irang River, in Manipur. The dam is situated in south eastern part of the Khoupum Valley with a latitude 24°41' north and 93° 33' east longitude which is 85 km away from Imphal, the capital of Manipur passed through the Tongjeimaril (Old Cachar Road). For running the project, the waters streaming down the hill slope are collected in an artificial lake. The main purpose of the project is to provide irrigation water to the rain fed agricultural land of 800 hectares in the valley. It is also to practice double or triple cropping under the programme of Green Revolution. The project is also to encourage the local people to rear fish in the lake as additional source of sustenance to the villagers.

According to the World Commission on Dam, "dams have made an important and significant contribution to human development, and benefits derived from them have been considerable … in too many cases an unacceptable and often unnecessary price has been paid to secure

those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers and by the natural environment." Applying a "balance-sheet" approach to assess the costs and benefits of dams that trades off one group's loss with another's gain is seen as unacceptable, particularly given existing commitments to human rights and sustainable development. The WCD's final report provides ample evidence that dams have failed to produce as much electricity, provide as much water, or control as much flood damage as their supporters originally predicted. In addition, these projects regularly suffer major cost overruns and time delays. Furthermore, the report found that: dams have forced people from their homes and lands, with impacts including extreme economic hardship, community disintegration, and an increase in mental and physical health problems. Indigenous, tribal, and peasant communities have suffered disproportionately. People living downstream of dams have also suffered from water-borne diseases and the loss of natural resources upon which their livelihoods depended. Large dams cause great environmental damage, including the extinction of many fish and other aquatic species, huge losses of forest, wetlands and farmland. The benefits of large dams have largely gone to the rich while the poor have borne the costs. (Aviva Imhof, Susanne Wong and Petter Bosshard 2000).

Objectives

- To find out the positive and negative impacts of the dam
- To analyze the hydrological characteristic of the valley
- To investigate the purpose and processes involved in the choice and construction of the dams in the valley.
- To evaluate the socio-economic and ecological conditions of the villagers.

Methodology

The study area is taken out from the Survey of India, Topographical Map No 83 H/6 and 83H/10 with a scale of 1:50,000 and coupled with Google Earth Image of 2010 and all the maps are prepare after proper ground verification and delineated the thematic boundaries according to the purposes. The areas of different categories are measured with the help digital planimeter. Most of the data are acquired through field survey and observation. After acquiring the relevant data, comparative analysis was carried out to find the positive and negative impacts of the Khoupum Dam Project and comparing the socio- economic and environmental condition of the valley

Impacts On The Upstream Areas

The damming of a river creates a reservoir upstream from the dam. The reservoir waters spill out into the surrounding environments, flooding the natural habitats that existed before the dam's construction. To date, over 400,000 km^2 of the earth have been flooded due to damming. (WCD) The newly created reservoir has more surface area than the river would have had, and therefore more evaporation occurs than is normal. This can lead to a loss of up to 2.1 meters in depth per year. According to arguments of hydropower opponents, reservoirs contribute to greenhouse gas emissions as well.

Khoupum dam also creates a reservoir at the confluent point of the three upstream:

Mengcheanthok, Duichungthok and Phego Pang. In the process, 60 hectares of cultivable land were submerged under the dam. As a result 40 % of the people settling above the dam have lost their permanent agricultural land. Due to this factor, they start clearing the forest for shifting cultivation in catchment areas which is about 24 squares kilometer. This shifting cultivation steadily clearing the forest leads to depletion of vegetation cover and land degradation.

People living above the dams are depended their livelihood on forest which accelerated the rate of deforestation from day by day due to their increasing population. Because of decreasing forest cover, the rate of soil erosion through landslide rain splash, rain wash, rill erosion becoming higher. Thus, increasing surface run off and reduced water channel capacity of the river valley due to siltation. Increasing suspended load of the rivers resulting in gradual rise of the river bed. As a result, the paddy field adjacent to the main three rivers are frequently covered by pebbles and boulders turn the agriculture land into stoned field and become unproductive areas. Number of beautiful spring and fountain in the foothill are dried up quickly, before they were the sources of water for terrace cultivation in hill slope. In some areas, the fertility of the soil is decreasing tremendously resulting in low production. So in order to sustain their life, they start using chemical fertilizer and pesticide ever in the jhuming field which cause chain reaction to the life of animals, birds, reptile and micro-organism. Hence, the varieties of animals and birds, such as, Otter, Talpa Europaea, Hornbill, Fox, ete. are vanished away from the region.

There is also high rate of siltation in the dam itself, according to the observation in 2007; the sediment filled dam is around one-third of the total areas within a span of three decades (1978-2007). If the presence trend of erosion and siltation continued, the dam will be completely filled by the sediment within next six decades.

From the above factors, the people living around the dam are socio-economically poorer than the other villagers in the valley. Their alternative sources of living are depended on fishing in the dam. But the amount of fish catch in a year per family is very low which cannot support the entire family members. In addition to this hardship, sometimes the government of Manipur had given the dam for private ownership. As a result, the people of Taolingpung, Tangkonjang, and Taosemjang who were earlier earning their livelihood through fishing activities from the lake has been disallowed by the government after introducing lease to the private society. So, all the high hope and expectation of the people from the dam has been belied.

Impacts in the Downstream River Channel and River Margin Communities

As the dam is constructed there is sudden change in the both natural hydrological and geomorphological processes which in turn reduced the sediment in the downstream and the Mengchean River become "hungry" for sediment. Because the rate of deposition of sediment is greatly reduced since there is less to deposit but the rate of erosion remains nearly constant, the water flow eats away at the river shores and riverbed, threatening ecosystems, deepening the riverbed, and narrowing the river over time. This leads to a compromised water table, reduced water levels, and homogenization of the river flow

and thus reduced ecosystem variability and reduced support for aquatic organism. As a result, the fertility of agricultural field below the dam becomes decreasing and lesser in production. Because of all these impacts, the agricultural communities below the dam start using chemical fertilizer, pesticide and High Yielding Variety of seeds which are greatly effects to the aquatic ecosystem. Before the construction of Khoupum Dam, the fertility of the valley was regain by the flood water, hence they never use chemical fertilizer, pesticides and High Yielding Variety of Seed, rather they used tradition crops which are eco-friendly to the environment.

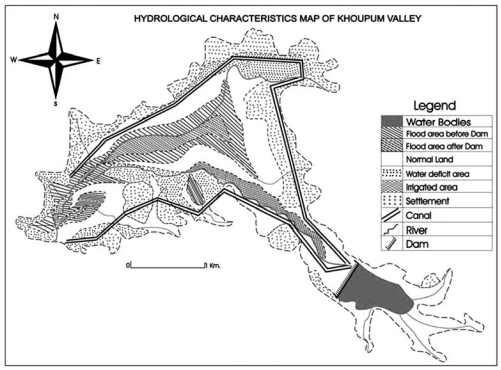


Table 1: Hydrological Characteristic of the Khoupum Valley

Land categories	Areas in hectares	Percentage
Areas under flood before dam	200	23.5%
Areas under flood after dam	90	10.5%
Net irrigated areas	50	5.8%
Water deficit/fallow land	200	23.5%
Normal land*	250	29.4%
Under water	60	7%

* Normal land means the areas which are neither flooded nor using irrigated water for cultivation

Source: personal field survey

Hydrological condition of the valley before dam was normal, only few areas of swampy areas are under water during the growing season; all the net growing areas were cultivated without deficiency of water and no land under fallow. But after the banding of water by the dam, the hydrologic condition of the valley was completely altered; it reduces the area of flood from 200 hectares to 90 hectares which is only 10.5 % of the net total growing areas and the valley experienced deficiency of water for cultivation especially the areas adjacent to the Mengchean River and surrounding foothill. According to the field observation, 200 hectares which is 23.5% of the areas are now under water deficit and fallow land. Such areas are still in increasing trend which result the net sown areas are declining. The Khoupum Dam Project which was sorely constructed for irrigation purpose is being provided water only 50 hectares of agricultural land which is lesser than the areas (60hectares) submerged by the Dam. Now only 29.4% of the cultivable lands are under normal lands which remain as a remnant before the construction of the dam. From these above point of view, Irrigation and Flood Control Department, Government of Manipur had poor assessment of hydraulic condition of the valley because the region received above 400 cm of rainfall annually, this amount is sufficient to carry out all types of agricultural activities besides the government failed to estimate the height of water level of the dam and the areas suppose to received irrigation water. Since the level of dam water is lower than the purpose irrigated land, the left canal is unable to flow water even on the day of inauguration, but to some extend the right canal served the purposed. On the day of inauguration in 1978-1980 the net irrigated areas were

about 64 hectares, which was reduced to only 50 hectares in 1990s. Around 2000 the Khoupum Dam which was constructed sorely for irrigation became failed because all the canals were degraded and unable to flow the water to the agricultural fields. Now only two distributaries supply water with an area of 34 hectares only.

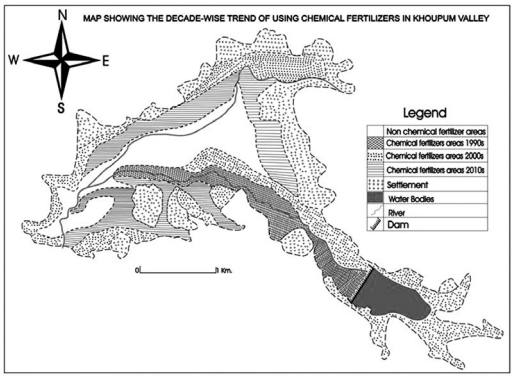
Geomorrphologically, dams alter two critical elements of the geomorphic system: the ability of the river to transport sediment and the amount of sediment available for transport. If the transport capacity exceeds the available supply, a sediment deficit exists and the channel can be expected to evacuate sediment from its bed and/or banks. If the transport capacity is less than the available sediment supply, then the channel can be expected to accumulate sediment. There are many adjustable attributes of a channel—its cross-section, bed material, platform, and gradient—and the response of a channel to sediment deficit or surplus varies. [Gordon E. Grant, John C. Schmidt, Sarah L. Lewss, 2003]. Typical downstream responses can include channel bed degradation or incision, textural changes such as coarsening or fining of surface grain-size distributions, and lateral adjustments, including both expansion and contraction of channel width. Geomorrphologically, after the impounding of dams, the ability of the river to transport sediment is exceeds the available supply of sediment. As a result there is active vertical erosion in the bed of the downstream rivers mainly the Meachean River. The volume of the water and load of sediment carried were also decreased to some extent and, lowering the water table adjacent to the river. Because of all these geomorphologic factors, the frequency and flood prone areas are minimized from 200 to 90 hectares.

Agriculturally, after the creation of lake, the net sown areas has increased to some extent due to drying up of swampy areas because of the restriction of natural flow of water in the downstream which resulted lowering the frequency of flood but the productivity become decreasing due declined in fertility which were regain by the flood water before the construction of dam. Prior to the dam, the entire valley were cultivated with high yield without using chemical fertilizer and insecticides. As declines in productivity, the farmer used chemical fertilizer in order to meet the increasing population.

Table 2: Decade wise Trend of Using Chemical Fertilizer in Khoupum Valley

Decades	Non-chemical fertilizer areas in hectares	Chemical fertilizer areas in hectares	Percentage of chemical fertilizer areas in hectares
1970s	740	0	0
1980s	732	8	1.08%
1990s	665	75	10.1%
2000	415	325	43.9%
2010	195	545	73.6%

Source: personal field survey



The above table portrays the agricultural activities practiced without using chemical fertilizer and pesticide before the emergence of Khoupum dam project, but after the decade the fertility of valley has declined which was proved by the agricultural productivity data. Around 1980s the farmer start using chemical fertilizer and pesticide in the nursery field which was about 8 hectares. According to the field observation, the first areas using the chemical fertilizer were found adjacent to the Mengchean River just below the dam around 75 hectares within two decades after the dam. Since then the areas under chemical fertilizer and pesticides were increasing more than double in 2000s which goes up to 325 hectares especially in the margin of the valley. In 2010 the area is expanded to 545 hectares which is 73.6% of the entire cultivable land in the valley. At present 195 hectares of land are having good yield without chemical fertilizer which were the swampy region before the embankment of dam. Besides, the areas under deficit of water and fallow land were increasing considerably.

Most resources devoted to identifying the downstream effects of dams on riverine ecosystems are committed to biological studies. We suggest that geomorphic studies directed at ecologically significant features of river morphology and hydraulics may sometimes be more valuable in short-term evaluations associated with the environmental assessment of new dams or the relicensing of existing dams. This is not to say that biological research on such issues as the ecological effects of dams on temperature, fish migrations, and altered flow regimes is not critically important. But we believe that, more often than has been realized, geo-morphological changes are the key to understanding the long-term eco-logical consequences of dams and other stream disturbances. (Franklin K. Ligon, William E. Dietrich, and William J. Trush, 1995)

Ecologically the valley has very rich biodiversity prior to the dam, there were 17 lakes/swamp (most of them were ox-bow lakes), for the habitat of fish, water birds and other small animals. But after the reserving of water by the dam, the water level of the main river became lower, as a result most of these ox-bow lake start shrinking their size and steadily dry up and vulnerable to human interference, and turn into cultivable land. These have tremendously effects to the wet land ecosystem, losing their habitat, and many native species of fish and water fowl were also extinct away.

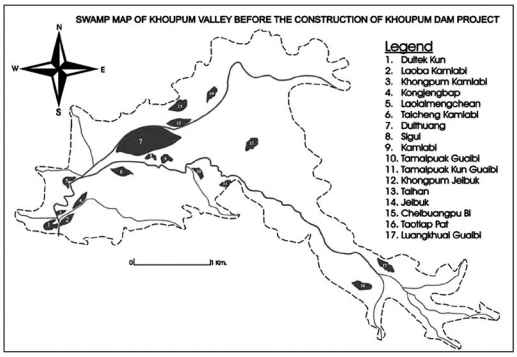


Table 3: Decades Wise Declining Trend of Wetland in Khoupum Valley

Decades	No. of Wetland/Swamps
1970s	17
1980s	12
1990s	5
2000	3
2010	1

Source: personal field survey

From the above table, we came to know that just after the impounding of water in the dam, the declining trend of wetland was very fast which is reduced to only 12 in 1980s, and again only 5 in 1990s. Now in 2010 only one swamp is found in south-western most part of the valley which is also reduced the areas more than half of the origin. Moreover, most of the meandering part of Mengchean river are cut-off by human activities and the river become almost straight which result in accelerating the water velocity, causing higher rate of bed and bank erosion. Hence, all the vegetation on the bank of the rivers is carried away by the water especially during the flood time. Now the river become highly altered, without vegetation, which were the home of birds, fish and other small animals before the construction of Khoupum Dam Project.

Socio-Economic Impacts

The attempt of comparing the social and economic changes as a result of creation of water reservoir in the valley was difficult due to lack of baseline data and documentation. The fact is the dam was constructed before 40 years and local communities did not participated in the planning and implementation process made extremely difficult to obtain social and economic data such as per capital income, and land size of earlier time. The few households who received compensation of the effected villages believed that the amount was very low compared to the economic and environmental damage caused. The main impacts ensured by the dam were the agricultural communities of the valley. As the dam existed there is tremendous effect on hydraulic condition and fertility of the agricultural land. The water level has decreased and the rate of erosion exceeds the rate of sediment deposition on the downstream valley which in turn declining the production. Hence, the farmer is force to use chemical fertilizer and pesticide in order to meet the demand of growing population. As we know, farming communities are very poor as well as uneducated as such they, cannot afford the sufficient and scientific agricultural inputs like fertilizer, pesticides, seeds etc. For instance, many affected farmers do not follow the fertilizer application rate recommended but go for the amount they can afford which accelerated the rate of land degradation. So far, the farming communities have cultivated their field without proper mechanized system. Hence, per acre yield is very low comparing to Imphal valley. Since 90% of the total household of the valley are directly or indirectly engaged in agricultural sector, their socio-economic status has been deprived after the construction of Khoupum dam.

Table 4 : Village Wise Break Up Of Poverty and Landless In the Valley

Name Of The Villages	Total No. Family	No. Of Family Below Poverty Line	Percentage of Below Poverty Line	No. Landless Family in the Valley	Percentage of Land Less Family in the Valley
Tangkongjang*	63	42	66.6%	24	38%
Taolingpung*	68	45	66.1%	21	30.8%
Taosemjang*	38	18	47.3%	15	39.4%
Duithanjang*	84	36	42.8%	24	28%
Thanagong	115	46	40%	21	18%
Gatao	74	17	22.9%	18	24.3%

Gaidimjang	189	34	17.9%	16	8.4%
Lubanglong	123	45	27.6%	34	27.6%
Satudai	156	31	19.8%	8	5.1%
Namgaijang	36	10	27.7%	2	5.5%
Taodaijang	76	15	27.6%	6	7.8%

* Dam affected villages

Source: personal field survey

According to the Economic Survey of Delhi 2001-2002, Below Poverty Line (BPL) can be defined as the people consumption less than 2400 calories per capita per day for rural areas and 2100 calories for urban areas. These calorie norms have been expressed in monetary terms as Rs. 362.68 per capita per *month* for rural and Rs 454.11for urban areas respectively 1990-2000 prices. Based on these criteria the author delineated the BPL in the study area.

Though there is no official socio-economic data of the valley before the construction of the dam, but according to the interview of the 15 persons above the age of 70 years from difference villages, they responded that there was not much economic disparity among the villages. From the table No. 4 we came to know that there is wide economic disparity among the villages. So far, the dam affected villages are found higher percentage of family living Below Poverty Line and Landless in the valley comparing to the other villages in the valley. It is evident that the percentage of the Below Poverty Line of the four dam affected villages is higher than the state average which is 22.30 % (Economic Survey Manipur 2009-2010). From these points of view the Khoupum Dam Project has much impact on the socio-economic life of the valley

In positive point of view, Irrigation and Flood Control Department, Government of Manipur provided few employment and fishing facilities to the villagers.

Table 5: Dam Related Facilities

Name Of The Villages	No. of Employees in Irrigation and Flood Control Department	No. of Fishing Family not less than 50 kg per year
Tangkongjang*	0	15
Taolingpung*	0	25
Taosemjang*	4	6
Duithanjang*	2	4
Thanagong	0	2
Gatao	0	0
Gaidimjang	2	0
Lubanglong	1	3
Satudai	1	0
Namgaijang	0	0
Taodaijang	0	0

Source: personal field survey

From the table No. 5 it is evident that only 10 persons are employed in affected areas of the valley in Irrigation and Flood Control Department, Government of Manipur .Not a single person from the worse affected villages got appointment in the department. Besides this employment, some of the families are earn their livelihood from dam through fishing. So far Taolingpung and Tangkonjang have 25 and 15 families caught more than 50 kilogram in a year and there are some few families from Taosemjang,

Duithanjang, Thanagong and Lubanglong caught above 50 kilogram per year. Apart from these families, there are number of families from every village engage in fishing in the dam during the monsoon season but they caught less than 50 kilogram in a year.

Conclusion

Khoupum Dam Project has both positive and negative impacts on environments, agriculture, social and economic life of the people. But when we balanced the both impacts, the negatives are much more than the positive impacts. The dam provided irrigated water to 50 hectares of land which is lesser than the areas submerged under water by dam (60 hectares). Because of the impounding of water by dam, all the swamps are dried up and turn cultivable land which increase the net sown agricultural areas but it has great effect to the wetland ecosystem and the fertility decrease due to active erosion in the downstream valley, hence the productivity become low and force the farmer to use chemical fertilizers and pesticides which is much impact to the environment and economy of the farming community of the valley. Khoupum Dam Project controls flood to some extent and reduced the flood prone areas from 200 hectares to 90 hectares but the areas under water deficit and fallow land are increased to 200 hectares after the dam. Dam provides fishing facilities to the upstream areas but there is no fish again in the downstream valley. Again dam generate employment but number of families living below poverty line and landless in the valley rose higher than before the dam.

From the above point of view, the construction of Khoupum Dam Project hampers the valley. To regain the hydrological characteristic of the valley, instead of damming the water , it is better to suggest the people to carried out the extensive afforestation in catchment areas which will intercepts the rain water and infiltrated to restore the underground water and regularized the flow of river in the valley as before.

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