Mitigating Impacts of Muck Disposal: Muck Management Good Practices in Malana II HEP

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ABSTRACT
Hydropower is a well established technology that uses water without any consumptive use. It is the most reliable renewable energy having both positive and adverse impacts. While hydropower projects can have adverse impacts on the environment, they can be mitigated if well managed. The present paper is aimed at showing the Case Study of a typical hydro project of Himalayan region where the predicted negative effects of muck dumping are effectively handled for the protection of land and aquatic ecology. The Malana-II HE Project (2x50) 100 MW is a Run-off the River Scheme, located between Latitude 32^0 5'06" N To 32^0 02'15" N & Longitude 77^0 16'51"E To 77^0 15'26" E on Malana Khad, a tributary of Parbati River in Beas basin, Kullu District, Himachal Pradesh. It envisages a 45 m high Concrete gravity Dam above river bed level. Dam site is located in Malana Valley (3 km up stream of Malana village) at EL± 2500m. The Environment clearance and Forest clearance for the project was granted by the MoEF in June 2005 and December 2005 respectively. Proper and environmental friendly dumping of muck is a challenging task in hydro power projects to prevent pollution of river water and protect riverine ecology. The restoration of muck dumping site for Malana-II HEP encompass engineering measures and biological measures. The adoption of engineering measures and biological measures for restoration and mitigation are site specific and depend upon geological formation, topography and slope of natural as well as deformed terrain (due to muck dumping). As per the approved Environment Management Plan of Malana-II HEP sixteen Muck Disposal Sites have been utilized for muck dumping. The restoration work has been commenced in three phases viz., Phase –I of restoration involve Engineering Measures ie., base protection work in the form of Rubble Masonry/Masonry wall/Retaining walls, Phase-II of restoration comprise of Engineering Measures i.e., slope stabilization by intermediate protection stabilization by intermediate protection in the form of Masonry Grids, Biomac-C + steel mesh, Phase-III of restoration are Biological Measures comprising of top soiling, terracing, grassing, tuft-plantation, shrubs plantation and then tree saplings of local species. In the case of Malana-II HEP the appropriate engineering and biological measures for muck dumping have not only restored the Muck Dumping areas but the efforts have also been recognized and appreciated by the Hon'ble High Court of Himachal Pradesh, Shimla by stating that "**Project can be a model project for other hydro electric projects especially with regard to the dumping of muck and for rejuvenating the land and afforesting the dumping sites".**

1. INTRODUCTION

Hydropower is a well established technology that uses water without any consumptive use. It is the most reliable renewable energy having both positive and adverse impacts. While hydropower projects can have adverse impacts on the environment, they can be mitigated if well managed and have to be considered in relation to the project benefits and in comparison to other energy options. It is evident that during construction of any Hydropower project a huge amount of muck (debris) is generated due to excavation from different structural units viz., Diversion tunnel, Dam, Intakes, Head race tunnels, Desilting tunnels, Surge shaft, Pressure shaft, Power House and Tail race tunnel etc. The proper and systematic disposal of this muck requires utmost importance and care. If care is not taken to dispose this in designated areas, the muck can fall into the river and contaminate its waters. Faulty practices and improper management would further deteriorate the landscape and would also augment the sediment load in the stream causing severe impact to the biotic components in the aquatic ecosystem as well as it will lead to sediment deposition, siltation etc. These impacts need to be mitigated to promote hydropower development that can be accepted by affected people and society. Therefore during the planning phase of the project, a comprehensive and realistic muck disposal plan should be

prepared and during entire construction period the same plan should be properly implemented. Present paper deals with the case study of hydro project located in Himalayan terrain where details about the formulation of muck disposal scheme, arrangement for maximum uses and realistic implementation of disposal of surplus debris, proper implementation of mitigatory measures through execution of Environment Management Plan can ameliorate the adverse impacts and enhance the positive impacts making the Hydro Power Project more environmentally friendly.

2. BRIEF DESCRIPTION OF THE PROJECT

The Malana-II HE Project is a Run-of- the River (ROR) Scheme with an installed capacity of 100 MW, located between Latitude 32°05'06" N & 32°02'15" N and Longitude 77°16'51"E & 77°15'26" E on Malana Khad, a tributary of Parbati River in Beas basin, Kullu District, Himachal Pradesh. It envisages construction of a 45 m high Concrete Gravity Dam above river bed level. Dam site is located in Malana Valley (3 km up stream of Malana village) at EL± 2500m and underground Power House is located on left bank of Malana Khad just upstream of Malana-I HEP diversion site at EL± 1910 m.

2.1. Statutory Clearances and Present Status

The Environment Clearance and Forest Clearance for the project were granted by Ministry of Environment & Forests (MoEF) in June 2005 and December 2005 respectively. Preliminary works have commenced in January 2006, major works commenced from July 2006. Now, the project has been commissioned and is in operation since July, 2012.

3. METHOD AND METHODOLOGY

The restoration of muck dumping site encompass engineering measures and biological measures. The adoption of engineering measures and biological measures for restoration and mitigation are site specific and depend upon geological formation, topography and slope of natural as well as deformed terrain (due to muck dumping). As per the approved Environment Management Plan, Sixteen (16) Muck Disposal Sites have been utilized for muck dumping. The pictorial view of the restoration measures adopted for rehabilitation of muck dumping sites & comparative account of muck dumping sites prior and post restoration see Figure-1 to 5. The restoration measures have been undertaken in three (3) phases to rehabilitate the muck dumping sites as enlisted below:

3.1. Phase –I of restoration- Engineering Measures (base protection work)

The First phase of rehabilitation of muck dumping site comprises of engineering measures which involves base protection work in the form of Rubble Masonry/Masonry wall/Retaining walls of required strength along the entire length of the base to hold the destabilized earth mass dumped for holding the soil and boulder mass.

3.1.1. Phase-II of restoration - Engineering Measures (slope stabilization by intermediate protection)
This phase consist of slope stabilization by intermediate protection in the form of Masonry Grids, Biomac-C + steel mesh. Thereafter top soiling was done with mixture of Soil, Manure & Vermi-compost for improving soil profile. An Integrated restoration technique was adopted for slope stabilization as per degree of slope:

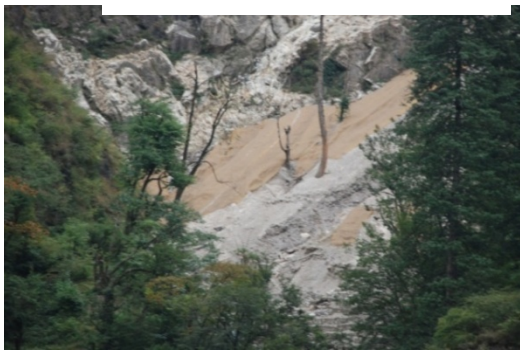
- For Low Slope: Random Rubble Masonry Grids, Dry Masonry Grids are formed
- For Moderate Slopes: Biomac-C (jute coir woven with polypropylene net) is adopted
- For High Slope: Formation of the terrace and installation of Biomac-C + Steel mesh after laying mixture of top soil and farm yard manure and vermin- compost

3.1.2. Phase-III of restoration - Biological Measures (Plantation)
In the third phase of restoration after the implementation of engineering measures and filling up the grids of the stabilized slopes in the dumping areas with mixture of soil and nutrient as substrate, the biological measures i.e. grassing, tuft-plantation, shrubs plantation and then tree saplings of local species on the fully protected and stabilized areas was undertaken in monsoon season. Enrichment/gap plantation was made continuous in winter and monsoon season until the survival rate reaches to appreciable extent.

Muck dumping site post restoration

Muck dumping site post restoration

Figure 1. Stepwise phases of restoration of Muck dumping



Muck dumping site post restoration

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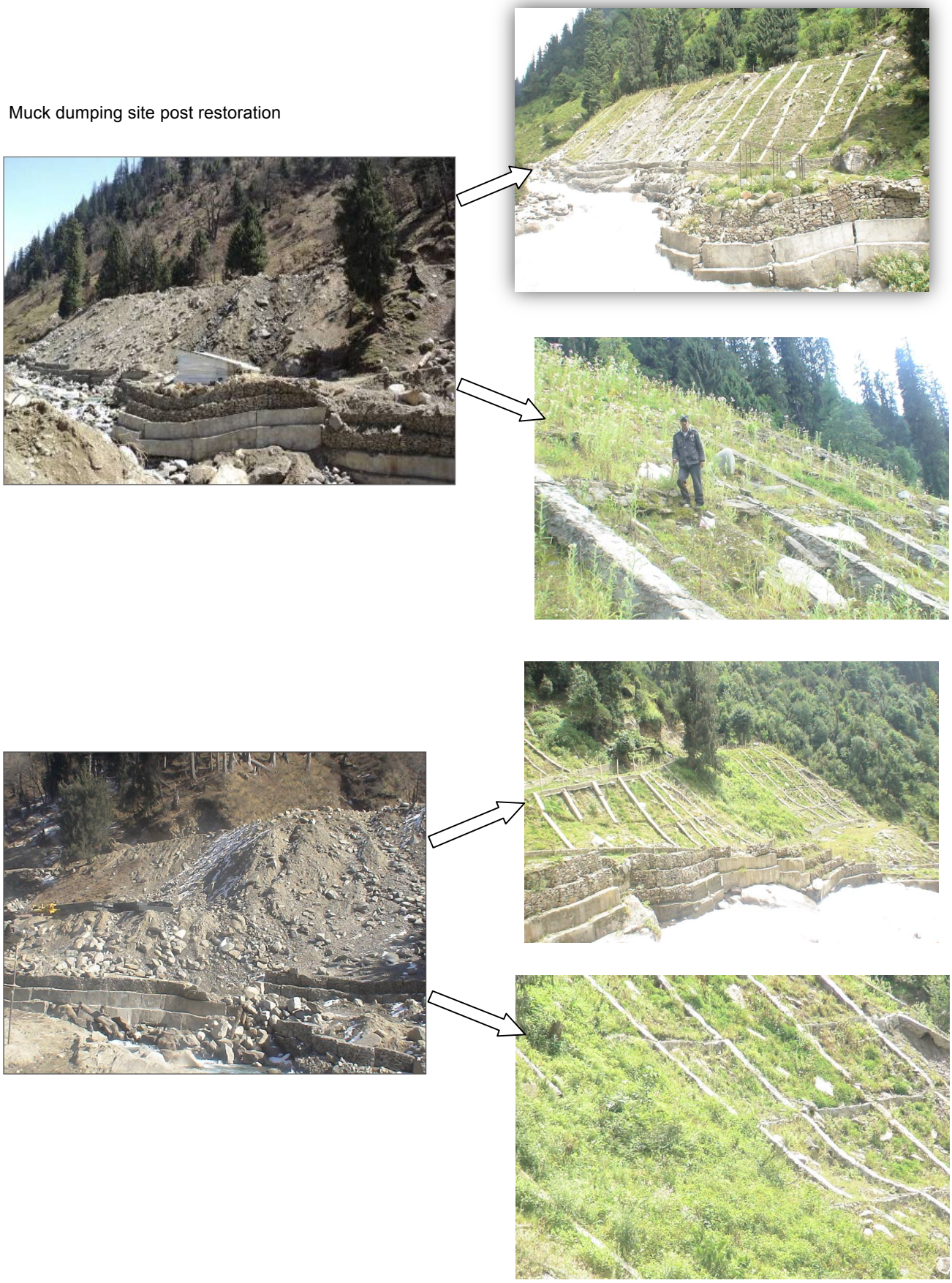

Figure 2: Restoration measures at Muck dumping site 1&2

Additional Muck dumping site-5 Post restoration

Muck dumping site post restoration

Muck dumping site-5 prior restoration

Figure 3. Restoration measure at Muck dumping site-5 and additional muck dumping site-5

Figure 4. Restoration measures at Muck dumping site 6&7

dumping site-7 prior restoration

Additional Muck dumping site-6 post restoration

Muck dumping site-7 post restoration

Road side- prior restoration

Figure 5. Restoration measures at Muck dumping site-11 & Road side

3. WORDS OF APPRECIATION FROM THE HON'BLE HIGH COURT OF HIMACHAL PRADESH, SHIMLA

The Hon'ble High Court of Himachal Pradesh, Shimla has appreciated the mitigatory measures adopted by the project for restoration of the muck dumping sites and considered it as a model project for adopting the mitigation measures in other hydro electric projects. The Hon'ble High Court opined that "*The project is coming up at a place where there are sharp inclines on the mountain side, which were almost vertical despite this problem the project proponent has managed the dumping of the muck in a manner that the sites have already started looking green. We are of the view that this project can be a model project for other hydro electric projects especially with regard to the dumping of muck and for rejuvenating the land and afforesting the dumping sites".*

4. CONCLUSIONS

The adverse impacts of hydro power projects can be mitigated by proper implementation of Environmental Management Plan. As in case of Malana-II HEP the appropriate engineering and biological measures for muck dumping viz. base protection work in the form of Rubble Masonry/Masonry wall/Retaining walls, slope stabilization by intermediate protection in the form of Masonry Grids, Biomac-C + steel mesh and biological measures i.e. top soiling, terracing, grassing, tuft-plantation, shrubs plantation and then tree saplings of local species has not only restored the Muck Dumping areas, but also ameliorated the negative impacts predicted initially and showed that hydro projects can be developed in sustainable manner by adopting suitable scientific methods, last but not least, the efforts has also been recognized and appreciated by the Hon'ble High Court of Himachal Pradesh, Shimla by stating that "**Project can be a model project for other hydro electric projects especially with regard to the dumping of muck and for rejuvenating the land and afforesting the dumping sites".**

5. ACKNOWLEDGEMENT

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