

Innovative concept of Hydropower generation- A case study of Sahastrakund Hydro Electric Project

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ABSTRACT

Large numbers of hydro power generation plants are installed at suitable sites in Maharashtra state, India. In many of the cases the main reservoir does not have water with sufficient potential head to create hydro power. In such cases the conventional practice is, to create a fore bay storage reservoir in the nearby valley, in such a way that, high potential head is obtain for hydro power generation. A hydro power plant is installed at the base of designed capacity. The storage capacity of this fore bay reservoir is decided by two days quantum of water required for hydro power generation. As per administratively approved previous planning, 14 villages and 5994 hectors of fertile land were getting submerge under the water spread area of the main reservoir of Sahastrakund Hydro Electric Project and 283 hectors of unfertile land were getting submerge under the consequent fore bay reservoir without any single village under submergence. But the organization "Sahastrakund Sangharsh Samittee" of project affected people strongly opposed the construction of this project as it was a curse to them. Land acquisition of 5994 hectors fertile land along the submerged river bank and rehabilitation of 14 villages, is very tedious and time consuming task. It also requirs lot of funds and needs alternate land for rehabilitation of project affected people. To overcome the problems and the major hurdles, a new innovative and adoptable alternative is planned and designed by the authors and succeeded to reduce the submergence from 6277 to 2570 hector. It also avoided the rehabilitation of all 14 villages along the Penganga river and converted the curse in to worship to them. The rehabilitation is now restricted to only four tiny Groups of hutments are being submerged, under water spread of the fore bay reservoir. These changes are proposed without compromising storage capacity and power generation. The water released after power generation is planned to provide irrigation facility to 24950 hector area. A new concept is also proposed to convey the irrigation water with PVC pipe distribution network and gravity flow Drip irrigation with zero energy to attain equitable water distribution, high water use efficiency, improve water productivity, and alleviate poverty and achieve sustainability in food production. This is major breakthrough in the history of hydropower generation and provides guidelines to the future hydropower generation plants.

River Penganga and Proposal of hydro power Generation

River Penganga is a tributary of river Godavari. Its total length is 673 Km. It rises from Ajanta hill range in Buldana District of Maharashtra , after travelling of 376 Km. from origin it is having a natural big fall of 36.60 meter depth known as "Sahastrakund Fall". The river has U shape turn downstream of this fall. Water head of 120 meter can be made available by joining the ends of the U loop, at u/s of fall. The proposal of utilizing such water head for power generation is stated in a book "Hydro Electric survey of India" written by J.W. Mear.

Previous alternatives and proposals studied to harness this head for Power Generation

Number of alternatives studies are made for so many years but a techno economically feasible solution could not arrived previously. The following difficulties were observed.

- i) The River cross section at the proposed location of dam is wide and depth is very small as compare to the rest part of river. Anticipated reservoir at this location to store the monsoon flow in the river would have very large submergence area. As well as the length of dam would be drastically more.
- ii) A reserved forest & Sanctuary situated on left side bank of river will be submerging.
- iii) Large submergence of fertile land area, Sanctuary and rehabilitation of number of village along the banks of river does not support the above proposal. Hence redundant. The different alternatives are enumerated below.

A) First Proposal (1964)

This detail proposal consisting construction of large dam across River Penganga, 8 km u/s of fall and conveying water across U turn, through a tunnel, in the adjoining valley for power generation in the anticipated power house No.1 & 2 were planned in 1964. This proposal was based at 75% dependable water availability. This was worked out to be 625 Million cubic meter **Mcum** at that time. The Upper Penganga Reservoir at Isapur Village was not existed at that time. Therefore a dam of 968 Mcum of gross capacity was proposed. The catchment area to be tapped in this proposal was 9500 sq.km. This proposal was dropped due to following reasons.

i) Large submergence of forest and private land

2000 Hecter of forest land and 14350 Hecter of private fertile land, 1400 Hectors of government land was coming under submergence. The saucer shape submergence area was major problem but in spite of this site condition, a carry over capacity of 335 Mcum was planned which resulted in aggravating the problem of project affected persons **PAP's**, and Land Acquisition. These were the major hurdles in implementing this proposal.

ii) Rehabilitation of large number of villages

36 full and 5 partially villages needs to be shifted outside submergence. The large population of these village have opposed strongly to this rehabilitation.

iii) Inadeqate Benefits

Project was planned only for power generation, for utilizing head of 120 m. It is not very promising commitment; considering quantum of large submergence and large numbers of village to be rehabilitated. Irrigation benefits were condiered but far away on downstrem side by constructing a seprate diversion weir.

B) II nd Proposal of (2009)

The project is redesigned to remove above mentioned difficulties. The dam site was shifted on further upstream side, outside of forest area so that no forest/ sanctuary would be under submergence. The carry over storage is totally deleted due to construction of Isapur dam on stream side. Storage was restricted to optimum capacity of 254.1 Mcum, even though 75 % dependable yield

is 454 Mcum. This cutback of storage capacity resulted in reduction in number of villages to be rehabilitated. The land to be acquired was significantly reduced to 6277 Hectors from 17750 Hectors. Number of villages to be rehabilitated was also reduced to 14 from 41. Project was planned for irrigation of 9500 hector by utilizing 40 m head. A saddle/fore bay dam of 26.7 Mcum was planned near village Hiramannagar. The conventional practice is keeping storage capacity of fore bay dam as 2 to 3 Mcum. Instead of this the capacity of saddle dam was proposed to store 26.7 Mcum of water. Thus the main dam's storage was kept as 220.4 Mcum only. This project was administratively approved in the year 2009 for Rs.5830 Millions. But the project could not be put into action.

Difficulties arisen in implementation of II proposal

- The Farmers whose Land is required for Submergence opposes the project due to emotional attachment, fear of uproot meant, probable difficulties in getting similar type of land, fear of inadequate compensation etc . Due to increase in population, present Land Holding is converted in to small and marginal. This resulted in increasing number of PAP,s.
- Rehabilitation of 14 villages to new places was also a time consuming, as well as difficult. Previous experiences of rehabilitations have sometimes negative impact. Similar to Land Acquisition the rehabilitation issue also involves same emotional problems.
- Peoples living at a particular place develops a strong attachment to that place hence they does not want to change even if better amenities are provided elsewhere.
- Government has published the proposed Land Acquisition and Rehabilitation bill 2011 on Internet. Vide this bill; various incentives are to be given while acquiring the land for public purposes. This induces high expectations, but could not be attempted till the pass of the act.
- The sudden increase of price of land in recent years and news of heavy compensation offered to project affected persons in Jaitapur Project or compensation offered for lands required for highway or industries etc; resulted in increasing expectations of PAP's about price of land and compensation packages.
- The proposed land acquisition and rehabilitation bill of 2011 is going to increase the cost of this component so heavily that the projects needs recasting to reduce the numbers PAP's and to reduce the land acquisition cost in view of changed scenario.

c III An innovative proposal (2013)

To mitigate the negative impact of rehabilitation and to reduce the quantum of land acquisition a new and innovative concept is proposed by the authors in which traditional concept of making storage on the same water stream is dropped altogether. It is found that a considerable storage can be made in saddle/ fore bay dam by shifting the location of the reservoir to downstream side. In this new and innovative planning overall water storage of main and fore bay dam i.e. (220.46+ 26.70) 254.10 Mcum is kept as planned previously. But its storages capacities are inter changed. The dam on the main stream is proposed to store 33.64 Mcum and the saddle is proposed to store 227.4Mcum of water. This alternative has a very positive impact. The Full Supply Level of dam on the main stream i.e Penganga River is dropped from 385.5m to 379.10m (6.40m) which resulted in reducing the submergence considerable from 5994 hectors to 1651 hectors. This new planning resulted in saving of rehabilitation of all the 14 villages along the Penganga river side as planned in the sanctioned proposal by the Government. The innovative idea does not require rehabilitation of any village hence adoptable to the peoples in the vicinity. The increased storage in saddle dam would be need rehabilitation of four small tiny group of hutments, locally knows as Tanda's. Out of 1651 hectors land now required for dam on the main stream , 470 hectors is land is under the flow of river ie Government land. Thus additional 1181 hectors private land is to be acquiring for dam on the main stream. The additional 1181 hectors private land to be acquired is already comes under flood zone of the river. The High Flood Level **HFL** at this site is 385.5m from MSL and acquisition level is $379.1 + 0.50 = 379.60$ m only from MSL; this far below the HFL . The storages capacity of saddle dam is increased from 26.7 Mcum as planned previously to 220.46 Mcum. This resulted in increasing

submergence area of Saddle Dam from 283 hector to 919 Hectors. Out of this area ,100 hectors of land is already acquired for Ningnur Minor Irrigation Tank and remaining 819 hector is also a barren land with negligible soil cover.

Rehabilitation of 4 tanda's(Small Groups of huts) is comparatively very easy as compare to 14 villages in earlier planning. Thus in this new plan, major saving of land from acquisition and saving of 14 villages form rehabilitation is very positive impact among the PAP's. The care is also taken that even in new planning no forest land needs to be acquired. In this new Planning a head for hydro power is reduced from 80.5 m to 65.70m which resulted in reduction in power generation from 25 Mw to 20 Mw, but saving of land and villages from submergence is important, in view of its destructive effects on PAPs.

Table : 1 The comparison between a 2nd proposal and 3rd proposal is as below .

		As per 2nd proposal 2009			As per 3rd proposal of 2013			
Sr · N o.	Description	Main dam	Saddle Dam	Total	Main dam	Saddle Dam	Total	Remark
1.	Storage Capacity in Mcum	227.4	26.7	254.1	33.64	220.46	254.4	No changing capacity
2.	Land Acquisition	5994 hect.	283 hect .	6277 hect	1651 hect	919 hect	2570 hect	Net Saving in Land Acquisition 3707 Hectors without reduction is storage capacity
3.	Rehabilitation	7 fully + 2 Tanda Fully 5 partly	Nil	7 fully + 2 Tanda Fully 5 partly	Nil	4 Tanda	4 Tanda	Rehabilitation is greatly reduced.
4.	Irrigation area	-	-	9500 hect	-	-	24950 hect	
5.	Evaporation loss	-	-	30.18 Mcum	-	-	12 Mcum	18.18.Mcum Water is saved due to new planned
6.	Installed capacity for hydro power	-	-	25 Mw	-	-	20Mw	Power generation is reduced slightly

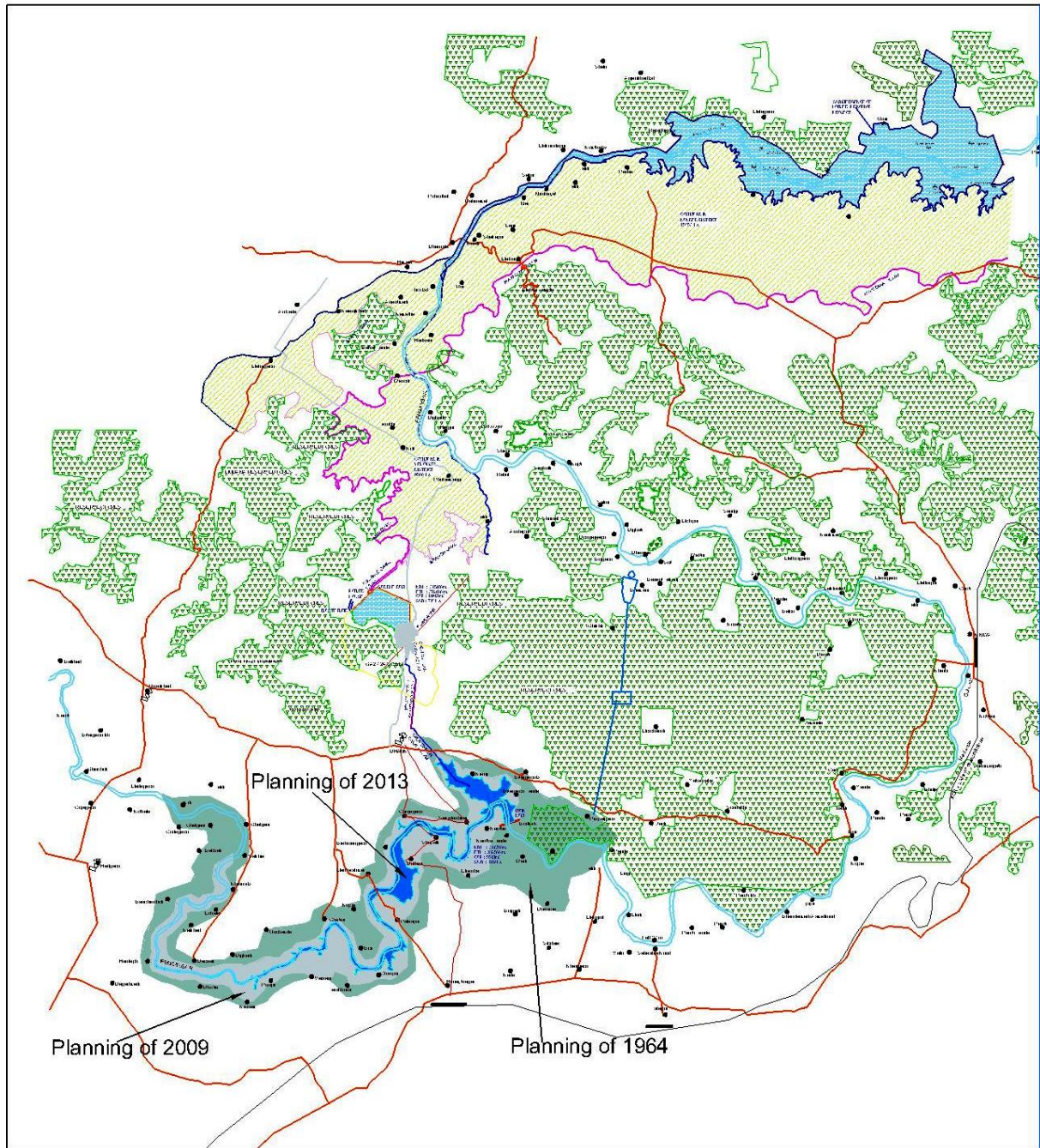


Figure 1. Map showing three alternative plannings of Sahastrakund HEP

Conclusion:

The project planning should be such that there shall be minimum rehabilitation and minimum acquisition Agricultural land. A planner should always think to save land not to be unproductive by making it to submerge under the water spread. The rehabilitation of the affected person should not be consider as to provide sufficient financial assistance and amenities to them, but it should be seen in the angle of their affection to the habitat area and the need of time for food security. The small insufficiency in the amenities may develop conflicts between the PAP's and Government, thus induces time and cost overrun. Saving of the forest and fertile land from submergence is need for early clearance from the environmental angle.