

PAKISTAN

WATER & POWER DEVELOPMENT AUTHORITY



WAPDA'S DEVELOPMENTAL PLAN

WATER AND POWER SECTOR DEVELOPMENT

- Irrigated agriculture is the backbone of Pakistan's economy. The agriculture sector is the major user of water and its consumption will continue to dominate the water requirements. Direct rainfall contributes less than 15 percent of the water supplied to the crops. The major user of water for irrigation is the Indus Basin Irrigation System. About 105 Million Acres Feet (MAF) out of 155 MAF of surface water is being diverted annually for irrigation while around 48 MAF is pumped from groundwater.
- Pakistan has a total 196.72 MA area out of that 72.70 is cultivable. The cultivated area (Irrigated & Barani) has come to 52.31 MA, whereas 47.62 MA is area under all sort of irrigation sources. (27 MA is the area under canal irrigation).
- With large cultivable land base of 77 Million Acres (MA) of which only 27 MA are canal commanded, Pakistan still has the additional potential of bringing about 20.39 MA of virgin land under irrigation.
- With increased population, Pakistan is fast heading towards a situation of water shortage Per capita surface water availability was 5260 cubic meters in 1951 when population was 34 million, which reduced to 1038 cubic meter in 2010 when the estimated population is 172 million. The minimum water requirement to being a "water short country" is 1,000 cubic meters. In the year 2012, Pakistan will have reached the stage of " acute water shortage"

WATER AND POWER SECTOR DEVELOPMENT

- According to the 1960 Indus Water Treaty, signed between India and Pakistan with the good offices of World / Bank, India was allowed exclusive rights to use waters of Ravi, Sutlej and Beas rivers, whereas the waters of Western Rivers, Indus, Jhelum and Chenab were assigned to Pakistan. Under the 1960 Treaty, the Indus Basin Replacement Works comprising two major dams, 5 barrages and 8 link canals were constructed to alleviate the problems. However, due to excessive sediment inflows in the river water, all the three storages (Tarbela, Mangla, Chashma) are rapidly losing their capacities. By the year 2025, these storages would lose 37% (6.27 MAF) of their capacity, which virtually means loss of one mega storage project.
- An annual average of over 35.2 MAF escapes below Kotri varying from 9 MAF to 92 MAF. However this surplus water in the river system is available in about 70-100 days of summer only. To save and utilize available water, construction of additional storage facilities is essential for sustainable irrigated agriculture, which supports about 70% of the population of Pakistan.
- National demand of electricity has been and would keep on growing rapidly. Based on the present generation capacity, the hydel:thermal mix in the country is 34:66, which is almost the reverse of an ideal hydel - thermal mix, which should be 70:30 for overall economic development of the Pakistan. Though induction of thermal generation initially helped in overcoming load shedding, it resulted in substantial increase in power tariff. Therefore, a sizeable injection of cheap hydropower through multipurpose storages is a viable option to keep the cost of electricity within affordable limits.

WATER AND POWER SECTOR DEVELOPMENT

- To facilitate the process of economic development and to ensure greater social stabilization in Pakistan, it is imperative that employment creation and poverty reduction issues are addressed on priority. Additional water storages and power generation would form the basis of this strategy during the next decade.
- At present the rated electric power generating capacity in Pakistan is only 18000 MW with the demand growing at 10% annually. The average per capita consumption is only 482 units. Power shortage in the industrial, agricultural and domestic sectors has been evident for the past few years with the shortage assuming critical proportions last year. The water shortage is even more acute. To feed a population of nearly 172 million people, existing water storage capacity of 15 Million Acre Feet (MAF) needs to be tripled in the years ahead so that the remaining 20 million acres of cultivable land can be brought under plough. Water conservation and increased water productivity must also be encouraged.

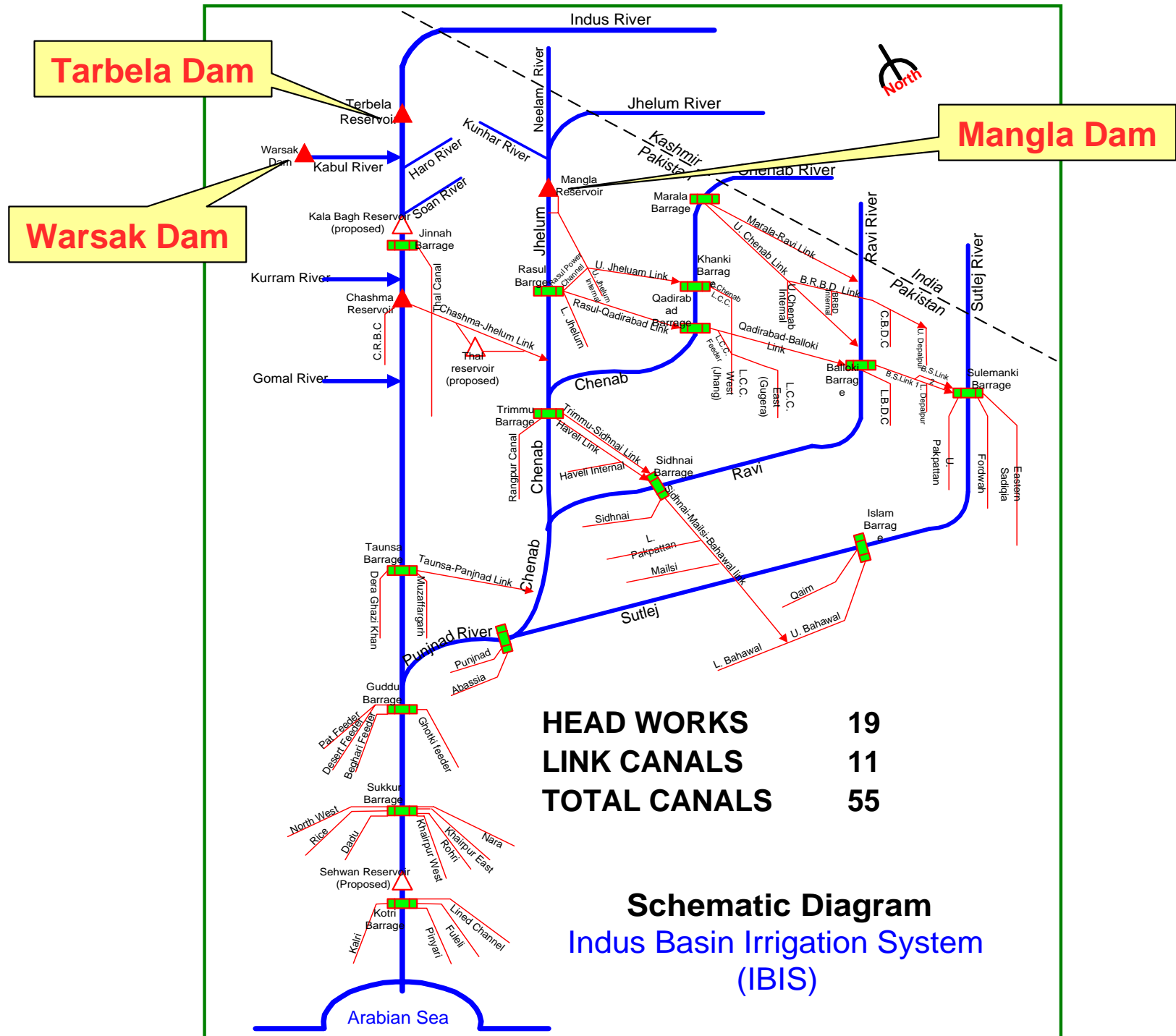
WATER AND POWER SECTOR DEVELOPMENT

- It is an economically unsustainable fact that the total water storages capacity in the country is only 15 MAF representing 13% of the total annual flows of 136 MAF. Countries in Asia, Africa and the Americas have a storage capacity many times greater. To address this problem the Government of Pakistan (GoP) is developing feasibility and detailed engineering studies for nearly 20 MAF of water storage and 25,000 MW of hydel power. This is apart from thermal power being developed by the private sector, Independent Power Producers (IPPs) and the Government.
- To achieve the above objectives the GoP through WAPDA and the private sector plans to concentrate on the following water and power projects in the next few years: (i) Construction of large dams including Diamer-Basha Dam for Public/Private Partnership (ii) Construction of Medium/ Small Water Storage Dams (iii) Construction of Hydropower Projects (iv) Construction of Canals (v) Protection of Irrigation Infrastructure (vi) Water Conservation Strategies. These projects would create additional water storages, generate cheap indigenously developed electricity and prevent flood damages. All these measures would also ensure food security, employment generation and above all poverty alleviation.

WAPDA's Fifty Years (1958 – 2008)

- **Construction of major Water infrastructure:**
 - **Completion of Indus Basin Replacement Projects**
 - 5-Barrages (Sidhnai, Mailsi Siphon, Qadirabad, Rasul & Chashma), 8 inter-river Link Canals (Trimmu-Sidhnai, Sidhnai-Mailsi, Mailsi-Bahawal, Rasul-Qaidrabad, Qadirabad-Balloki, LCC Feeder, Balloki-Sulemanki, Chashma-Jhelum, Taunsa-Panjnad), Mangla and Tarbela Dams
 - **SCARPS Program (over 70 SCARPS)**
 - **Ghazi Barotha Hydropower Project**
 - **Development of Water Resources under WAPDA Vision 2025**
 - 5-Dams (Mangla Dam Raising, Mirani, Sabakzai, Gomal Zam & Satpara), 3-Mega Canals (Raineer, Kachhi & Greater Thal), 5-Hydropower Projects (Allai Khwar, Khan Khwar, Duber Khwar, Jinnah, Neelum-Jhelum), 2-Drainage Projects - RBOD I & III (under implementation), **25000 MW Electricity (Under study)**
- **Expertise development in water & power engineering**

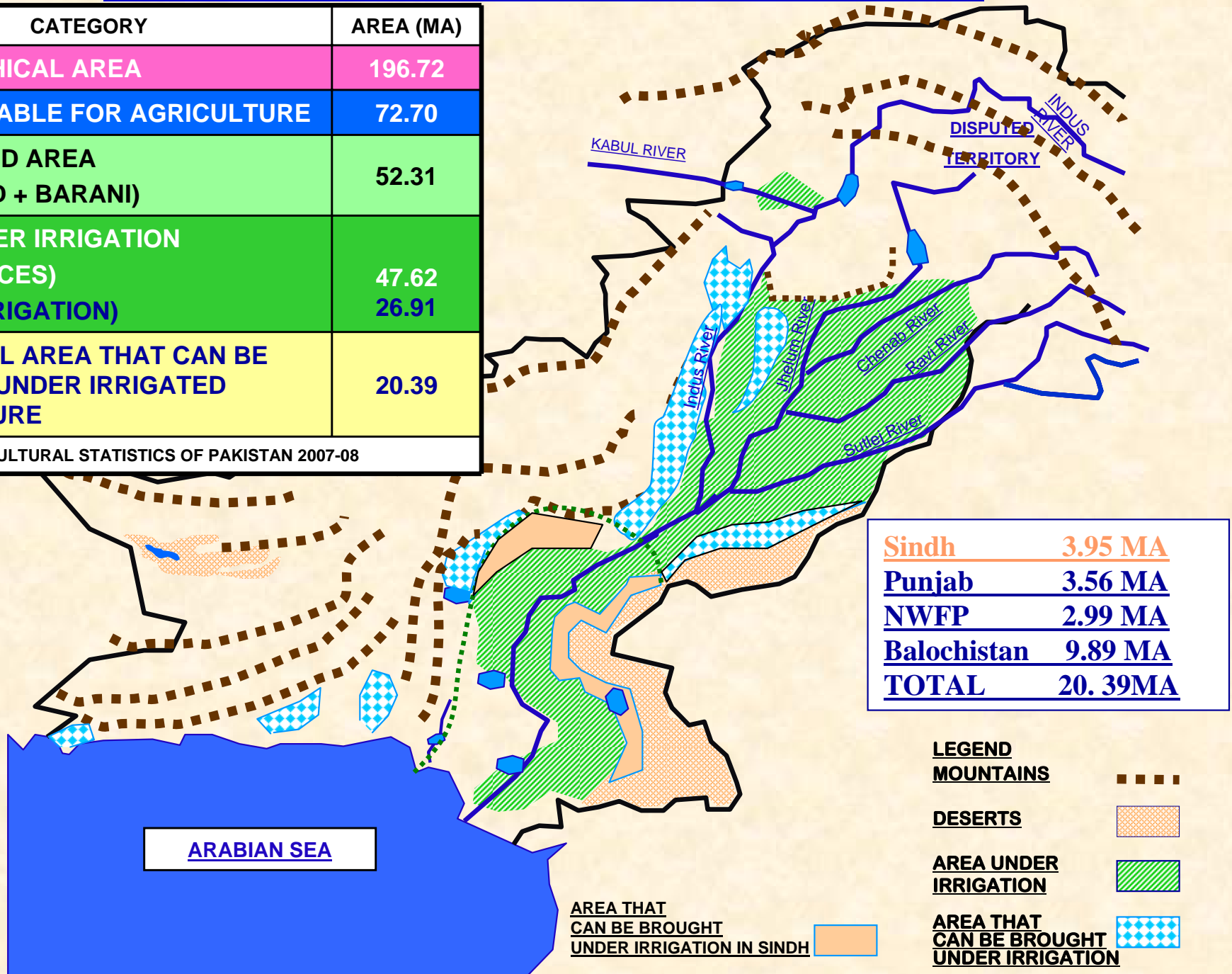
INDUS BASIN IRRIGATION SYSTEM



LAND USE IN PAKISTAN

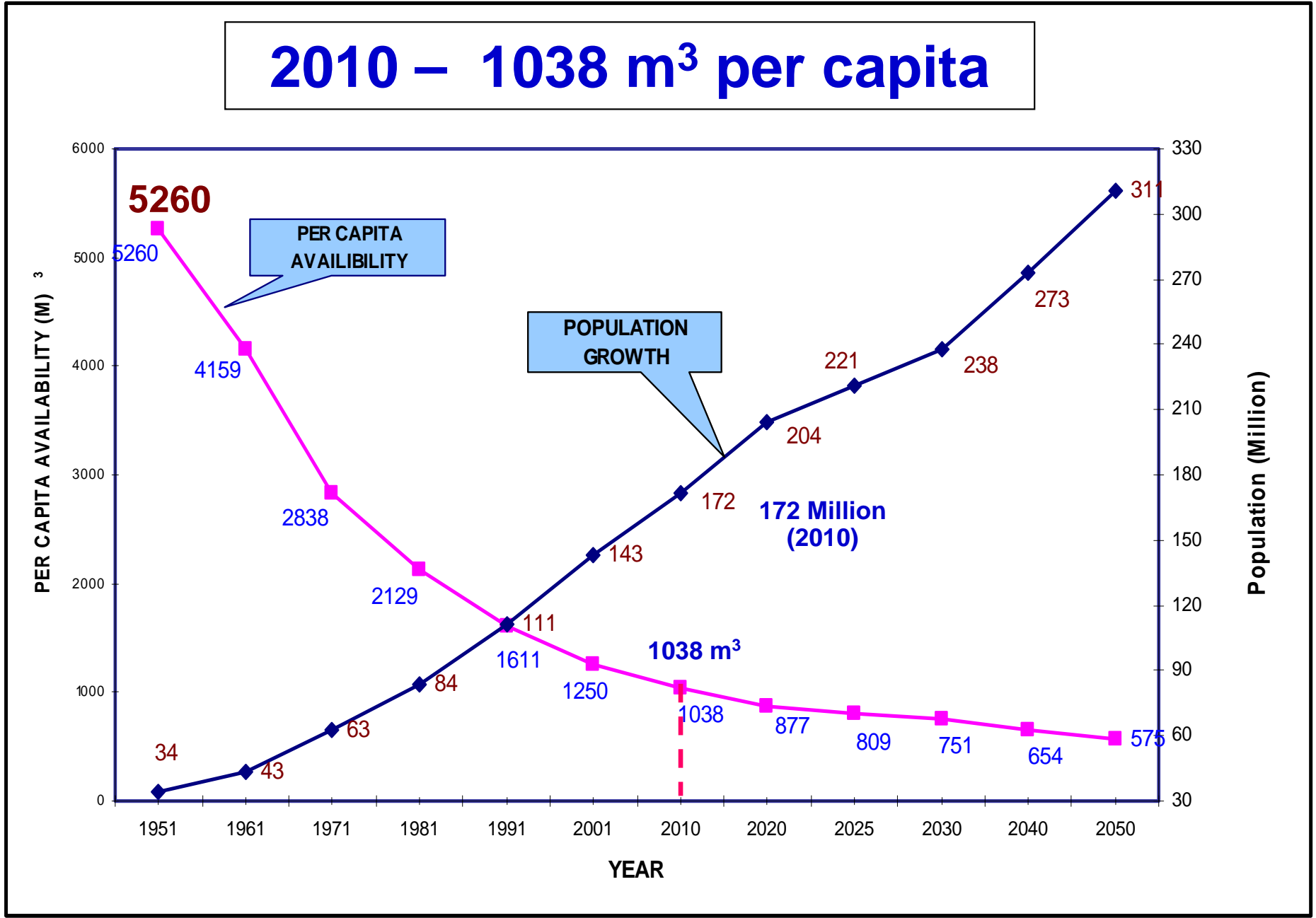
CATEGORY	AREA (MA)
GEOGRAPHICAL AREA	196.72
AREA SUITABLE FOR AGRICULTURE	72.70
CULTIVATED AREA (IRRIGATED + BARANI)	52.31
AREA UNDER IRRIGATION (ALL SOURCES)	47.62
(CANAL IRRIGATION)	26.91
ADDITIONAL AREA THAT CAN BE BROUGHT UNDER IRRIGATED AGRICULTURE	20.39

SOURCE: AGRICULTURAL STATISTICS OF PAKISTAN 2007-08



WHERE DOES PAKISTAN STAND IN WATER AVAILABILITY vis-a-vis POPULATION

2010 – 1038 m³ per capita



As per global criteria, 1000 m³ per capita is the threshold value

RESERVOIR SEDIMENTATION (MAF)

RESERVOIR	LIVE STORAGE CAPACITY		LIVE STORAGE LOSS		
	ORIGINAL	YEAR 2009	YEAR 2009	YEAR 2012	YEAR 2025
TARBELA	9.68 (1974)	6.78 (70%)	2.90 (30%)	3.18 (33%)	4.30 (44%)
MANGLA	5.34 (1967)	4.46 (83%)	0.88 (17%)	0.90 (17%)	1.14 (21%)
CHASHMA	0.72 (1971)	0.37 (51%)	0.35 (49%)	0.29 (40%)	0.38 (52%)
TOTAL	15.74	11.61 (74%)	4.13 (26%)	4.37 (28%)	5.82 (37%)

NEW STORAGES CURRENTLY BEING DEVELOPED/EXAMINED

UNDER IMPLEMENTATION	
MANGLA DAM RAISING – AJK	2.88 MAF
DIAMER-BHASHA – NA/NWFP	6.40 MAF
GOMAL ZAM - FATA	0.89 MAF
KURRAM TANGI - FATA	0.90 MAF
	11.07 MAF

IN PLANNING STAGE	
DASU – NWFP	0.8 MAF
MUNDA – FATA	0.8 MAF
AKHORI – PUNJAB	6.0 MAF
SHYOK – N / Areas	5.0 MAF
Total:	12.6 MAF

WATER DEVELOPMENT POTENTIAL

DOWN STREAM KOTRI AVERAGE ANNUAL FLOWS

1976-2000	32.3 MAF
2001-2008	12.3 MAF

DOWN STREAM KOTRI AVERAGE ANNUAL FLOWS (1976-2008) 32.3 MAF

ANTICIPATED USES

- **Down stream Kotri requirement 8.6 MAF**
(3.6 MAF + 5 MAF)
@ 5000 cusecs round the year
- **Mangla Dam Raising Project 2.9 MAF**
- **Afghanistan uses on River Kabul -**
- **Indian future uses on Western rivers 2.0 MAF**
(Based on area indicated in Indus Water Treaty)

NET AVAILABLE FOR DEVELOPMENT 18.8 MAF

After Diamer Basha Dam Project 12.4 MAF

MAJOR WAPDA PROJECTS COMPLETED 2000-2009

- **Ghazi Barotha Hydropower Project US\$ 2250 Million**
- **Mirani Dam Project Rs. 5811 Million**
- **Sabakzai Dam Project Rs. 2005 Million**

MAJOR WAPDA PROJECTS UNDER EXECUTION

DAMS

- Mangla Dam Raising
- Gomal Zam Dam
- Satpara Dam
- Kurram Tangi Dam

CANALS

- Raineer Canal
- Kachhi Canal
- Greater Thal Canal

DRAINAGE PROJECTS

- RBOD-I
- RBOD-III

HYDROPOWER PROJECTS

- Allai Khwar
- Khan Khwar
- Duber Khwar
- Jinnah
- Neelum-Jhelum

WATER SECTOR PROJECTS UNDER STUDY

STORAGES

- | | |
|---------------------------------|-------------------------------|
| • Di Amer Basha Dam | Ready for Construction |
| • Kurram Tangi Dam | -do- |
| • Akhori Dam | Under Study |
| • Sukleji Dam | -do- |
| • Sehwan Barrage Complex | -do- |
| • Munda Dam Project | -do- |
| • Shyok Dam Project | -do- |
| • Yulbo Dam Project | -do- |

CANALS

- | | |
|--|-------------|
| • Chashma Right Bank Canal
(Lift-cum-Gravity) | -do- |
|--|-------------|

Irrigation of Skardu / Bunji Plains **-do-**

Training & Capacity Building **-do-**

HYDROPOWER PROJECTS UNDER STUDY

Project

Diamer-Basha

Golen Gol

Kohala

Tarbela 4th Ext.

Dasu

Bunji

Phandar

Palas Valley

Spat Gah

Basho

Keyal Khwar

Lawi

Harpo

Thakot HPP

Pattan

Yulbo

Shyok

**Refurbishment/Rehabilitation of
Mangla Power House**

River

Indus

Golen Gol-Mastuj

Jhelum

Indus

Indus

Indus

Ghizar

Chor Nullah

Spat Gah

Basho

Keyal Khwar

Shishi

Harpo Lungma

Indus

Indus

Indus

Shyok

Jhelum

HYDROPOWER PROJECTS WHICH CAN BE UNDERTAKEN FOR EXECUTION DURING NEXT FIVE YEARS

<u>PROJECT</u>	<u>RIVER</u>
Di Amer Basha Dam	Indus
Kohala	Jhelum
Bunji	Indus
Munda	Swat
Dasu	Indus
Patan	Indus
Others (Matiltan, Palas Valley etc.)	

32 SMALL/MEDIUM DAMS IN PAKISTAN

PHASE-I – (2009-2012)

<p><u>BALUCHISTAN</u></p> <ul style="list-style-type: none"> •Hingol Dam - (3 MW) US\$ 263 M •Naulong Dam - (4.4 MW) US\$ 146 M •Winder Dam – (0.3 MW) US\$ 21 M •Pelar Dam – (0.72 MW) US\$ 21 M •Garuk Dam – (0.72 MW) US\$ 22 M 	<p><u>NWFP</u></p> <ul style="list-style-type: none"> •Bara Dam – (5.8MW) US\$ 178 M •Daraban Zam Dam – (0.75 MW) US\$ 34 M
<p><u>SINDH</u></p> <ul style="list-style-type: none"> •Nai Gaj Dam - (4.2 MW) US\$ 212 M •Darawat Dam – (0.45 MW) US\$ 40 M •Sita Dam Project – (0.15 MW) US\$ 49 M 	<p><u>PUNJAB</u></p> <ul style="list-style-type: none"> •Ghabir Dam – (0.15 MW) US\$ 14 M •Papin Dam – (0.2 MW) US\$ 27 M
<p><i>Phase-I – Estimated Cost = US\$ 1026 Million</i></p>	

PHASE-II – (2010-2013)

<p><u>BALUCHISTAN</u></p> <ul style="list-style-type: none"> •Sukleji Dam •Basol Dam •Badinzai Dam •Purali Dam 	<p><u>NWFP</u></p> <ul style="list-style-type: none"> •Chaudwan Zam Dam •Tank Zam Dam •Sheikh Haider Dam •Chashmai Akor Dam •Chowkas Dam •Totakan Dam •Kuhai Dam •Siran Dam
<p><u>SINDH</u></p> <ul style="list-style-type: none"> •Salari Dam •Nali Dam •Khenji Dam •Naing Dam 	<p><u>PUNJAB</u></p> <ul style="list-style-type: none"> •Kot Fateh Dam •Mujahid Dam •Lawa Dam •Mohra Shera Dam •Jamalwal Dam
<p><i>Feasibility study, detailed design under process</i></p>	

PAKISTAN'S HYDROPOWER POTENTIAL (RIVERWISE SUMMARY)

Sr. No.	River/ Tributary	Power (MW)
1.	Indus River	37780
2.	Tributaries of Indus (Northern Areas) & NWFP	6006
	Sub Total (1+2)	44746
3.	Jhelum River	3143
4,	Kunhar River	1435
5.	Neelum River & its Tributaries	1844
6.	Poonch River	397
	Sub Total (3+4+5+6)	6819
7.	Swat River & its Tributaries	2371
8.	Chitral River & its Tributaries	2282
	Sub Total (7+8)	4653
9.	Schemes below 50 MW on Tributaries	1055
10.	Schemes below 50 MW on Canals	408
	Sub Total (9+10)	1463
	TOTAL	57681

CONSTRUCTION SCHEDULE FOR 20000 MW HYDROPOWER GENERATION

#	Name of Project	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
1	Diamer Basha		■	■	■	■	■	■	■	■	■	■	■					
2	Golen Gol	■	■	■	■													
3	Kurram Tangi		■	■	■	■												
4	Munda				■	■	■	■	■	■								
5	Kohala				■	■	■	■	■									
6	Keyal Khwar		■	■	■	■	■	■	■									
7	Phandar					■	■	■	■	■								
8	Basho					■	■	■	■									
9	Lawi		■	■	■	■	■	■	■									
10	Dasu						■	■	■	■	■	■	■	■				
11	Bunji								■	■	■	■	■	■	■	■		
12	Akhori												■	■	■	■	■	■
13	Lower Spatgah									■	■	■	■	■				
14	Palas Valley										■	■	■	■	■	■		
15	Tarbela 4th Ext.			■	■	■												
16	Rehabilitation of Mangla Power House		■	■	■	■												
17	Training & Capacity Building			■	■	■	■											

SMALL/MEDIUM DAMS PHASE-I (2009–2012)

Sr #	Project	2009	2010	2011	2012	2013	
1	Hingol Dam	—————					
2	Naulong Dam	—————					
3	Winder Dam	—————					
4	Pelar Dam	—————					
5	Garuk Dam	—————					
6	Nai Gaj Dam	—————					
7	Darawat Dam	—————					
8	Sita Dam	—————					
9	Bara Dam	—————					
10	Daraban Zam Dam	—————					
11	Ghabir Dam	—————					
12	Papin Dam	—————					

SMALL/MEDIUM DAMS

PHASE-II (2010–2013)

Sr #	Project	2009	2010	2011	2012	2013	2014
1	Sukleji Dam						
2	Basol Dam						
3	Badanzai Dam						
4	Salari Dam						
5	Nali Dam						
6	Khenji Dam						
7	Naing Dam						
8	Chaudwan Zam Dam						
9	Tank Zam Dam						
10	Sheikh Haider Dam						
11	Chashmai Akor Dam						
12	Chowkas Dam						
13	Totakan Dam						
14	Kuhai Dam						
15	Siran Dam						
16	Kot Fateh Dam						
17	Mujahid Dam						
18	Lawa Dam						
19	Mohra Shera Dam						
20	Jamalwal Dam						