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# Mangla Dam Raising Project (Pakistan): General Review and Socio-Spatial Impact Assessment

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*Abstract* – In this research paper, different aspects of Mangla dam raising project have been reviewed. The raising project like the construction of the dam brought with it dislocation of a large number of people as one major city and three towns in the state of Azad Jammu and Kashmir have been affected (partially inundated). The affected population of these areas has been offered a generous compensation package by the government and various development projects have been launched for rehabilitation and even uplift of the living standards of these people. It is too early to comment on the outcome of these resettlement efforts but an attempt has been made to highlight different human issues through an initial socio-spatial impact assessment of the project.

*Keywords* – Mangla dam raising; river Jhelum; sedimentation; resettlement; socio-spatial impact.

## 1. INTRODUCTION

Pakistan has recently successfully completed the raising of Mangla dam, a major water works system on river Jhelum. This project has restored and even enhanced the storage capacity of Mangla dam reservoir. Pakistan's agriculture sector will definitely benefit from this increase in available water resource. The raising of the dam was accompanied with a dislocation of a large number of people. In Mangla dam's case this was a second displacement as the dam when originally constructed brought about a relocation of unprecedented proportions during 1960s, which was a first of a kind experience for planners and engineers. Hundreds of villages and many towns were inundated and thousands of people lost their land and to some extent their culture. All affectees received handsome compensation packages as they are doing now but still grievances prevail and even new fears have emerged. This brief research study focuses on introducing and discussing the matters associated with displacement of people as a result of the Mangla dam raising project, and the socio-spatial impact on the communities being directly affected. Some background information about geophysical features of the dam site, design and construction project, and comments on demographical setting of areas adjacent to the dam are also included.

## 2. GEOPHYSICAL REVIEW

The dam is located 115 km south-east of Islamabad, on the river Jhelum at Mangla. The dam is physically located both in

the state of Azad Jammu and Kashmir and the province of Punjab (district Jhelum). It can be reached by traveling towards north (about 16 km) from Dina town on the Islamabad-Lahore G. T. road (a section of N-5).

The Jhelum basin (upstream of Mangla) extends over the southern slopes of the north-west terminus of the Himalayan mountain range and the reservoir is situated in the south-west sub-basin in the Siwalik soft rocks. The original catchment area at the dam site is about 12,870 sq. miles. The mountain range in which the river Jhelum flows is rugged, contains steep slopes, and presents extreme weather conditions. At lower elevation vegetation is found and cultivation is practiced if surface runoff is available. The catchment area lies in the active monsoon belt, in summer heavy rainfall and in winter light showers and snowfall is the norm [1]. In winter precipitation is mostly deposited in the Mangla catchment as snow, which is a source of runoff during summer months. The runoff from this precipitation is more than runoff due to rainfall [2]. The major source of rainfall is the monsoon weather system with August/September being the most active months. Mangla catchment has two peak flow conditions, one occurring in June and the other in the months July-September. The higher June inflow is attributed to increased quantity of snow-melt (due to rising temperatures) while the July-September increase is a combination of rainfall and snow-melt. Water and Power Development Authority (WAPDA) of Pakistan has 22 stream-gauging and climatological stations scattered in Mangla catchment area for monitoring reservoir operations. Some of these stations are dedicated rain-gauge or river-gauge stations that are also being used as flood warning centers. Data from these stations (1967-2000) shows that mean annual precipitation is about 32.5 in. in the Mangla catchment area [1].

Sedimentation has always been considered a source of problem in the Mangla reservoir and a potential storage loss of 1% per year was calculated during 1960s. It was also determined that serious issues with storage capacity would emerge after 40-50 years of operation leading to problems like passing increasing concentrations of sediment through power turbines and irrigation valves etc. Data on sediment inflow and accumulation is available (from 1967 onwards) and shows a less than predicted rate of loss of storage capacity since the construction of the dam. The loss of storage capacity due to sedimentation was such a source of concern for the designers



Fig. 1 Layout of Mangla dam extension works, affected towns, and location of resettlement sites. (Image courtesy: WAPDA)

of the dam that a provision for raising the dam in future was incorporated in the original blue prints [1].

### 3. DEMOGRAPHICAL BACKGROUND

As stated earlier, the Mangla dam reservoir is physically located both in the state of Azad Jammu and Kashmir and the province of Punjab. When the dam was constructed during 1960s, WAPDA acquired land up to an elevation of 1210 ft. all along the periphery of the reservoir. This periphery extends up to 250 miles. Hundreds of villages, many small towns, and at least one major city (Mirpur) was inundated as a direct consequence of this project. Population in the state of Azad Jammu and Kashmir suffered more, the city of Mirpur was relocated and reconstructed on a new site.

For the 30 ft. raising of the dam, land has been acquired from elevation 1210 ft. to 1250 ft. and the areas that lie on the periphery of the reservoir that have been affected by this

project include Mirpur, Islamgarh, Chaksawari, and Dudial (lying on the left bank of the river Jhelum) in the state of Azad Jammu and Kashmir (Fig. 1). On the Punjab side, the reservoir periphery (on the right bank of the river Jhelum) is thinly populated and the effect of the raising is minimal. WAPDA has estimated that a population of about 44,000 will be affected by the raising project [1]. Of the cities/towns being directly affected, Mirpur is the largest one with a population of more than 100,000. Due to its size and strategic location, Mirpur serves as a nerve and business center for rest of the region. It is connected with all other towns through a good network of metalled roads.

After the construction of Mangla dam, the displaced inhabitants were resettled in Punjab and Sindh provinces and also on the periphery of the reservoir. Many of these families were unable to integrate with distant cultures of far off places where they were relocated. As a result they sooner or later

disposed off their land and came back to Mirpur and adjoining areas. A large number of people from the state of Azad Jammu and Kashmir in general and Mirpur and adjoining areas in particular were given work permits for UK. Their investment in rebuilding a new life for their families in Mirpur has played a major role in infrastructure development and improvement of living standards in this part of the country [3]. Further discussion on socio-spatial aspects of the project follows in section 5.

#### 4. DESIGN AND ENGINEERING ASPECTS

Mangla dam is an earth filled dam with original design height of 380 ft. above river bed and a length of 10,300 ft. It was completed in 1967 and the main structures of the dam include 4 embankment dams, 2 spillways, 5 power/irrigation tunnels, and a power station. The main reservoir extends over an area of 97.7 sq. miles. The original dam design had a gross storage capacity of 5.88 Million Acre Feet (MAF). The dam generates 1000 MW of hydropower from 10 units of 100 MW capacity each. These units were installed in stages from 1967 to 1994 [1].

The dam was constructed with international support for maximizing the use of available water in river Jhelum for agricultural use. River Jhelum being one of the three western rivers (other two are Indus and Chenab) whose rights were allocated to Pakistan according to the Indus Waters Treaty, negotiated by the World Bank between India and Pakistan in 1960. The Mangla dam reservoir provides storage to two main rivers, Jhelum and Poonch, and two minor rivers Kanshi and Khad. The reservoir extends east, west, and north into sub-mountainous valleys and gorges of both the state of Azad Jammu and Kashmir and the province Punjab. Towards south, this body of water is regulated by the main spillway with nine orifices, controlled by radial gates and an emergency spillway (west of main spillway) for ungated discharge. Although not designed for flood control, the dam has been effectively used for this purpose for decades.

The original conservation level of the Mangla dam reservoir was fixed at 1202 ft. The dam was filled to maximum capacity in 1967 and the first impounding was carried out in the same year. Since then, it is estimated that about 2 billion tons of sediment has accumulated in the reservoir, which has reduced the gross storage capacity to 4.75 MAF, a loss of about 20%. The original design included a provision for raising the dam by 40 ft. Some 18 million USD were spent additionally for this purpose at the time of construction, keeping in view a future requirement for restoring reservoir capacity. The hydropower units were also designed and installed for the future raised conditions [3].

Various alternate approaches for recovering the lost capacity of Mangla reservoir were proposed [2], [3]. As every alteration involved a new displacement of people, the issue was deliberated upon for a long time by the government. Finally based on thorough national and international evaluations, an optimized raising height of 30 ft. was accepted by WAPDA. This height provides an additional 2.9 MAF of storage capacity, which is more than enough for recovering the 20% loss. It is important to note that the government agencies were

very careful and sensitive in comparing economic and technical aspects with social issues (arising as an outcome of the displacement of people) during the course of project evaluations. The raising project was formally started in fall 2002 and it was completed and inaugurated in October 2011. The expected cost was PKR 50 billion in 2002. The project was ultimately completed with total expenditure exceeding PKR 100 billion [5]. As a result of the raising, the height of the conservation level now stands at 1252 ft. A 14% increase in power generation (664 GWh per annum) is also expected [1], [3].

#### 5. SOCIO-SPATIAL IMPACT

The towns located on the periphery of the Mangla dam reservoir that are being directly affected as a result of the raising project are Mirpur, Islamgarh, Chaksawari, and Dudial (Fig. 1). Mirpur is the largest one, well planned, and the most populated city of the state of Azad Jammu and Kashmir. Other three towns are relatively small and their growth is rather unplanned with living standard inferior to that of Mirpur. The population in all towns including Mirpur is a mix of people from different parts of the erstwhile princely state of Jammu and Kashmir (now administered by Pakistan and India separately) and also those who have settled here after coming from adjoining areas of Punjab due to family, business or any other social/personal reasons. The present day city of Mirpur replaced the old Mirpur town that was inundated when Mangla dam was constructed during 1960s. The new Mirpur that was developed is far better in civic amenities as compared to the old one. Generally resettling in new Mirpur was a pleasant experience for most of the population as it brought with it an improved standard of living and better opportunities. (Culturally Mirpur is more affiliated with Punjab.) In addition to this, as agreed in the resettlement plan, work permits to displaced people were to be provided for UK by the government of Pakistan. Many people availed this opportunity, they found work, established themselves, and later not only called for their families but also helped their kinship to travel and settle in UK. These people invested in their home towns by starting businesses and contributed towards development of the whole region. As a result, the building of the dam has been a life changing experience for many displaced people especially those from Mirpur. The contribution of these immigrants has a lot to do with acceleration of urbanization process not only in Mirpur but in the entire state of Azad Jammu and Kashmir [1].

For the people who were given land as compensation in the provinces of Punjab and Sindh, the experience has been mixed. Many of these people sold their land and returned to areas near their inundated home towns as they were unable to amalgamate with the native communities of remote places where they were relocated [3].

While planning the resettlement of people for raising project, all lessons learnt from the previous relocation were taken into consideration. All issues were handled with great respect for human sentiment. An unprecedented compensation package has been offered to the affected population and the agencies involved with the project took every step possible to

ensure fair play and transparency in their operations. The initial negative response of the people affected by the raising project was addressed through confidence building measures adopted by WAPDA and firm assurances from the government [4].

WAPDA has acquired all affected land of the raising project (15,783 acres). On the side of the province Punjab, this land is mostly barren where as on the state of Azad Jammu and Kashmir side although no urban land was acquired yet large populated areas have been affected. The number of houses and other buildings (including shops, schools, basic health units/dispensaries, mosques, shrines etc.) affected by this project is around 8,000. For the land lost by people, WAPDA has paid compensation at market price value with additional 15% as acquisition charges. For cultivatable land, WAPDA has agreed to allow the owners to use what they owned during winter (when reservoir waters recede) for agriculture. For houses the replacement cost and an additional 10% was paid along with the provision for owners to take all salvageable material. In case of shanty houses, PKR 300,000 were paid as replacement charges to every resident family [1].

In light of previous resettlement experience and through scoping sessions carried out by WAPDA's socio-ecological consultants, the displaced people have been resettled in areas closer to their native towns. A new city has been planned/developed near Mirpur for a population of 30,000 [4]. This city includes all amenities of a modern town. Four new towns have also been planned to accommodate affectees who would like to relocate to a site that lies in close vicinity of the village/town they used to live in. People willing to have a house in the new city have to pay for the piece of land they wish to acquire. The refugees (of the border conflicts between Pakistan and India) previously living on WAPDA acquired land will be given small residential plots without any charges. In order to address grievances of some old affectees of 1960s displacement, compensation amounts will be paid to about 10,000 families. Over all, the cost of compensation and

relocation is about 55% of the total budget allocated for the project as estimated by WAPDA.

## 6. CONCLUSION

The restored storage capacity of Mangla dam reservoir will help Pakistan's agriculture. It certainly contributes towards sustaining and improving the livelihoods of thousands of farmers in areas that are irrigated by this water.

If the resettlement program as envisaged by the government is successfully carried out, the affected people will be rehabilitated in a short span of time. There is no price for natural feelings of affection of a person for his or her native land, but the suffering can be reduced if there is hope for future prosperity. Renewed economic activity, return to normalcy, and improved standard of living accompanied with opportunities for progress will help the relocated people to settle in their new lives.

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