Assessment of technical condition of Kherwar dam - feasibility study

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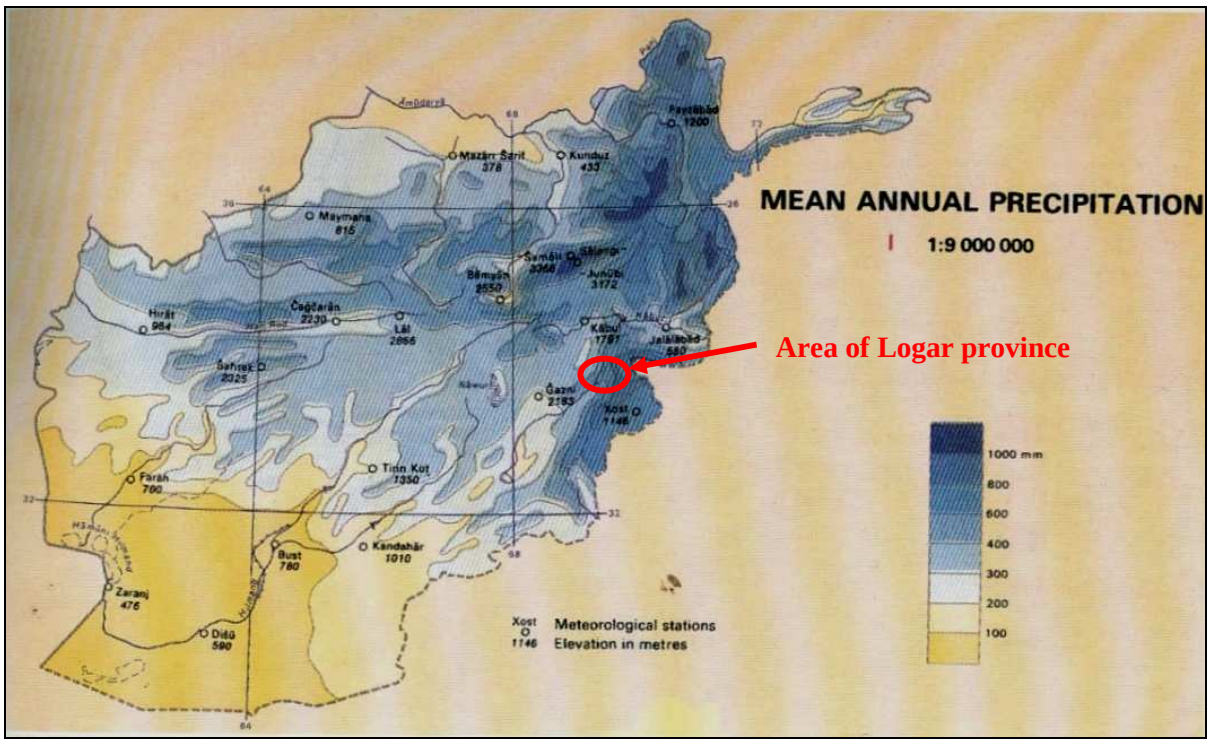
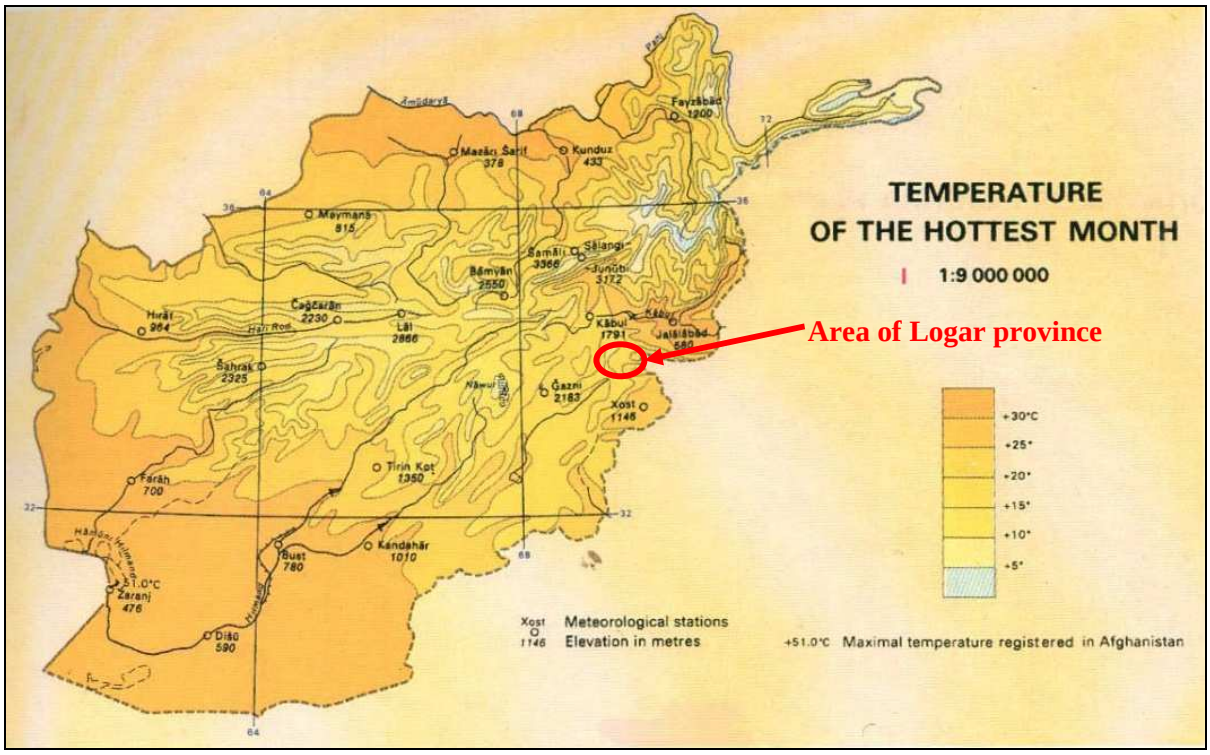
Climate situation in Logar province

Logar province is situated in eastern part of Afghanistan and borders with Kabul, Nangarhar, Paktya, Ghazni and Maydan Wardak provinces. Average altitude of the province is 1935 meters above sea-level. Mean annual temperature is 10,7 °C. Temperature of the hottest month is about 25°C to 30°C and temperature of the coldest month is about -5°C to -10°C. Mean annual precipitation is at intervals 600 mm to 800 mm. With respect to these data we can say, that Logar province has hot and dry climate.

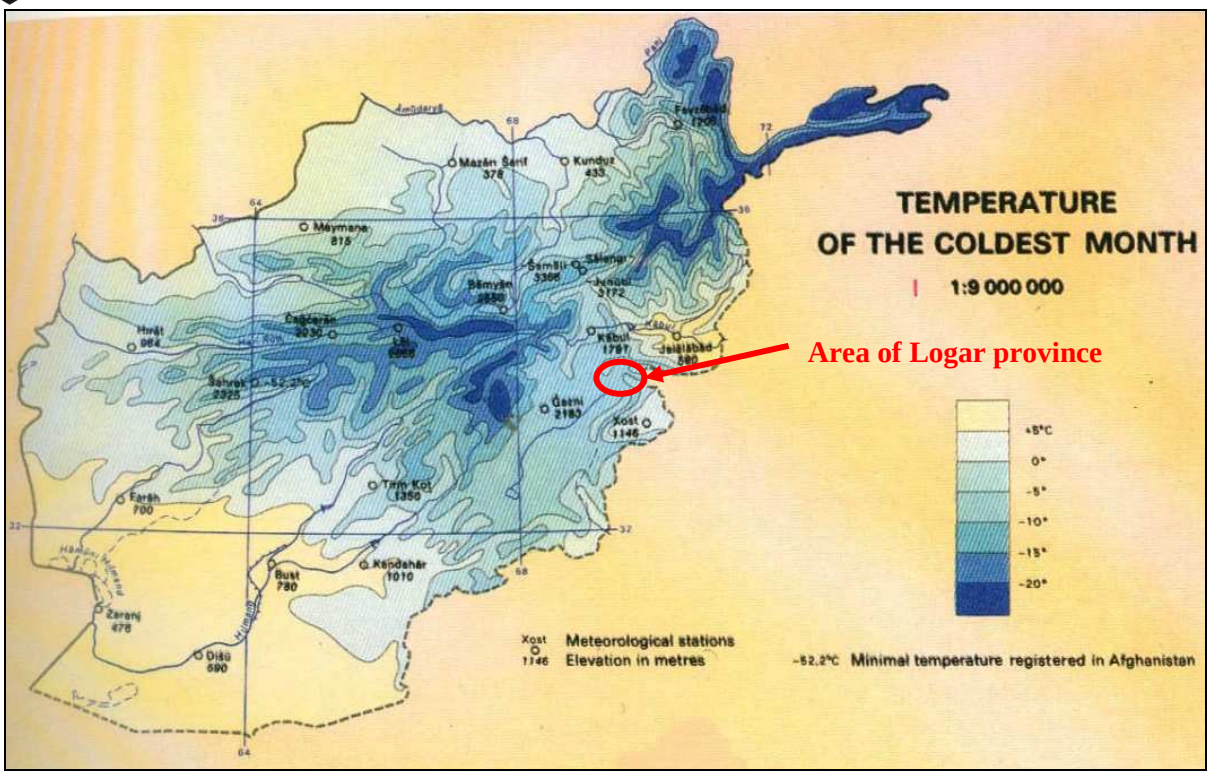
Province is divided into 7 districts. Each of the districts has different morphology that influences local climate. In Logar province, there are both mountains and lowlands.



Pic.1 – Map of Afghanistan mean annual precipitation



Pic.2 – Map of Afghanistan temperature of the hottest month.



Pic.3 – Map of Afghanistan temperature of the coldest month

Hydrological situation in Logar province

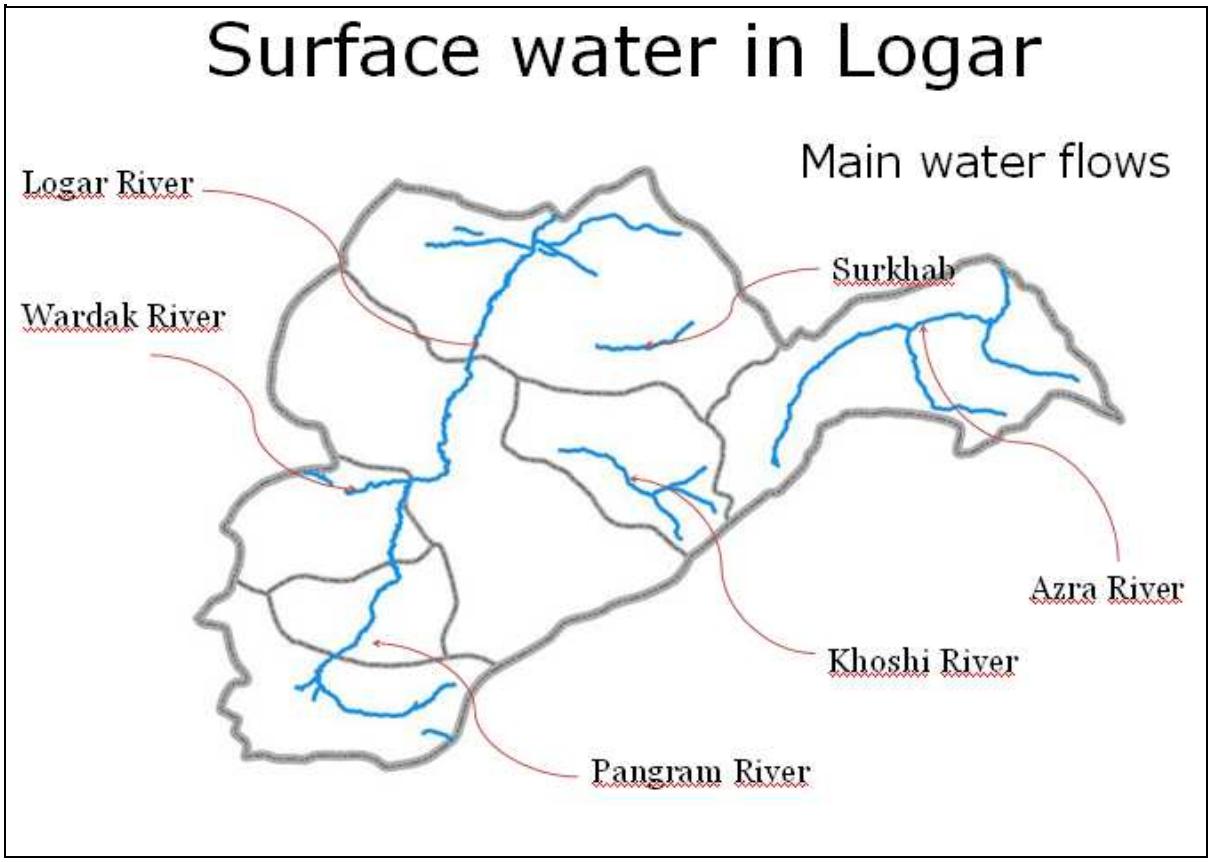
From hydrological point of view, Logar province belongs to rather dry areas and water appears more in mountain districts and at stable river basins that flows through province. Among the stable rivers are: Logar River, Wardak River, Pangram River, Surkhab River, Khoshi River and Azra River.

The Logar River is formed by junction of Wardak River and Pangram River at borders of Pol-e Alam and Baraki Barak district and flows through whole province. These river flows are crucial for irrigation water supply.

Rivers Surkhab, Khoshi and Azra are just local water flows and they reach Logar River for junction just in flooding season.

Main waterways (water flows) receive water through surface run-off, undersurface run off and by allocation from underground aquifers.

Circulation of water is influenced by spring snow melting. Precipitation mainly appears in winter in the form of snowfall. Rainfall appears in spring, and after that, a dry and hot weather and no precipitation usually appear. River beds get recharged (refilled) from spring melting. In the spring season, the underground aquifers get full and serve as a source of water in the summer period.

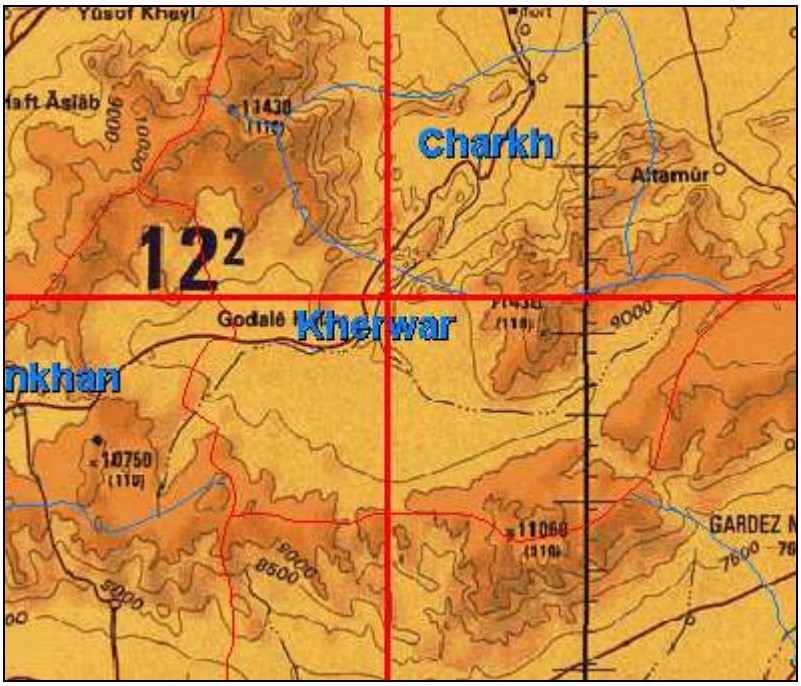


Pic. 4 – Map of Logar stable rivers.

Location of Kherwar dam

The dam is located in Logar province in a southern district of Kherwar. Dam was built at River Pangram.

Coordinates of the dam is: 42 S VC 88259 32293.



Pic. 5- Location of the dam in Kherwar district

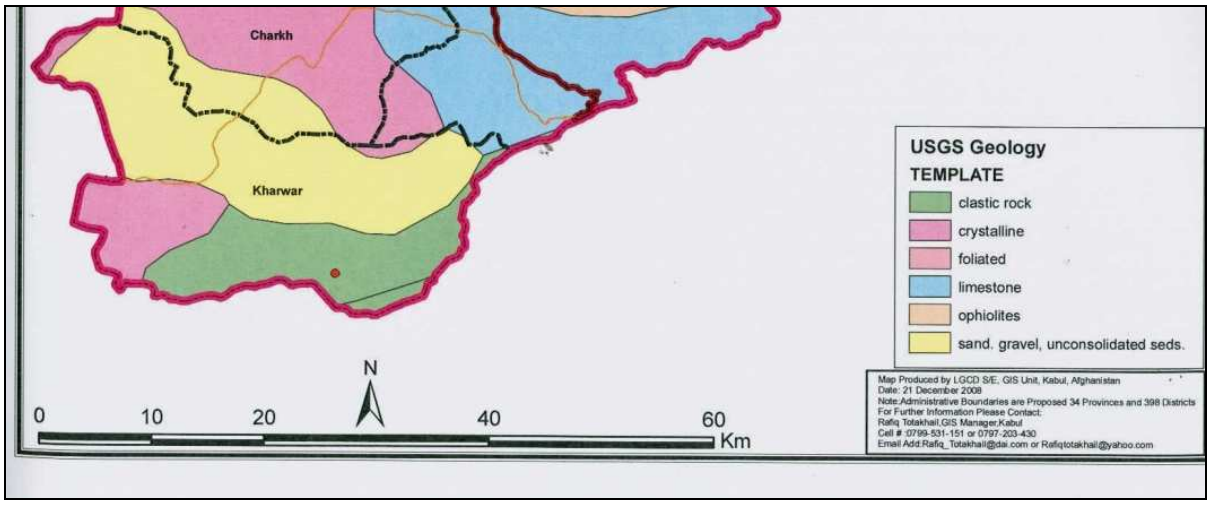
Pic.6 – Satellite image with exact position of the dam

Morphological and geological situation in Kherwar district

District Kherwar is not among mountainous regions of the Logar province. There are mountains there, but do not cover the whole district area and are not characteristic relief of Kherwar district. Mountains are formed mainly in northern and southern part of the district. At northern part, there are numerous mountain gorges and passes. In between of these mountain systems there is a big platform with human settlements, especially around Pangram river. Area of the platform is agricultural land that is tilled and irrigated.

From geological point of view, Kherwar is divided into three areas. First one is western part that was formed in Paleozoic age. This part of district contains crystalline rocks and those are phyllites, locally micaschists. Second part of Kherwar district is northern part that was formed in quaternary age. This part of district contains sand, gravels and unconsolidated sediments. Third part of Kherwar is northern part that was formed in Jurassic – Cretaceous age. This part contains clastic rocks. That are limestones, sandstones and shales, sandstones.

The dam is located in northern part of the district near to mountain pass named Kherpechak. The dam body is situated between rock ledges of sandstone. Water side of the dam faces the platform and air side of the dam faces to deep narrow gorge. Length of this gorge is about 3.8 kilometers.



Pic.7 - simplified geological map of Kherwar district.

History of the dam (source of this information is Provincial Ministry of Water and Energy)

Construction work on the dam started in thirties of 20th century (in 1310 by afghan calendar) under Shah Muhammad Nadir rule, but construction was stopped for lack of money. Since that time nobody finished the construction of dam body and dam was not ever filled with water. Area of the dam is hardly accessible, and the surrounding areas were used in the past by various fighting elements as safe heavens.

Current technical condition of the dam

We can asses the technical condition of the dam just by outer appearance. That is caused by absence of technical documentation and absence of detailed ground reconnaissance. So we do not know if proper geological and geotechnical research was performed in order to evaluate pertinence of geologic sub grade especially in the light of bare capacity and permeability. Other information that is missing is documentation of material that was used for dam body construction, material and method of placing the foundation.

We performed air recco (Nov 4, 2009) that revealed incompletion of all operational objects and their sequences. Dam body is probably made of stone packing with stone facing filled-out with cementation mortar. We have no information about quality of inner part of the dam. The dam was never full filled with water so the dam body pip shall be in a good condition because water never had a chance to destroy it. Facing of the dam is evidently damaged by erosion (some of the stones fell out of the wall and cementation mortar is infringed).

Bottom culvert (drain) is functional. It is evident through the observed water flow. The issue remains what is the technical condition inside the culvert (technical condition of the culvert from the point of view of permeability).

There is supposed to be an insulation layer between the water flowing through the culvert (drain) and the inner dam body. If the water leaks into dam body through the poorly insulated or damaged culvert, it has probably caused damages inside the dam body. However, these are only our assumptions, since we did not have opportunity to make closer survey of the dam. Provincial Ministry of Water and Energy claims that entrance to the culvert heel is damaged and requires reconstruction.

There is a control tower at the culvert. This tower unfortunately doesn't have any access way. There is a bridge missing, that would connect the tower and the dam crest. Since the tower is not accessible, nobody can asses what kind of device is inside and whether it is operational. Supposedly it is a device to operate/handle the culvert (drain) stopper. So we don't know if the device is useable or if it is repairable or if it needs to be changed. Technical condition of the tower only seems to be good. Foundation of the tower is set to rock ledge of sandstone so it shall be stable.

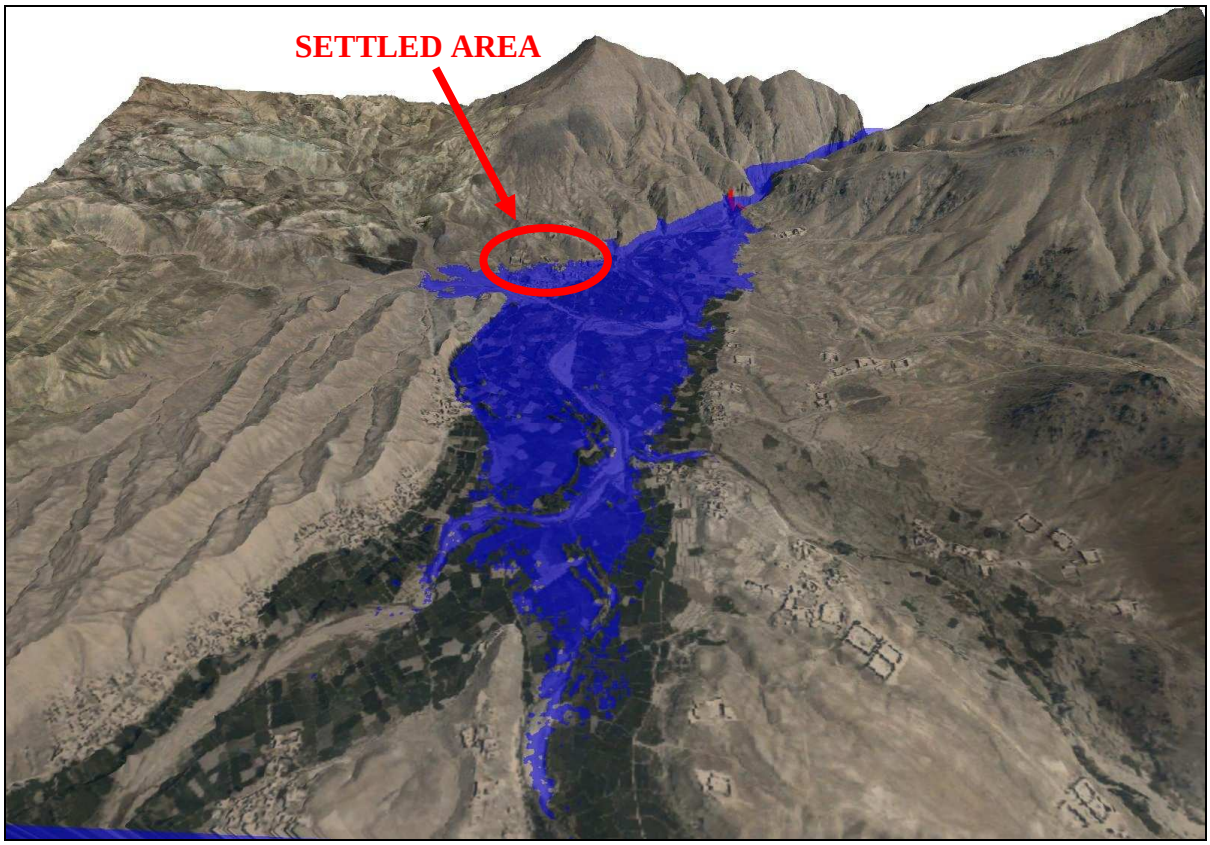
Safety overflow construction is located on the right side of the dam body and it has width 5 meters. Technical condition of the overflow construction seems to be good. There shall be needed just small reconstruction of boundary walls. The question is capacity of the overflow. This capacity shall be evaluated by hydrological calculation based on hydrological data. Unfortunately we don´t have any valuable hydrological data.

Near to the dam there are some service objects, among those a guard house, a building for dam operational controller and serviceman. These objects are in bad technical condition and it will need proper reconstruction.

Pic.8 – Aerial photograph of water facing of the dam with control tower.

Pic.9 – Aerial photograph of air facing of the dam.

Pic.10 – Aerial photograph of potential submersion area.



Pic. 11 – Active capacity of the dam (2430 m)

Summary – conclusion and recommendation

It is clear from the previous chapter, that from technical point of view, the dam is in overall good shape and the needed reconstruction would not be expensive. However, what is important is to draw up all data and put it into context.

If the dam would to be used for its original purpose – retention dam for irrigation purposes, following COA is recommended.

1. hydrological survey (collection and evaluation of hydrological data)

Collection of hydro data for at least 5 years, observation, evaluation.

The data should show, whether the river / precipitation/floods are strong enough to fill the body of the dam. It will demonstrate how the dam will influence the water system behind (under) the dam, the river flow. Without such detailed survey, it is impossible to rule out following scenarios.

1. not enough water to fill the dam (low precipitation etc.)
2. the river stream would be so weak upon the exit from the dam that it would not reach the junction with Wardak river
3. all water would filter through the bottom of the dam (porous bottom) and the river would not continue at all
4. active capacity of the dam would submerge the to-be-irrigated fields (see pic.11)

.....and others

2. geological and geophysical research

The issue is that construction of the dam began at thirties of twentieth century, but the construction was never finished. It means that the dam body was never filled with water and the subgrade was never loaded. The dam is situated at rock ledge, so bearing capacity and stability of the dam shall be acceptable, but we recommend verification through detailed geological research. There is also no information about technical condition of inner dam body. The fact is that the construction of dam was under climate effects for 70 years. Downstream the Pangram River, there is village in distance about 4,5 kilometers from the dam. In case of big flooding when dam can be in emergency conditions the village will be exposed to danger of being destroyed by water (in case of dam failure).

The detailed dam body survey should provide the info on the subsurface of the dam (material condition inside of the dam), whether the dam has stable body. A drilling set would have to be used to perform the low-profile boreholes in beforehand identified areas of damages. The survey would have to be performed by subject matter expert, for a period of several weeks (it is time consuming procedure). Geophysical survey (performed by x-ray or sonar) is required to asses, whether there are cracks in the rock matter under the dam body and what is density of the rock.

3. property settlement

The dam was built 70 years ago, and since then people already settled /inhabited the area of potential flowage and area of potential active capacity of the dam. It means that dam is now in unsuitable position. Agricultural land and also settled areas would be covered by water and justification between landowners would be really difficult. Map of affection area is drawn at picture no. 11. We have experiences from Surkhab dam. Surkhab was build about same time as Kherwar dam and the land issues are still pending.

The hydrological and geological survey are equally important, both have to be performed at the same time. Only if results of BOTH are favorable, then the property settlement phase can be started.

A crucial issue is, that proper dam maintenance by trained/professional personnel and equipment would have to be ensured. The amount of sediment that flows through the drain can be enormous (due to the erosion and quality of the soil), and it can clog the drain /culvert and the dam water becomes uncontrollable. That would pose significant danger for the population living further down the river.

Although it can be costly, this phase cannot be skipped. (Czech PRT project – partial excavation of Surkhab dam in order to restore its retention capacity totaled over 900 000 USD, and only one third of the total sediment was excavated from the dam).

The dam could also be converted to the Micro-hydro power plant, however hydrological study would need to be performed as well, and the dam structure would have to be supplemented by several other structures/constructions including the turbine.

Based on complexity of such a project, timeframe for completion of the hydrologic study which is longer than expected PRT's presence in Logar and unfavorable security situation, Czech PRT is not currently considering the Kherwar dam as a potential project.

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