Lake Profile Brief

This is based on the results of Multiple Lake Threat Assessment
and its Scenario Analysis. Refer to the Technical Report for details.

## Lake Mangla   Geographic Information

Lake Mangla is a multipurpose reservoir constructed as a result of the Indus Waters Treaty between
Pakistan and India. The entire Pakistani irrigation system was previously dependent on unregulated
Indus River flows, characterized by low water availability during critical growing periods because of
seasonal river flow variations attributed to a lack of storage reservoirs to store surplus water during the
monsoon high river discharge periods. The Mangla Dam, the seventh largest in the world, was
constructed in part to strengthen this irrigation situation. The Mangla Power Station is the second
biggest in Pakistan, with approximately 280 villages being submerged, and more than 100,000 people
displaced because of the dam construction. Although the operation and management of Lake Mangla
has been the subject of many bilateral discussions between Pakistan and India, there is little information
regarding the need for GEF-catalyzed management interventions for any transboundary environmental
issues.
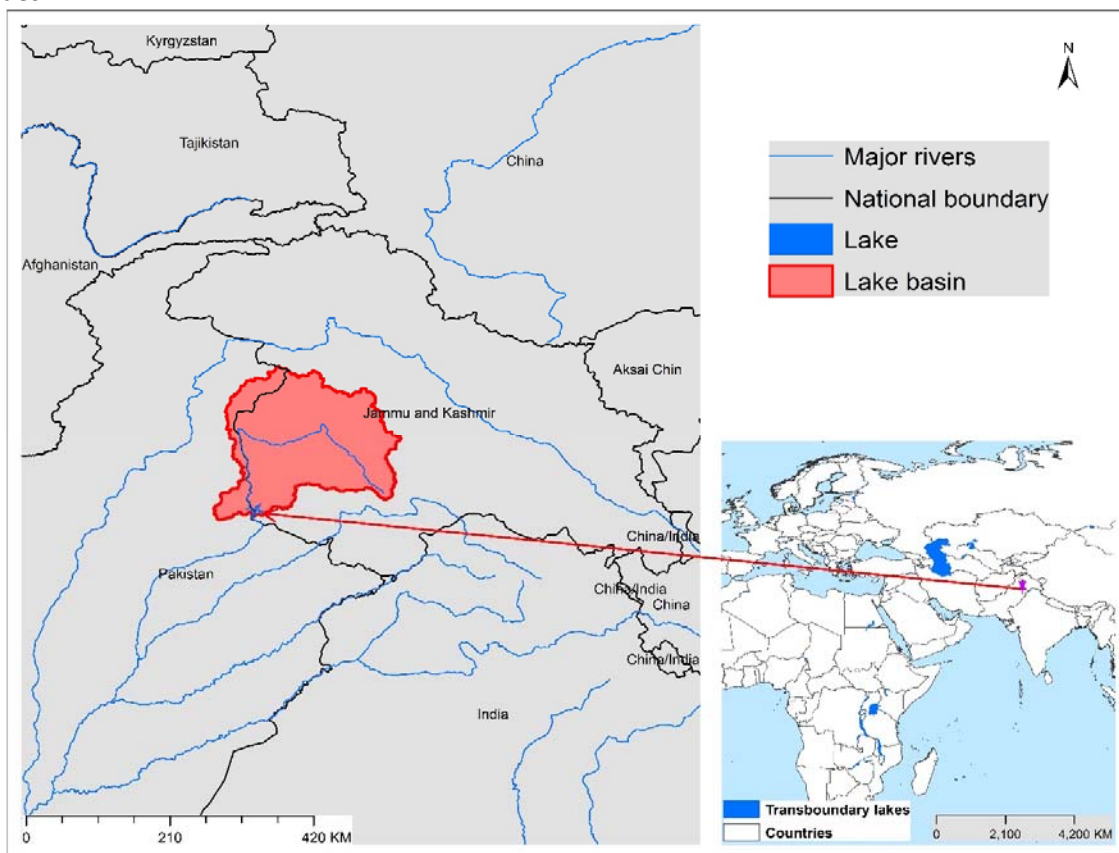
TWAP Regional Designation	Southern Asia		Lake Basin Population (2010)	9,832,974
River Basin	Indus		Lake Basin Population Density (2010; # km^{-2})	210.2
Riparian Countries	India, Pakistan		Average Basin Precipitation (mm yr^{-1})	804.3
Basin Area (km^2)	85.4		Shoreline Length (km)	266.0
Lake Area (km^2)	31,114		Human Development Index (HDI)	0.54
Lake Area:Lake Basin Ratio	0.002		International Treaties/Agreements Identifying Lake	Yes

Lake Mangla Basin Characteristics
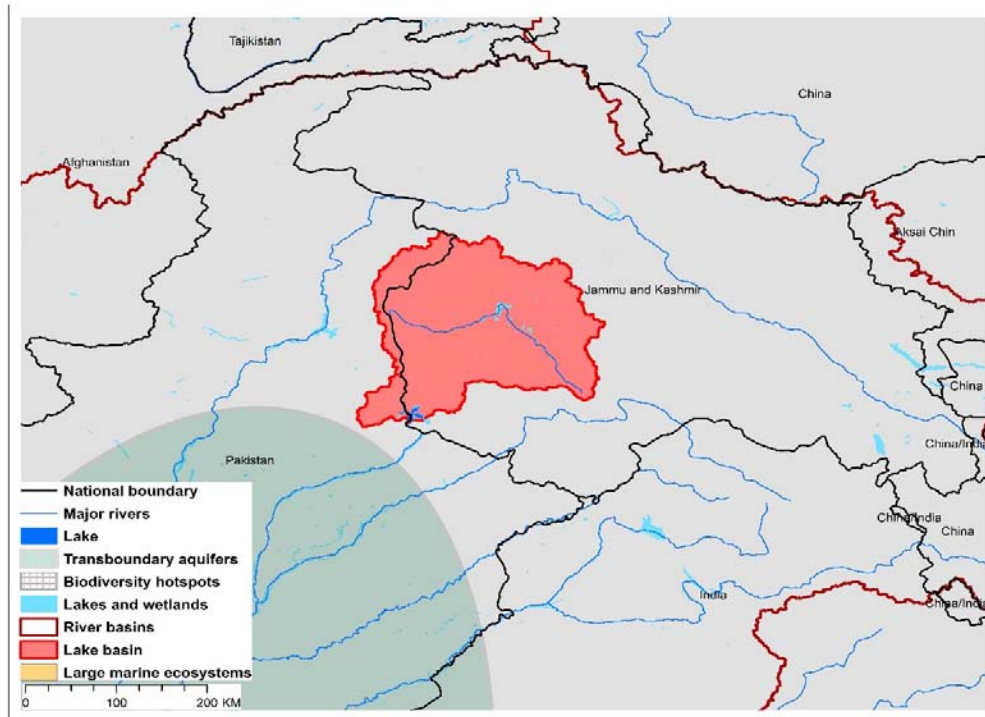
(a) Lake Mangla basin and associated transboundary water systems
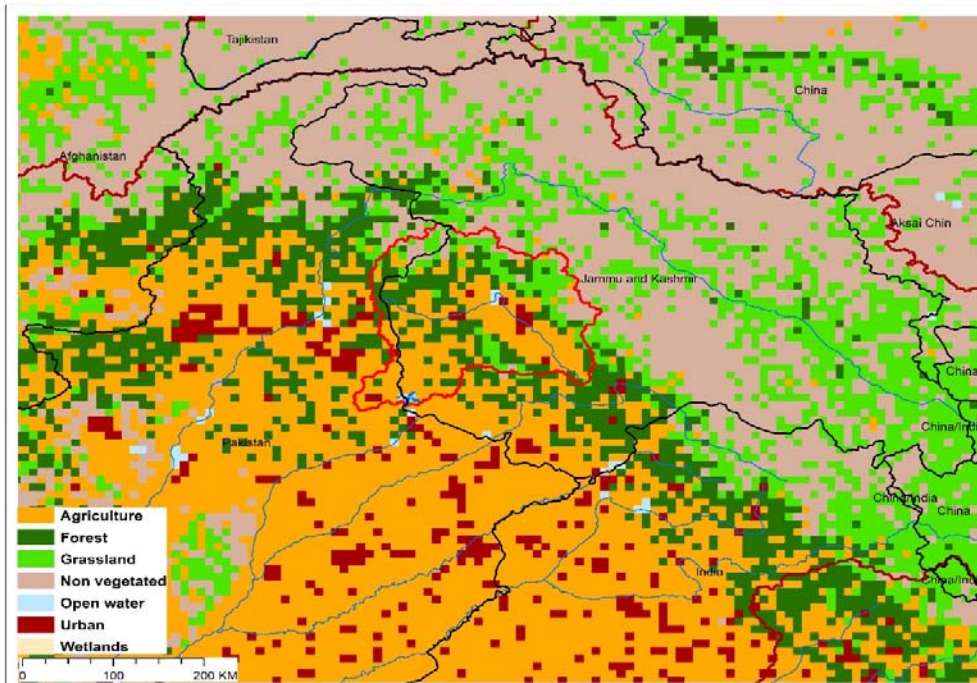
(b) Lake Mangla basin land use

Lake Mangla Threat Ranking

A serious lack of global-scale uniform data on the TWAP transboundary in-lake conditions required their potential threat risks be estimated on the basis of the characteristics of their drainage basins, rather than in-lake conditions. Using basin characteristics to rank transboundary lake threats precludes consideration of the unique features that can buffer their in-lake responses to basin-derived disturbances, including an integrating nature for all inputs, long water retention times, and complex, non-linear response dynamics.

The lake threat ranks were calculated with a spreadsheet-based interactive scenario analysis program, incorporating data and information about the nature and magnitude of their basin-derived stresses, and their possible impacts on the sustainability of their ecosystem services. These descriptive data for Lake Mangla and the other transboundary lakes included lake and basin areas, population numbers and densities, areal extent of basin stressors on the lake, data grid size, and other components considered important from the perspective of the user of the data results. The scenario analysis program also provides a means to define the appropriate context and preconditions for interpreting the ranking results.

The Lake Mangla threat ranks are expressed in terms of the Adjusted Human Water Security (Adj-HWS) threats, Reverse Biodiversity (RvBD) threats, and the Human Development Index (HDI) score, as well as combinations of these indices. However, it is emphasized that, being based on specific characteristics and assumptions regarding Lake Mangla and its basin characteristics, the calculated threat scores represent only one possible set of lake threat rankings. Defining the appropriate context and preconditions for interpreting the lake rankings remains an important responsibility of those using the threat ranking results, including lake managers and decision-makers.

Table 1. Lake Mangla Relative Threat Ranks, Based on Adjusted Human Water Security (Adj-HWS) and Reverse Biodiversity Threats, and Human Development Index (HDI) Score

(Estimated risks: red – highest; orange – moderately high; yellow – medium; green – moderately low; blue – low)

Adjusted Human Water Security (Adj-HWS) Threat Score	Relative Adj-HWS Threat Rank		Reverse Biodiversity (RvBD) Threat Score	Relative RvBD Threat Rank		Human Development Index (HDI) Score	Relative HDI Rank
0.87	16		0.38	52		0.54	25

It is emphasized that the Lake Mangla rankings above are discussed here within the context of the management and decision-making process, rather than as strict numerical ranks. Based on its geographic, population and socioeconomic assumptions used in the scenario analysis program, the calculated Adj-HWS score for Lake Mangla indicates a moderately high threat rank compared to other priority transboundary lakes.

The Reverse Biodiversity (RvBD) for Lake Mangla, which is meant to describe its biodiversity sensitivity to basin-derived degradation, places the lake in a low threat rank, compared to the other transboundary

lakes. Management interventions directed to improving the biodiversity status must be viewed with caution, however, since we lack sufficient knowledge and experience to accurately predict the ultimate impacts of biodiversity manipulations and preservation efforts. Further, the RvBD scores indicate the relative sensitivity of a lake basin to human activities, and high threat scores *per se* do not necessarily justify management interventions. Such interventions may actually increase biodiversity degradation, noting that many developed countries have already fundamentally degraded their biodiversity because of economic development activities. Thus, activities undertaken to address the Adj-HWS threats may actually degrade the biodiversity status and resources, even if the health and socioeconomic conditions of the lake basin stakeholders are improved as a result of better conditions, thereby increasing stakeholder resource consumption.

The relative Human Development Index (HDI) places the Lake Mangla basin in a medium threat rank in regard to its health, educational and economic conditions.

Table 2. Lake Mangla Threat Ranks, Based on Multiple Ranking Criteria
(Scores for Adj-HWS, RvBD and HDI ranks are presented in Table 1; the ranks may differ in some cases because of rounding of tied threat scores; Estimated risks: red – highest; orange – moderately high; yellow – medium; green – moderately low; blue – low)

Adj-HWS Rank	HDI Rank	RvBD Rank	Sum Adj-HWS + RvBD	Relative Threat Rank	Sum Adj-HWS + HDI	Relative Threat Rank	Sum Adj-HWS + RvBD + HDI	Overall Threat Rank
18	25	53	71	39	43	22	96	36

When multiple ranking criteria are considered together in the threat rank calculations, the Adj-HWS and HDI scores considered together place Lake Mangla in the upper quarter of the threat ranks. The relative threat is somewhat reduced when the Adj-HWS and RvBD threats are considered together. Considering all three ranking criteria together, Lake Mangla exhibits a moderately low threat ranking.

Further, a series of parametric sensitivity analyses of the ranking results also was performed to determine the effects of changing the importance of specific criteria on the relative transboundary lake rankings. This analysis involved increasing or decreasing the weights applied to the threat ranks derived from multiple ranking criteria to reassess the relative impacts of the weight combinations on the threat ranks. For example, in determining the sensitivity of the Adjusted Human Water Security (Adj-HWS) and Biodiversity (BD) ranking criteria, the threat rank associated with the first was assumed to be of complete (100%) importance (i.e., rank weight of 1.0), while the other was assumed to be of no (0%) importance (i.e., rank weight of 0.0). The relative importance of the two ranking criteria was then successively changed, with weight combinations of 0.9 and 0.1, 0.8 and 0.2, etc., until the first ranking criteria (Adj-HWS) was assumed to be of no importance (rank weight of 0.0) and the second (BD) was of complete importance (rank weight of 1.0). In the case of Lake Mangla, the 0.5 and 0.5 weight combinations for three cases of parametric analysis for Lake Mangla resulted in respective threat rankings of 3rd, 1st and 4th, respectively, among the total of 8 Asian transboundary lakes in the TWAP study (see Technical Report, Section 4.3.3, pp44-50).

In essence, therefore, identifying potential management intervention needs for Lake Mangla must be considered on the basis of both educated judgement and accurate representations of its situation. A fundamental question to be addressed, therefore, is how can one decide that a given management

intervention will produce the greatest benefit(s) for the greatest number of people in the Lake Mangla basin? Accurate answers to such questions for Lake Mangla, and other transboundary lakes, will require a case-by-case assessment approach that considers the specific lake situation and context, the anticipated improvements from specific management interventions, and its interactions with water systems to which the lake is linked.