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RESETTLEMENT ASPECTS OF

MANGLA DAM RAISING

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SYNOPSIS

Pakistan is in a dire need of development of water resources in the country. Raising of Mangla dam is acknowledged to provide such an opportunity. The alternatives to Mangla raising have been examined which include desilting of Mangla reservoir and creation of a number of small storages through construction of dams in Jhelum basin upstream of Mangla dam.

After giving justification for Mangla raising, the project and its salient features have been described. This is followed by an examination of effects of the dam raising on land, houses and population on periphery of the reservoir. The compensation package developed for resettlement of the affectees is described and suggestions are made for successful implementation of the package.

NEED FOR MANGLA RAISING

Pakistan is a land rich but water short country. About 9 million hectares (22 million acres) of its cultivable land are lying unutilized for want of water supplies. The capacity of its two major storage reservoirs, Tarbela and Mangla, is depleting rapidly due to heavy sedimentation. By now about 25% of the cumulative capacity of these storages has already been lost, whereas the population and hence the food demand of the country is increasing rapidly. The situation demands regaining the capacity of the reservoirs lost to sedimentation and augmentation of the water storage capacity of the Indus river system. Raising of Mangla dam provides such an opportunity.

THE MANGLA DAM PROJECT

Mangla dam is constructed on river Jhelum 115 km southeast of Islamabad, the capital of Pakistan. The Jhelum basin upstream of Mangla extends over the southern slopes of the northwest terminus of the Great Himalayan mountains and the reservoir is situated in the southwest sub-basin in the range of Siwalik soft rocks. The climate of Mangla reservoir catchment is characterized by intense rainfall during summer monsoon and winter rain and snowfall with rather large variation from year to year. There is fairly high difference between daily and annual temperatures. The mean maximum and minimum temperatures at Mangla are 32ºC and 24ºC respectively.

Construction of Mangla dam was completed in 1967 with a gross storage capacity of 7260 mcm (5.88 maf). Main features of the project include an embankment dam blocking Jhelum river and three other large embankments to

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close gaps in the reservoir rim. Total length of these embankments is over 13,000 m with a maximum height of 116 m above the river bed level. Total amount of fill placed in the embankments is about 111 mcm. The project is provided with two spillways. The main spillway having nine orifices controlled by radial gates, is designed for a maximum discharge of 28600 cumecs (101,000 cusecs). The emergency spillway is an ungated overflow weir type concrete structure having a maximum discharge capacity of 6,440 cumecs (230,000 cusecs). The hydropower generating system comprises 10 units of 100 MW capacity each. The power station is fed by five tunnels of 8 to 9 m diameter and 475 m length each. Figure 1 and Figure 2 show the plans of Mangla Dam.

Mangla reservoir provides storage to the two perennial rivers, Jhelum and Poonch and two non-perennial rivers Kanshi and Khad. Being at the junction of four rivers, the main reservoir has a squarish shape with its narrow legs extending into the rivers valleys. At the conservation level of 366.5 m (1202 ft.), the reservoir has a surface area of 260 sq. km (100 sq. miles) and a peripheral length of 400 km (250 miles). Since its initial filling, 2 billion tons of sediment has deposited in the reservoir which has reduced its gross storage capacity by about 20%.

At the time of original design and construction of Mangla dam a provision was kept for raising of the dam by 12 m (40 ft.). For this purpose the additional necessary works were undertaken at an additional cost of US$ 18 million. The ten power units installed in stages from 1967 to 1994 are also designed for the raised Mangla conditions. From the technical, economic and socio-environmental considerations, raising of the dam has now been optimized to 9 m (30 ft.). This will provide an addition of 3550 mcm (2.9 maf) to the capacity of the reservoir against 1500 mcm (1.2 maf) capacity lost to sedimentation so far. Thus by raising the dam, the original capacity of Mangla reservoir will not only be restored but also enhanced. The Project is owned by the Government of Pakistan with Water and Power Development Authority (WAPDA) being the implementing agency. Consultancy services for detailed engineering and construction supervision are being provided by a consortium of local and expatriate firms, local consultant being in lead. A consortium of Chinese and local contractors has undertaken the dam raising works since June, 2004 which are scheduled to be completed in September, 2007. The project cost inclusive of dam raising and resettlement is estimated as 62.5 billion rupees. A major component (55%) of this cost is allocated to payment of compensation and resettlement.

ALTERNATIVES TO MANGLA RAISING

Prior to taking decision for raising of Mangla dam, various alternative options were examined to restore the capacity of Mangla reservoir lost to sedimentation and also to augment storage of Jhelum river water. The options included (i) creation of a number of small storages through construction of dams in Jhelum basin upstream of Mangla dam and (ii) desilting of Mangla reservoir. The alternatives are presented in the following.

(a) Storage Sites Upstream of Mangla

The Jhelum basin upstream of Mangla has been studied quite thoroughly to identify damsites for storage and generation of hydropower. The earlier studies include Dams Investigation Circle (1957) [1]. Binnie, Deacon & Gourley (1959) [2], Chas. T. Main (1960/61) [3], DMO, WAPDA (1975) [4], Montreal Engg. Co. (1984) [5], GTZ/HEPO (1990 [6] & 1994 [7]) and MJV (2001) [8].

The possible storage dam sites on Jhelum river and its tributaries (Poonch, Kunhar, Neelum and Kanshi) are shown in Figure 3 and their evaluation is given below:

Jhelum River

Jhelum river has two distinct reaches. In the upper reach from the Line of Control to the confluence of Neelum, the river has a very steep bed slope (7.4 m/km), due to which no significant storage can be developed in this reach.

In the lower reach, from the Neelum confluence to Mangla reservoir, the gradient is milder (2.7 m/km). But, in this reach the valley is narrow and does not have a potential for development of significant storage. The geologic conditions are also unfavourable due to a major fault in the vicinity. In addition, a large spillway would be required for routing of Jhelum river floods. Because of unfavourable conditions, the construction of storage dams will be very expensive.

For example, a possible damsite at Dhangali identified prior to construction of Mangla dam is located in upper reach of Mangla reservoir where depth of stored water is about 5.5m. A 95m high dam at Dhangali provides a storage capacity of 987 mcm (0.80 maf) only. The geological conditions at the site are very unfavourable for a high dam. Moreover, a population of about 17,000 will be displaced. Construction of dam in the reservoir area will pose a challenge adding to cost. Shifting the dam upstream of the reservoir would reduce its storage capacity to less than half. Even with small storage capacity, a large spillway would be required to pass the Jhelum river flood flows. Construction of dam on this site is, therefore, not considered feasible.

Poonch River

The Poonch river from the Line of Control to Kotli town has steep slope (6.9 to 8.3 m/km) and the valley is narrow. Therefore no significant storage can be developed in this reach.

In the reach downstream of Kotli, the river gradient is relatively mild (3.7m/km). In this reach potential storage sites at Kotli and Rajdhani were identified by Dams Investigation Circle in 1957.The Kotli damsite was proposed about 8 km downstream of Kotli town with a storage capacity of 420 mcm (0.34 maf). Due to a large growth in habitates, this damsite will now inundate part of Kotli town and 7 villages which will displace about 20,000 people. In addition infrastructure and cultivable land will be lost. The site is, therefore, not considered feasible.

The damsite at Rajdhani was proposed about 20 miles downstream of Kotli with a storage capacity of 1062 mcm (0.86 maf). At the time when this damsite was proposed in 1957, Mangla dam was in planning stage and the planned conservation level was 24 ft. below the present level. Even at that time, the damsite was located within the then proposed reservoir. At present, the dam at the proposed site will have over 40 ft. of Mangla reservoir water on its toe. Shifting of dam upstream of Mangla reservoir would reduce its storage capacity to 185 mcm (0.15 maf) only. After construction of Mangla dam, the site has no more remained feasible for storage dam.

Kunhar River

Kunhar river has very steep bed slope. The gradient is 20 m/km in the upper reach and 11 m/km in the lower reach. The valley throughout is generally narrow. Due to these unfavourable conditions, the damsites on Kunhar river do not have a potential for development of significant storages. In the earlier studies, possible sites at Naran and Patrind were identified essentially for hydropower development. Considering the present development along Kunhar river, these sites with very limited storage potential involve major resettlement, relocation of part of MNJ road and loss of cultivable terraces. Combined together, the sites have a storage potential of 852 mcm (0.69 maf) only against a large displacement of 49,000 persons. The sites are therefore not feasible for storage dams.

Neelum River

A damsite with 1.8 maf storage capacity was identified about 16 km upstream of Titwal town. But the Neelum valley in this reach is thickly populated and the reservoir at this site will inundate 28 villages, 9 bridges and 18 km of Muzaffarabad-Keran road. Moreover the project would be located very near to the Line of Control. Mainly for socio-environmental reasons, construction of storage dam at this site is not feasible.

Kanshi River

Kanshi river has a very small catchment with insignificant contribution of flow into Mangla reservoir. It is therefore, not worth to construct a storage dam on this river.

To sum up, the following adverse conditions are generally identified on the possible storage damsites upstream of Mangla.

- Steep gradients of the rivers, requiring high dams even for small storages.
- Narrow river valleys, possessing small storage potential.
- Adverse geological conditions, adding to the project costs.
- Large spillway requirements against small storage capacities.
- Large population displacement.
- Inundation of towns, villages, infrastructure and cultivable land.

Because of small storage potentials coupled with highly unfavourable conditions, storage dams upstream of Mangla are technically and economically not feasible. The large population displacement and other negative impacts render the storages development not feasible socio-environmentally as well.

(b) Desilting of Mangla Reservoir

Dredging of Mangla reservoir has been considered as an option to regain its capacity lost to sedimentation. The quantity of sediment deposited in Mangla reservoir is very large, amounting to 2,000 million tons. In addition to a large number of barges and dredgers, haulage of the dredged material to dump area would require 22,000 trucks of 10 ton capacity to work continuously for 5 years. Later on, to keep the reservoir desilted, an all time deployment of 3000 trucks of 10 ton capacity would be required. The unmanageable operations and prohibitive costs make this option unfeasible. Dredging in reservoirs on such a large scale has not been undertaken anywhere in the world and is not a viable option.

It is concluded from the study that construction of small storage dams upstream of Mangla or desilting of the reservoir are not viable alternatives and Mangla raising is the only option to achieve the objective of regaining the lost capacity and augment the storage capacity of the reservoir.

ENVIRONMENTAL AND SOCIAL SETTING OF MANGLA REGION

The natural vegetation around Mangla reservoir belongs to the degraded form of dry subtropical broad-leaved forest. The plant cover varies from place to place and is often sparse. In most of the places only isolated trees and shrubs are seen. The wild fauna in the reservoir periphery is scarce due to human activities in the area. About 70% of the land area is either barren or covered with trees and shrubs used for grazing and fuel wood. The cultivable areas are scattered on periphery of the main reservoir where rainfed cultivation is practiced. The cultivable tracts have scattered settlements and family compounds for livestock and storing household consumables. With the seasonal recession of the reservoir, vegetables and wheat are grown in the moist and silt-laiden reservoir land.

The towns located on the rim are Mirpur, Islamgarh, Chaksawari and Dudial. Mirpur is the largest town of AJK with a population of around 100,000. This town was developed in 1960's for resettlement of affectees when the old Mipur town was inundated at the time of original construction of Mangla dam. The population of other three towns ranges between 6,000 and 10,000. Suburban population of these towns has grown on the reservoir periphery. The growth is unplanned and devoid of adequate civic amenities, such as water supply and sanitation. Electric supply and telephone service is available on most of the places. The fairly good network of asphalt roads exists providing access to the more prominent suburban settlements.

The Mangla resettlement associated with original construction of the dam in 1960's was one of the largest resettlements of its type in the world at that time. There were 81,000 people relocated, 32,900 houses replaced, and 35,600 hectares

(88,000 acres) of land acquired. Six towns and 255 villages were affected. The displaced families were resettled in Punjab and Sindh provinces and also on periphery of the reservoir. The major resettlement works included infrastructure development of new Mirpur town and 7 hamlets along with construction of public amenities. A paved road around the reservoir was also built.

There were lessons to be learnt from the resettlement process. Most of families resettled on far off places could not get integrated in a different culture and moved back to Mirpur area after disposing off the land allotted in those areas.

The social and economic circumstances of the project region continue to be immensely affected by the consequences of Mangla dam, completed in 1967, including the emergence of new economic opportunities like fishing and the emigration of thousands of Mirpuries out of the country, mostly to the United Kingdom.

The remittances from migrants in that period strengthened the urbanization process and at present surrounding areas of Mirpur have emerged as semi-urbanized population. A large number of palacial houses have been built which are mostly unoccupied or under- utilized. The presence of these palacial houses scattered in virtually all the area around the reservoir, confirms the social and kinship links, the expatriate Mirpuries aspire to keep with their ancestral land. Other than the well off families dependant on remittances, there are families belonging to middle class or semi-agrarian base. Sale of land is rare due to cultural values. There is an attitude in locals to purchase land within or near their villages leading to competition.

There is a relatively large Muhajir community (refugees) living on the reservoir periphery since 1965. They are settled in suburbs of Mirpur in semi permanent houses constructed on WAPDA's acquired land without proper physical and social infrastructure. Despite some improvements in their income level, the Muhajirs have been reluctant to invest in quality construction houses due to status of land ownership with WAPDA.

SALIENT FEATURES OF MANGLA DAM RAISNG WORKS

Major works of the Mangla dam raising project include earth works for raising of main dam, intake embankment, Sukian dyke and Jari dam. A total of about 31 mcm of fill will be placed for 9m (30 ft.) raising of about 13 km total length of these dams. Ancillary works would include construction of impervious blanket upstream of Sukian dyke and a toe berm upstream of intake embankment. To improve drainage of the foundations, drainage wells will be installed on downstream toe of the raised main dam and trench drains will be provided in nallas downstream of Sukian dyke. The provisions will ensure safe collection of foundation seepages and thus provide enhanced safety of the embankments. Concrete works include 1.5 m raising of sill level of nine orifices of the main spillway and construction of 18 m high control weir across approach channel of the emergency spillway. A total of 150,000 cu.m. of concrete will be required in these works.

SOCIO-ENVIRONMENTAL IMPACT OF MANGLA RAISING

In the Mangla reservoir area, Jhelum river forms boundary between AJK and Punjab. To cater for expansion of the reservoir, 6,400 hectares (15,783 acres) of land will be acquired all along periphery of the reservoir. This will include 5,034 hectares (12,433 acres) in AJK and 1,356 hectares (3,350 acres) in Punjab. The existing reservoir and its expanded periphery after raising of Mangla dam is shown in Figure 4.

The land to be acquired in Punjab (Jhelum and Rawalpindi districts) is mostly highly broken and barren, devoid of population. In AJK the affected area may be divided in four sectors namely; Mirpur sector, Islamgarh sector, Chaksawari sector and Dudial sector. No distinctively urban land is to be acquired in these sectors but pockets of dense inhabitation would be affected. In the cultivated land, constituting about 30% of the affected area, cultivation will generally continue with changed pattern. The impact on uncultivable land will not be significant. The number of houses and other buildings affected is estimated around 8,000. Other buildings in the affected area include cattle houses, shops, garages, poultry farms, brick kilns, stone crushers, etc. Community and public amenities include mosques, graveyards, shrines, schools, dispensaries, road, etc.

A population of about 44,000 will be displaced due to expansion of the reservoir. The displacement will be accompanied by temporary loss of source of income for shopkeepers, rural tenants and other social groups. Women in the affected area are active in performing not only their traditional domestic role but they also contribute directly to the acquisition of household income. This is particularly so with the women belonging to Muhajir communities and those working on brick kilns.

A large number of brick kilns located around reservoir periphery are providing employment to the low income communities. Construction activity of settlements for the displaced population will generate a high demand of bricks from the existing kilns. This will be a positive impact of the project for those associated with the brick kiln industry. With the raising of the dam, the brick kilns in the affected area will have to be abandoned. The kiln owners may choose to re-establish their kilns on higher ground above the affected area. In that case the families engaged on the brick kilns will retain continuity in their earning. There are about 900 fishermen in the area. The increased capacity of Mangla reservoir will provide good opportunity and habitat for enhancing fish breeding and production in the reservoir.

COMPENSATION PACKAGE

The dam raising project is committed to adequately compensate the persons who lose their land or other property. The project's commitment is being translated into reality through an unprecedented liberal compensation package for the affectees which was agreed and formally signed by Government of Pakistan, Government of AJK and WAPDA. Salient components of the package include the following.

Land compensation: Compensation for land will be paid at market price. An additional payment of 15% will be made as compulsory acquisition charges. Over and above these statutory provisions, the owners will be permitted to cultivate their land during recession of the reservoir in winter.

Compensation for houses: The house owners will be paid replacement cost of the buildings plus 10% additional. The owners will also be allowed to carry salvage material (malba) of their houses. Even the house owners not having land titles will also receive compensation for their houses. Those who own low cost shelters only, will receive a minimum of 300,000 rupees, which is sufficient to construct a two-room living unit.

Development of new city and four towns: In the light of the experience gained from the past resettlement, it has been planned to resettle all the displaced population in close vicinity. For that purpose a new city adjacent to Mirpur is being developed for a population of over 30,000. This habitat is being developed with modern amenities including treated water supply, sewage collection, treatment and disposal, asphalt concrete paved roads, electricity, telephone, educational, health and commercial facilities, sports facility and recreational parks. For those affectees who would choose to resettle near to their origins, four towns are being developed on the reservoir periphery. These towns will also be provided with all the basic amenities. The proposed location of New City and four towns is shown in Figure 4. The development of infrastructure and construction of public amenity buildings will be at the cost of the project. The house owners from the affected area will be given plots of 5 marla to a maximum of one kanal size according to their original holding and they will pay for the cost of land as they would have already received cash compensation for their land holding. Since the refugee settlers on government/WAPDA owned land do not have the land title, each house owner will be given residential plot of 5 marla, free of cost.

Vocational training: Vocational training is planned to be imparted to enhance earning skills of the affectees. For this purpose, a vocational training institute is being established in the new city area and vocational training schools will be constructed in the four new towns. For training of female, four existing vocational schools are being upgraded and provided with funds for their operations.

Bridges and access dykes: Presently a suspension bridge exists on river Jhelum at Dhangali which allows passage of light traffic only. For heavy-traffic, a concrete bridge is being constructed at this location at the project cost, which will greatly reduce traveling distance from Dudial to Islamabad. Feasibility study will be conducted for another bridge between Mirpur and Islamgarh, spanning over Jari reservoir. Access dykes will be constructed to maintain land access to Kharak and Chohan after the reservoir retention level is raised.

Electricity: It has been agreed to pay to Government of AJK net hydel profit of Mangla @ Rs.0.15/kWh. To improve the electric supply network, six grid stations will be constructed in AJK area. Government of AJK has also been authorized to establish hydropower projects up to 300 MW.

Miscellaneous components: As part of compensation package, fishing rights of the Mangla reservoir and operation of recreational facilities in the lake have been transferred to Government of AJK. The Government of AJK has also been given the right to draw water from Mangla reservoir for drinking and irrigation.

Compensation to old affectees: The compensation package for raising of Mangla dam includes a provision for the old affectees who were displaced in 1960's at the time of the original construction of the dam and found to be not properly compensated for their land. An amount of Rs. 200,000 per family will be paid in such cases. Of the order of 10,000 families are expected to receive this cash award from the project funding.

Cost of compensation and resettlement: The estimated cost of compensation and resettlement comes to about 55% of Rs. 62.5 billion total cost of the dam raising project. The high proportion of compensation and resettlement component is attributable to (i) high cost of land (ii) replacement cost of a large number of houses in the affected area (iii) infrastructure development of new city and four towns and construction of a large number of public utility buildings at the project cost and (iv) cash compensation to the old affectees of Mangla dam project. The proportion of the cost on compensation and resettlement also works out high due to the fact that the raising project requires raising of dams with relatively minor modifications in the two spillways and no investment in the hydro power generating system. In case of new project, these components would have required large investments.

PUBLIC RESPONSE

The provision of raising of Mangla dam was generally known but on announcement of implementation of the project, the response of those who will be displaced due to expansion of the reservoir was generally negative. The public was apprehensive of the compensation for their land holding, houses and other assets and concerned about their resettlement. Dissemination of details of the attractive compensation package, however, brought a positive change in the response. While the package was appreciated by the public, there were doubts expressed about its implementation. This concern has been addressed satisfactorily by a visible commitment in the form of an agreement signed between Government of AJK, Government of Pakistan and WAPDA. The agreement includes components of the compensation package and makes a ministerial level committee responsible for monitoring implementation of the package. With these measures, public confidence improved to a considerably higher level.

CONFIDENCE BUILDING MEASURES

While the agreed compensation package is implemented, high importance will have to be given to CBMs which would include:

- wide spread dissemination of information regarding the compensation package, its implementation schedule and procedures for assessment of compensation
- participation of stake holders in the assessment process
- acknowledgement of stake holders right to be listened and redressel of their grievances
- payment of compensation in a transparent manner
- keeping stake holders posted on progress of resettlement works
- promptly attending to unforeseen situations adversely affecting stake holders

The successful implementation of compensation package associated with raising of Mangla dam will serve as a model for the upcoming projects at home and elsewhere.

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