

A Comprehensive Study on Hydropower Potential of Nepal



Presented By:

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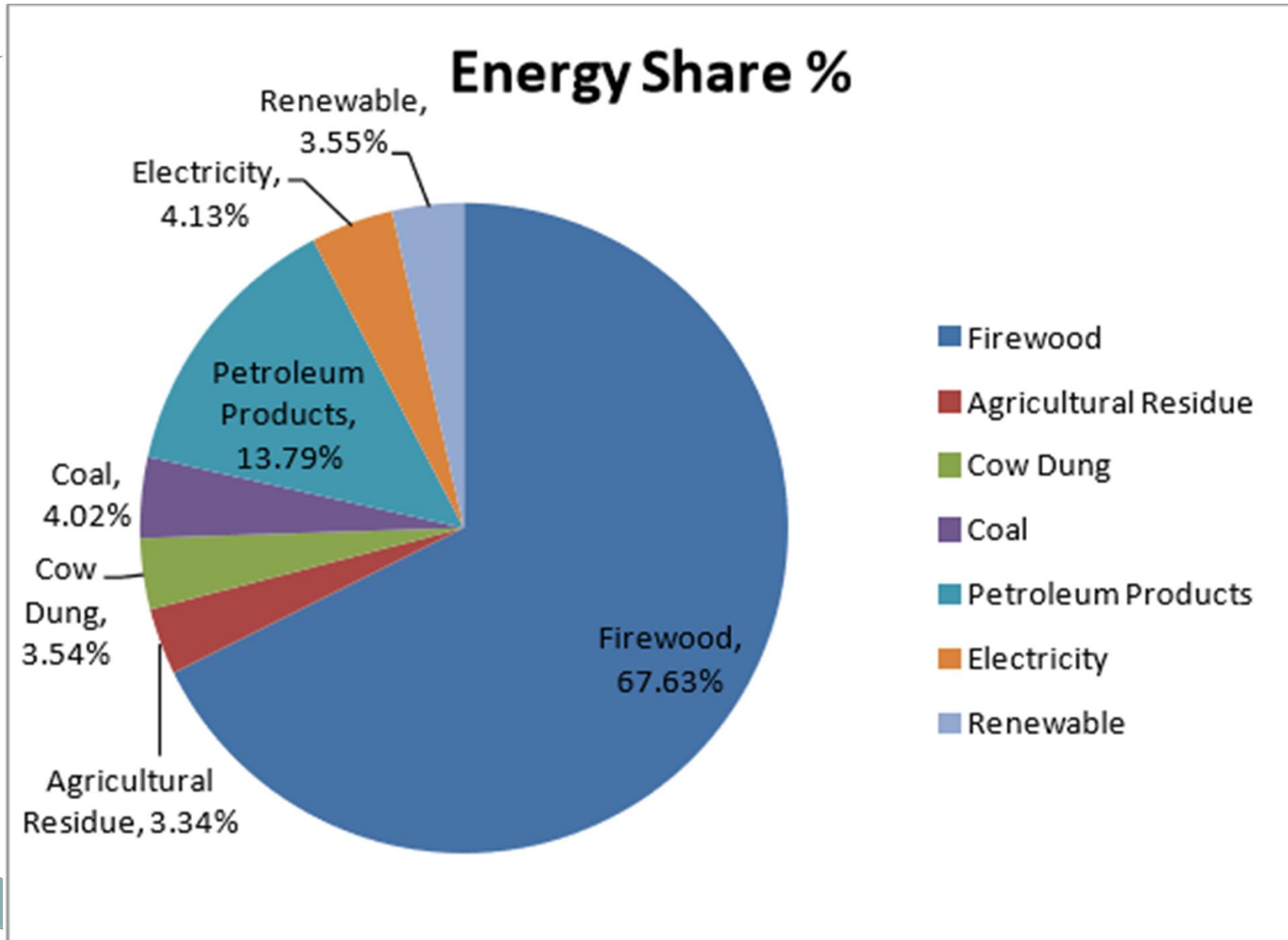
Date: May 04, 2018

Background



- Pharping Hydropower Project (500 kW) First Hydro Project of Nepal (1911 AD)
- About 600 MW of Hydropower developed in Last 100 Year
- Nepal faced Extreme Load Shedding for some Years
- Supply 961.2 MW and Power Gap 482.9 MW (Economic Survey of first 8 month of F/Y 2016/17)
- 140 Projects with 3524 MW of Installed Capacity (Different Stage of Development: Economic Survey of first 8 month of F/Y 2016/17.)

Energy Consumption



Demand Forecast

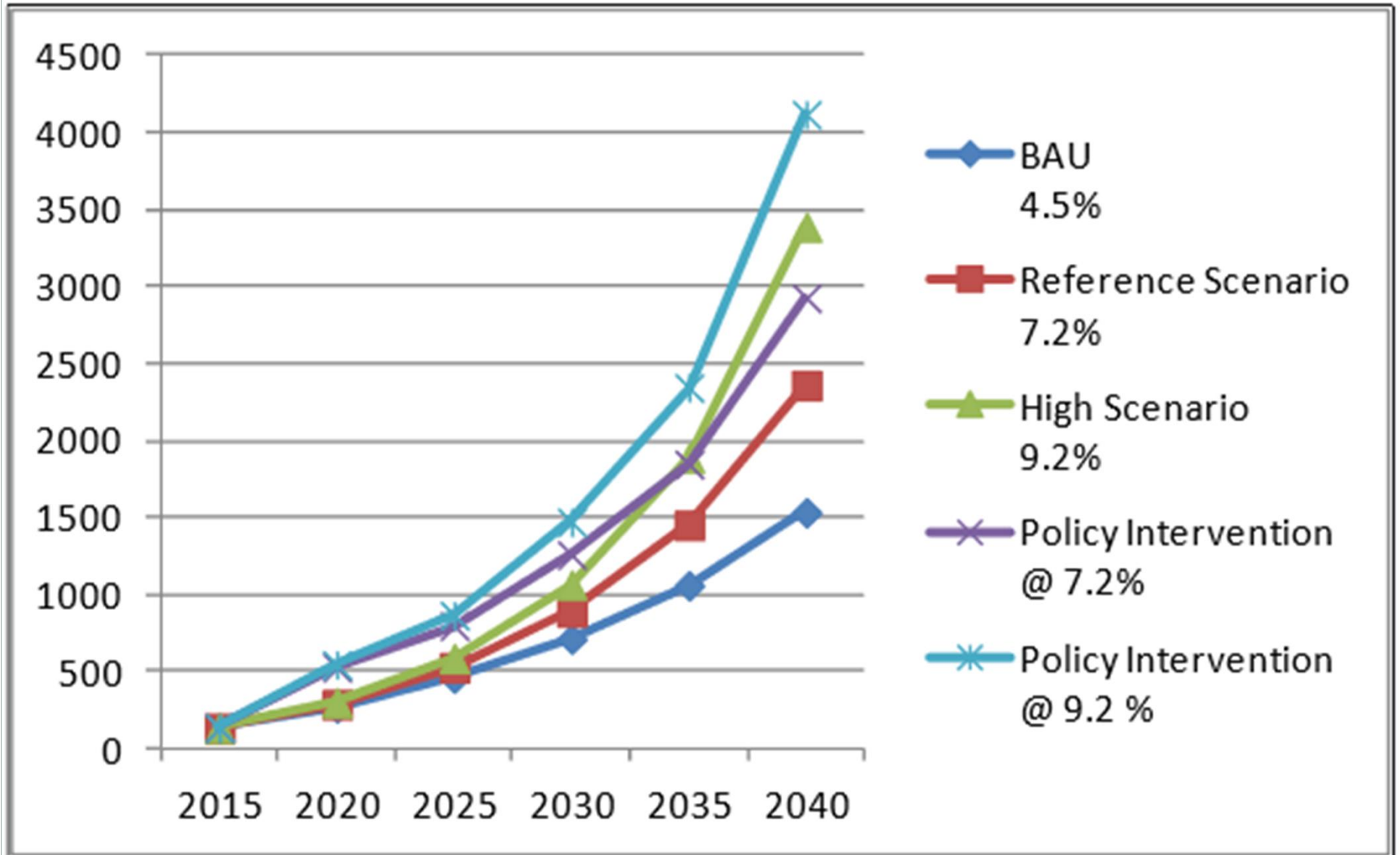


Figure 5.2-2 Per Capita Electricity Demand (GWh) : Source: WECS

Demand Forecast

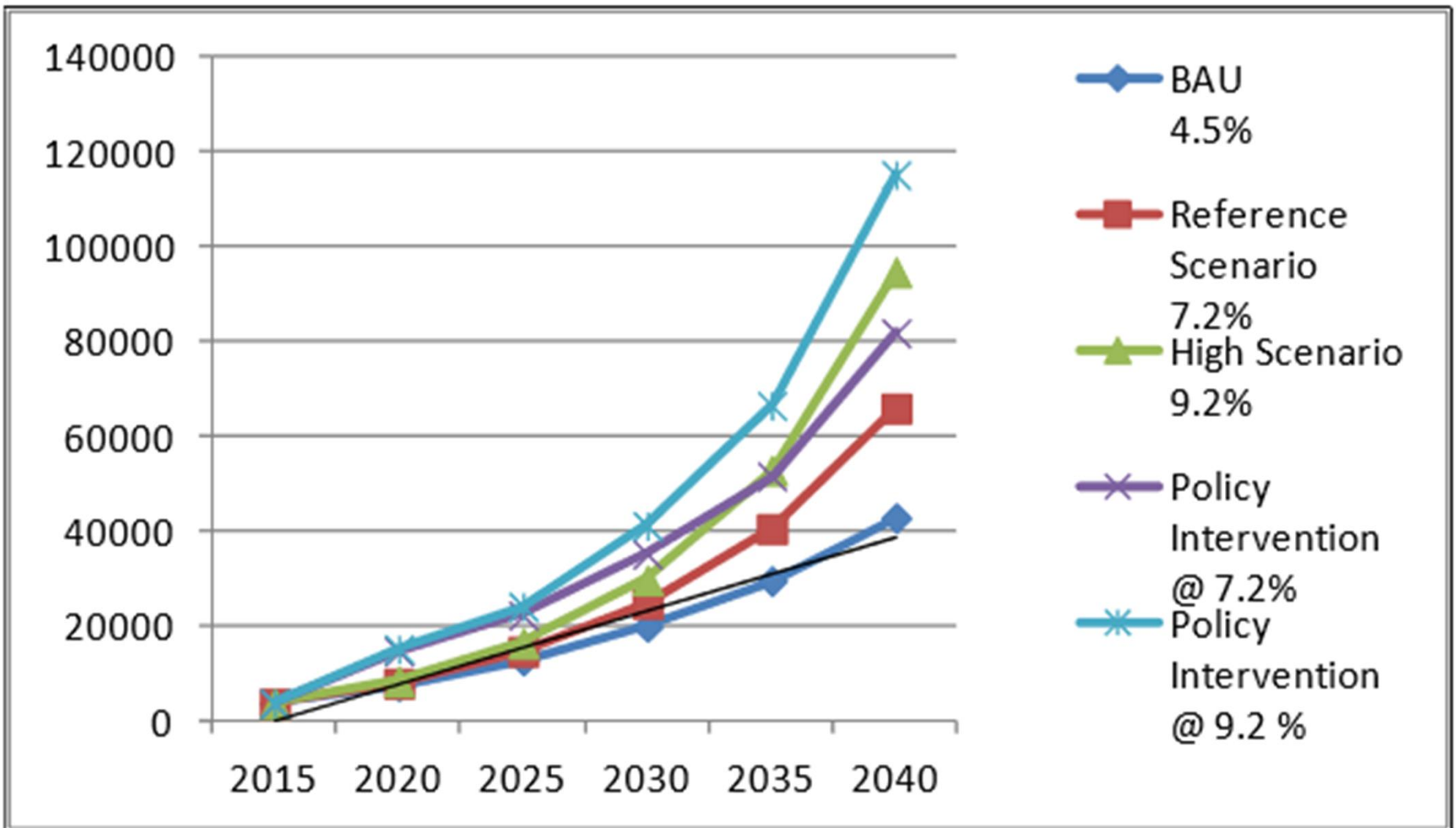


Figure 5.2-1 Electricity Demand Forecast of Nepal (GWh) , Source: WECS

Major Political Commitments in the Sector



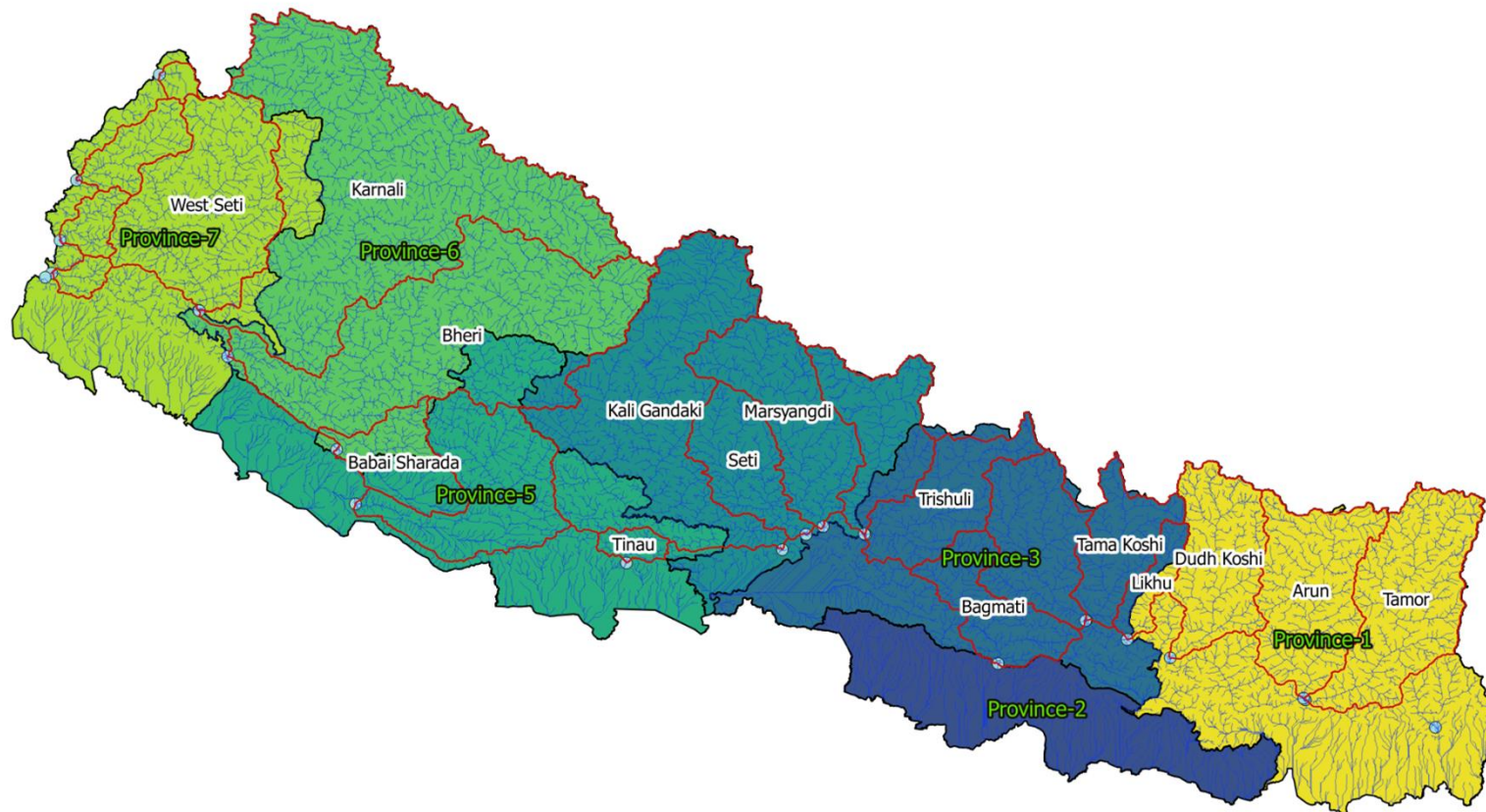
- Ministry of Water Resources, "Task Force Study for 10 Years Hydropower Development Plan", 2065 **(10000 MW in 10 Years)**
- Ministry of Energy, "Task Force Report on Twenty Years Hydropower Development Work Plan", 2066 **(25000 MW in 20 Years)**
- "Energy Emergency Action Plan", 2011 **(2500 MW in 5 Years)**
- Ministry of Energy, "A Concept Paper on National Energy Crisis Alleviation and Energy Development Decade", *Magh 2072*
- Former Honorable Minister for Energy, Janardan Sharma, "Nepalko Pani, Janatako Lagani", 2017 AD **(10000 MW by 2082)**
- Former Honorable Minister for Energy, Mahendra Bahadru Shahi, "Present Situation of Energy Sector and Immediate Work Plan: A White Paper", *Shrawan 2074* **(12000 MW Domestic Consumption in 5 to 10 Years time)**
- Political Commitments by all Governments
- Manifesto of Bam Gathabandhan, 2074 **(20000 MW in 10 Years)**

Review of Manifesto of *Bam Gathabandhan*

- 20000 MW Power Generation in 10 Years (Hydro, Biomass, Solar, Wind, Waste to Energy and Other Renewable Sources)
- Export of Spill Energy to India, Bangladesh and China
- Karnali Chisapani, Budhigandaki, West Seti, Nalsyaugad, Uttarganga, Naumure, Upper Jhimruk, Sunkoshi 1, Sunkoshi 2, Tamor, Tamakoshi 3 and other Projects will be constructed within 10 Years.
- “*Ghar Gharma Bijuli, Jan Janma Share*” model for Investment
- Starting East West Transmission Line and Rasuwagadhi-Kathmandu-Birgunj within One Year.
- Constructing High Voltage Transmission Line Koshi, Gandaki and Karnali Corridor including Mid Hill Highway High Voltage transmission Line.
- Construction of Under Ground Transmission Line
- Electrification to All in 3 Years.

River Basins of Nepal

Major Rivers of Nepal



Similar Previous Study



- Dr. Hari Man Shrestha (83000 MW)
- Dr. Raghu Nath Jha (53836 MW at Q40) , (36,247 MW at Q60) and (27544 MW at Q80)
- Similar Study has been now made by Water and Energy Commission Secretariat

Hydro Potential (Dr. Hari Man Shretha)

RIVER BASIN-WISE HYDRO POTENTIAL OF NEPAL

RIVER BASIN	POTENTIAL (MW)
	TOTAL
Kosi	22,350
Gandaki	20,650
Karnali	32,010
Mahakali	4,160
Southern rivers	4,110
Total:	83,280

Source : Unlocking Nepal's Large Hydropower Potential and Future Large Storage Hydropower Projects Planning , S.C. Agrawal, CEO (SAPDC) Arun 3

Present Findings



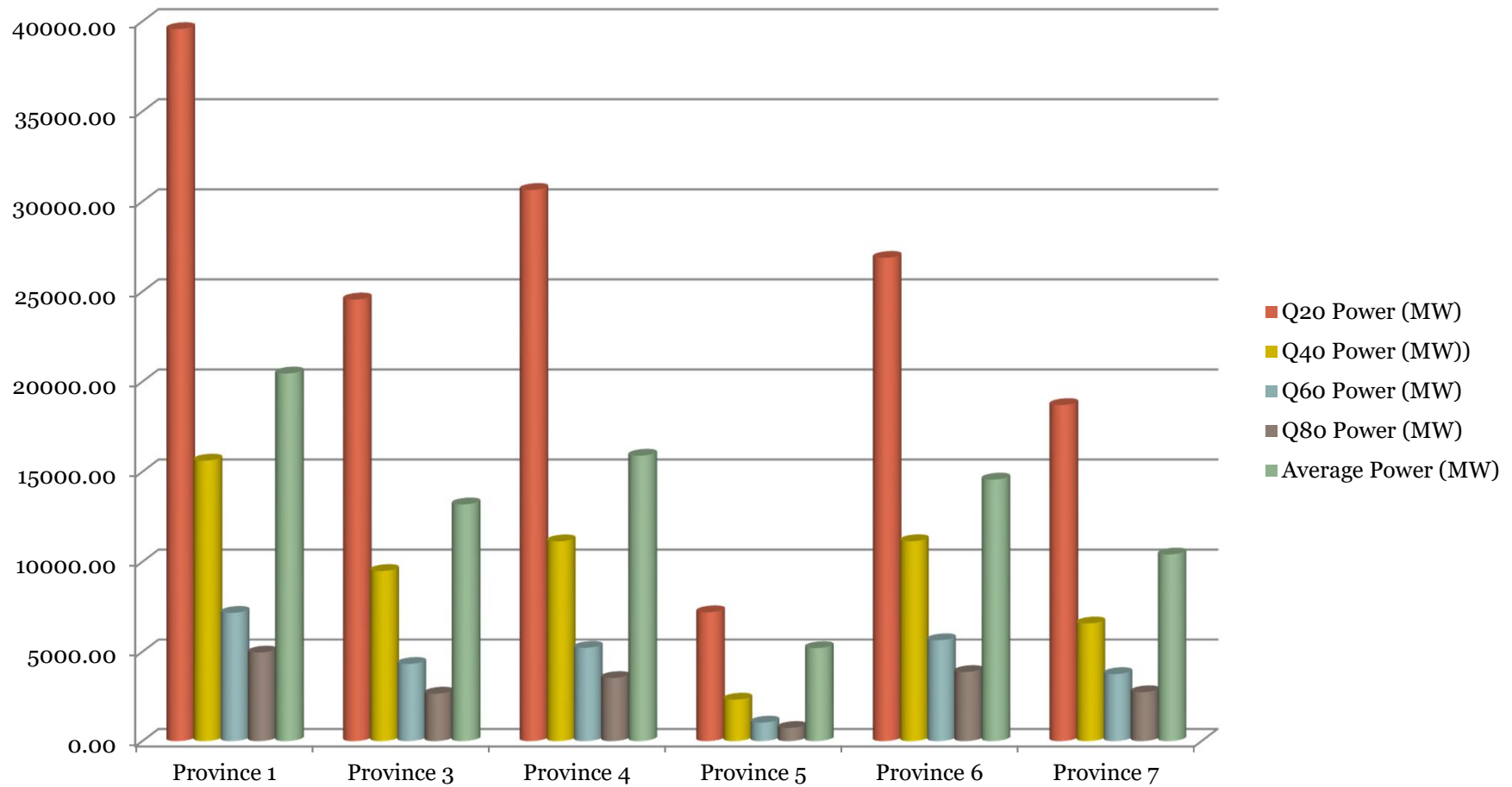
Q20 Power (MW)	Q40 Power (MW)	Q60 Power (MW)	Q80 Power (MW)	Average Power (MW)
147536	56278	27127	18472	79704
Q20 (GWh)	Q40 (GWh)	Q60 (GWh)	Q80 (GWh)	Average Energy (GWh)
470089	274790	173847	130233	569964

Province wise Comparison (MW)



S.N.	Province	Q20 Power (MW)	Q40 Power (MW)	Q60 Power (MW)	Q80 Power (MW)	Average Power (MW)
1	Province 1	39567.81	15615.77	7164.16	4951.78	20453.26
2	Province 3	24560.88	9489.08	4318.46	2655.63	13185.11
3	Province 4	30639.43	11133.15	5217.33	3528.00	15890.63
4	Province 5	7197.46	2320.71	1033.62	736.37	5205.40
5	Province 6	26870.39	11140.85	5644.29	3865.58	14564.31
6	Province 7	18699.54	6577.95	3749.16	2734.40	10405.10
	Total	147535.51	56277.51	27127.02	18471.75	79703.81

Province wise Comparison (MW)

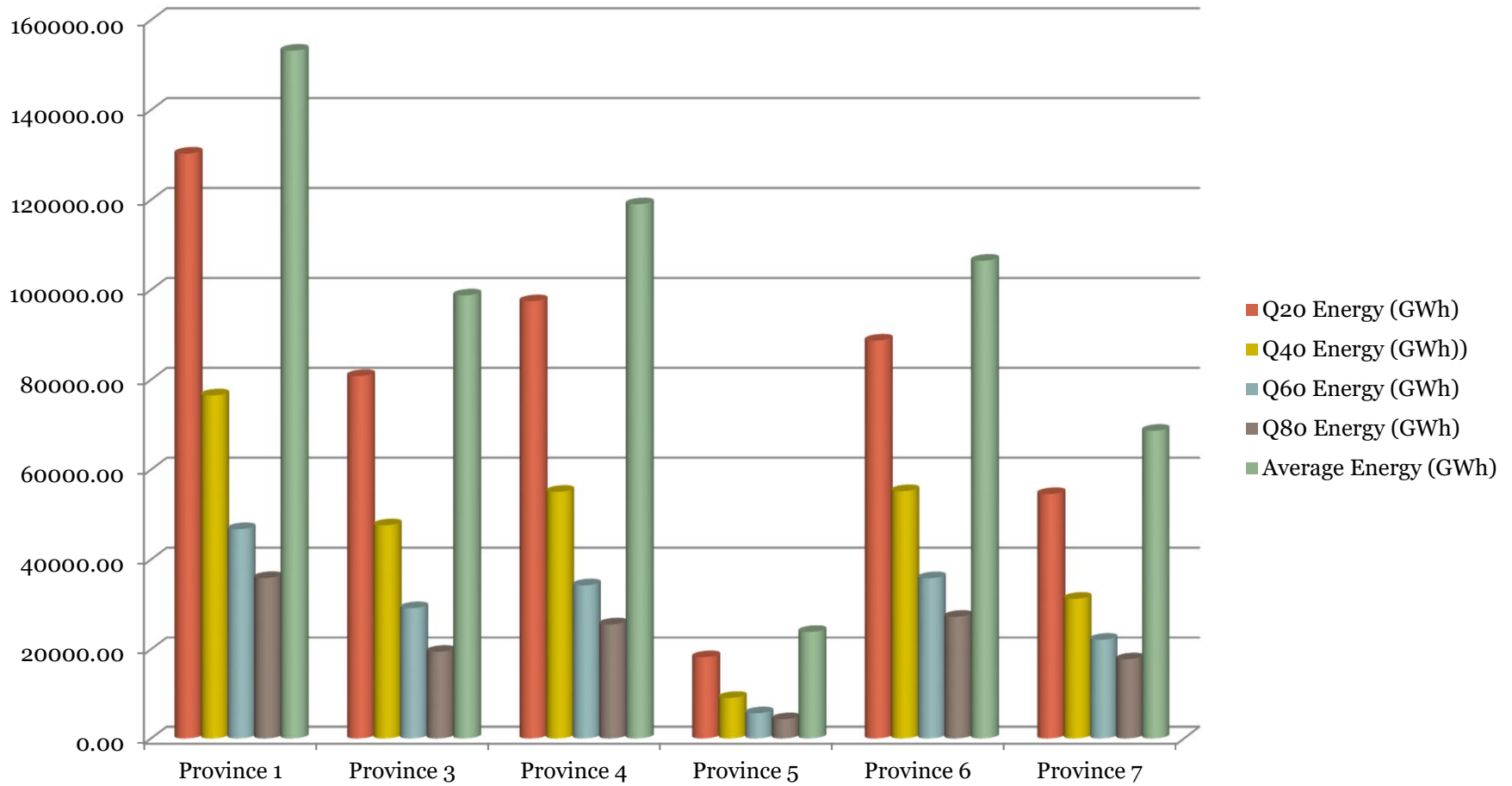


Province wise Comparison (GWh)



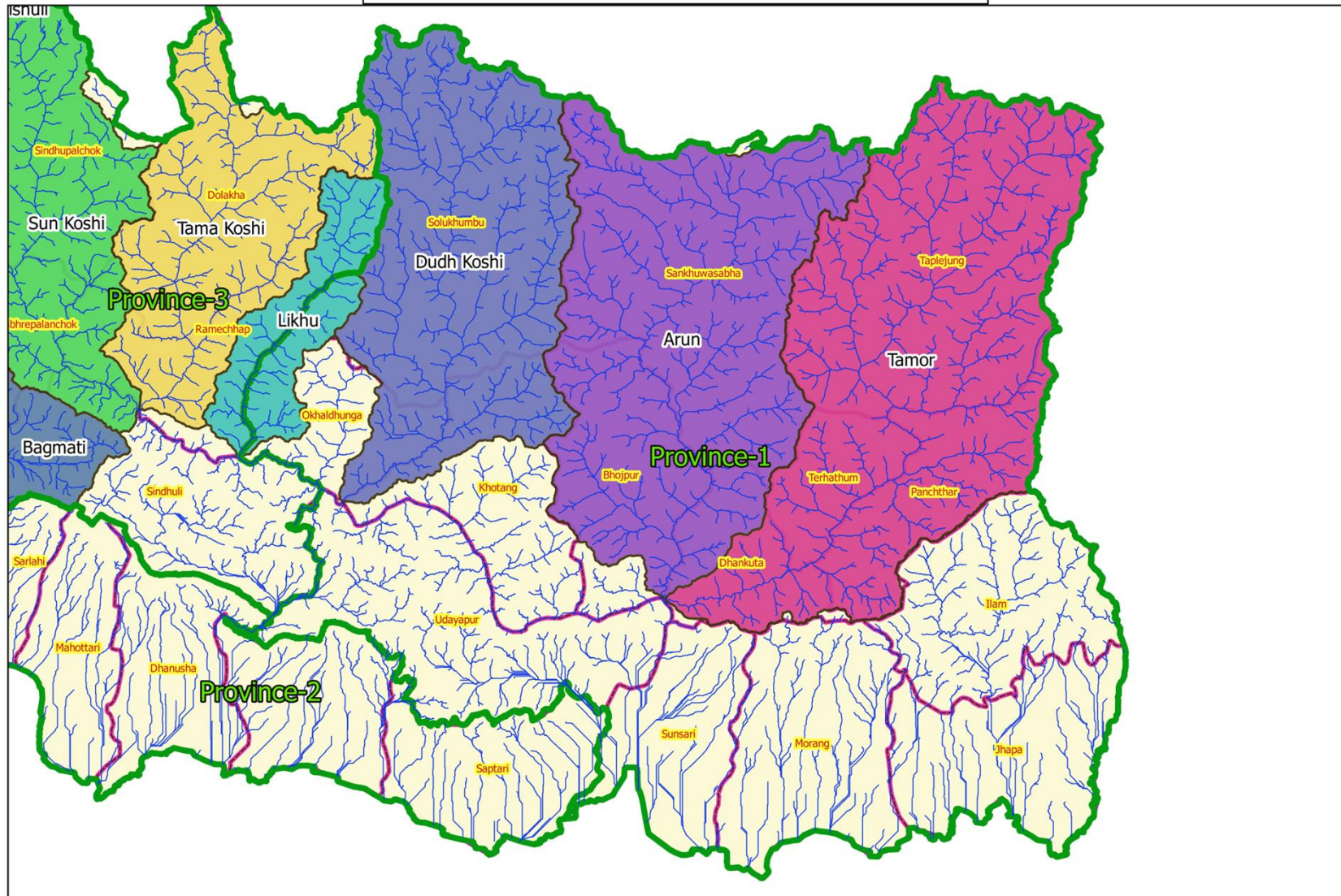
S.N.	Province	Q20 Energy (GWh)	Q40 Energy (GWh)	Q60 Energy (GWh)	Q80 Energy (GWh)	Average Energy (GWh)
1	Province 1	130293.72	76519.78	46766.75	35888.58	153190.82
2	Province 3	80832.33	47610.52	29176.05	19434.11	98753.81
3	Province 4	97454.42	55062.44	34264.46	25573.31	119017.67
4	Province 5	18224.02	9103.19	5661.58	4318.85	23894.13
5	Province 6	88709.75	55210.82	35845.55	27263.44	106463.68
6	Province 7	54574.99	31283.48	22132.37	17754.22	68643.68
	Total	470089.22	274790.25	173846.76	130232.51	569963.79

Province wise Comparison (GWh)



Province 1

Major River Basins of Nepal
Province - 1



Potential of Province No: 1



S.N.	River Basin	Q20 Power (MW)	Q40 Power (MW)	Q60 Power (MW)	Q80 Power (MW)	Average Power (MW)
1	Arun River Basin	15538.04	6699.69	3089.58	2126.80	8182.87
2	Tamor River Basin	8749.17	3367.09	1428.63	907.31	4566.41
3	Mai Khola and Branches	478.99	166.36	70.23	42.94	246.53
4	Sunkoshi River Basin , Bhotekoshi and Indrawati	3401.88	1047.18	477.68	344.95	1670.26
5	Likhu Khola River Basin	758.48	286.20	138.12	100.07	385.75
6	Dudh Koshi River Basin	10641.24	4049.24	1959.93	1429.71	5401.44
	Total	39567.81	15615.77	7164.16	4951.78	20453.26

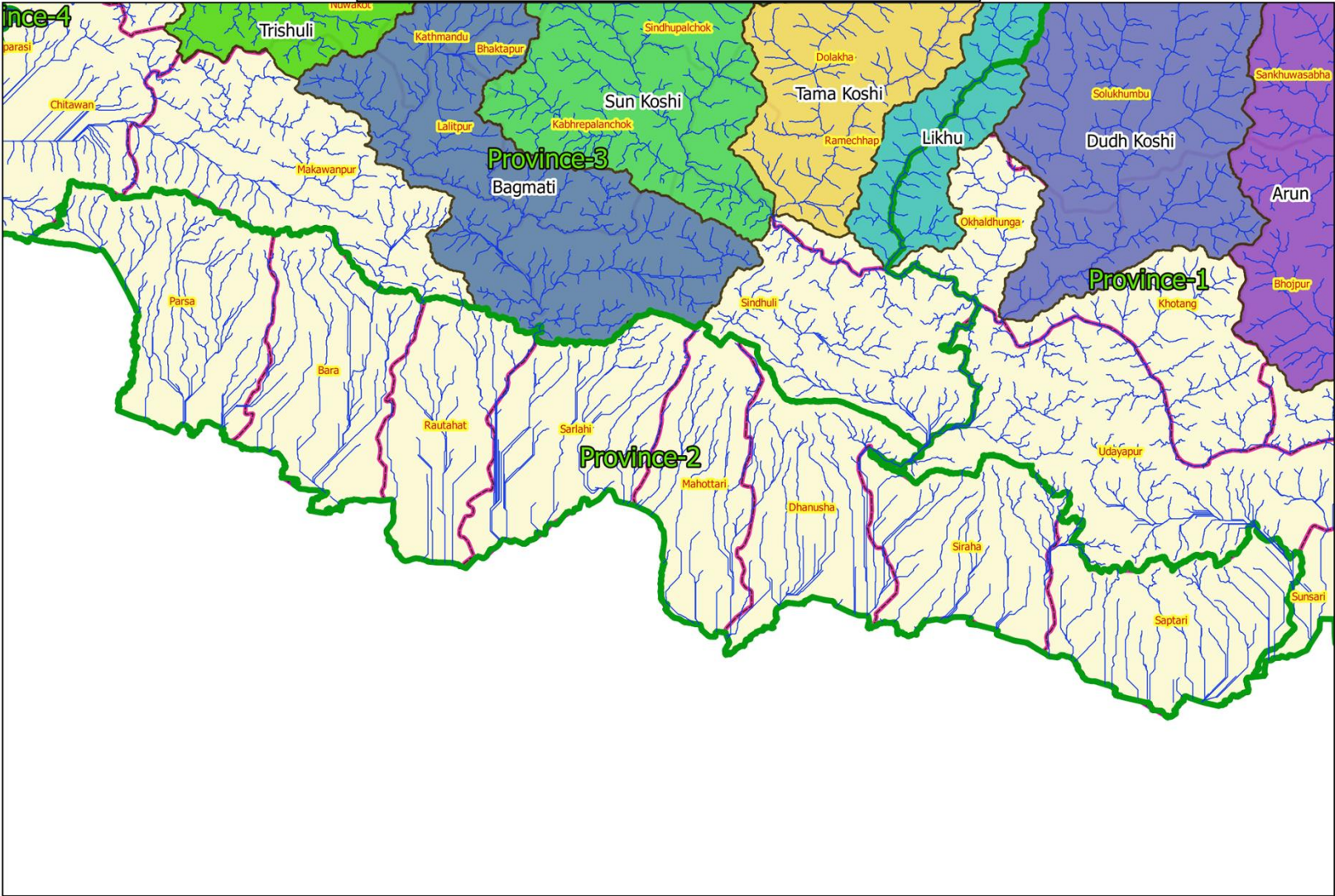
Potential of Province No: 1



S.N.	River Basin	Q20 (GWh)	Q40 (GWh)	Q60 (GWh)	Q80 (GWh)	Average Energy (GWh)
1	Arun River Basin	53197.07	32838.94	20105.28	15424.64	61288.09
2	Tamor River Basin	28254.49	15908.57	9021.35	6529.00	34201.47
3	Mai Khola and Branches	1504.57	788.80	449.87	313.54	1846.48
4	Sunkoshi River Basin , Bhotekoshi and Indrawati	10189.75	5109.28	3164.94	2491.53	12509.89
5	Likhu Khola River Basin	2451.58	1434.02	919.93	727.20	2889.17
6	Dudh Koshi River Basin	34696.25	20440.17	13105.38	10402.66	40455.71
	Total	130293.72	76519.78	46766.75	35888.58	153190.82

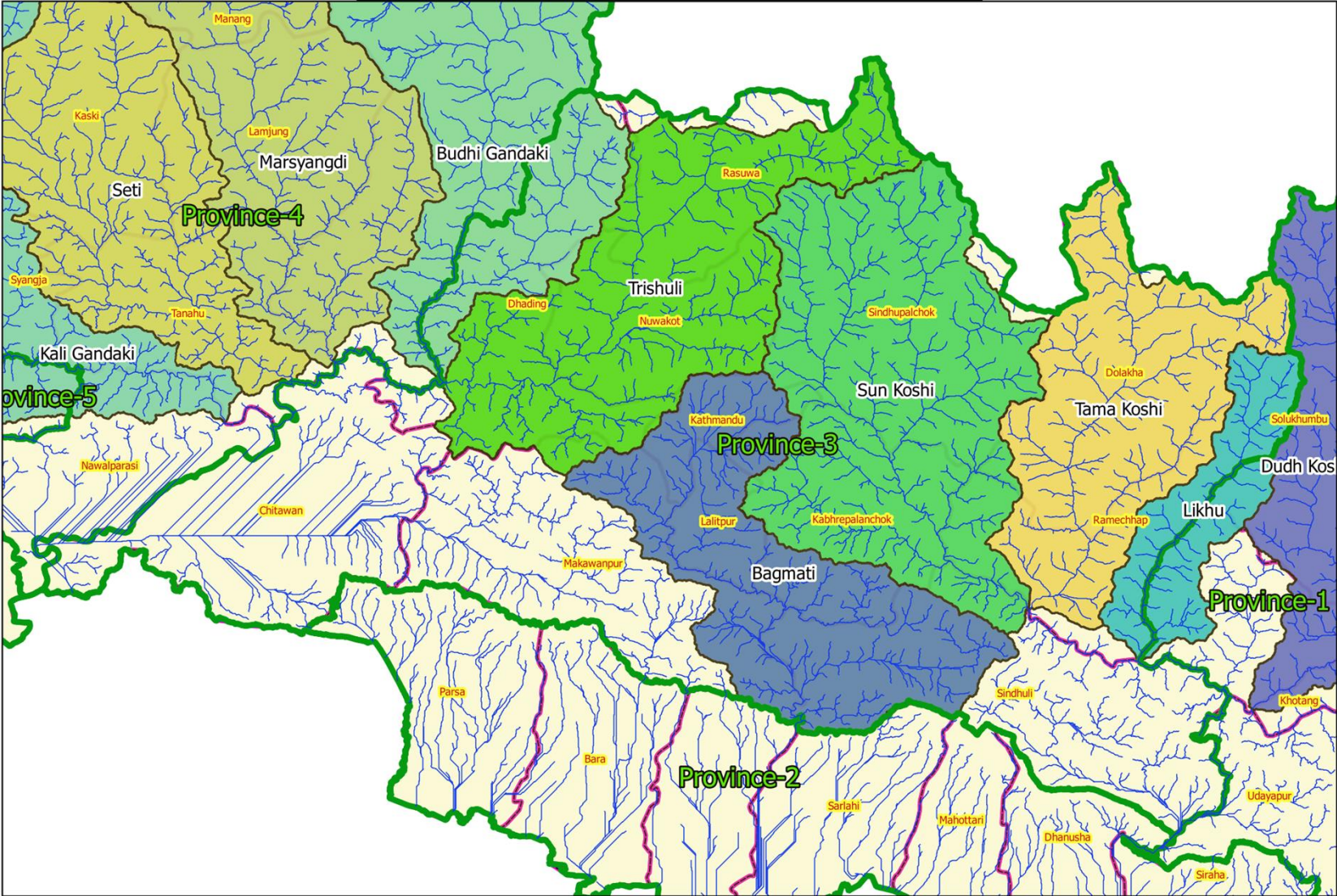
Province 2

Major River Basins of Nepal
Province - 2



Province 3

Major River Basins of Nepal
Province - 3



Potential of Province No: 3



S.N.	River Basin	Q20 Power (MW)	Q40 Power (MW)	Q60 Power (MW)	Q80 Power (MW)	Average Power (MW)
1	Sunkoshi River Basin , Bhotekoshi and Indrawati	7918.60	2970.30	1435.36	1015.54	4162.26
2	Likhu Khola River Basin	993.52	374.90	180.85	131.06	505.40
3	Tamakoshi River Basin	6543.23	2008.82	920.97	609.74	3433.47
4	Bagmati River Basin	1774.81	583.45	261.10	164.74	1028.83
5	Trishuli River Basin	6441.80	3204.62	1351.40	623.21	3605.27
6	Budhi Gandaki River Basin	888.93	347.00	168.78	111.33	449.87
	Total	24560.88	9489.08	4318.46	2655.63	13185.11

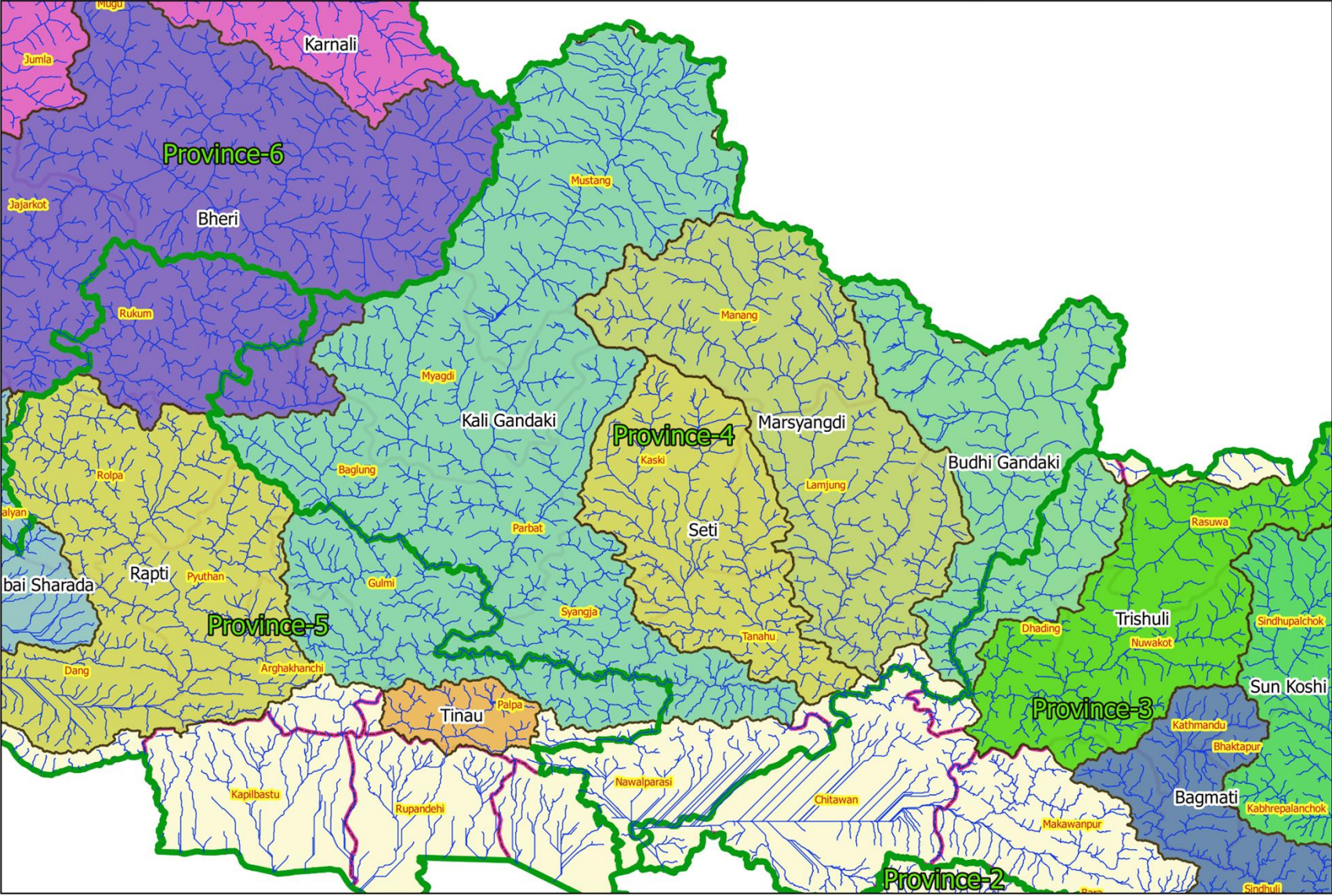
Potential of Province No: 3



S.N.	River Basin	Q20 (GWh)	Q40 (GWh)	Q60 (GWh)	Q80 (GWh)	Average Energy (GWh)
1	Sunkoshi River Basin , Bhotekoshi and Indrawati	25665.22	14724.37	9402.63	7356.25	31174.49
2	Likhu Khola River Basin	3211.38	1878.47	1204.65	952.45	3785.37
3	Tamakoshi River Basin	19974.29	9691.84	5982.80	4448.26	25716.00
4	Bagmati River Basin	5471.47	2812.04	1694.48	1205.52	7705.72
5	Trishuli River Basin	23593.28	16783.69	9804.89	4667.72	27002.77
6	Budhi Gandaki River Basin	2916.69	1720.12	1086.59	803.90	3369.45
	Total	80832.33	47610.52	29176.05	19434.11	98753.81

Province 4

Major River Basins of Nepal
Province - 4



Potential of Province No: 4

S.N.	River Basin	Q20 Power (MW)	Q40 Power (MW)	Q60 Power (MW)	Q80 Power (MW)	Average Power (MW)
1	Trishuli River Basin	1339.32	841.23	345.35	137.03	818.65
2	Budhi Gandaki River Basin	4949.44	2000.06	971.65	612.60	2525.54
3	Marsyangdi River Basin	8412.31	3159.79	1527.64	1091.25	4210.24
4	Seti River Basin	1234.33	407.56	185.57	131.76	639.59
5	Madi River Basin Damauli	1043.33	338.31	169.15	124.05	543.04
6	Kaligandaki River Basin	11798.72	3794.29	1740.92	1245.34	6168.44
7	Myagdi Khola River Basin	960.52	311.89	151.30	101.41	519.26
8	Bodigad River Basin	699.15	217.19	97.55	65.56	361.33
9	Bheri River Basin Rukum	202.32	62.84	28.20	19.00	104.56
	Total	30639.43	11133.15	5217.33	3528.00	15890.63

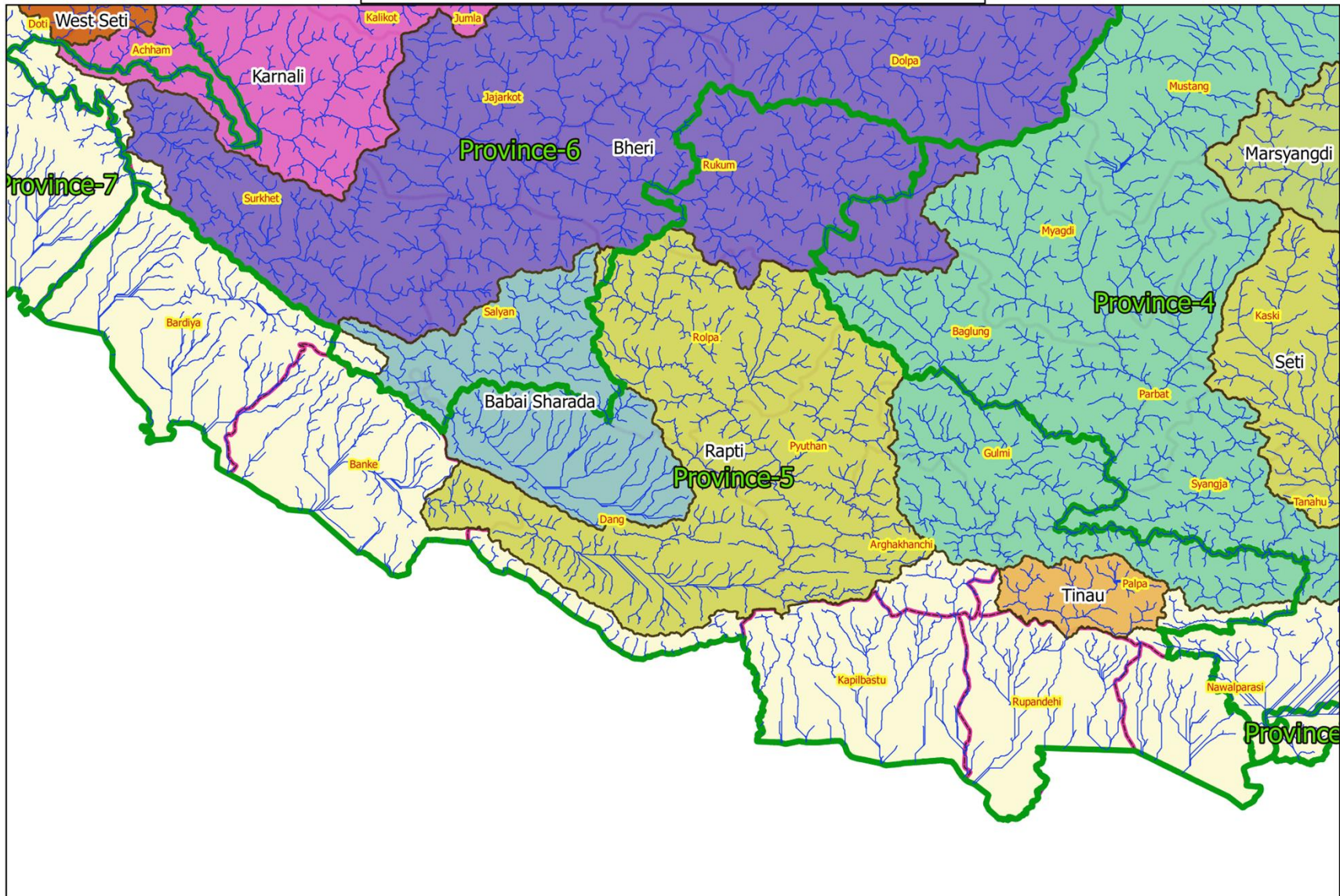
Potential of Province No: 4



S.N.	River Basin	Q20 (GWh)	Q40 (GWh)	Q60 (GWh)	Q80 (GWh)	Average Energy (GWh)
1	Trishuli River Basin	5487.53	4497.61	2586.58	1026.33	6131.51
2	Budhi Gandaki River Basin	16469.28	9875.36	6188.12	4401.22	18915.75
3	Marsyangdi River Basin	27075.13	15739.23	10021.15	7934.01	31533.84
4	Seti River Basin	3828.10	1981.20	1218.37	956.43	4790.38
5	Madi River Basin Damauli	3260.59	1694.88	1109.07	900.10	4067.27
6	Kaligandaki River Basin	35774.27	18421.94	11361.61	9007.34	46200.35
7	Myagdi Khola River Basin	2860.81	1509.01	967.58	733.59	3889.18
8	Bodigad River Basin	2093.05	1041.79	629.86	476.29	2706.25
9	Bheri River Basin Rukum	605.66	301.42	182.12	138.00	783.13
	Total	97454.42	55062.44	34264.46	25573.31	119017.67

Province 5

Major River Basins of Nepal
Province - 5



Potential of Province No: 5

S.N.	River Basin	Q20 Power (MW)	Q40 Power (MW)	Q60 Power (MW)	Q80 Power (MW)	Average Power (MW)
1	Kaligandaki River Basin	882.66	286.68	127.93	92.69	449.26
2	Bodigad River Basin	452.40	140.53	63.05	42.45	233.74
3	Rapti River Basin	2990.83	966.28	403.93	304.43	3035.28
4	Bheri River Basin	1963.77	609.89	273.66	184.32	1014.65
5	Babai Sharada River Basin	217.75	64.59	34.21	22.57	122.64
6	Karnali River Basin	690.0279346	252.750873	130.847193	89.91647838	349.823697
	Total	7197.46	2320.71	1033.62	736.37	5205.40

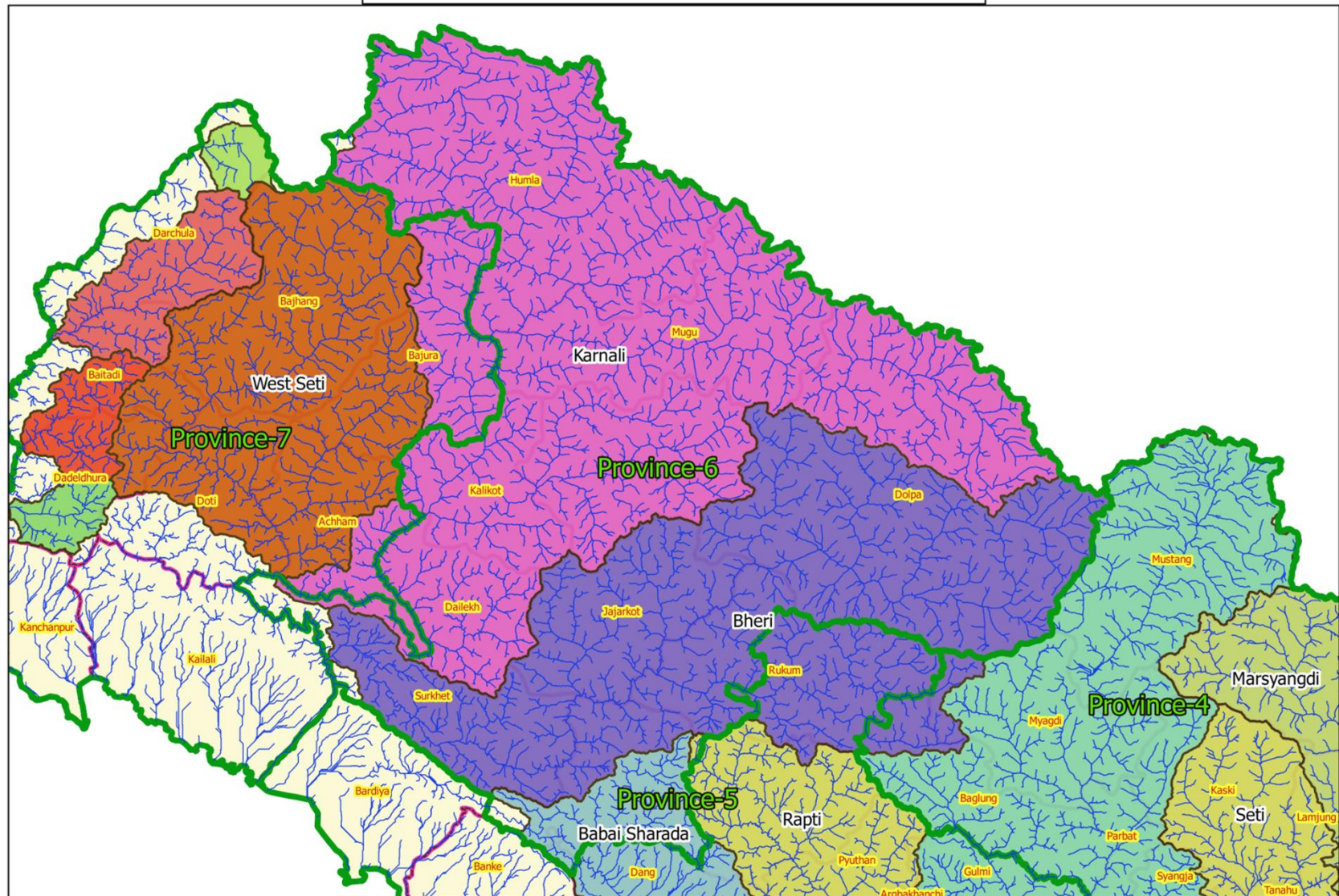
Potential of Province No: 5



S.N.	River Basin	Q20 (GWh)	Q40 (GWh)	Q60 (GWh)	Q80 (GWh)	Average Energy (GWh)
1	Kaligandaki River Basin	2673.25	1383.90	838.54	671.26	3364.86
2	Bodigad River Basin	1354.34	674.07	407.23	308.34	1750.70
3	Rapti River Basin	5433.66	2511.03	1580.62	1183.45	7640.38
4	Bheri River Basin Rukum	5878.74	2925.59	1767.64	1338.81	7599.52
5	Babai Sharada River Basin	669.65	330.78	222.09	164.40	918.56
6	Karnali River Basin	2214.38	1277.83	845.46	652.59	2620.11
	Total	18224.02	9103.19	5661.58	4318.85	23894.13

Province 6

Major River Basins of Nepal
Province - 6



Potential of Province No: 6



S.N.	River Basin	Q20 Power (MW)	Q40 Power (MW)	Q60 Power (MW)	Q80 Power (MW)	Average Power (MW)
1	Bheri River Basin	8778.31	3413.22	1629.63	1167.23	4605.61
2	Babai Sharada River Basin	302.33	110.21	54.36	38.35	162.43
3	Karnali River Basin	17789.75	7617.43	3960.30	2659.99	9796.27
	Total	26870.39	11140.85	5644.29	3865.58	14564.31

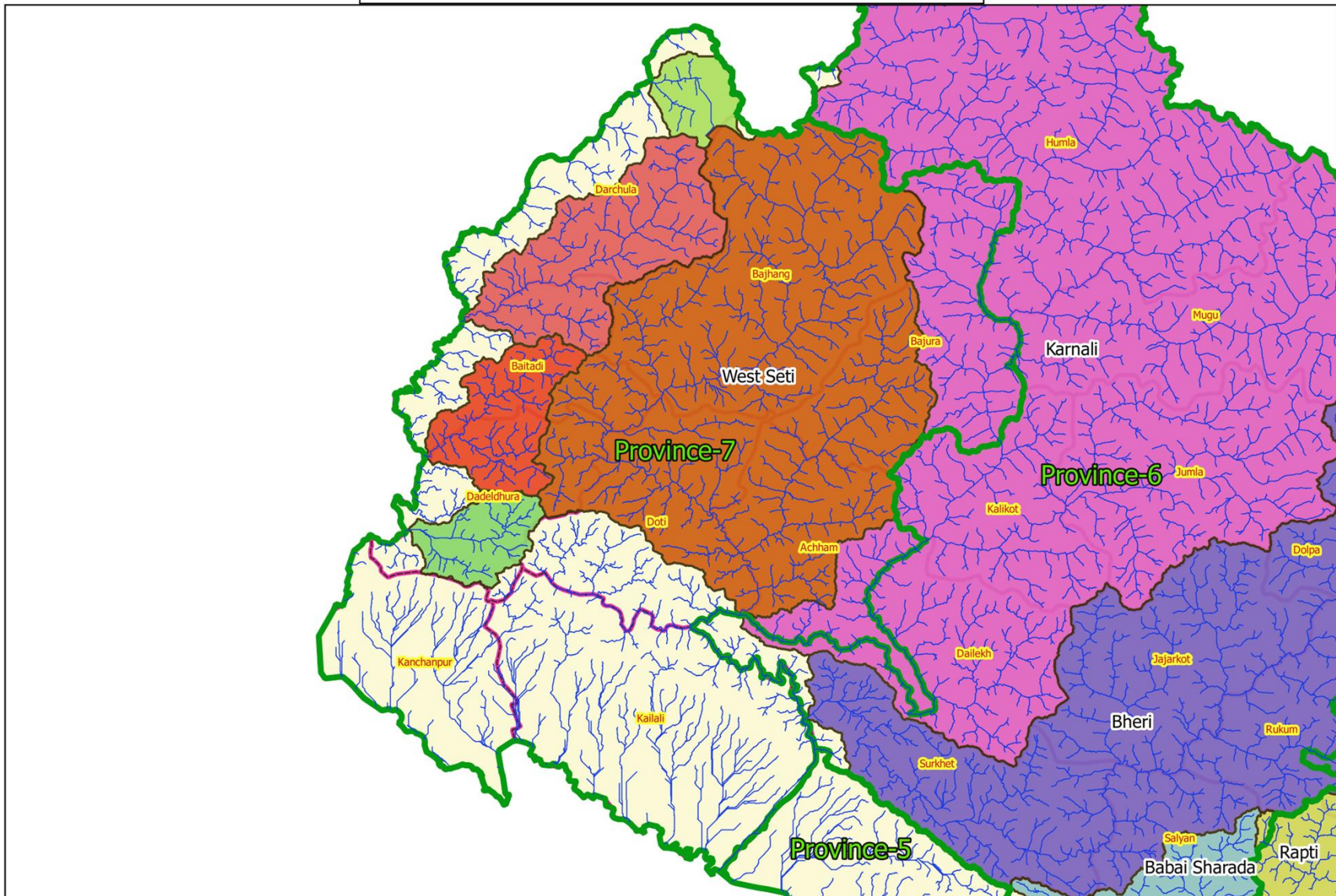
Potential of Province No: 6



S.N.	River Basin	Q20 (GWh)	Q40 (GWh)	Q60 (GWh)	Q80 (GWh)	Average Energy (GWh)
1	Bheri River Basin	28181.15	16959.44	10641.25	8425.93	34495.11
2	Babai Sharada River Basin	961.65	553.27	354.84	277.42	1216.58
3	Karnali River Basin	59566.94	37698.11	24849.47	18560.10	70751.99
	Total	88709.75	55210.82	35845.55	27263.44	106463.68

Province 7

Major River Basins of Nepal
Province - 7



Potential of Province No: 7



S.N.	River Basin	Q20 Power (MW)	Q40 Power (MW)	Q60 Power (MW)	Q80 Power (MW)	Average Power (MW)
1	Karnali River Basin	5509.44	2179.77	1124.37	761.57	2905.18
2	Seti River (FarWestern) Basin	6103.27	2002.85	1171.63	847.75	3193.16
3	Mahakali Basin	7086.83	2395.33	1453.16	1125.07	4306.76
	Total	18699.54	6577.95	3749.16	2734.40	10405.10

Potential of Province No: 7



S.N.	River Basin	Q20 (GWh)	Q40 (GWh)	Q60 (GWh)	Q80 (GWh)	Average Energy (GWh)
1	Karnali River Basin	22786.71	13624.52	8968.51	6817.53	26999.47
2	Seti River (FarWestern) Basin	19119.09	10546.05	7682.99	6194.48	23916.10
3	Mahakali Basin	14883.57	8390.74	6326.33	5394.79	20348.22
	Total	56789.37	32561.31	22977.83	18406.80	71263.79

Findings Comparison with Dr. Raghunath Jha Study

S.N.	River Basin	Present Study By Er. Khimananda Kandel		Research Findings by Dr. Raghu Nath Jha Study	
		Q40 Power (MW)	Q40 Energy (GWh)	Q40 Power (MW)	Q40 Energy (GWh)
1	Arun River Basin	6699.69	32838.94	4965.10	32959.00
2	Tamor River Basin	3367.09	15908.57	3643.50	22644.40
3	Sunkoshi River Basin , Bhotekoshi and Indrawati	4017.48	19833.66	2962.80	19176.20
4	Likhu Khola River Basin	661.11	3312.48	607.50	3826.70
5	Dudh Koshi River Basin	4049.24	20440.17	2741.50	17405.10
6	Tamakoshi River Basin	2008.82	9691.84	2087.90	12805.40
7	Trishuli River Basin	4045.84	21281.29	5666.10	36607.10
8	Budhi Gandaki River Basin	2347.06	11595.47	3286.00	20544.20
9	Marsyangdi River Basin	3159.79	15739.23	3251.80	20505.20
10	Seti River Basin	407.56	1981.20	780.00	4957.10
11	Madi River Basin Damauli	338.31	1694.88	477.50	3073.90
12	Kaligandaki River Basin	4750.57	23030.72	4338.80	27685.80
13	Bheri River Basin	4085.94	20186.45	4140.75	27362.34
14	Babai Sharada River Basin	174.80	884.05	106.60	729.24
15	Karnali River Basin	10049.94	51322.64	8950.94	57705.18
16	Seti River (Far Western) Basin	2002.85	10546.05	2462.87	16527.28
17	Mahakali Basin	2395.33	8390.74	2261.83	14980.90
18	Other Basins	1716.09	6111.87	1105.00	7043.00
	Total	56277.51	274790.25	53836.00	346538.00

Basin Validation

S.N.	Name of Basin	Studied Project	Parameters	Finding
1	Arun River Basin	Arun III (900 MW)	Design Discharge = 344.68 m ³ /s, Gross Head = 286.21 m, Catchment Area = 26749 km ² , Annual Energy = 3684.61 GWh	Design Discharge = 316.00 m ³ /s and Head = 308 m, Catchment area = 26649 km ² , Annual Energy = 5561.00 GWh
2	Sunkoshi River Basin	Madhya Bhotekoshi Hydropower Project (102 MW)	Annual Energy 542.2 GWh	Annual Energy = 547.95 GWh
3	Tamakoshi River Basin	Upper Tamakoshi (456 MW)	Installed Capacity = 456 MW and Annual Energy 2281.2 GWh	Installed Capacity = 475 MW and Annual Energy = 2289 GWh
4	Bagmati River Basin	Kulekhani Hydroelectric Project (60 MW)	Annual Energy = 165 GWh	Annual Energy Generation = 162.44 GWh
5	Trishuli River Basin	Trishuli Hydropower Project (21 MW)	Annual Energy = 163 GWh	Annual Energy Generation = 152 GWh
6	Budhi Gandaki River Basin	Budhigandaki Hydropower Project (1200 MW)	Annual Design Energy = 3383 GWh	Annual Energy Generation = 2922 GWh

Basin Validation.....

7	Marsyangdi River Basin	Marsyangdi Hydropower Project (69 MW)	Average Flow = 210 m ³ /s and Annual Energy = 462.5 GWh, Turbine Discharge = 91.5 m ³ /s (for all 3 turbines)	Average Flow = 223 m ³ /s and Average Energy = 453 GWh at Q50
8	Seti /Madi River Basin	Tanahun Hydropower Project (140 MW)	Annual Energy = 585.7 GWh	Annual Energy Generation = 544.8 GWh
9	Kaligandaki River Basin	Kaligandaki A Hydropower Project (144 MW)	Maximum Generted Annual Power = 795.84 GWh in the Year 2065	Annual Energy = 807 GWh (The Project seems functioning in Q50 Mode)
		MW)	BS	
10	Karnali River Basin	Karnali Chisapani Hydropower Project (10800 MW)	Average Flow = 1389 m ³ /s and Average Energy = 20842 GWh	Average Flow = 1389 m ³ /s and Average Energy = 20572 GWh
11	Seti River (FarWestern) Basin	West Seti Hydroelectric Project (750 MW)	Average Energy = 3,636 GWh	Average Energy = 3284 GWh
12	Mahakali Basin	Pancheshwor Multipurpose Project (6720 MW)	Average Flow = 582 m ³ /s and Average Energy = 10671 GWh	Average Flow = 640 m ³ /s and Average Energy = 10719 GWh

Review of Government Prioritized Projects

S.N.	Name of the Project	Installed Capacity (MW)	Q20 (MW)	Q40 (MW)	Q60 (MW)	Q80 (MW)	Q Average (MW)
1	Karnali Chisapani Hydropower Project	10800	4876	1786	925	635	2472
2	Budhigangaki Hydropower Project	1200	758	317	154	93	390
3	Nalsyau Gad Storage HEP	410	178	75	34	21	94
4	Uttarganga Storage Hydropower Project	300	360	112	50	34	186
5	Dudhkoshi Storage	300	1172	407	175	118	578
6	Tamor Storage	200	846	326	138	88	442
7	Sunkoshi 3 Hydropower Project	536	654	266	132	92	367
8	Tamakoshi 3 Hydropower Project	650	1129	348	159	105	590
9	Khimti Those Hydropower Project	200	83	25	12	8	45
10	Lantang Khola Reservoir Hydropower Project	310	355	223	92	36	217
11	Naumure Hydropower Project	300	448	95	48	30	267
12	West Seti Hydropower Project	750	833	294	164	120	439
13	Tila 1 Hydropower Project	440	336	167	102	73	203

Review of Government Prioritized Projects

S.N.	Name of the Project	Installed Capacity (MW)	Q20 (GWh)	Q40 (GWh)	Q60 (GWh)	Q80 (GWh)	Average Energy (GWh)
1	Karnali Chisapani Hydropower Project	10800	15648	9030	5975	4612	18515
2	Budhigangaki Hydropower Project	1200	2559	1561	970	662	2922
3	Nalsyau Gad Storage HEP	410	587	367	215	153	702
4	Uttarganga Storage Hydropower Project	300	1078	536	324	245	1393
5	Dudhkoshi Storage	300	3604	1905	1120	851	4329
6	Tamor Storage	200	2733	1539	872	632	3308
7	Sunkoshi 3 Hydropower Project	536	2197	1337	873	676	2746
8	Tamakoshi 3 Hydropower Project	650	3442	1674	1027	765	4422
9	Khimti Those Hydropower Project	200	259	123	79	59	340
10	Lantang Khola Reservoir Hydropower Project	310	1455	1193	686	273	1626
11	Naumure Hydropower Project	300	1305	478	303	214	1997
12	West Seti Hydropower Project	750	2684	1534	1079	866	3285
13	Tila 1 Hydropower Project	440	1277	907	672	530	1523

Attractive Projects of Nepal

S. N.	Name of the Stream	Name of the Project	Remarks
1	Arun River Basin	Arun 3 (900 MW), Kimathanka Arun (450 MW will have more power), Arun 4 (300 MW), Upper Arun (335 MW) and Lower Arun (400 MW)	Arun 3 (900 MW) and Kimathanka Arun (450 MW will have more power) are the most attractive Projects and Both Projects can be developed in coming 10 Years (Province No: 1)
2	Tamor River Basin	Tamor Storage (200 MW), Super Tamor (155 MW), Tamor Mewa (128 MW)	Tamor Storage (200 MW) will of higher installed capacity, Both Super Tamor (155 MW) and Tamor Mewa (128 MW) can be developed in coming 10 Years (Province No: 1)
3	Saptakoshi River Basin	Sunkoshi 2 (1110 MW), Sunkoshi III (536 MW), Tamakoshi II (650 MW), Khimti Shibalay (200 MW)	All of these three Projects can be developed in 10 to 15 Years time. Apart from this, there are attractive projects in Balephi River as well. (Province No: 3)
4	Dudh Koshi River Basin	Dudhkoshi Storage (300 MW), Dudhkoshi 9, 111 MW	Dudhkoshi Storage project can be developed in Higher Installed capacity in 10 Years and apart from this there are 2 to 3 attractive projects in the upper part which should be developed by Government. (Province No: 1)
6	Trishuli River Basin	Langtang Reservoir (300 MW), Rasuwa Bhotekoshi (120 MW)	Langtang Reservoir (300 MW) Project can be developed in higher capacity is this one of the best hydropower Projects of Nepal (Province No: 3)
7	Budhi Gandaki River Basin	Budhigandaki Hydroelectric Project (1200 MW), Upper Budhigandaki (203 MW), Budhigandaki (254 MW), Budhi Gandaki Syar Khola (270 MW) Budhigandaki Prok (420 MW)	Budhigandaki HEP (1200 MW) can be developed in Lower installed capacity and Budhigandaki Prok (420 MW) is the attractive Project Budhigandaki HEP (1200 MW) : Province 3 and 4 and all other projects in Province 4

Attractive Projects of Nepal

8	Marsyangdi River Basin	Upper Marsyangdi 2 (600 MW), Upper Marsyangdi 1 (138 MW), Lower Manang Marsyangdi (140 MW), Manang Marsyangdi (282 MW), Manang Chame Storage (177.2 MW)	Upper Marsyangdi 2 (600 MW) is the most attractive Project and all of the projects can be developed within 15 Years time. (Province No: 4)
11	Kaligandaki River Basin	Kaligandaki Gorge (164 MW), Badigad Storage Project (380 MW)	Kaligandaki Gorge project can be developed in higher installed capacity and Badigad Storage Project can also be developed. Kaligandaki Gorge Project Lies in Province No: 3 and Badigad Storage Project lies in Province No. 4 . Apart from this there are attractive projects in Myagdi Khola and Nilgiri Khola.
14	Rapti River Basin	Naumure Storage (300 MW), Upper Jhimruk Storage (100 MW)	Naumure Storage (300 MW) and Upper Jhimruk Storage (100 MW) are the main identified projects and both the projects can be developed by 2030.
15	Bheri River Basin	Bheri 3 Storage(480 MW), Bheri 4 (300 MW), Bheri Khalanga (128 MW), Nalsyaugad (410 MW), Bheri 2 (243 MW), Thuli Bheri (121 MW), Jagdulaa HEP (307 MW), Thuli Bheri 1 (110 MW), Chera (148.7 MW), Saru Khola (100 MW),	Nalsyaugad (410 MW), Bheri 3 Storage (480 MW), Jagdulla HEP (307 MW) etc. are some of the attracting projects. All of these projects lies in Province No: 6 . There are possible projects in Sani Bheri River as well.

Attractive Projects of Nepal

16	Karnali River Basin	Karnali Chisapani (10800 MW), Upper Karnali (900 MW), Betan Karnali (688 MW), Karnali Storage (184 MW), Phulkot Karnali (210 MW), Phukot Karnali (426 MW), Tila 1 (440 MW), Mugu Karnali (159.62 MW), Humla Karnali 1 (274 MW), Humla Karnali Cascade (916 MW), Namlan (303 MW)	Karnali Chisapani Project (10800 MW) well known project of Nepal but license boundary now overlaps with Betan Karnali (688 MW) and Seti Storage Project. Upper Karnali (900 MW) Phukot Karnali (426 MW) and Humla Karnali Cascade (916 MW) are the most attractive projects in this basin. Karnali Chisapani and Upper Karnali will have power sharing among Provinces and Humla Karnali lies in Province No: 6.
17	Seti River (FarWestern) Basin	West Seti (750 MW), Seti Storage (600 MW), Seti Nadi 3 (165 MW), Chainpur Seti (210 MW)	West Seti (750 MW), Chainpur Seti (210 MW) are the most attractive projects. Apart from these identified projects there is also possibility of promoting some other projects. Province No: 7
18	Mahakali Basin	Pancheshwor Multipurpose Project (6570 MW)	Pancheshwor Multipurpose Project (6570 MW) project is a bilateral projects to be developed by Nepal and India. Since there are 100s of attracting projects in Nepal, this project may not be so attractive from return perspectives for developing immediately.

Suggestion to Government



- Upto10 MW Installed Capacity : By Local Governments and Private Sector
- 10 to 50 MW Installed Capacity : By Provincial Governments and the Private Sector
- 50 MW to 100 MW : By Provincial Government
- 100 MW to 1000 MW : By Central Government
- 1000 MW and Above : Central Government in Cooperation with International Community

Suggestion to Government

- One Window Planning of Energy Sector
- Necessity of Defined Energy Mix Planning
- Reform in Energy Sector necessary
- Paradigm Shift of the Government Institutions
- Fast Track Working Modality (Procurement Aspects)
- Basin Transfer Aspects
- Budget Allocation for R&D Activities
- Energy Sharing Aspects
- Investment Aspects
- Regional Cooperation

Available Software Tools

1 : Hydropower Studio Model

2 : Hydrology Model

3 : River Basin Models

4 : Web Based Platform for Energy Development

Available on Purchasing

Hydropower Studio Model Inputs

Particulars		Dundun Gad(Duikholi 1)	Dundun Gad(Duikholi 2)	Chunban Khola(Duikholi 3)
District		Rolpa	Rolpa	Rolpa
Name of Project		Duikholi 1	Duikholi 2	Duikholi 3
Name of the Project (River Name 1n)		Dundun Gad	Dundun Gad	Chunban Khola
Intake		1	2	3
Coordinate of Intake (Decimal Degree)	Longitude	82.579967	82.553859	82.54107
	Lattitude	28.473188	28.478418	28.524745
Coordinate of Powerhouse	Longitude	82.56053	82.536406	82.53263
	Lattitude	28.478736	28.477223	28.502449
Catchment Area		97.1	115	51
Monsoon Wetness Index		1220	1220	1220
RL of Intake (m)		1600	1460	1560
RL of Powerhouse (m)		1519.64	1408.78	1460
Gross Head (m)		80.36	51.22	100
Total Length of Waterways (kM)		2.439	2.356	3.791
Length of of Headrace (kM)		2.338	2.28	3.403
Length of Penstock (kM)		0.101	0.076	0.388
Toposheet No:		2882 11A	2882 11A	2882 07C
Roadhead Distance (kM)		35	28	34
Roadhead Name		Korchawang	Korchawang	Korchawang
Distance from PH to Grid (kM)		25.5	24	20
Location of the Nearest Grid		Musikot near Bhalakcha	Musikot near Bhalakcha	Musikot near Bhalakcha
Sand Available Distance (kM)		65.39	48.1	51.5
Sand Available Location		Khola and Lungri Khola Junction at	Khola and Lungri Khola Junction at	Khola and Lungri Khola Junction at
Nearest Market Centre		Tulsipur	Tulsipur	Tulsipur
Province No		5	5	5
Installed Capacity (kW)		941	661	644

Hydropower Studio Model Outputs

Installed Capacity (kW)	941		661		644	
Probability of Exceedence	Q65	▼	District		Achham	▼
Hydrology Basin	Rapti (Jhimrukh Modi) River Bas	▼	Rapti (Jhimrukh Modi) River E	▼	Rapti (Jhimrukh Modi) River Bas	▼
Canal or All Penstock	Headrace Canal	▼	Headrace Canal	▼	Headrace Canal	▼
Canal Width (m)	1.45		1.5		1.15	
Water Depth (m)	0.725		0.75		0.575	
Required Discharge (lps)	1560		1720		858	
Discharge Capacity of Canal (lps)	1593.00		1744.00		859.00	
Width of Desanding Basin	3	▼	3	▼	3	▼
Size of the Basin (LxBxh1xh2)	49.33 x 3 x 3.79 x 4.78 m		54.67 x 3 x 4.09 x 5.18 m		27.33 x 3 x 2.48 x 3.03 m	
Length of Forebay (m)	30	▼	35	▼	20	▼
Width of Forebay (m)	3	▼	2.5	▼	3	▼
Height of Forebay (m)	2.56		2.66		2.08	
Discharge Holding Capacity (Sec)	130.37		120.00		124.48	
Height of the Tank ok ?	OK		OK		OK	
Approximate Diameter (mm)	838		869		668	
Proposed Diameter (mm)	900	▼	900	▼	700	▼

Hydropower Studio Model Outputs

Velocity of Flow in Pipe (m3/s)	2.45	2.70	2.23
%age Headloss	1.17%	1.97%	2.24%
Penstock Thickness (mm)	7.00	5	7
Factor of Safety	3.59	3.39	3.71
Is Penstock Thickness Ok	Ok	Ok	Ok
Type of Turbine Proposed	Francis	Francis	Francis
Transportation Category	Normal		Not Applicable
Remoteness Factor	1	Transmission Line	33 kV
Equipment Cost (Powerhouse/Transmission Line and Switchyard Cost) per kW	500	1 US\$ = (.....NRs.)	106
Hydropower LCOE (Rs./kWh)	5.52	7.22	7.67
Solar LCOE (Rs./kWh)	13.67	13.67	13.67
NPV (Million NRs.)	6.61	-72.51	-91.1
B/C Ratio	1.02	0.78	0.73
IRR (%)	10.28%	6.41%	5.53%
Bank Interest Rate (%)	0.1	0.1	0.1
Peymnt Period (Years)	10	10	10
Return on Equity (%)	11.15%	5.03%	4.92%
Rate Analysis	Default	Ok	



Thank You