

RIVER BASIN

INDUS

[INDIA]

SCHEDULE A
ASSESSMENT OF RIVER BASINS (RBs) IN SOUTH ASIA

Sr. No.	Details	Response
1	Physical Features - General Information	
1.1	Name of River basin (also indicate regional names)	English: Indus, Sindhu (India), Sindh: Mehran and Sindh, Tibetan: Sengge Chhu (Lion River), Urdu: Quama Darya
1.2	Relief Map and Index Map of RB with Country/ State/ Province boundary marked to be attached.	Refer Annexure 1
1.3	Geographical location of the place of origin (Country/District.)	Indus River rises from Mansarovar in Tibet at an elevation of about 5182 m (Source: Water Resource Ministry, India http://wrmin.nic.in/riverbasin/indus.htm)
1.4	Area (in Sq. Kms.),	Indus Basin extends over an area of 11,65,500 km ² (Source: Water Resource Ministry, India http://wrmin.nic.in/riverbasin/indus.htm)
1.5	Population (in Millions); Name of population centers/ Cities (duly marked on the map: refer 1.2) having Population -	According to a 2001 estimate (UNESCO, 2001) the population of the basin is 150 million. However, a 1991 estimate places the population at 196 million (Fahlbusch et al., 2004).
	(a) More than 0.5 Million - 1 Million	
	(b) More than 1 Million – 10 Million	
	(c) More than 10 Million	

1.6	Approximate areas of upper regime, middle regime and lower regime;	Upper Indus Basin: 181 500 sq kms (Factors Controlling Sediment Yield in a Major South Asian Drainage Basin: The Upper Indus River Basin, Northern Pakistan Khawaja Faran Ali ¹ and Dirk H. de Boer ² Centre for Hydrology, Department of Geography, University of Saskatchewan) http://www.campbellsci.ca/campbellscientific/Download/Poster_CGU_Ali_deBoer_2006.pdf Delta Region: 5000 km sq (of which 2000 sq km is protected area) (Source: http://www.iucn.org/themes/wani/flow/cases/Indus.pdf)
1.7	Country and States (Province) in which the basin lies (indicate % area covered);	Plains: India: none, Pakistan: 199667 sq km. Uplands and hills: Pakistan: 209,578 sq kms, India: 122449 sq kms, China 46461 sq kms, Afganistan : 75595 sq km,
2	Hydrological and Land use Features:	
2.1	Average annual rainfall (in mm) ;	1000 mm in southern tibet (origin), 650 mm in monsoon in Jammu, 6-7 inches in Sindh(southern Pakistan). But snowmelt is a mjoy componenet of discharge. Indus delta is one of the driest in the Indian subcontinent, lying just to the west of the Thar Desert of Rajasthan - and rainfall is extraordinarily erratic owing to the passage of cyclones from the Arabian Sea. The Punjab plains, however, receive considerable rainfall from the summer monsoon: at Abbottabad the average annual rainfall is around 1,200mm (47 inches) and at Murree around 1,700mm (67 inches) with as much as 730mm (28 inches) in July and August alone. The upper basin of the Indus receives 4-8 inches of rainfall (higher in the west) in the winter months owing to northwestern winds.

		Higher elevations in Kashmir and the Northern Areas receives a large amount of precipitation in the form of snow, but the lower valleys are extremely dry and quite warm in the summer. Annual temperatures fall below freezing in the northern mountainous regions in the winter, while exceeding 100 degrees Fahrenheit in the plains of Punjab and Sindh in the summer. Jacobabad, which is one of the hottest spots in the world, lies to the west of the river in Sindh http://en.wikipedia.org/wiki/Indus
2.2	Maximum-minimum temperatures in Degree Centigrade	46 degrees centigrade in Sindh in summers and , -10 degrees celsius in Tibetain plateau (though climate change is a consideration)
2.3	Average annual yield (discharge) of water in Cubic Meter and the average yield for last past five years	Average annual <i>inflow</i> is 175 million acre feet (Source: http://www.ce.utexas.edu/prof/mckinney/ce397/Topics/Indus/Indus(2001).doc)
2.4	Major tributaries	Ravi, Beas, Jhelum, Satluj, Chenab, Gilgit, Kabul, Zanskar
2.5	Percentage shares of major water uses & Surface and groundwater abstraction in percentages-Convert intoTable	
	(a.) Agriculture,	
	(b.) Industries,	
	(c). Domestic,	
	(d). urban,	
	e). environmental flows.	

2.6	Major cropping pattern	<p>Tibet: Spring/ Qunigke barley, Rice , WheatOver 80 per cent of the total population of Tibet is still engaged in primary sector agriculture (TIN 1999a). Farmers are mainly concentrated in valleys where they utilise fertile soil for crop cultivation, while pastoral and semi-nomads are found on plateaus and mountains suitable for raising animals.</p> <p>India: Jammu and Kashmir: Agriculture, the predominant sector of the economy of Jammu and Kashmir, supports about 80 per cent of its population. The state is divided into three agro-climatic zones: Jammu, Kashmir and Ladakh each has its own specific geo-climatic condition, which determines the cropping pattern and productivity. Rice is the chief crop of Kashmir zone, followed by maize, barley and wheat. Jammu region dominates both n maize and wheat production. In the Ladakh region, barley is the major cereal crop followed by wheat. The production of three important food crops, namely, rice, maize and wheat, contributes a major portion of the foodgrain in the state and accounts for 84 percent of the total cropped area; the balance 16 per cent is shared by inferior cereals and pulses. Nearly 75 per cent of the country's temperate fruits, mainly apples, are grown in the state. (http://planningcommission.nic.in/plans/stateplan/sdr_jandk/sdr_jkexecutive.pdf) Punjab: Zone1: Sub-mountain undulating zone:Pathankot, Ropar, Gurdaspur, Hoshiarpur,Balachaur and Patiala.</p> <p>Zone 2: Undulating plain region: Nawanshahar,Tanda, Gurdaspur, Rajpura, Machhiwara block of Ludhiana.</p>
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2.7	Cultivable area under irrigation	<p>Culturable area of the basin is about 9.6 M.ha in India(Source:http://wrmin.nic.in/riverbasin/indus.htm) in Pakistan, of the total cultivated area of 20.8 million hectares, 16.64 million hecatres is irrigated (approximately 80%) (Source: Pakistan Water Gateway)</p>
2.8	Cultivable area not under irrigation	

2.9	State other Water Uses- eg. Navigation, power, recreation etc.	Indus waters are used for numerous purposes: hydropower, navigation, recreation, ecology and religious significance.
3	Ecosystem Features	
3.1	Agro-climatic zones	<p>Tibet:</p> <p>Pakistan:</p> <p>(http://www.iwmi.cgiar.org/pubs/working/WOR24.pdf)</p> <p>Punjab Mixed Cropping (PMC)</p> <p>This zone contains nearly two million acres canal command area, mostly on the left bank of the Indus below the Jinnah barrage. The Paharpur and Chashma Right Bank canal command areas in the NWFP Province also included in this zone. The low cropping intensities and yields are due to rough topography, sandy soils and high seepage. The presence of fresh groundwater and localized waterlogging in most of the area favors the potential for tubewell development.</p> <p>Punjab Rice Wheat (PRW) This zone comprises of about 2.8 million acres, virtually all of it is underlain by fresh groundwater. This area has intensive development of tubewells. The abundance availability of water results in highest cropping intensities. The Basmati rice is the dominant cash crop. The rapid mechanization was observed due to relatively high returns to farming combined with a shortage of labour.</p> <p>Punjab Sugarcane Wheat (PSW) This area lies between PMW and PRW, and covers about 4.4 million acres. The major crops</p>

		<p>are wheat and sugarcane. About one third of the zone is saline, but the groundwater is extensively used in the rest of area. Water shortages do exist and are largely attributed to low watercourse efficiencies. Punjab Cotton Wheat (PCW) This is the largest agro-climatic zone in the Indus Basin Irrigation System, covering over 11 million acres on left bank of the Indus among Sindh Province, India, and the other Punjab zones. Cotton and wheat are dominant crops with some of the highest yields in Pakistan. Groundwater is extensively used regardless of that approximately one fourth of total area is severely saline and waterlogged.</p> <p>Sindh Cotton Wheat (SCW) It covers about 6 million acres. Nearly half of the north and most of the south is saline or waterlogged. Yields of the cultivated area are favourable. Groundwater potential through tubewell development is minimal due to saline/brackish water. Surface water supplies are hampered by high losses, particularly at watercourse level.</p> <p>Sindh Rice Wheat (SRW) About two-thirds of 4.4 million acres in the north is saline and the entire south is similarly classified. Rice is most favourable crop for that type of soil. Because of high water table cropping intensities and yields for other crops are lower, particularly in the south of the basin.</p>
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3.2	Major sub ecosystems (zoogeographical zones)	<p>Tibet Plains :The Tibetan Plateau is the highest and largest plateau on earth and towers over the central part of the continent of Eurasia. It is bounded by the Himalayan mountain chain in the south, and connected with the Altyn Tagh and Gangkar Chogley Namgyal Mountains in the north. Its western part merges with the Karakoram mountains and its eastern part slopes downward more gradually with Minyak Gangkar and Khawakarpo Mountains. (http://www.tibet.com/Eco/intro.html)</p> <p>India: Hilly region of Jammu and Kashmir, Plains of Punjab</p> <p>Sandy Desesrt of Pakistan</p> <p>Indus Delta: Magrove forests n the sindh Province, Pakistan. The present Delta covers an area of about 600,000 hectares and is characterised by 17 major creeks and innumerable minor creeks, mud flats and fringing mangroves (Meynell and Qureshi 1993). The mangrove ecosystem of theIndus Delta is perhaps unique in being the largest area of arid climate mangroves in the world.</p> <p>(http://www.iucn.org/themes/wani/econ/CaseStudy05Indus.pdf)</p>
3.3	Major soil types	Tibet: India: Pakistan: dominated by silty loams and silty clays
3.4	National parks/sanctuaries, lakes, wetlands, etc.	Hemis National Park: Jammu and Kashmir, Dolphine reserve at the Indus Delta. For more details, please refer to:The Indus River : Biodiversity, Resources, Humankind/edited by Azra Meadows and Peter S. Meadows. Delhi, Oxford University Press
3.5	Brief information about the delta region of the basin (area, location, major urban centers in the delta, etc.)	Indus delta is a vast region of about 16,000 square miles (40,000 square kilometers).The Indus Fan is the second largest sediment body in the modern oceans.

		<p>(source:http://www.who.edu/pclift/IndusDeltaProject.html)</p> <p>It is indentified as one of the critical/ endangered regions. It is home to the endangered Indus River Dolphin.(Source: http://www.worldwildlife.org/wildworld/profiles/g200/g156.html)</p> <p>Pakistan's fifth largest city, Hyderabad, lies about 130 miles north of the mouths of the Indus. Towns are found throughout the delta, but there are no large cities on the delta south of Hyderabad. (Source:http://en.wikipedia.org/wiki/Indus_River_Delta)</p>
4	Water Quality	
4.1	Prevailing water quality standards (e.g. Class I, II, III.etc, indicating permitted uses)	<p>The water quality of Indus River and its tributaries is generally considered excellent for irrigation purposes. The total dissolved solids (TDS) range from 60 mg/l in the upper reaches to 375 mg/l in the lower reaches of the Indus, which are reasonable levels for irrigated agriculture and also as raw water for domestic use. The disposal of saline drainage from various irrigation projects has been a major factor in the increased TDS in the lower reaches of the rivers in the Punjab. There is progressive deterioration downstream and the salinity is at its maximum at the confluence of the Chenab and Ravi rivers, where the TDS ranges from 207 to 907 mg/l. A slight improvement in water quality is noted further downstream at Panjnad due to dilution from the inflow from Sutlej River. The quality of the Indus water at Guddu, however, is within acceptable limits for agriculture; TDS being in the range of 164-270 mg/l.</p> <p>In the upper reaches of the Indus River, the Dissolved Oxygen</p>

		(DO) content remains above 8.5 mg/l which is well above the acceptable levels of 4 mg/l. The Biochemical Oxygen Demand (BOD) downstream of Attock has been recorded as 2.9 mg/l. At Kotri, it has a SS content of 10 to 200 mg/l. Indus River water quality has been studied at the Dadu Moro Bridge and Kotri Barrage, with nitrate levels at 1.1 and 7.5 mg/l, phosphate at 0.02 and 0.3 mg/l, BOD at 2.4 and 4.1 mg/l, faecal coliforms at 50 and 400 per ml, and aluminium at 1.8 and 0.2 mg/l respectively. Due to industrial waste discharges from Punjab and Sindh, a high content of heavy metals such as nickel, lead, zinc and cadmium have also been found in Indus water.
4.2	Stretches (along the River) in Kms	
4.3	Sources of Pollution, with data indicating quantum and/or severity.	
4.4	Prevailing abatement techniques e.g: ETP, STP, legislation,etc.	
5	Current status of the resource development & potential for development	
5.1	Water availability: a. Per capita water availability (in lpcd)	Per capita water availability in Pakistan is slowly reaching the scarcity threshold. In 2004, the availability was just about 1000 cubic meters per capita per year. Pakistan depends almost entirely on the Indus river system . (Source: http://www.southasianmedia.net/Magazine/journal/11_water_management.htm)
	b. Per hectare water availability (in Cubic meters for cultivable command area):	

	c. Availability of environmental flows (Current reserve, if any):	There is no current reserve, and the freshwater inflow to the lower Indus has been decreasing rapidly , affecting ecosystems and livelihoods. Thus there is an urgent need for allocating Environmental flows. (For more information, please refer:THE LOWER INDUS RIVER: BALANCING DEVELOPMENT AND MAINTENANCE OF WETLAND ECOSYSTEMSAND DEPENDENT LIVELIHOODS, IUCN, c 2001)
	d. Availability of ground water/ Average annual ground water abstraction/recharge.	In Pakistan, there are presently about 300,000 tubewells in the Indus Basin Irrigation System and the annual pumpage in all canal command areas has been estimated to be 50 bcm.Analysis of piezometric data shows that groundwater pumping is largely replenished by canal waters and rainfall in most canal commands, except for five in which annual decline in groundwater level is more than 10 cms. (Source: WATER AVAILABILITY AND SOME MACRO LEVEL ISSUES RELATED TO WATER RESOURCES PLANNING AND MANAGEMENT IN THE INDUS BASIN IRRIGATION SYSTEM IN PAKISTAN,Asim R. Khan,)
5.2	Structures: a. Major dams/barrages (with utilization categories):	In Pakistan:Tarbela Dam and Ghazi Barotha Hydro Power Project ,Jinnah Barrage (950,000 cusecs),Chashma Barrage (1.1 million cusecs), Taunsa Barrage (750,000 cusecs), Guddu Barrage (1.2 million cusecs), Sukkur Barrage (1.5 million cusecs) and Kotri Barrage (750,000 cusecs) (Source: Pakistan Water Gateway: Indus Basin). India: Live storage Capacities of structures on Indus in India:completed projects 13.8 km ³

		(Source: http://www.waterinfo.net.pk/fsib.htm)
	b. Proposed dams:	
	c. Live storage of major dams:	Please refer to 5.2
	d. Live storage through proposed dams:	
	e. Inter basin transfer systems:	Data not found
	f. Any Other:	
5.3	Command area of major dams	
5.4	Agencies functioning in the basins: a. Public agencies/ CSOs which construct/ implement the infrastructures projects: b. Private agencies/ CSOs involved in infrastructure development	Central Water Commission, Government of India, Ministry of Water and Power, Pakistan and respective state irrigation/ water resources departments.
6	Existence of National/State/Provincial Laws or Notifications relating to water- Management / use/development/opportunity for private sector participation or for privatization of water resources	
7	Key Issues:	Water conflicts between India and Pakistan over water sharing of Indus and its tributaries. Deforestation of the upper reaches of the river leading to sedimentation and high runoff. Water scarcity, especially in the lower Indus basin.

8	Enabling instruments- Law/ Policy/ Economic & Financial Measures for introducing IWRM in the basin	<p>Indus River System Treaty enshrined Indian right to store limited quantity of water on River Jhelum and this was for irrigating 3.6 million-acre area.(The Indus Water Treaty which was signed on September 19, 1960, divided the six rivers of Punjab between India and Pakistan. India got unrestricted use of the Beas, the Ravi and the Sutlej, and Pakistan got the three western rivers of Chenab, Indus and Jhelum. The Treaty also allows either country to have restricted access for domestic and agricultural use, generation of hydroelectric power through a "run-of-the-river" project, and non-consumptive use including navigation - provided the same quantum of water is returned to the river.). There were plans to initiate Jhelum River Conservation Plan.The plan deals with treating catchments area of the river from Veerinag to the Wullar Lake. Funds for this purpose would also be provided under the Prime Ministers' package.(Source:http://www.tribuneindia.com/2003/20030521/j&k.htm)</p>
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