SOAN DAM PROJECT

Presented by

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Fasten your seatbelts for

- $90 billion of new economy per year
- Up to 38 MAF low cost storage
- 5000+ MW hydel power
- Perfect flood control and flood harvesting
- Reliable environmental flow from upper Indus to Arabian sea
- De Silting of Tarbela
- Efficient large scale farming
- **Millions** of new jobs

Figure-1: Surface water in Pakistan

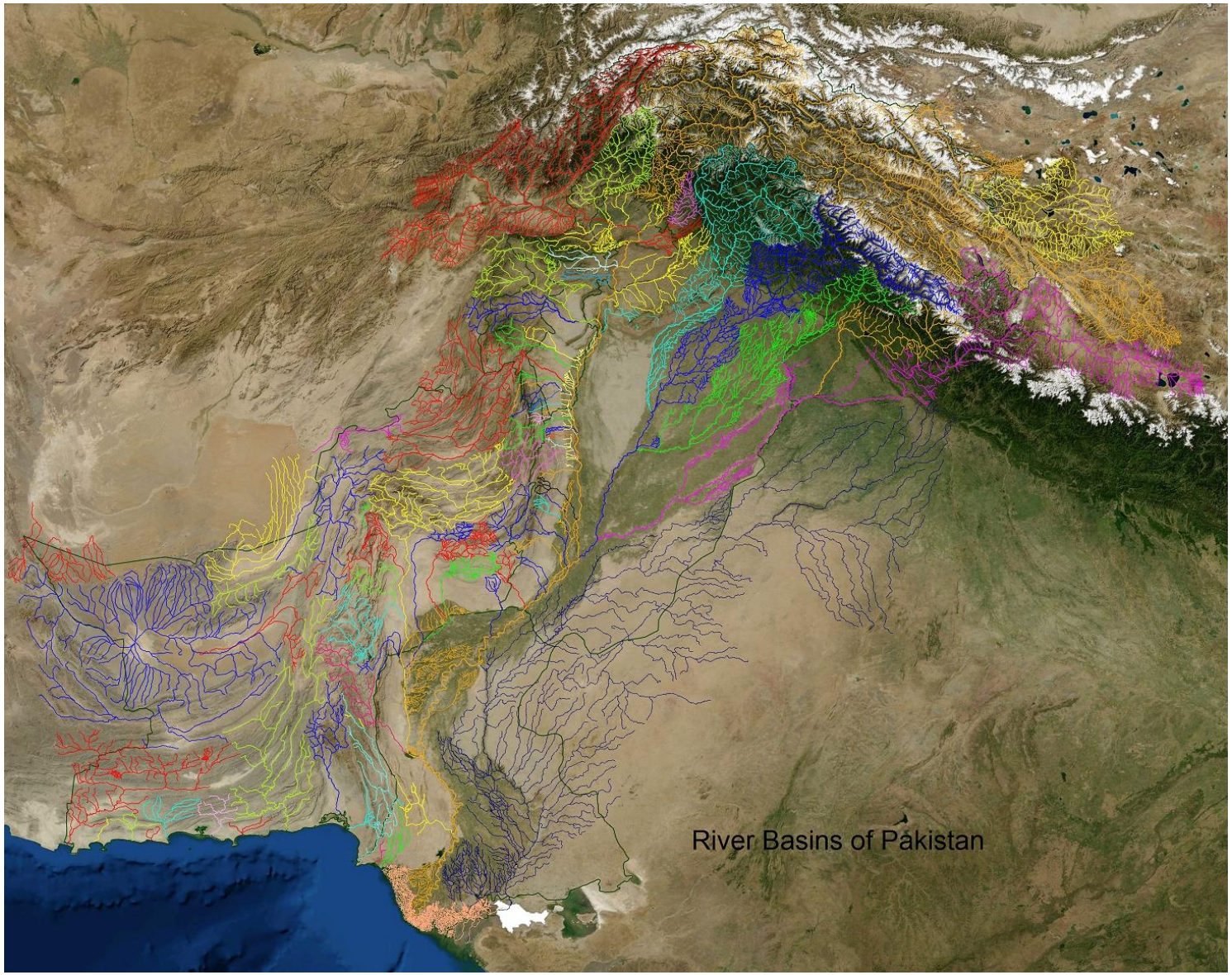


Figure-2: Total Water 138-142 MAF

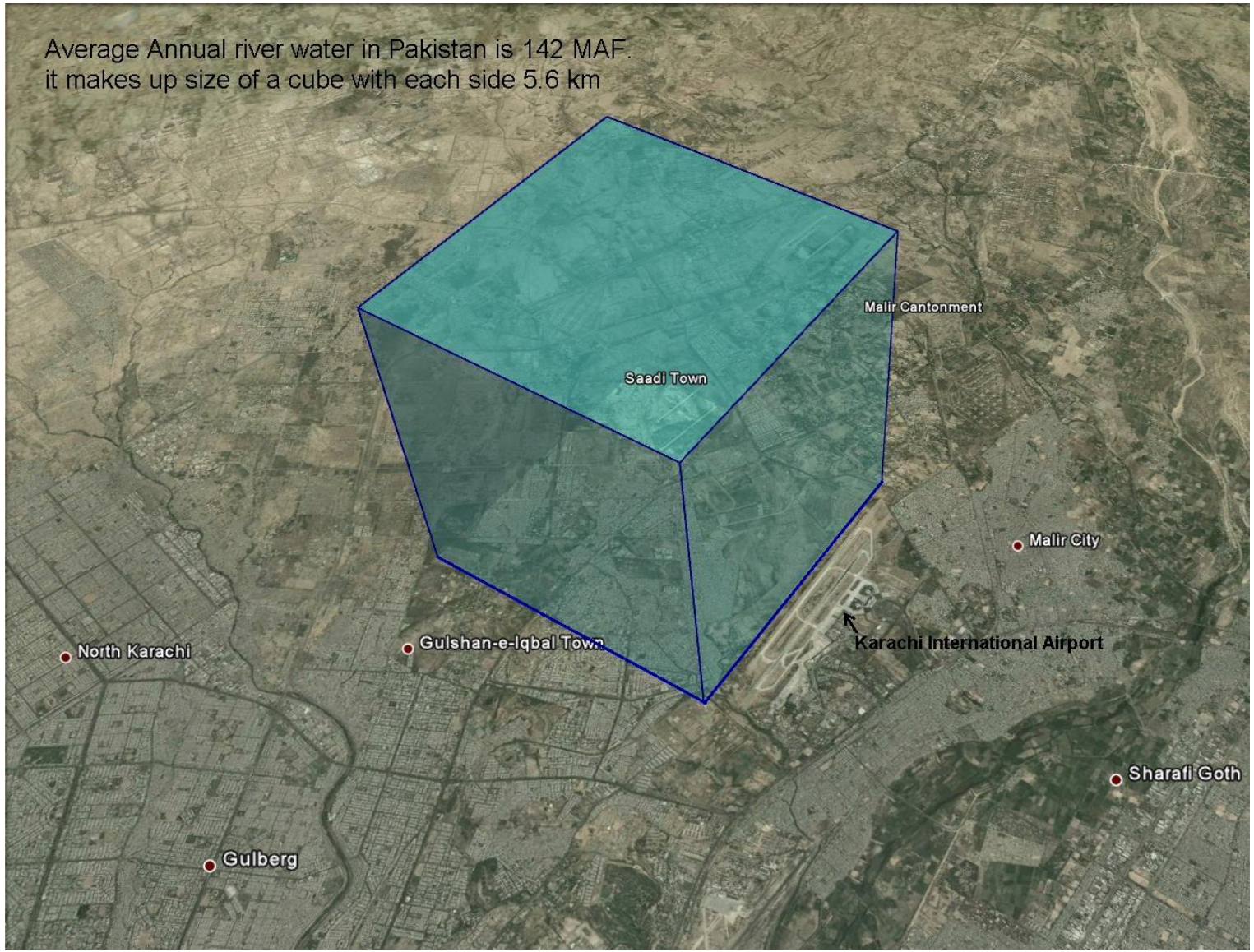
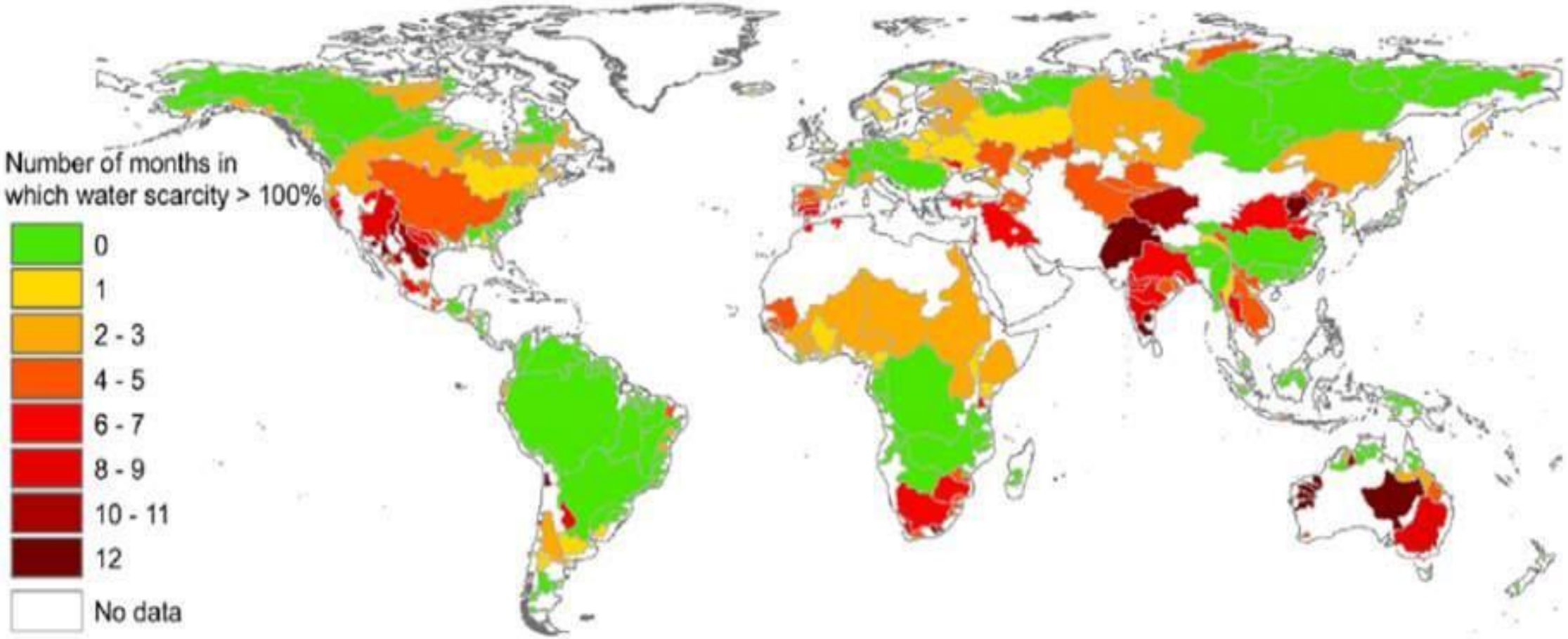


Figure-3: Total Water

Figure-4: Water stress map



Why more storage?

- Skewed flow of rivers. (80% water flows in 100 flood days)
- Environmental Flow. 300+ dry days below Kotri
- Flood control. Damage of uncontrolled floods
- Cropping pattern: winter staple crops demand
- Growing energy demand
- Water quality.
- Depleting storage
- Climate, Shrinking winter, GLOF.
- Demographic changes. 220 million, 450 million by 2050

How much storage is needed

- 2015 IMF report
  - By 2025, demand-supply gap of water in Pakistan will reach approximately 83 MAF.

- Department of Irrigation and Water Management Research Centre, University of Agriculture Faisalabad
  - Pakistan will face 31% water shortage by 2025 if water reserves are not increased by 35 MAF (Link)

How much storage is needed?

- 31 MAF Shortfall by 2025
  - https://tribune.com.pk/story/1173339/water-scarcity-pakistan-pressing-ever/
- IRSA
  - Pakistan dumps $21bn worth of water in the sea each year: IRSA

- Water worth 45 billion dollars being wasted annually

Storage options

- Diamer Basha Dam : 6.4 MAF
- Kalabagh Dam: 6.1 MAF
- Akhori Dam: 6.0 MAF
- Kurram Tangi Dam: 0.9 MAF
- Soan Dam at Dhok Pathan: 38.4 MAF
  - A difference of “Order of Magnitude”

Figure-5: Storage Capacity comparison

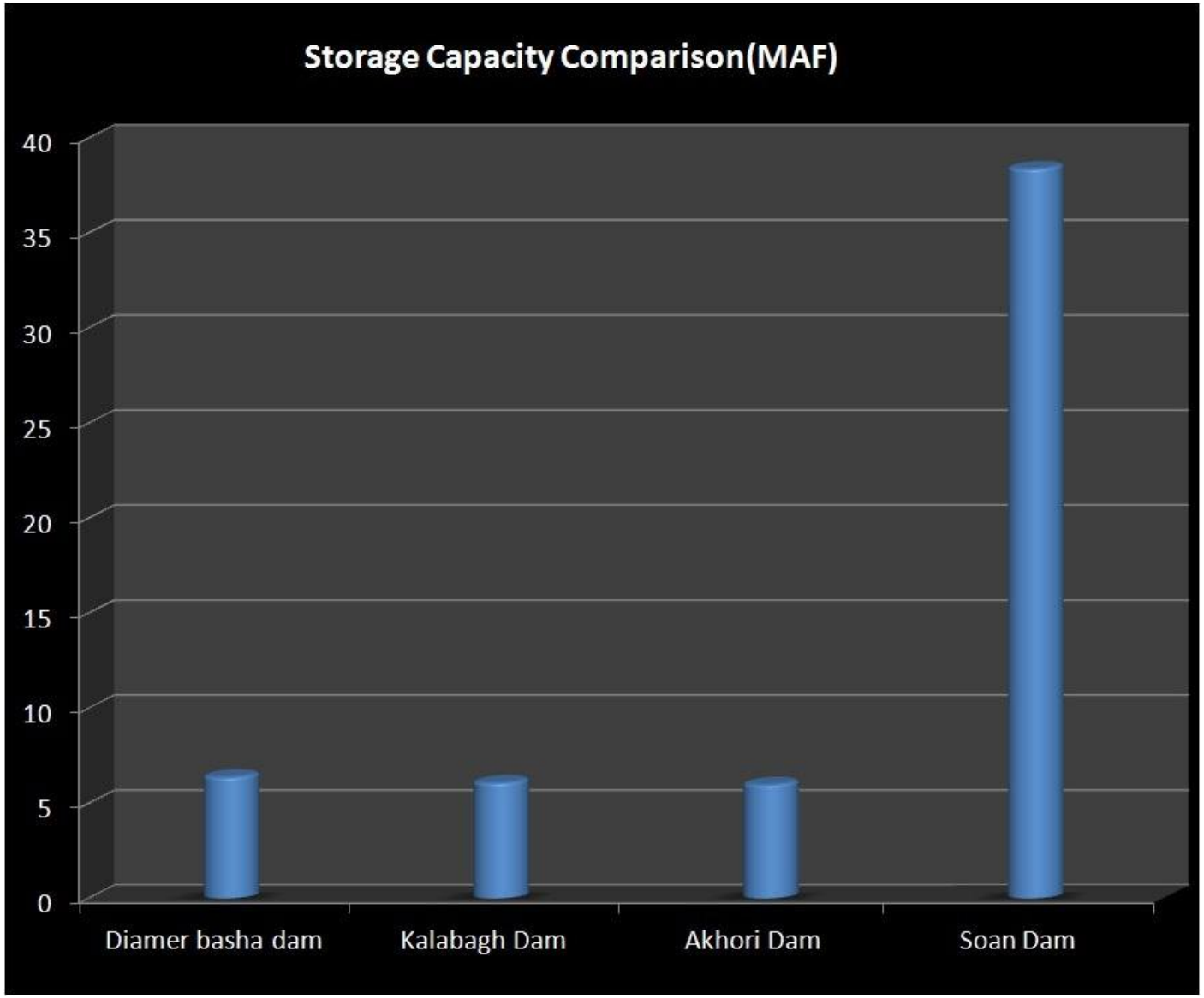


Figure-6: Soan Dam Site at Dhok Pathan

Figure-7: 3D view with old design overlay

Figure-8: Chas T. Main study map 1960's

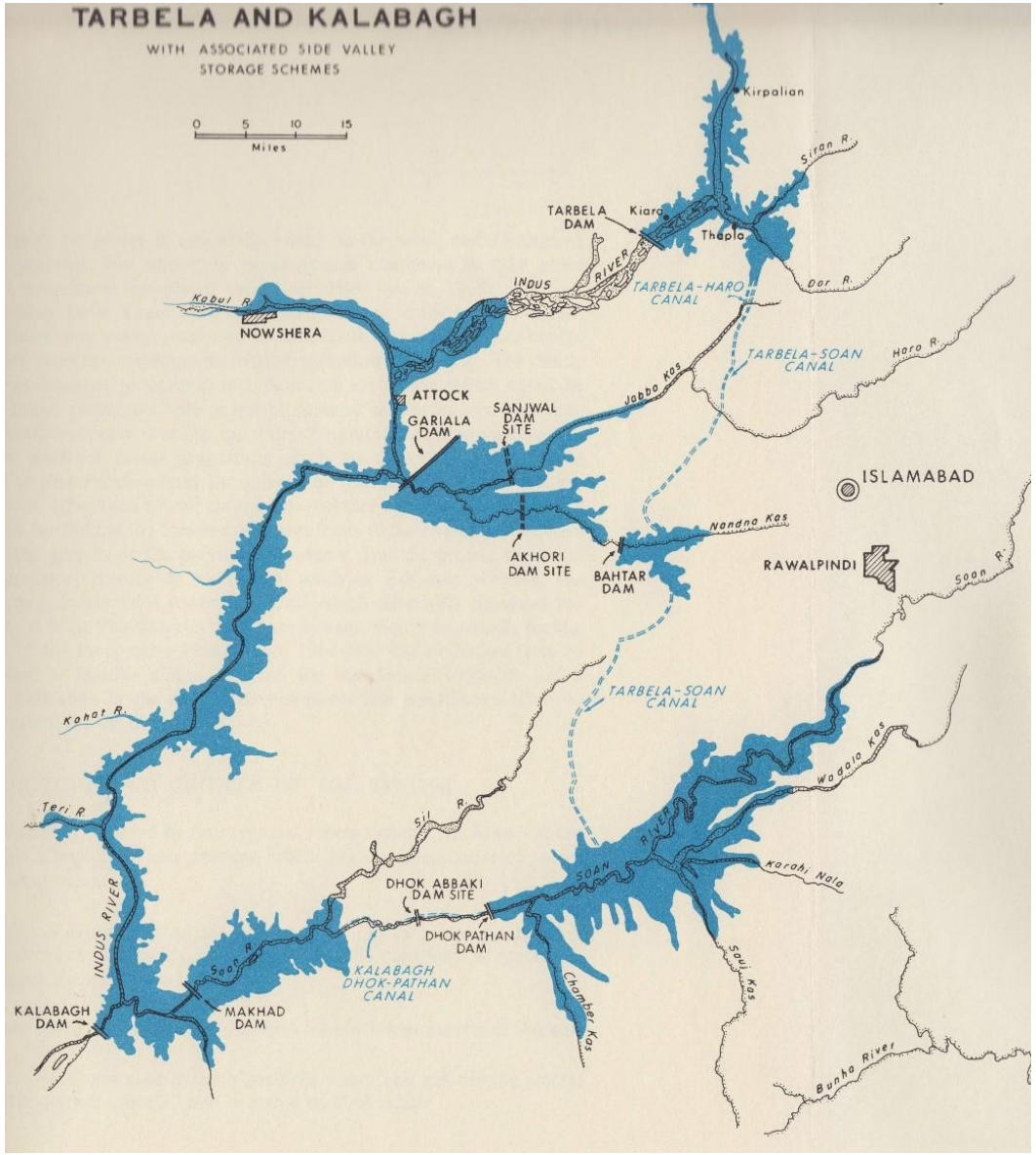


Figure-9: Original Dhok Pathan project layout

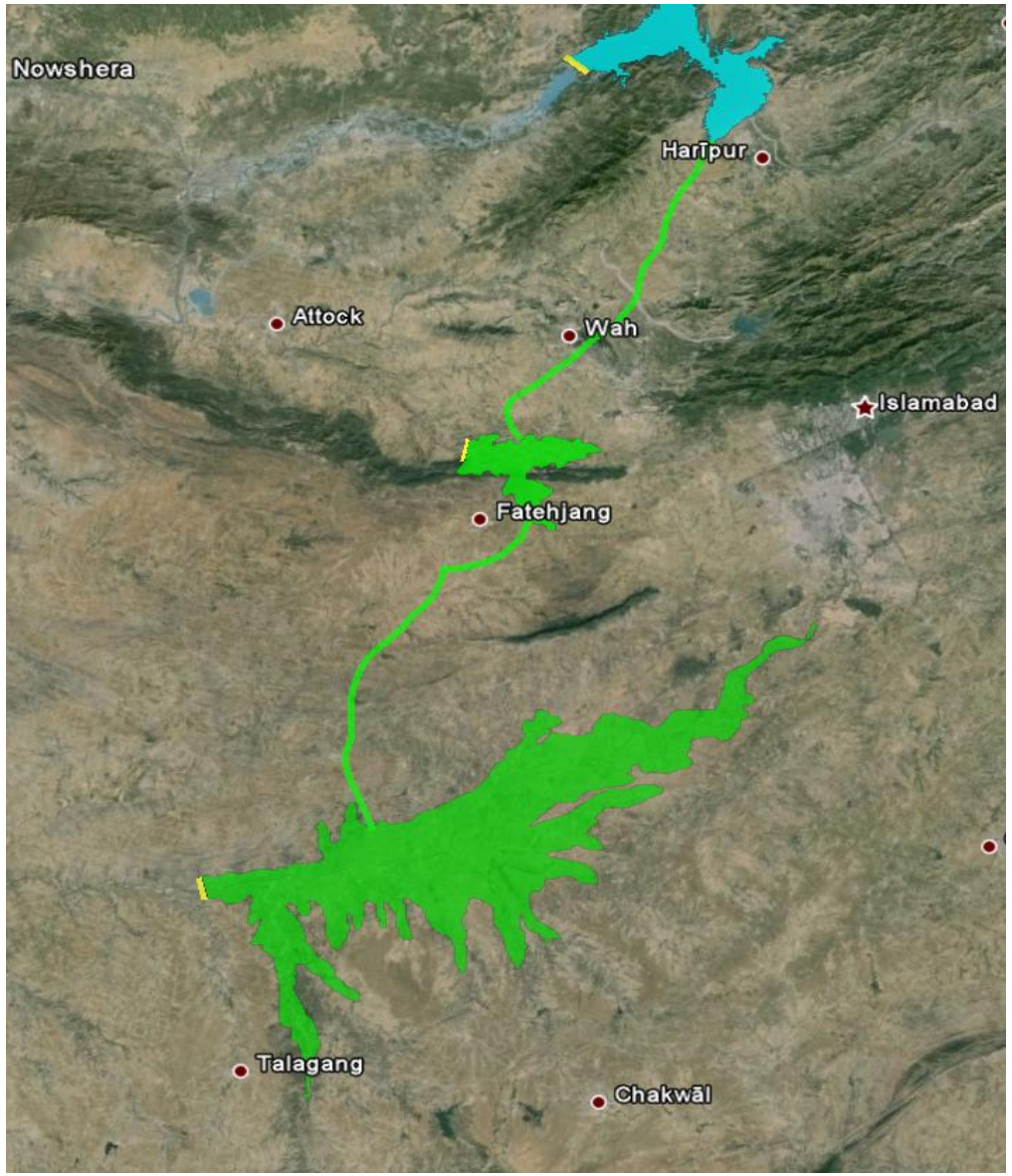


Figure-10: additional adjustments

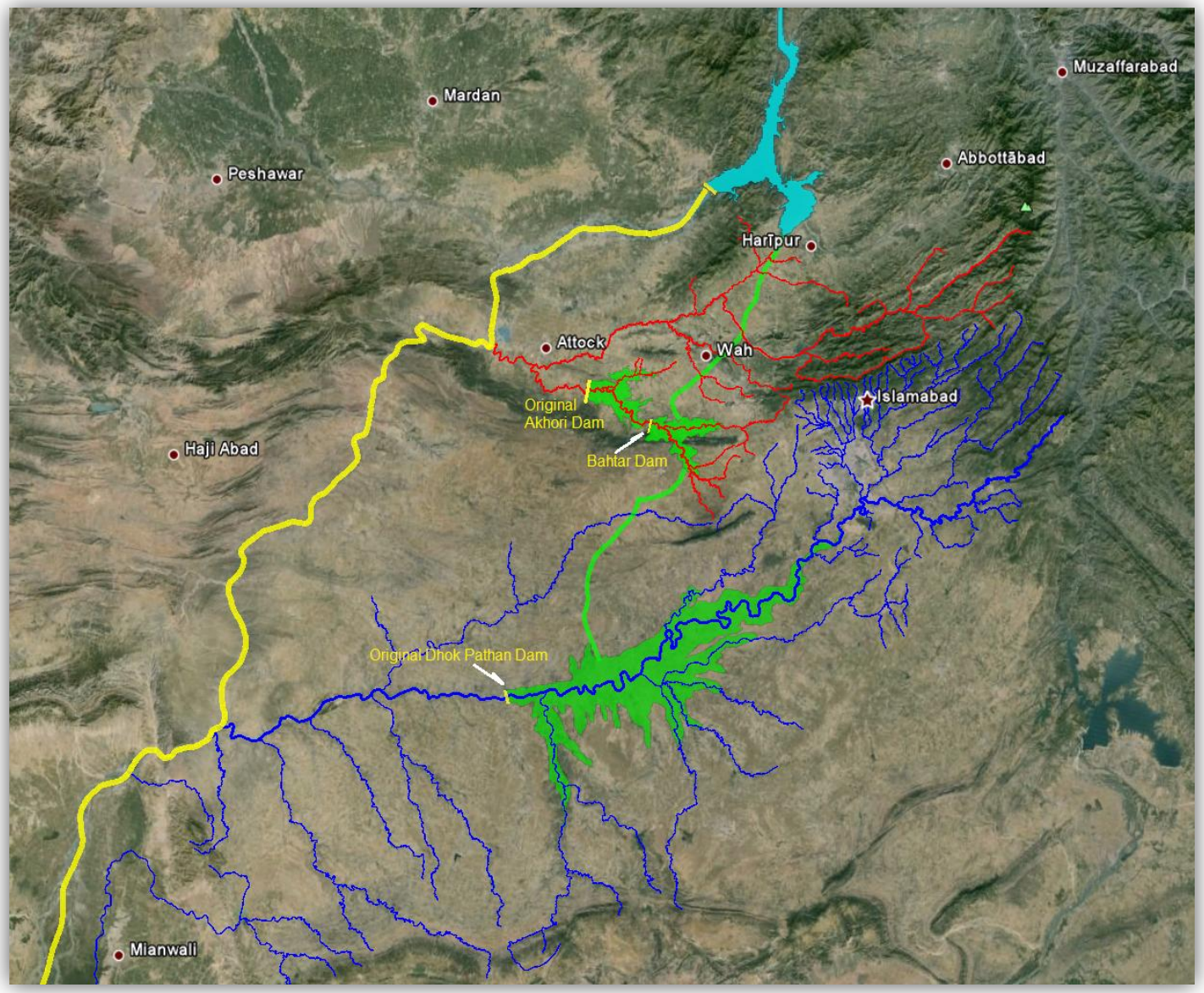


Figure-11: Soan Lake limits 38 MAF vs 8.5 MAF

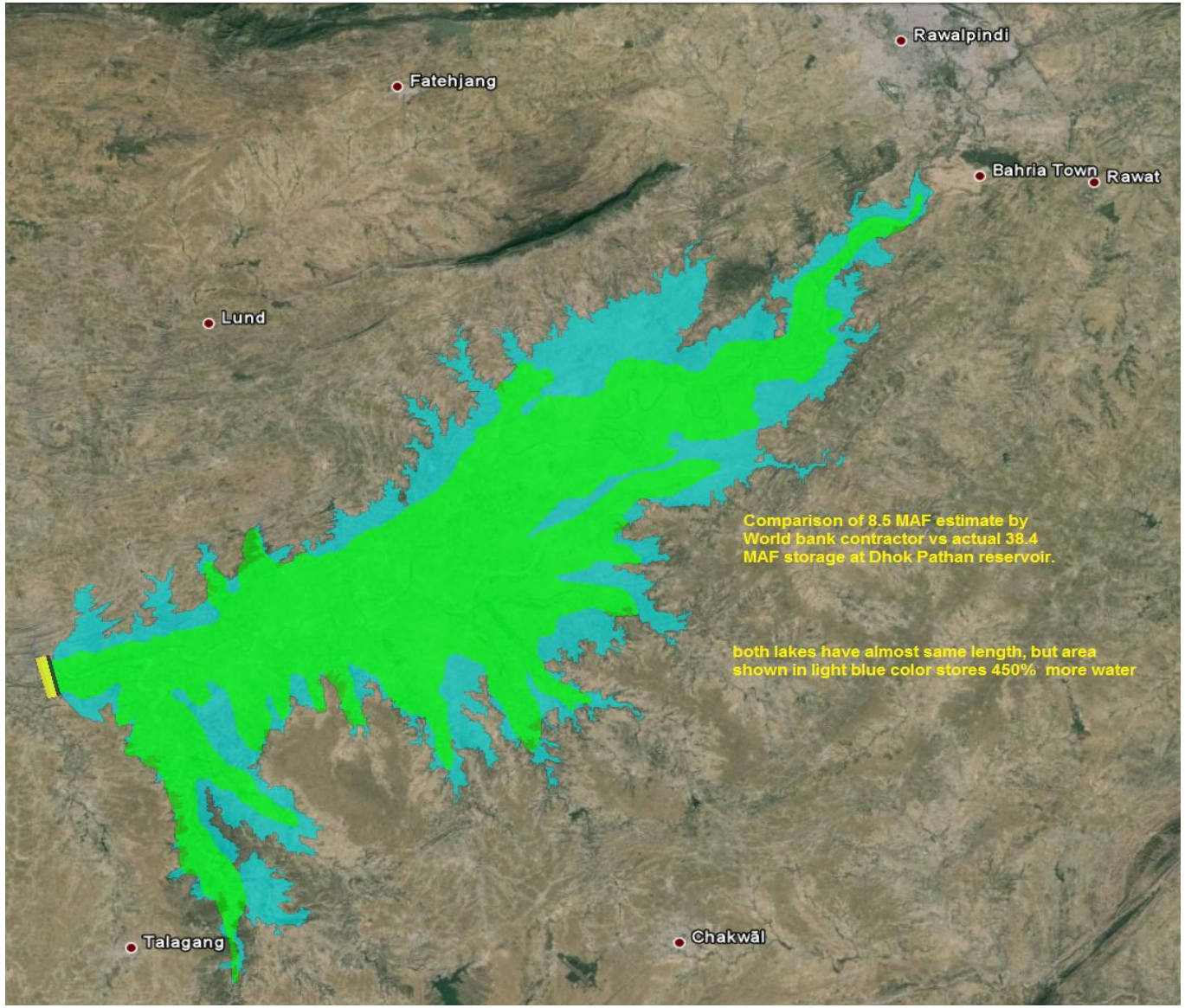


Figure-12: Soan Lake limits for 38.4 MAF storage

Table -1: Storage Capacity using SRTM DEM v4.2

Sr.#	lake depth (m)	Level (MASL)	Area (Acres)	Gross Storage (MAF)
1	5	295	44.5	0.00
2	10	300	670	0.01
3	15	305	1482	0.02
4	20	310	3089	0.06
5	25	315	5319	0.13
6	30	320	9141	0.25
7	35	325	13607	0.44
8	40	330	20842	0.72
9	45	335	29881	1.13
10	50	340	40132	1.71
11	55	345	51951	2.46
12	60	350	69002	3.46

Table -1: Storage Capacity (continued)

Sr.#	lake depth (m)	Level (MASL)	Area (Acres)	Gross Storage (MAF)
13	65	355	85826	4.73
14	70	360	104204	6.28
15	75	365	125675	8.17
16	80	370	145466	10.39
17	85	375	167260	12.96
18	90	380	189444	15.88
19	95	385	214141	19.19
20	100	390	234760	22.88
21	105	395	258478	26.92
22	110	400	278625	31.33
23	115	405	300506	36.08
24	120	410	322262	41.19

Data Sources for topographic calculations

- Space Shuttle Radar Topography Mission (SRTM 4.2)
- ASTER Global Digital Elevation Model
- JAXA's ALOS 3D
- Survey of Pakistan Topo sheets

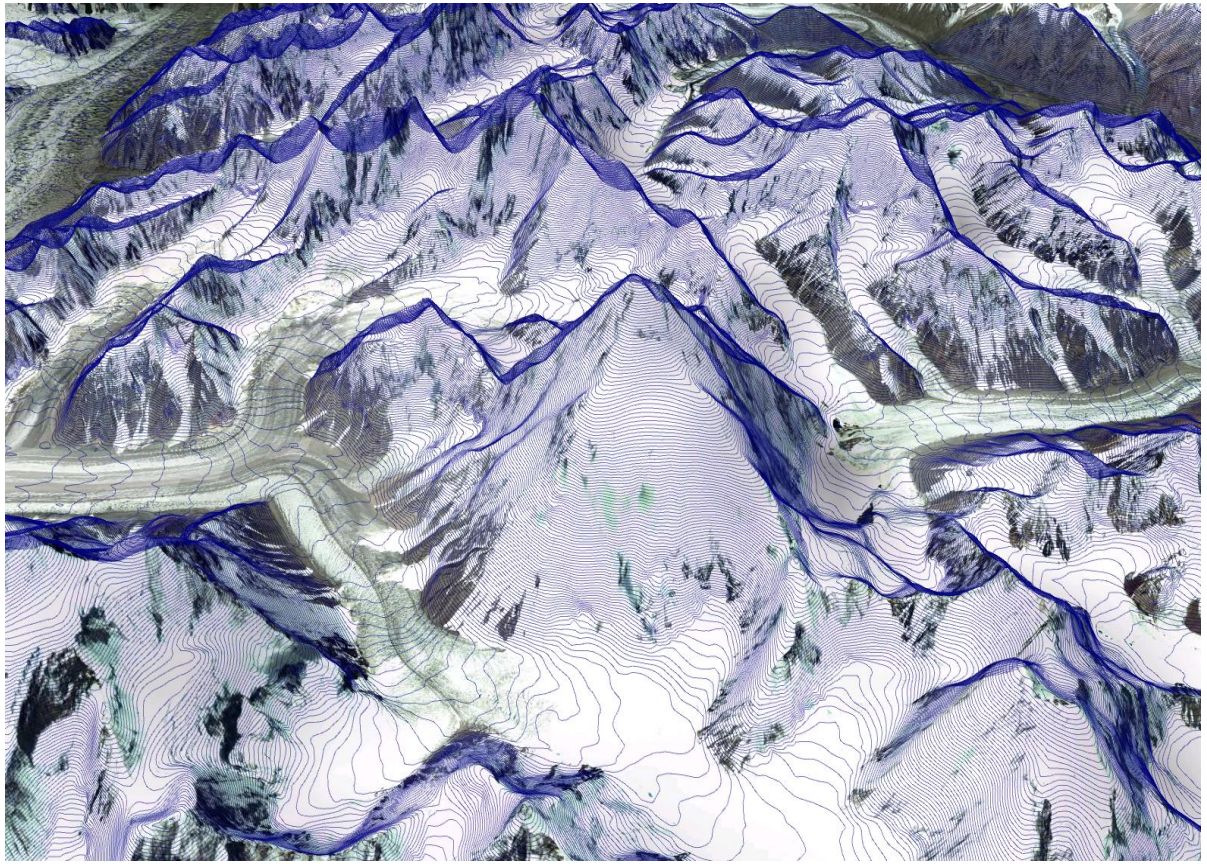


Figure-13: A National Assembly "record" about Soan

NATIONAL ASSEMBLY OF PAKISTAN

ASSEMBLY DEBATES

Monday, the 16th September, 1996

DHOK PATHAN DAM PROJECT ON SOAN RIVER

623. ***Malik Lal Khan:** Will the Minister for Water and Power be pleased to state:

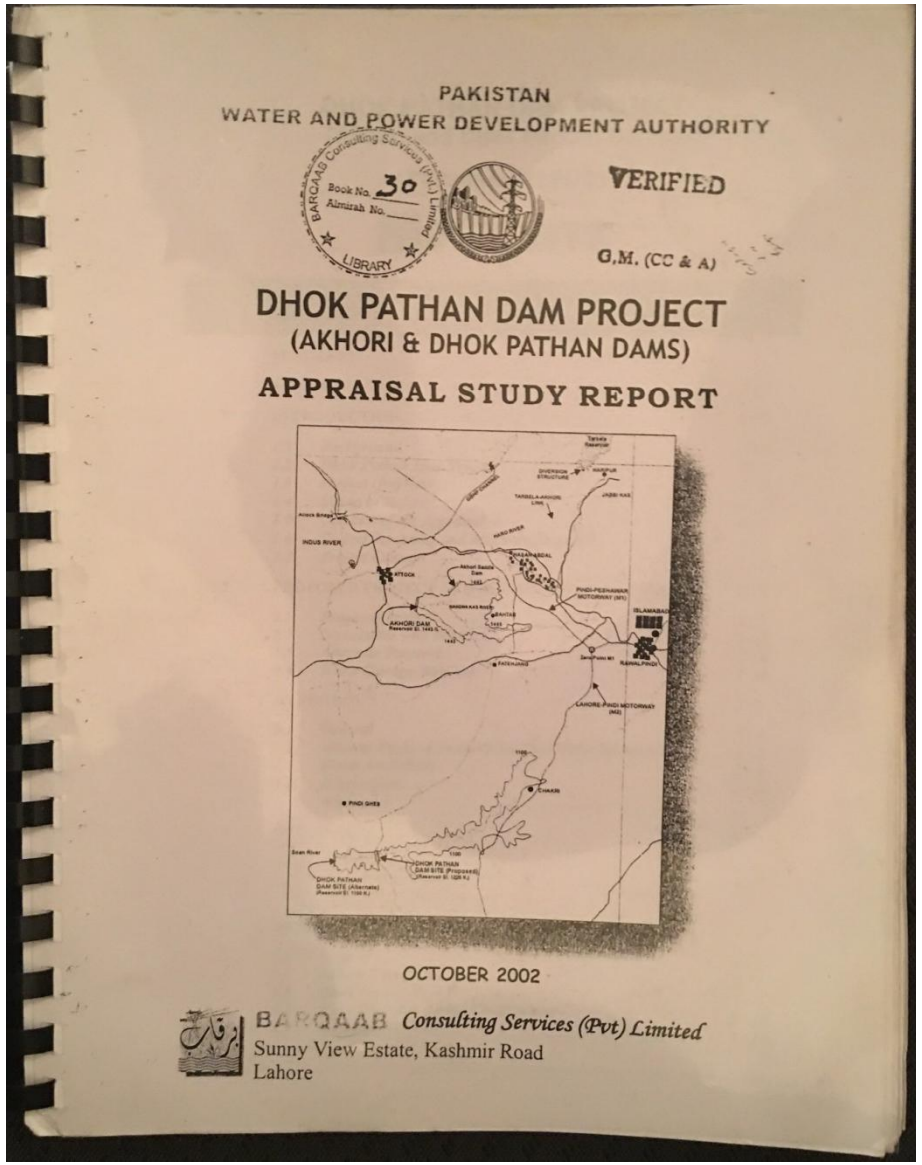
(a) whether it is a fact that prior to plan of Kalabagh Dam, there was a plan to construct a Dam at Dhoke Pathan, Tehesil Talagang, District Chakwal; and

(b) if the answer to (a) above be in the affirmative, whether the Government intends to implement the said plan; if not, the reasons therefor?

Minister for Water and Power (Malik Ghulam Mustafa Khar): (a) Yes, feasibility report of Dhok Pathan Dam Project on Soan river was carried out by Ministry of Industries in 1957. It was an off-channel storage dam with a nominal storage of 1.2 MAF compared with 6.77 MAF of the proposed Indus/Kalabagh Dam.

(b) The projects was not considered economically viable because of the huge capital outlay required for construction diversion tunnel, conveyance channel and the dam itself. Also, the recurring annual expenditure of the project was calculated to be much higher than its irrigation benefits. Hence the project was dropped.

Figure-14: 2001 study



PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY

VERIFIED
G.M. (CC & A)

DHOK PATHAN DAM PROJECT
(AKHORI & DHOK PATHAN DAMS)

APPRAISAL STUDY REPORT

OCTOBER 2002

BARQAAB Consulting Services (Pvt) Limited
Sunny View Estate, Kashmir Road
Lahore

Figure-15: 2001 study downgrades

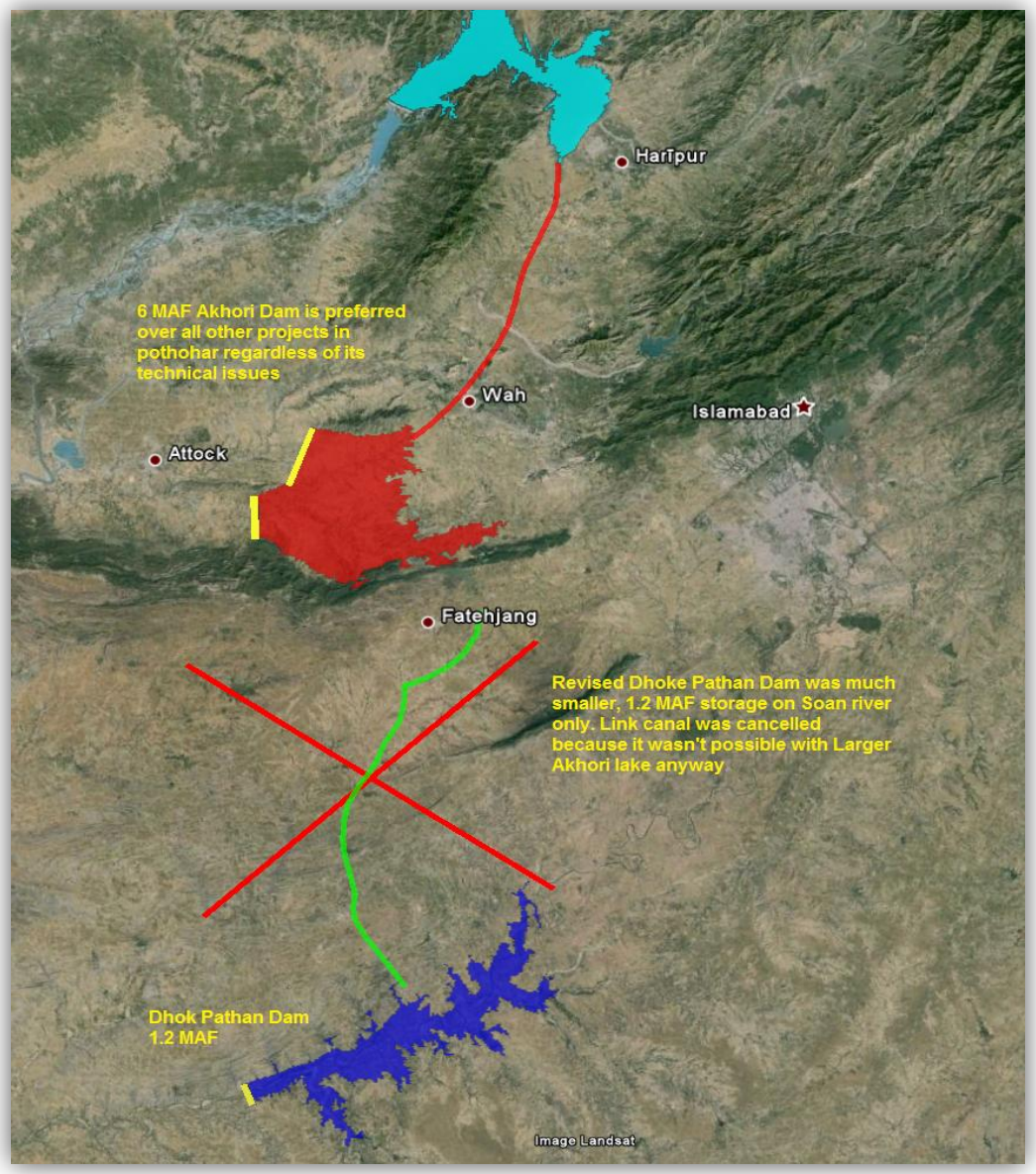


Figure-16: Similar but **larger** Tharthar project in Iraq

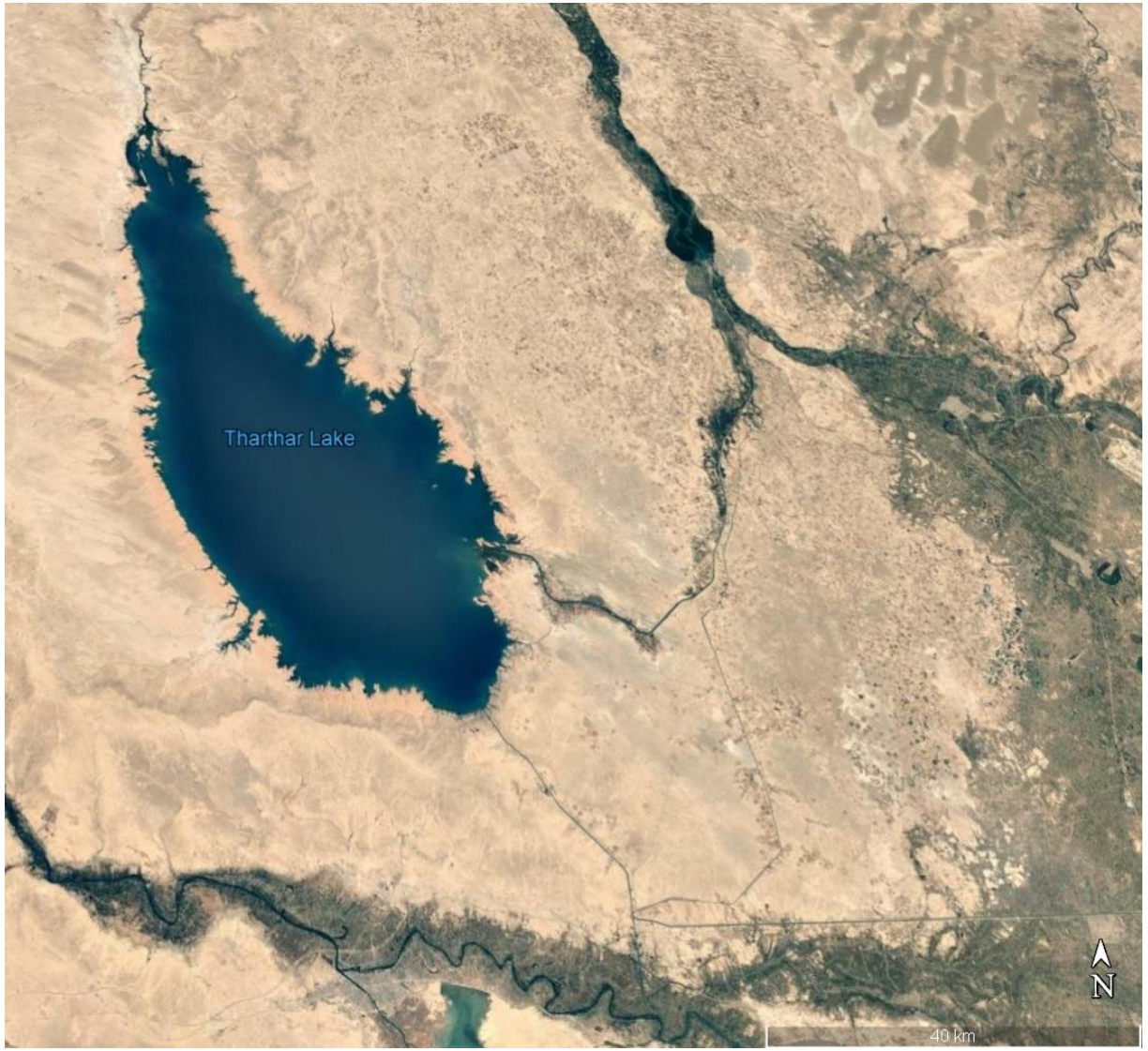


Figure-17: Tharthar regulator canal, 314000 cusecs

Figure-18: Soan re-visited

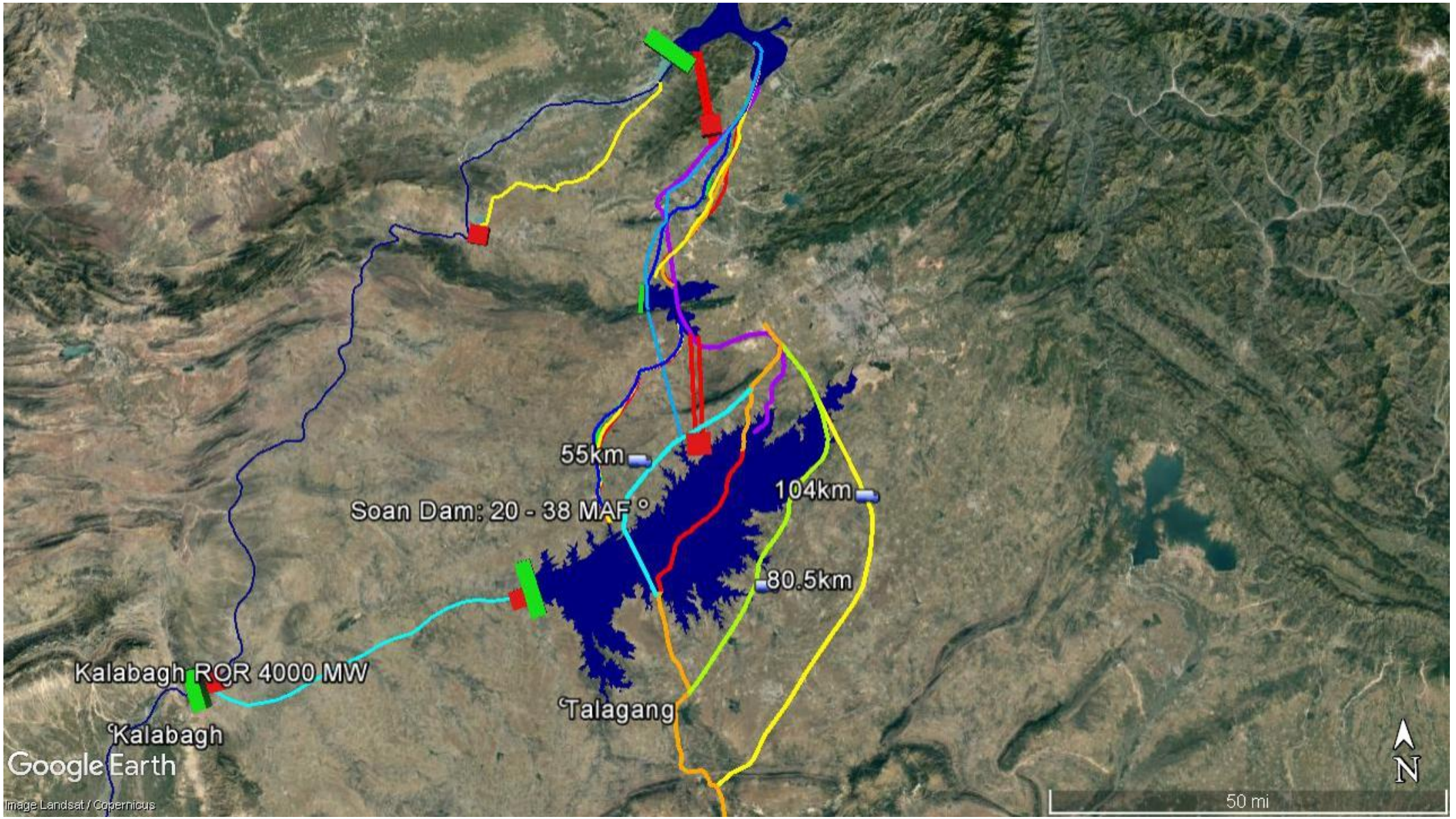


Figure-19: Akhori overlap

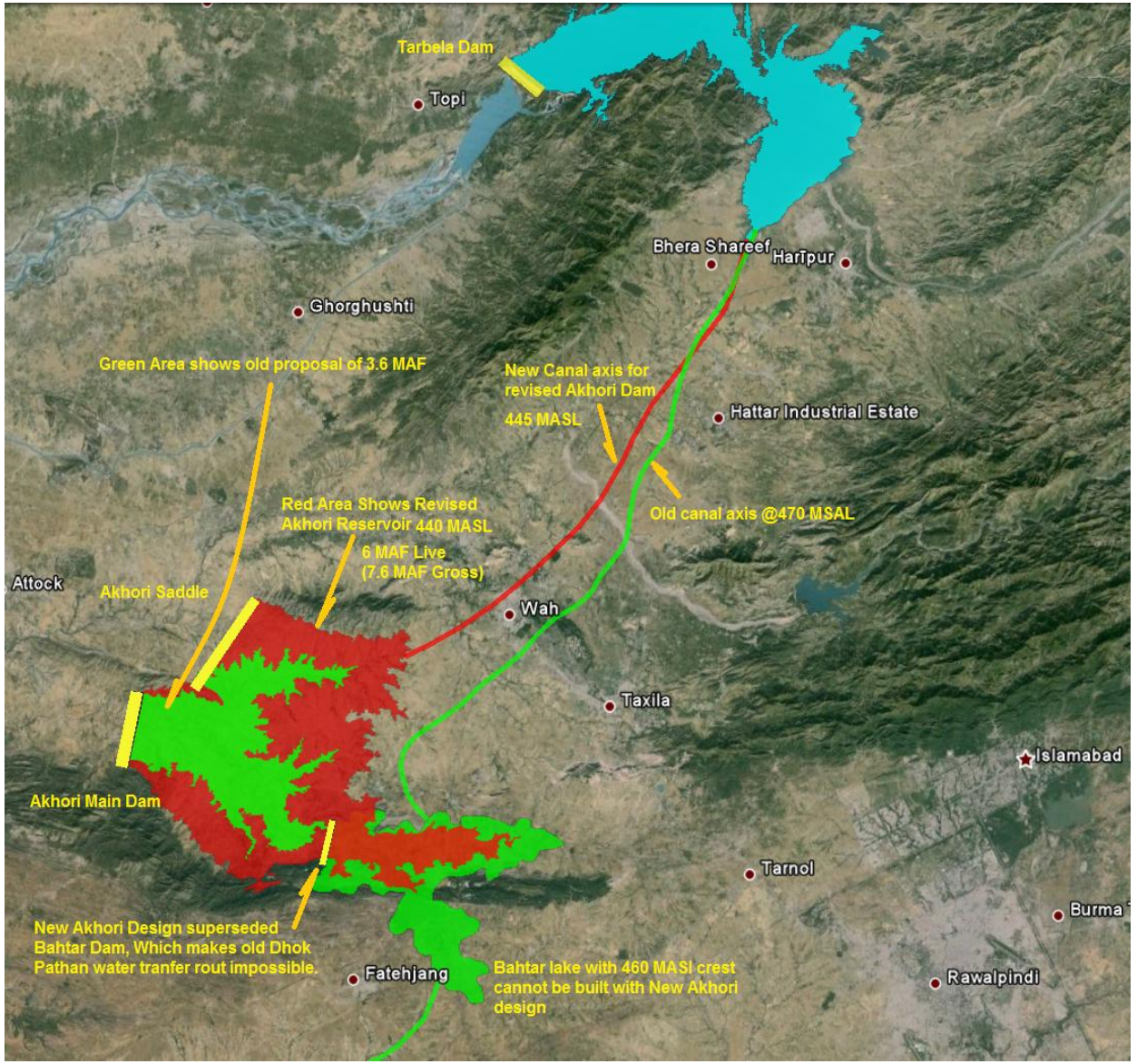


Figure-20 :Ghazi Barotha Canal

Table -2: link canal level vs Tarbela storage

Sr.#	Soan link canal intake level (meters)	Storage available in Tarbela for flood control (MAF)
1	420	6.8
2	425	6.6
3	430	6.2
4	435	5.7
5	440	5.1
6	445	4.5
7	450	3.7
8	455	3
9	460	2.2
10	465	1.3
11	470	0.5
12	472.42	0

Soan link canal design parameters

- 100 flood days are available to fill 38 MAF.
- using safety factor for fluctuations, use 80 days for 38 MAF
- It means 0.475 MAF per day, 240000 cusecs or 6800 cumecs
- 1550 ft elevation, 472.44 MASL is highest possible intake point.
- 1510 ft elevation, 460.25 MASL is a good elevation for SLC
- Lower draw down levels can help de-silting and better buffer storage at Tarbela
- Above 1510, Tarbela hits filling bottleneck, when due to dam operation SOP, daily net storage capacity drops from 246000 cusecs to just 24600 cusecs

Table-3: Soan link canal Earthwork

#	Haripur Crest level (MASL)	Bahtar lake level (MASL)	Dhok Pathan Crest level (MASL)	Link canal Length (KM)		Earthwork for 150m crest (MCM)		Total Earthwork
				Length A	Length B	Length A	Length B	A+B
1	420	415	410	62.0	26.1	193.6	tunneling	193.6+
2	435	430	425	50.8	49.2	131.8	219.5	351.3
3	440	435	430	50.3	48.8	95.1	197.2	292.3
4	445	440	435	47.3	48.1	144.0	154.0	298.0
5	450	445	440	48.2	47.2	98.7	134.3	233.0
6	460	455	450	46.6	45.3	43.3	78.5	121.8

Figure-21: Panama canal a century ago

Figure-22: Recent extension of Suez canal

Figure-23: Earthwork at Thar Coal Project

Figure-24: Silting of Tarbela 1973 vs. 2017

Silting problem of Tarbela dam

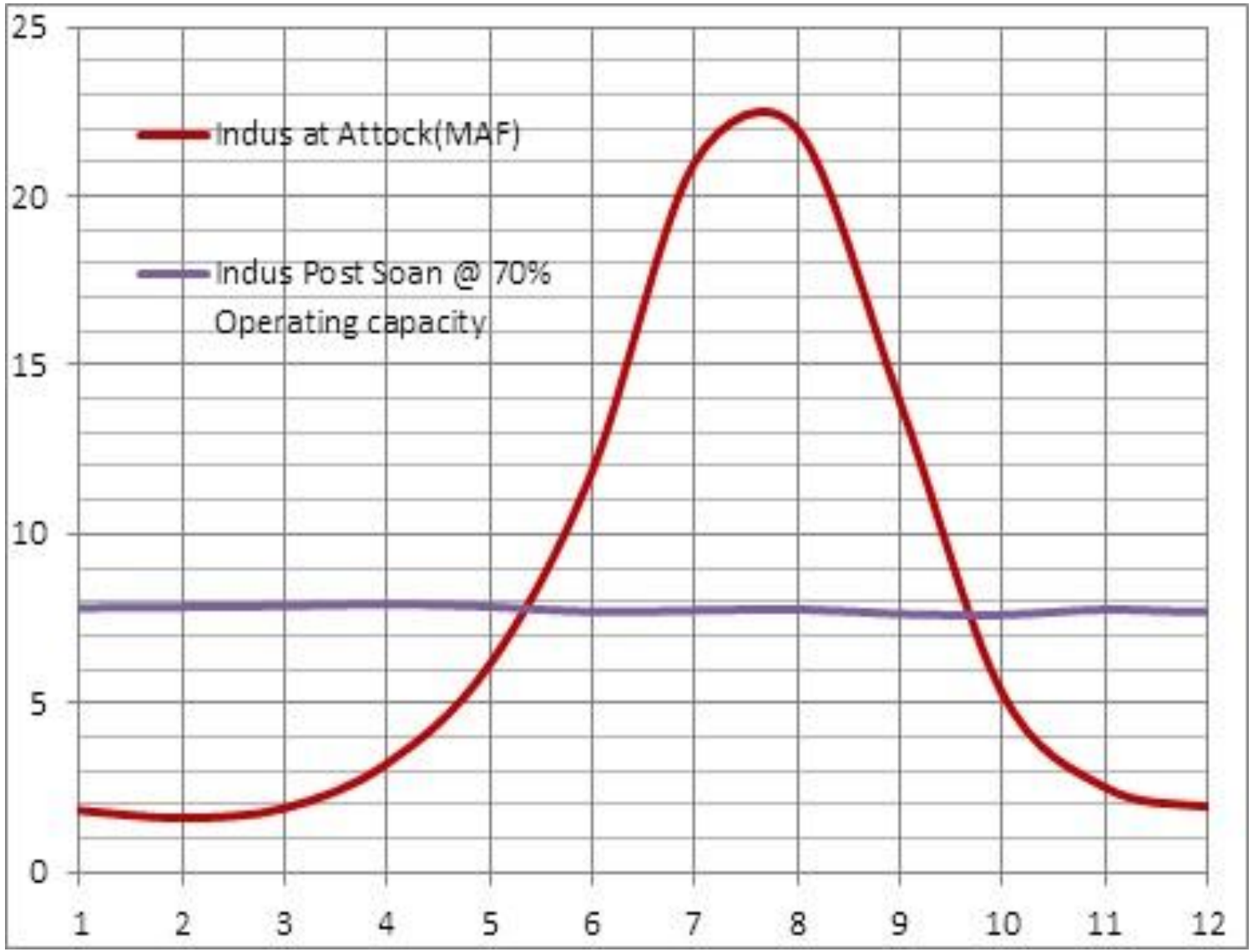
- Economics of sediment transport
- Dredging is not an option
- Tarbela upstream sediment can be released and diverted using auxiliary Bahtar dam via Soan link.
- Deeper cross section of upstream canal segment can do the job.
- Fertility boost of Indus command
- Indus delta environment and land growth

Storage utility

- Extra winter water up to 22 MAF
- Flood control storage 10 MAF for wet years
- Carry over reserve 10 MAF for dry years
- Environmental flow 6 MAF for October-June period

Figure-25: Flood control

Figure-26: Flow Regulation capacity of Soan project



Hydro Electric Power potential

- Soan project will generate hydel power while filling and drawdown operation.
- Hydroelectric head is 135m -110m upstream and 200 - 125 m downstream.
- For 38MAF water, it translates into 9000-7300 for 100 filling days and 5040-3150 for other 265 days. Any additional flow will generate additional power.
- average surplus power generation will be 5000+ MW

Figure-27: Indus delta

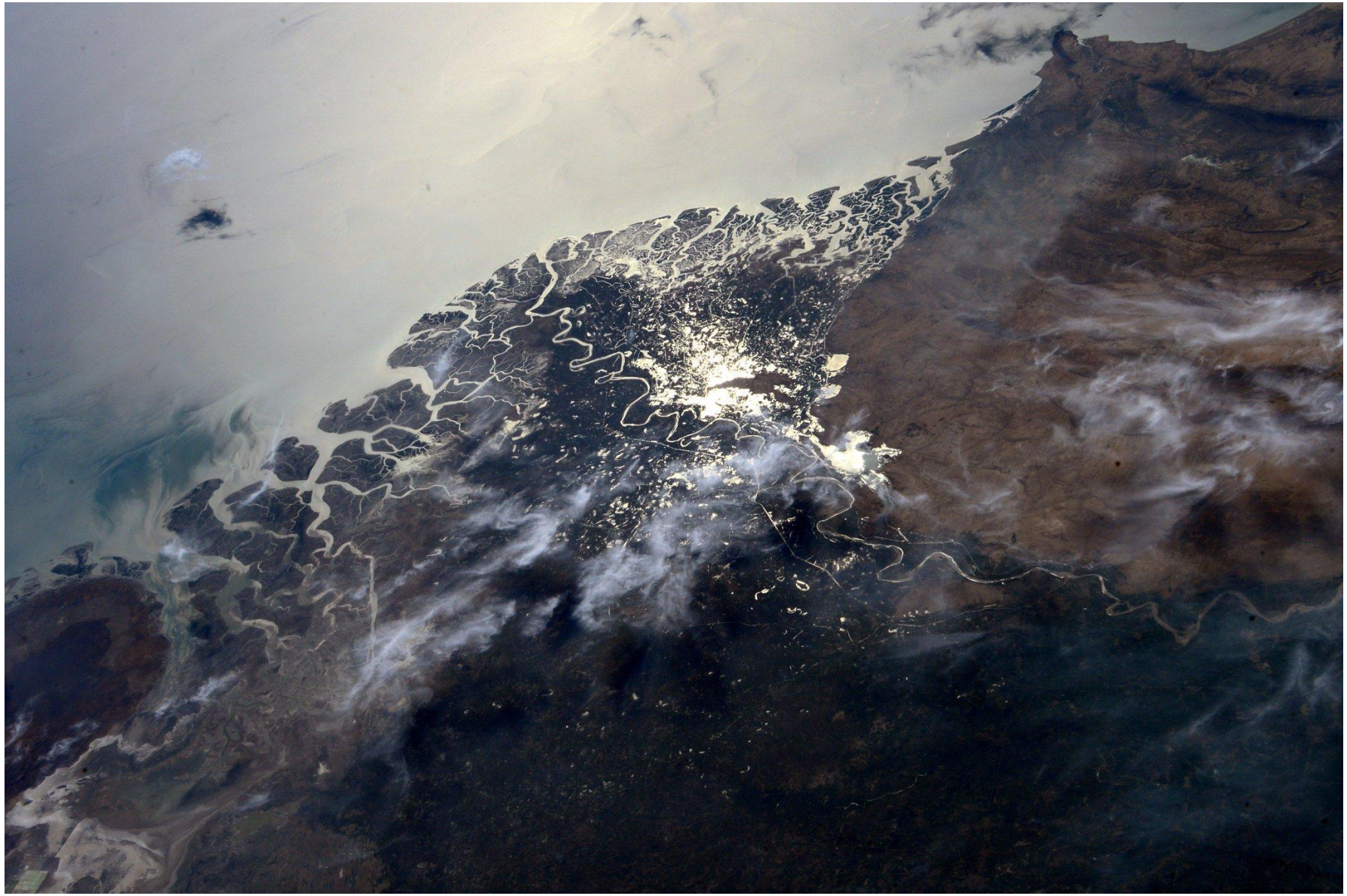
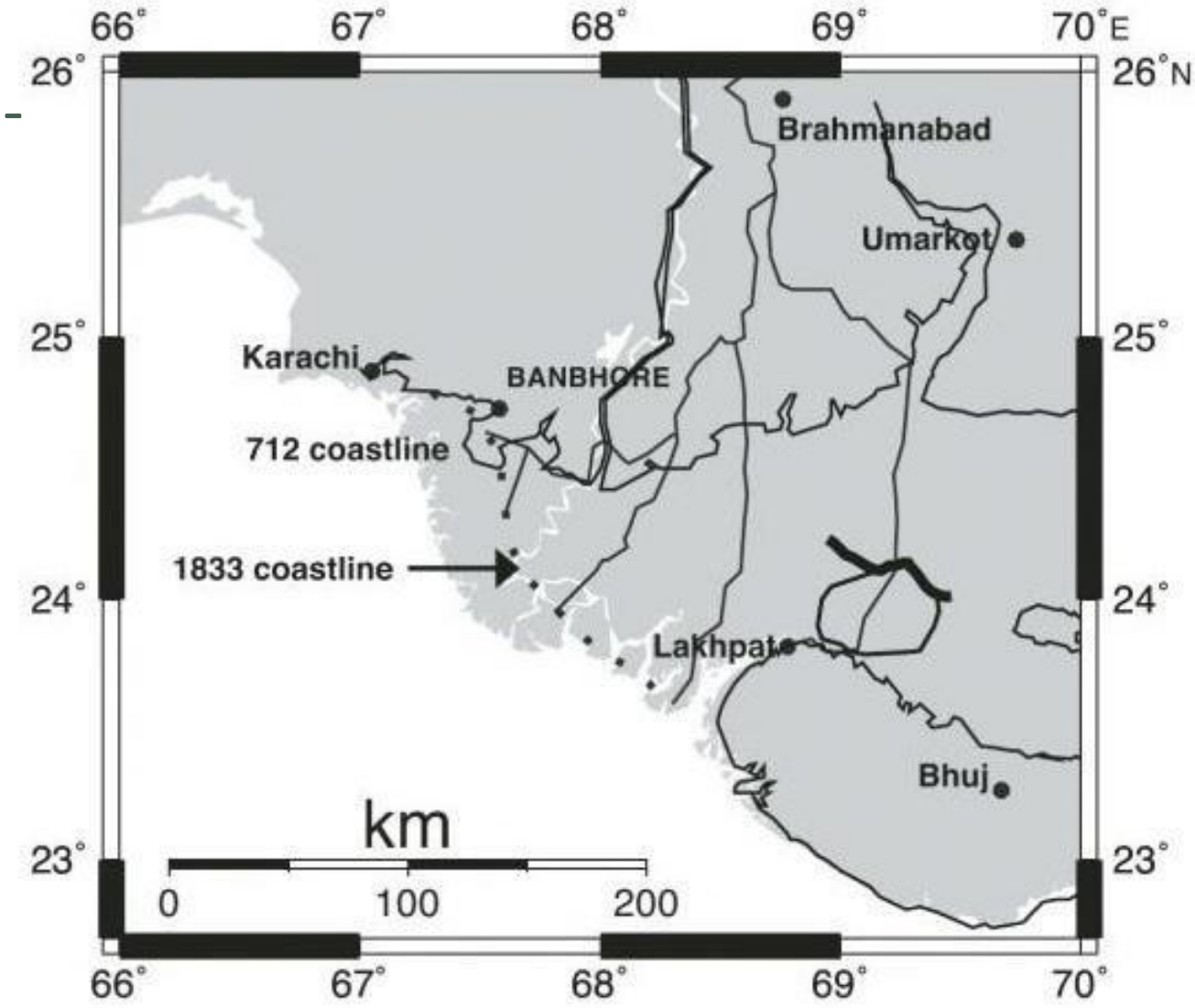


Figure-28: Delta Flow

- Current flow about 30 MAF in 6-8 weeks
- 300 + dry days
- Reserved storage of 6 MAF for October-June period
- 15000 cusecs for 365 days a year



Opportunities

- Staple grains
- Cash crops
- Oil palms in Sindh
- Livestock
- Forestry
- High density Olive cultivation in Potohar
- Fisheries

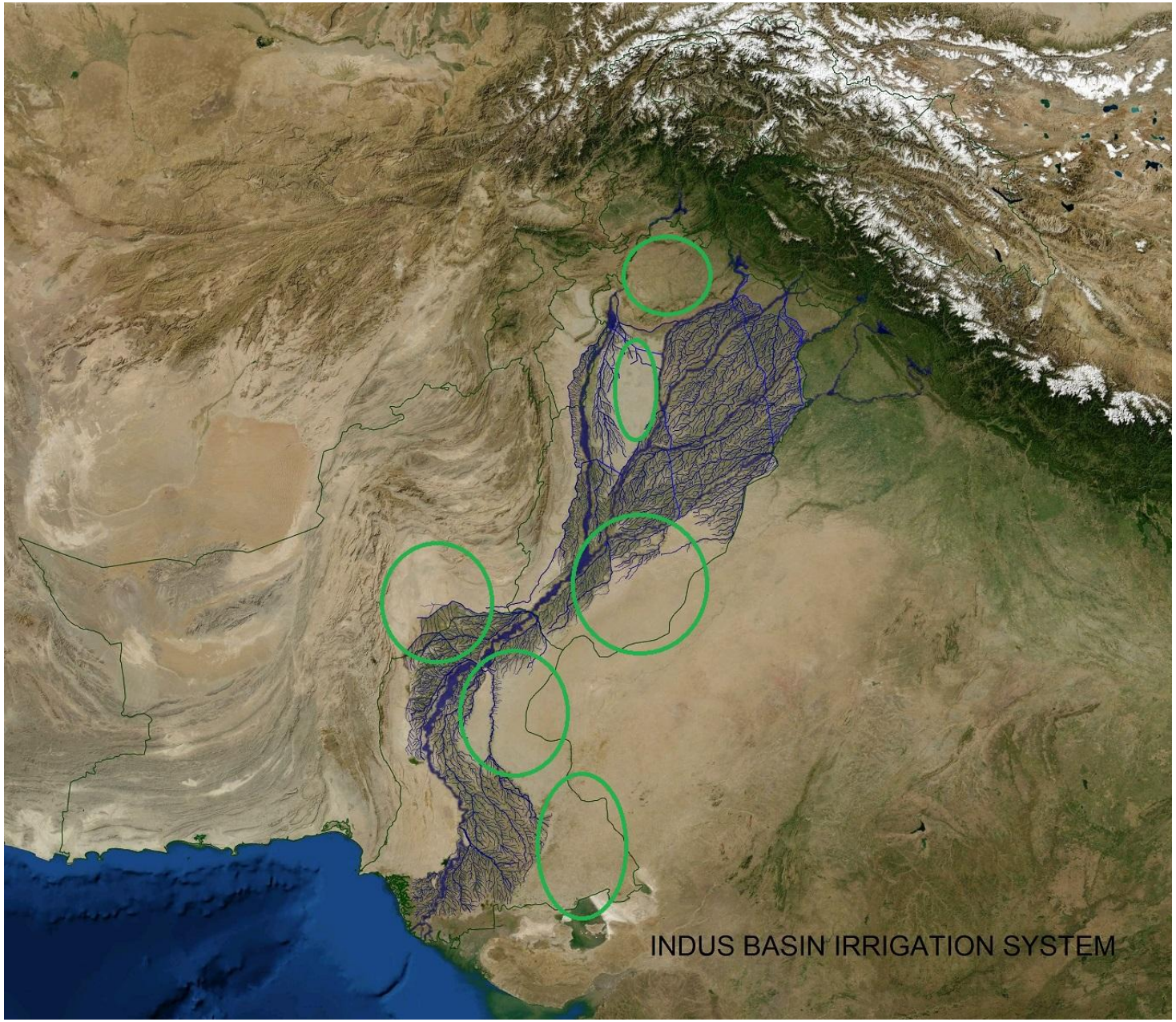


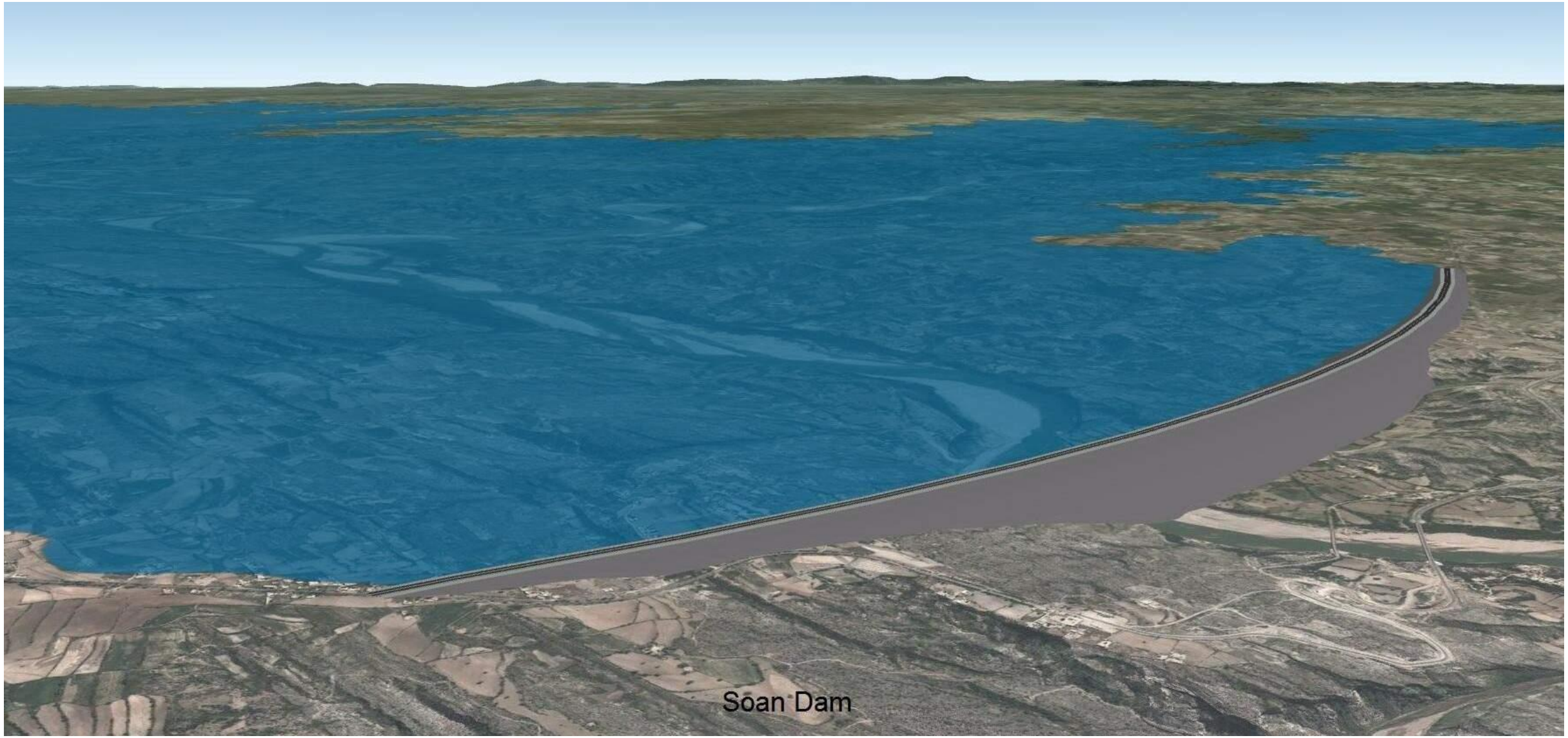
Table -4: Comparison Matrix

Sr.#	Parameter	Soan Dam	Akhori Dam	Diamer Basha Dam	Kalabagh Dam
1	Storage size (MAF)	38.4	6	6.4	6.1
2	Storage Cost	Very Low	Medium	High	Medium
3	Upstream Flood/disaster Control	Will keep Tarbela ready for floods	Harms Tarbela's flood control	May trigger landslides	Disasterous for KPK
4	Downstream Flood control	Excellent	Low	Average	Low
5	Environment friendly	Excellent	below Average	Average	below Average
6	Carry-over Capacity	Excellent	Fair due to off channel design	Fair due to location	Poor, due to size and location
7	Power potential (MW)	5240	600	4500	3600

Table -4: Comparison Matrix (continued)

Sr.#	Parameter	Soan Dam	Akhori Dam	Diamer Basha Dam	Kalabagh Dam
8	Relocation due to inundation	Lake length is same as shown in old estimate map	More population to relocate vs storage capacity	Less populated area	Strong opposition in KPK
9	Disaster Safety	Safer due to off-channel site	Poor	Poor	Good
10	Storage life due to silting	Very Long	Long	Medium	Medium
11	Net economic Impact	$140 Billion/year	~$14 Billion/year	~$20 Billion/year	~$15 Billion/year
12	Sedimentation transport	Releases sedimentation in Tarbela	None	Helps Tarbela	Harmful for Lower Indus
13	Environmental flow capacity for Indus delta	15000 cusecs flow for 365 days a year	Will decrease Kotri downstream flow	Will decrease Kotri downstream flow	Will decrease Kotri downstream flow

Figure-29:Conceptual view



Extensions and Alternatives

- Although Soan is the best centralized water storage option, possible extensions and alternatives are available to fit the provincial needs and priorities
- Future demand of storage remains 70-80 MAF as per national and international estimates.
- Water supply is steady or decreasing, but we can improve it by storing the floodwater
- In presence of enough storage, we can adjust the seasonal cropping pattern to prioritize food security.

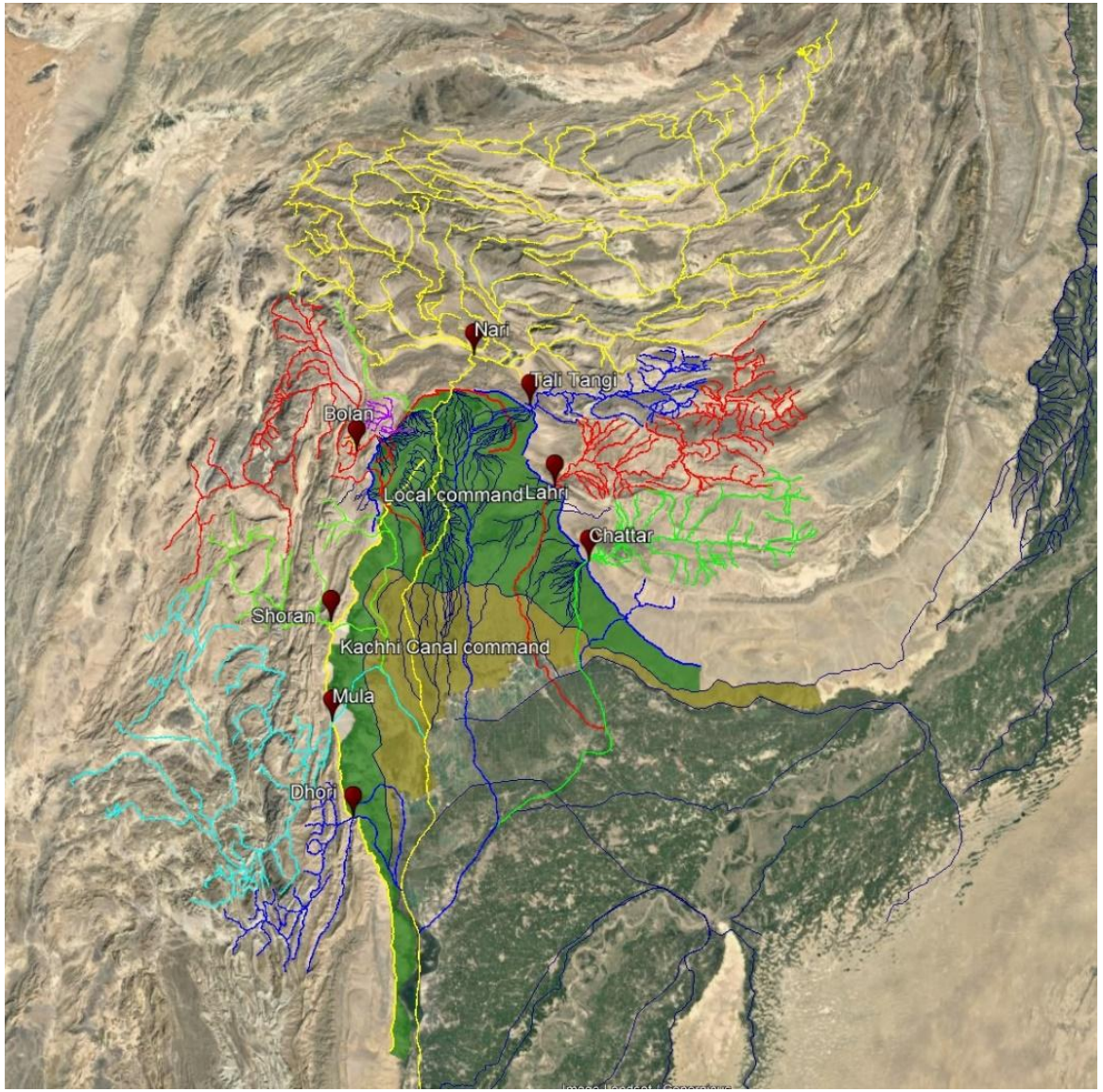
Table -5: Provincial storage

Sr.#	Province	Site	Storage(MAF)	Comments
1	Balochistan	Chattar	0.4	Kachhi plain
2	Balochistan	Lahri	0.4	Kachhi plain
3	Balochistan	Tali Tangi (Chakar)	0.4	Kachhi plain
4	Balochistan	Nari	1.2	Kachhi plain
5	Balochistan	Bolan	0.8	Kachhi plain
6	Balochistan	Shoran	0.4	Kachhi plain
7	Balochistan	Mula	0.4	Kachhi plain
8	Balochistan	Dhori	0.4	Kachhi plain
9	KPK	Khybar dam (High Warsak)	5-10	Comparable to Mangla dam
10	Punjab	Rohtas Dam	6-10	Less attractive after Mangla raising
11	Punjab	Sanghar Zam	0.8	Suleman range, Rud-e-Kohi
12	Punjab	Vehova Zam	0.8	Suleman range, Rud-e-Kohi
13	Punjab	Kaha Zam	0.8	Suleman range, Rud-e-Kohi
14	Sindh	Bhit Dam	10-15	Large scale pumped storage
15	Sindh	Nara Dam	7	large scale storage in Sindh

Kachhi plains, Balochistan

- Inland delta of Kachhi plain is surrounded with several seasonal rivers, with an annual flow of about 2 MAF.
- Without flood control, a stable irrigation system is difficult to maintain.
- Once completed, Kachhi canal along with Pat feeder can command 60% of Kachhi plains.
- Local water can easily irrigate the rest of 40% area, which is comparable to Lower Jhelum canal command in Punjab.

Figure-30:Kachhi plains



Sindh

- Sindh has two local storage options, Nara and Bhit.
- Nara river bed can store 8 to 10 MAF water up to 55 MASL, which can be linked back to Rohri canal and Indus river upstream proposed Sehwan barrage.
- Nara dam can act as side valley storage for Indus floods at Sukkur. It can collect floodwater of Chenab, Ravi and Sutlej catchments, which is not possible in Punjab.
- Storage size is flexible due to dunes surrounding old Nara bed. Depressions can be used for storage, agriculture and wildlife reserve, while crests can be used for housing and forestry.
- Evaporation and seepage losses are considerable, but site can regulate Indus delta flow and flush LBOD effluents.
- Inundated land can be replaced by abundantly available Thar area in command.

Figure-31:Nara Dam

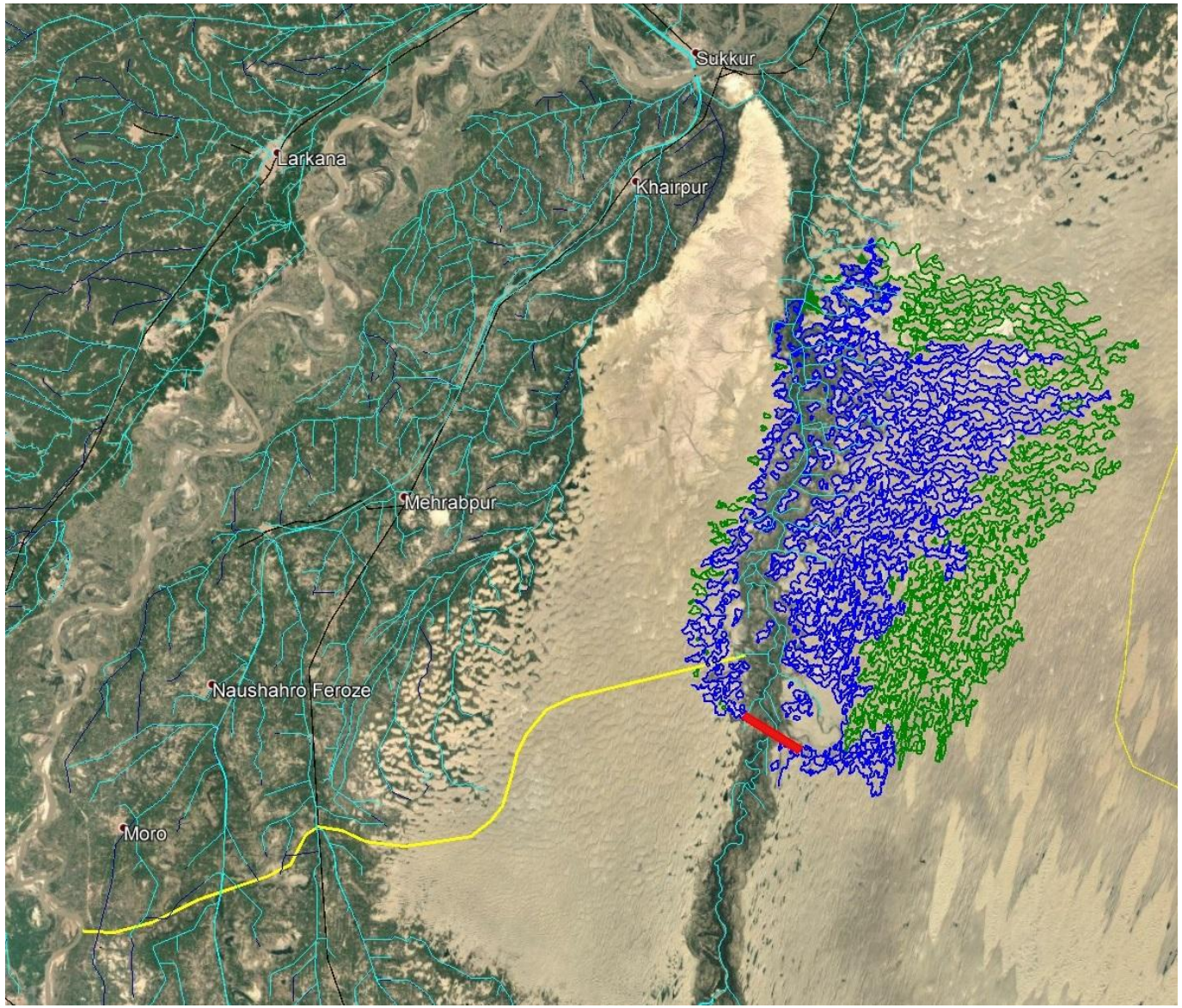
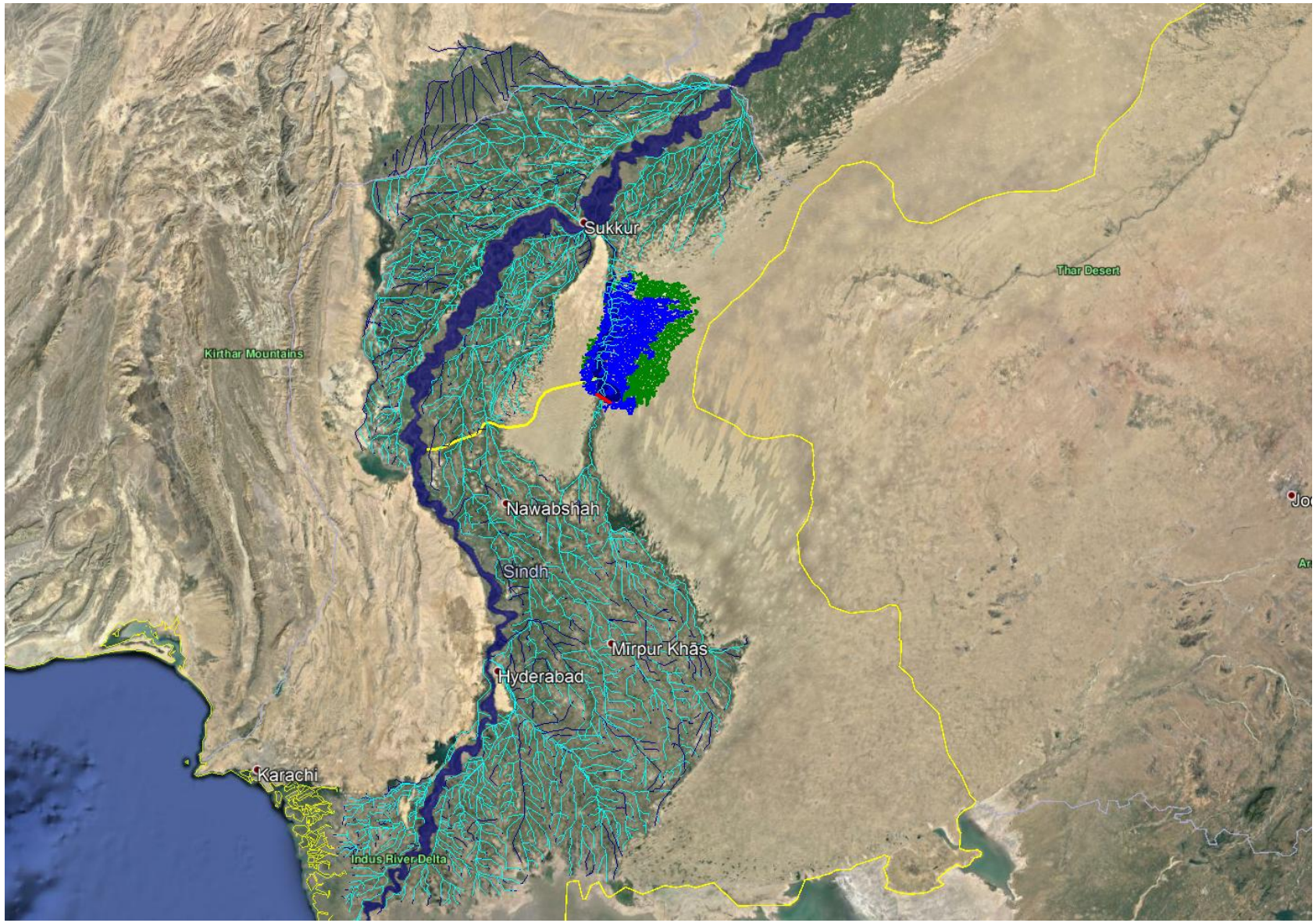


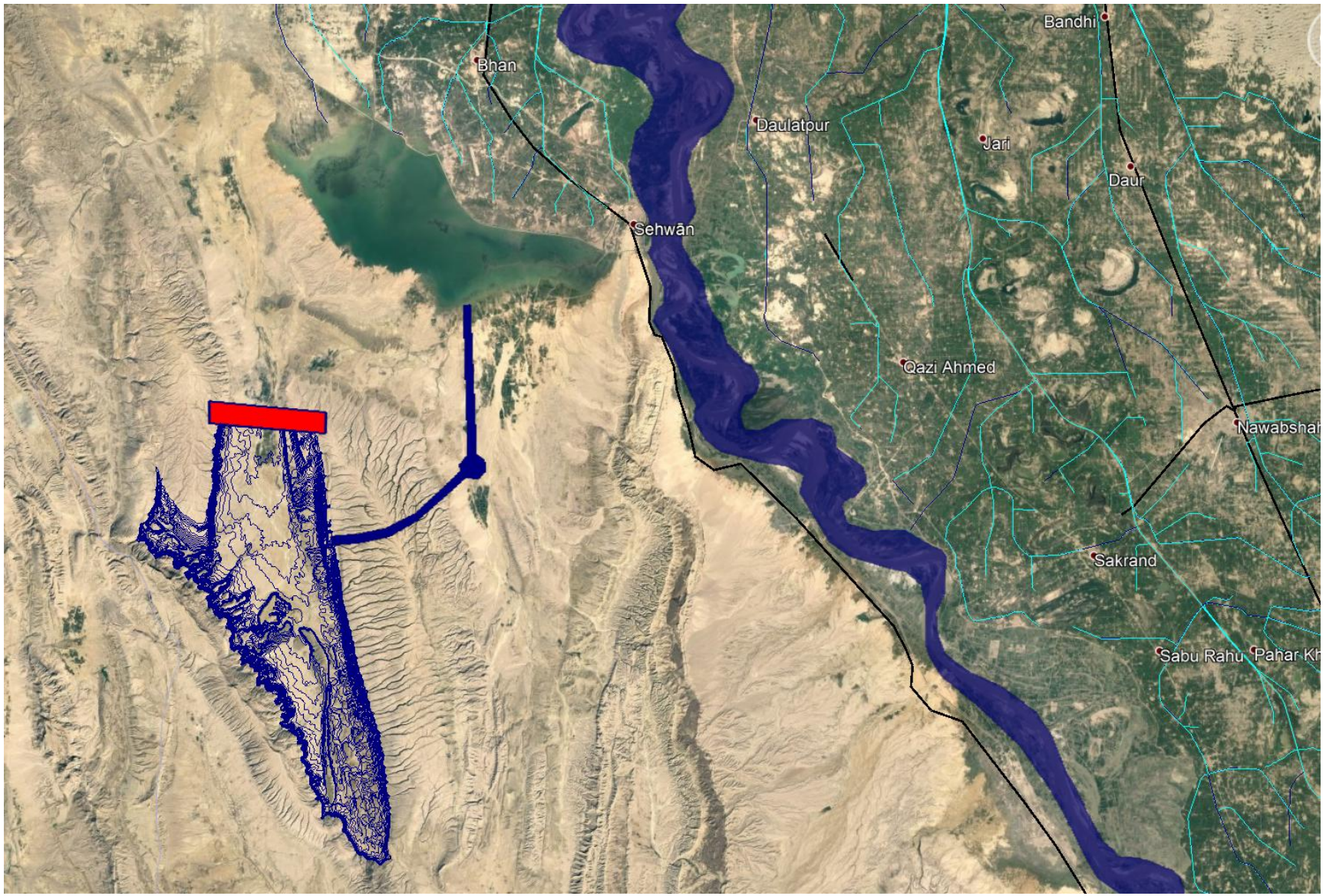
Figure-32:Nara Dam



Bhit Site

- Bhit site has huge storage capacity but it is located higher than Indus river.
- Proposed Sehwan barrage can be helpful for reducing intake channel length, via Manchar lake.
- It can store 10 to 15 MAF water with pumping, using Manchar lake as intake source. Storage size is flexible due to dunes surrounding old Nara bed.
- Reversible turbines can be used to reclaim energy used for pumping.
- Project can use Solar and wind Energy abundantly available nearby.
- Both Nara and Bhit storage can command lower indus, which makes about 50% of agriculture land.

Figure-33:Bhit Dam

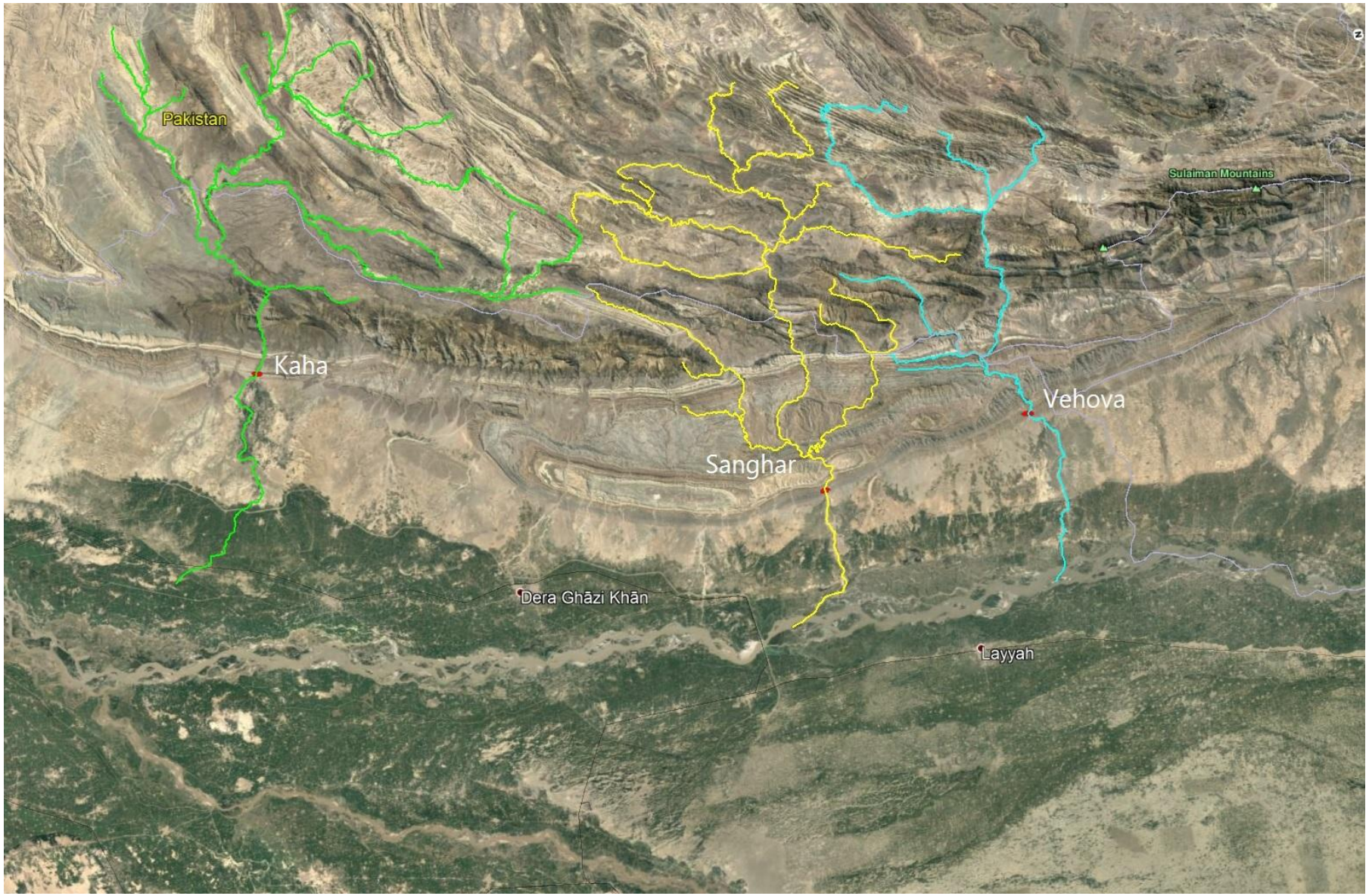


Punjab

- If Soan Dam is not built as a national storage, Its scaled down version can be used for willing provinces.
- Another storage can be built near Rohtas as needed. Rohtas storage can store 6 to 10 MAF.
- Hill torrents of Koh-e-Sulaiman (Rood e Kohi) can be tamed like Kachhi streams of Balochistan.
- Building dams on three major streams (Vehova, Sanghar and Kaha), which make about 70% of local catchment, can help controlling floods and improve old fashioned spate irrigation.

Figure-34:Rohtas Dam

Figure-35:Hill torrents



Khyber Pakhtunkhwa

- Warsak dam on Kabul has silted up. A raised dam on grouted foundation can be built like Aswan dam.
- Mohmand Dam(Munda dam) storage can be linked with Khyber dam (raised Warsak).
- Khyber dam can store 5 to 10 MAF water with hydel generation capacity of 1500 MW.
- These linked dams can be very useful if Pakistan needs to divert Chitral river in future.

Figure-36:Mohmand Dam

Figure-37:Mohmand Khyber link

Figure-38: Top view of Mohmand-Khyber link

Questions and answers