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Rapid Environmental Assessment of Potential Sites for Kohala Hydropower Project

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1. Background of Kohala Hydropower Project

WAPDA (Water and Power Development Authority) under the directive from the Government of Pakistan initiated the feasibility study and detailed engineering design for the Kohala Hydropower Project. The project is located in Muzzaffarabad District of AJK (Azad State of Jammu and Kashmir). The purpose of the project is to enhance the country's capacity of generation of hydropower through the addition of 1100 MW power generation to overcome the country's power shortage due to rapid economic development.

The dam site is near Siran in the upper reaches of River Jhelum around 174 km from Islamabad, while the powerhouse site is located downstream of River Jhelum near the Kohala Bridge at Barsala. The dam and powerhouse will be connected through a tunnel.

The Kohala Hydropower Project was first identified by MONENCO from Canada. Later it was studied by GTZ under comprehensive Planning of Jhelum River Basin. Sixteen alternative dam site locations were identified since 1984 and various studies have been carried out for selecting the appropriate site.

Figure 1. Location of Dam site and tunnel alignment from Google Earth

The contract for Consultancy Services was awarded to the KHC (Kohala Hydro Power Consultants) on 26th June 2007 at a Cost of Rs. 312.467 million for the conduct of the Feasibility study, detailed Engineering Design and Tender Documents within a period of 24 months.

The CWE (China International Water and Electric Corporation) has offered an investment of 1.0 million dollars in Kohala Hydropower Project and has proposed a new dam site near Gahri Dupatta, 6 kms downstream from the initial site at Siran. The CWE has completed 600 projects in 60 countries and it is already working in Pakistan. The PPIB (Private Power Infrastructure Board) has issued LOI to the CWE on 15the January 2009.

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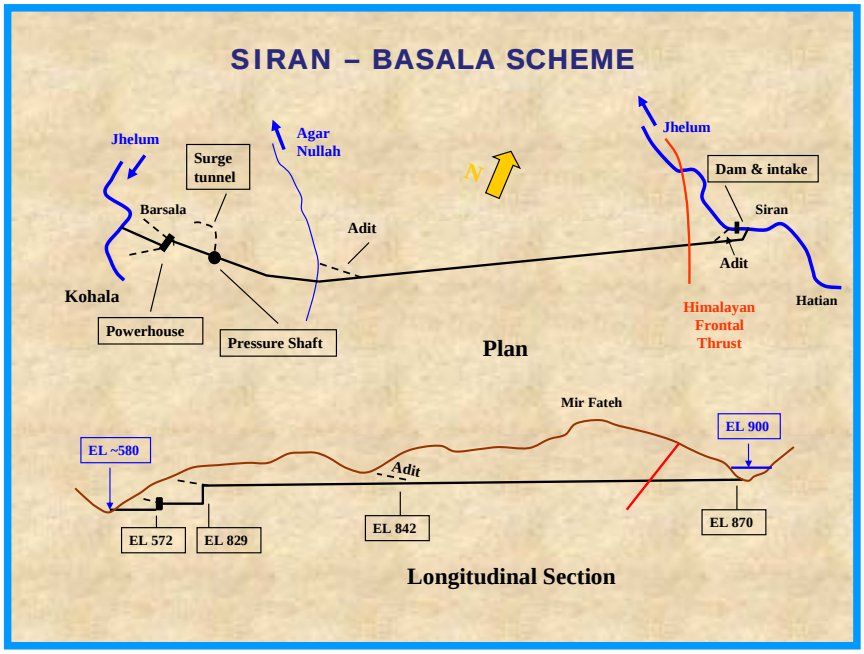

Figure 2. Location of Dam site (Siran-Barsala) and Power house

2. Initial Environmental Assessment of new Dam site at Ghari Duppata

The findings of the initial environmental assessment of new dam site at Ghari Duppata conducted by the WAPDA are illustrated as under:

- The land affected due to Dam axis at Siran is about 36.83 ha but with the change of the Dam axis the additional land affected will be 35.92 ha.
- It has been claimed that 19 houses would be affected or submerged at Siran dam site, whereas 114 houses will be affected or submerged at Ghari Duppata dam site. These families will have to be relocated. The land infrastructure including two suspension bridges will be lost.
- The relocation of 114 additional households will need development of special Resettlement Action Plan (RAP) before the start of the construction phase of the project.
- The plants affected due to shifting of the Dam axis downstream will be much higher (37606 fruit and forest plants) than the plants affected at the Siran site.
- The number of land based infrastructure affected will also be greater in number resulting in an additional cost of Rs. 43.16 million.
- The most sensitive issue is that 3 graveyards having about 12 graves will be affected and will need to be shifted above the reservoir level.
- Estimated environmental cost will be around Rs. 1241 million

The comparative features of the two dam sites for the Kohala hydro-power Project in AJK are presented in **Table 1**.

Table 1. Comparative Features of the two Dam Sites identified for the Kohala Hydro-power Project in the AJK

Feature	Dam Site at Siran selected by Kohala Hydropower Consultants	*Dam Site at Garhi Dupatta selected by CWE, China
Hydrology		
Chatchment Area (km^2)	14,005	-
Average Flow At Dam Site (m^3/sec)	311	312
Mean Annual Runoff (million m^3)	9,836	-
1 In 1000 Year Flood (m^3/sec)	3300	-
Main Dam		
Type	Concrete Gravity Dam	Rock fill Dam
Height (meters)	57	-
Crest Length (meters)	350	960
Crest Elevation (meters)	905 m.a.s.l.	-
Reservoir		
Max. Conservation Level	900 m.a.s.l.	-
Gross Capacity (million m^3)	49	-
Area (Km^2)	9.14	-
Power Tunnel		
Discharge (m^3/sec)	400	-
Length (km)	**17.50**	**15**
Powerhouse		
Gross Head (meters)	320	-
Installed Capacity (Mw)	**1100**	**1100**
Number Of Units	**4**	-

** Detailed features of the dam site as proposed by CWE, China were not available*

3. Brief Methodology of Rapid Environmental Assessment by PARC

A team of three members form the Natural Resources Division of PARC comprising of Dr. Bashir Ahmed (Director Environment), Irfan Ali (Water Resources Engineer) and Imran Ahmad (GIS/RS Analyst) visited both the dam sites i.e. the dam site proposed by Kohala Hydropower Consultants at Siran and the dam site proposed by CWE located at Garhi Dupatta. The mission has thoroughly visited both the dam sites to look into the following parameters:

- Loss of agricultural lands;
- Loss of infrastructure (houses, bridges, etc.);
- Loss of biodiversity;
- Disaster risks associated with the presence of active fault line;
- Social acceptance by the local people; and
- Design parameters.

4. Findings of Rapid Field Assessment by PARC

4.1 Loss of Agricultural Lands

The loss of agricultural land was assessed during the rapid field assessment survey and the findings are illustrated as under:

- It was estimated that the loss of additional agricultural lands would be higher than the claimed figure of 35.92 ha;
- The submergence of agricultural land is a loss of premium fertile lands and vegetation resources which has not only agriculture value but also have potential for recreational, tourism purposes. In addition it is a source of livelihood for local families;
- Large part of agricultural terraced land would be submerged as presented in figures 3 to 6. At least two more terraces of this size would be lost due to the newly proposed dam site.

Figures 3 and 4. Fertile agricultural lands to be affected due to new dam site at Garhi Dupatta

Figures 5 and 6. Productive agricultural lands and infrastructure to be affected at new dam site

4.2. Loss of Infrastructure

- In the survey, it was estimated that the number of houses which might be submerged or affected due to the change in dam site resulting due to the change in the reservoir location are higher than 114 as depicted in Figures 5 and 6;
- Many houses downstream of the Garhi Dupatta dam site might also be affected and/or submerged will have to be relocated;
- The infrastructure including two suspension bridges, paved roads and some part of Muzafarabad-Srinagar highway will also be lost due to new proposed dam site at Garhi Dupatta; and
- Nineteen houses to be affected by the construction of the dam site at Siran seem reasonable as depicted in the feasibility.

Figure 7. Loss of houses and biodiversity affected by the proposed dam site

Figure 8. Loss of infrastructure and housings due to new dam site

4.3. Disaster Risk Associated with Active Fault Line

The issues related to Disaster risk of active fault line in illustrated as under:

- The HFT (Hamalin Frontal Thrust) i.e. fault line is passing through the proposed site of the reservoir (**Figure 7**), if the dam is constructed at Garhi Dupatta site. The global technical experts have serious concerns, if a reservoir is constructed on or near the fault line; and
- The Power tunnel designed by the Kohala Hydropower Consultants crosses the HFT. Further, the CWE claims that presence of shale stone in the bed of tunnel is prone to severe damages. But this site has the advantage that damage can be avoided by passing the flow through spillway if tunnel is damaged due to HFT.

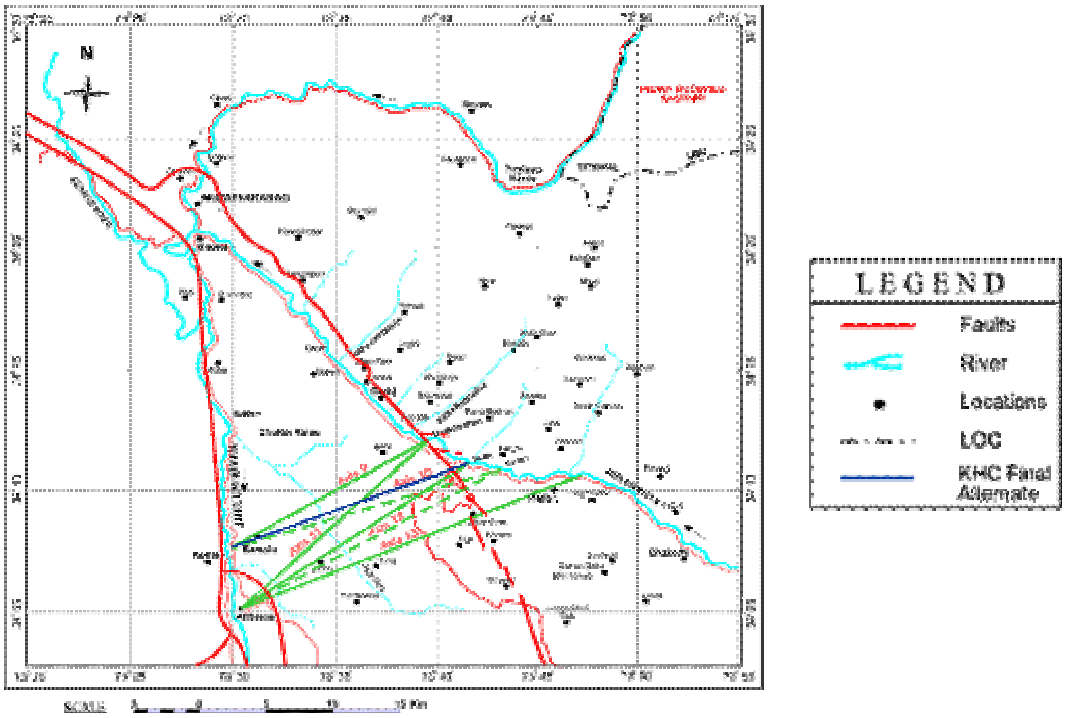

Figure 9 Fault line passing through the reservoir of the new dam site

4.4. Loss of Biodiversity

The loss of biodiversity was also assessed during the rapid assessment and findings are:

- The irreversible loss of fruits, forest and other flora & fauna would be much higher due to change in dam site at Garhi Dupatta than the claimed.
- Existing terraced agricultural lands have tourism potential and aesthetic value of the area would also be lost.

Figure 10 Biodiversity loss due to the new dam site

Figure 11 Biodiversity in the area proposed by CWE

4.5. Social Acceptability

The social acceptability of the change in site is also a problem and it may cause delays in the acquisition of land for initiating the construction of the dam. The issues are:

- Local residents had the mixed response towards the new dam site at Garhi Dupatta. Some people were ready for resettlement, if fair and attractive compensation is offered. Some people were afraid of past experiences of Mangla dam and recent earthquake catastrophe.
- Majority of people were in favour of dam site at Siran rather than at Garhi Dupatta.

4.6. Design Parameters

The issues related to design parameters are listed as under:

- The crest length at Siran dam site is 350 m whereas the crest length at new dam site will be 950 m, almost three time the length of the Siran site;
- By changing the dam site at the new location, the length of power tunnel will be reduced by 2.5 km and project time by 10 months and hence there will be a decrease of Rs. 2 billion in the project cost. ***This reduced cost and time is being achieved at the cost of irreversible loss of natural resources in the area.***

4.7. Major Issues to be Addressed

The summary of issues to be addressed while making the decision for the dam site is presented as under:

- How the issue of loss of agricultural lands higher than the Siran site will be addressed, which will also affect the livelihood of the displaced people? How the compensation will be determined? The issue of displaced persons can be addressed through compensation of their lands and also by providing alternate sources of livelihood. The question is how transparency

and timeliness can be maintained, while making compensation assessment plan and its implementation. If savings in the construction of dam at the Garhi Dupatta Site are larger than the additional compensation and the benefits of the dam, a way out can be found to have win-win situation.

- The HFT which passes through the reservoir can trigger the earthquake in the area due to ponding of water. This is a serious issue and as the area is prone to earthquake disasters, therefore detailed studies are needed prior to making any decision.

5. Experiences of Elsewhere

The international experiences related fault line risks are illustrated in Box I.

Box I. Exposing the Hidden Dangers of Dam-Induced Earthquakes - A Fault-line Runs through it

Besides posing a major risk to dams, scientists are increasingly certain that earthquakes can be triggered by the dams themselves. Globally, scientists believe that there are over 100 instances, strewn over six continents, of dam reservoirs inducing earthquakes. The most serious case could be the magnitude of 7.9 of Sichuan earthquake in China in May 2008, which some experts believe may have been induced by the Zipingpu Dam.

What Causes Reservoirs to Trigger Earthquakes?

Reservoir-induced Seismicity, or RIS, is thought to occur in two ways: a) by the added weight of a reservoir; and b) by the water that seeps into cracks underground or along a fault. In the first case, the filling of a reservoir with millions, even billions, of tons of water can add stress to faults, causing them to rupture. In the second case, water seeps into the rock and changes the fluid pressure in micro-cracks and fissures in the ground under and near a reservoir. The load effect of the first case is immediate, while the pore pressure effect is delayed because it requires the flow of the water through rock. This delay can cause some reservoirs to begin triggering earthquakes years after the first impounding.

6. Way Forward

A detailed feasibility is needed for the revised site of the Kohala Hydro-power Project at Garhi Dupatta including the use of fine resolution remotely sensed images for the exact assessment of land and infrastructure losses. Without that it is not possible to compare the benefits and losses due to the change of the site. Apparently, based on the rapid environmental assessment it appears that the loss of agricultural lands and infrastructure will be higher at Garhi Dupatta Site from that of the Siran Site.

The way forward is to fully assess the benefits of changing the site in terms of reduced cost of construction and develop more feasible and socially acceptable ways of addressing the issues of compensation for the displaced people and provision of alternate livelihood sources so that the displaced people have fully functional livelihoods. The number of the displaced people is relatively small and their concerns can be addressed. WAPDA has to develop better packages for the displaced persons and implementation mechanisms for transparent and timely payments to the displaced persons.

Based on the rapid environmental assessment and observed information, the new Dam site at Garhi Dupatta seems environmentally and socially unacceptable to the major portion of the local communities. Until an attractive package of compensation is developed there might be issues related to acquisition of land for the Kohala Hydro-power Project.

The NRD Research Briefings is a Series of Issues, which are being prepared and circulated to the policy and decision makers, research and development experts, NGOs and private sector in the country with an objective to synthesize and disseminate the research outputs related to natural resources management research conducted by the establishments of the Natural Resources Division of PARC.

The NRD Research Briefings was started during February 2009 to present outputs of studies undertaken by the Natural Resources Division of PARC and its research establishments including the MARC-Gilgit, AZRC-Quetta, AZRIs at D. I. Khan, Bahwalpur and Umerkot and national research institutes at NARC. The comments and suggestions can be sent at the following email address:

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The scientists and engineers of NRD and its establishments interested to get their papers published in these Briefings can send their files through email.

***Reference**: Ahmad, B., I. Ali and S. Ahmad. 2009. Rapid Environmental Assessment of Potential Sites for Kohala Hydropower Project. Vol. (1), No. (8), NRD, PARC, Islamabad, Pakistan.*