Paper No. 149

Medium term strategy of hydroelectric development in Pakistan

By

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MEDIUM TERM STRATEGY OF HYDROELECTRIC DEVELOPMENT IN PAKISTAN

By

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INTORDUCTION

Pakistan today is seized with a difficult power situation. Shortfall was at its maximum in 1985. This adversely affected the economy both in industrial and agricultural sectors and also caused inconvenience to the domestic consumers. The Government is mobilizing available physical and financial resources to correct the imbalance between electric supply and demand. Prime Minister of Pakistan has directed that the shortage must be overcome by January 1990. It requires herculean effort to do this. WAPDA has prepared a short-term plan to eliminate load shedding by the target date. The short term plan as given in Table–A relies largely on thermal generation, particularly, combustion turbines, which are quicker to install and require lesser initial capital outlay. This obviously is the only choice in view of the time constraint. Nonetheless, the operating costs would increase, oil import bill despite the fall in oil prices (which might go up before very long) will continue to rise and pressure on our dwindling gas resources may be difficult to sustain. Higher thermal generation costs will result in increased industrial production costs leading the economy into a vicious inflationary spiral.

On the other hand, for the development of nuclear power, stakes are very high. Events have proved that reliance on much needed foreign technical and financial assistance is fraught with dangers. Out of the total shortage of about 1500 MW in 1985, 900 MW was attributeable to the non implementation of Kundian Nuclear Power Station. Our efforts for development of nuclear power should no doubt go on unabated; that being the ultimate answer to the future energy needs of not only Pakistan but the entire world.

Pakistan is one of the countries which has vast hydropower resources but has still to go a long way before making a serious dent in the total potential. Out of the estimated exploitable hydel potential of about 30,000 MW, only 3000 MW has been developed and another 6000 MW which is mostly secondary power is in various stages of development. Even if human knowledge expands beyond its present day boundaries that man could find a more abundant energy resource both in terms of viability and controllability, one could not envisage a resource more multidimentional, and in harmony with its surroundings than hydel power. The intrinsic worth of a hydel scheme is not ponderable by simple arithmatic. It is generally a water reserve a flood control barrier, a boost to agriculture in the command area and of course a clean and a renewable source of energy with very little coperating and recurring costs. A global view of the power generation additions would reveal that the countries and regions which still have unexploited hydel power potential, are concentrating on such resources to the maximum. For instance, in Latin America, Inter American Development Bank's (IDB)'s over-whelming emphasis over the next decade will be on hydro electric power. In fact, in the past, the bank's lending for hydro power generation has been 96.9% of the total lending for generation. This policy of the bank in favour of hydel development speaks for itself. The countries which had substantially exhausted their big hydel resources have turned towards small hydro to utilize as much of this renewable source of power as may be humanly possible.

SHORTCOMINGS OF HYDEL POWER

Hydroelectric power generation, although the most economic source has the following drawbacks:

- Long gestation period.
- Higher capital outlay.
- Energy generation dependent on seasonal variation in river flows.

These drawbacks are discussed below.

–LONG GESTATION

– Large hydel projects take almost a decade to plan and investigate and perhaps another decade to fully develop-given the financial and manpower resources. Kalabagh falls in this category. After almost two decades of planning, it is ripe for entering into development stage and commissioning around 1995.

Other big prospective projects are located in the upper reaches of rivers particularly Indus. River Indus beyond Tarbela was so far considered to be inaccessible but thanks to Kara Korrum Highway (KKH), new vistas of development have been thrown open. WAPDA has already done some studies and has prepared an Inventory and Ranking list of large projects. Basha Dam (3360 MW) located 195 miles upstream of Tarbela has been ranked best after Kala-bagh. Given the resources, it should reach the take off stage in less than a decade and completion around the turn of the century. This should be followed by Dasu (2712 MW) located 43 miles down-stream of Basha, Bunji (1290 MW) 70 mles upstream of Basha, Thakot (2415 MW) downstream of Dasu and a score of other projects, going well into the next century. Of the large projects, all that we can hope to achieve in the present century – in fact in the next decade and a half, with best of efforts, is Kala-bagh followed by Basha.

Both Kalabagh and Basha put together cannot cater for our power requirements at the turn of the century conservatively estimated at 14000 MW. A large number of thermal power plants shall have to be added to match the power generation with the projected load, but the recurring cost of the thermal plants is more. Current cost of fuel alone for a thermal plant (Steam) is Rs. 0.35 per kwh while it is more than Rs. 1.75 per kwh for a combustion turbine running on HSD (Table-D) refers). If the thermal component goes on increasing, the generation costs would increase correspondingly, affecting the cost of industrial and agricultural products. Obvious question is: must we continue to burn the scarce and valuable fuel (and hence the economy) or think of something better. The answer is not difficult. Look for medium sized hydel projects with lower gestation.

– CAPITAL OUTLAY

What is true of long gestation projects is true of high capital cost projects also. A developing country like Pakistan with limited financial resouces cannot possibly conceive of undertaking more than one or two super projects at a time with long term investment. This constraint again calls for looking for medium size projects requiring proportionately less capital outlay capable of yielding early return to punctuate the large projects. In this way, it can be aimed to keep the system predominantly cheap hydel as long and as far as possible with thermal addition only where unavoidable.

– SEASONAL, VARIATIONS

As is well known and perhaps bitterly experienced for the last few years, our hydel plants are subject to violent seasonal vaiations. This is a universal phenomenon but is more pronounced in this part of the world. For instance, ratio of minimum and normal high discharge of Indus and Jhelum is about 1:30. This is very high when compared to say Danube and Rhine of about 1:10. The large reservoirs at Tarbela and Mangla have mitigated the seasonal variation to some extent but have not been able to overcome the problem adequately.

In fact, some overriding factors have reduced the good effects of the reservoirs to some extent. Firstly, the river Indus is a late riser. As a result, the Tarbela reservoir goes on depleting till as late as June bringing the headpond level to a minimum of 1300 ft SPD from the normal maximum operating level of 1550 ft. As a consequence, the power production goes down to almost 25% of the rated capacity. In the absence of thermal substitute, this results in a critical power shortage on the system from April to June, with wide load shedding.

The situation gets worse when the second overriding factor comes into play. The reservoirs at Tarbela and Mangla are primarily meant for irrigation purposes, power being a by-product. During the months of December and January, the reservoirs may have some releaseable surplus at least with some adjustment in the release pattern, but flows downstream of Mangla and Tarbela are drastically reduced because of limited irrigation demands. This is the period when crop requirement is minimal and the canals are closed for annual maintenance. The hydel power generation in December and January is, therefore, the lowest and has to be supplemented with thermal power if loadshedding is to be avoided.

THERMAL GENERATION

From the above, it transpires that the most critical period for the system is during December and January and again from April to June. Additional investment to the extent of generating sufficient power has to be made to fill the gap during the shortage periods. This shortage is generally ment by putting up thermal stations steam or combustion turbine plants, which provide consistent and reliable source of power generation. Apart from filling the seasonal variations, thermal generation (combustion turbines) are ideal for taking care of daily peak loads in the system. Moreover, thermal stations particularly the combustion turbines are quicker to build and require less initial capital outlay. In other words, they start yielding return on capital investment much earlier and therefore find favour in situations where financing is a major constraint.

Thermal plants have another big advantage in their having the flexibility of being located near the load centres. This is of particular value in stabilising voltage and balancing load flow in a far and wide spread out system, like that of WAPDA where the major source of generation viz. hydel, is up in the North with load being mostly located in the centre and South.

Despite these advantages, the thermal plants require expensive and scarce fuel to burn, for generating power. A comparative cost per KWH for the various types of generation in WAPDA System for the last 10 years is given in Table–D. It may be noted that Pakistan's fossil fuel resources estimated at 1200 MTCE that is 15 TCE per capita stand at one percent of the world average. Almost 70-75% of the petroluem product requirement is imported. During the year 1983-84, 6.48 MT of oil amounting to $ 1463 million was imported which was almost 54% of total export earnings during the same period.

RECOMMENDATION AND REMEDIAL MEASURES

It would, therefore, be an ideal arrangement if the shortcomings of hydel power could be overcome by planning suitable hydel developments. Following are some of the possible solutions.

(i) Hydroelectric projects with reservoirs should be built as early as possible.

(ii) The reservoirs should be as far upstream as possible so that they act as 'key' to all the downstream developments with or without reservoirs.

(iii) There should be downstream reservoirs to act as substitutive, balancing and re-regulation

reservoirs to enhance the generation capacity during low flow period irrespective of the irrigation demands.

(iv) Medium sized projects requiring lower gestation period as well as lower capital cost should be investigated and developed to take the place of thermal projects.

(v) Hydel Stations with the peculiar characteristic of generating more power during April to June period should be identified and developed.

(vi) There should be hydel development on early rising rivers e.g. Jhelum, Swat, Chitral and their tributaries.

WAPDA is conscious of these aspects and has been engaged in planning and investigating the hydel projects with the requisite characteristics. Following are the cases in point:–

– Kalabagh is vitally important because it will not only have a reservoir for firming up its own power plant capacity but also act as a substitutive reservoir for Tarble to raise its operating head from 1300 to 1390 ft SPD for the period April to June. It will increase the minimum power generation from 50 MW to 105 MW per machine of a rated capacity of 175 MW. Furthermore, it will act as a balancing or regulation reservoir to allow maximum possible releases from Tarbela in December and January (depending on the releaseable surplus of Tarbela Storage) irrespective of irrigation restriction. The usefulness of the proposed development at Tarbela of 4750 MW with 17 Units would be adversely affected, if Kalabagh is delayed, leave alone the direct power benefit of Kalabagh. A comparison between Fig. I and II would illustrate this.

– Basha is important not only as a key reservoir project (7.5 MAF) to supplement water storage and generate power but also to act as substitutive storage for Tarbela raising the minimum draw down level to 1500 ft SPD, thereby maximising its power benefits. The maximum output for machine would rise to its rated capacity of 175 MW. Similarly, Basha would provide water during December & January commensurate with its releaseable surplus, irrespective of the irrigation restriction to be controlled at Kalabagh. A comparison between Figures II & III illustrates this.

– Ghazi Gariala Hydropower project (under planning) with a proposed capacity of about 750 MW will be a relatively low gestation project. With a small proposed pondage it will absorb diurnal fluctuations downstreams of Tarbela. Secondly, it will have the peculiar feature of providing more power when generation at Tarbela and Kalabagh is the lowest. It will do so by taking full advantage of the additional head with Kalabagh drawn down to 825 SPD from April to June. The contribution of this project particularly in April to June is noticeable in Fig. IV.

– Jinnah 120 MW, Chasma 250 MW, Taunsa 120 MW and Guddu Barrage (50 MW) Hydel Projects are low gestation medium size projects which will take full advantage of the firmed up flow in the Indus because of upstream storage at Tarbela, Kalabagh and Basha. However, these will be limited in power generation in December and January because of restricted irrigation releases (Fig. IV) unless downstream re-regulation is provided.

There may be other medium size projects which are in early conceptual stages.

– To take maximum advantage of power generation at Kalabagh and Jinnah, a storage in

Thal would provide the desired objective of maximising power generation during December –January (effect not shown). To take maximum adventage of power generation at Kalabagh, Jinnah, Chasma, Taunsa and Guddu during December and January, possibility of storing water in Chutiari Lake will be a good food for thought (effect not shown).

These engineering proposals are without prejudice to the water rights of the provinces.

– Key Storage Hydroelectric Projects on river Kunhar at Naran, Suki Kinari and Patrind with total power potential of 650 MW and reservoir capacity of 0.75 MAF will not only provide direct power benefits but additional power generation at Mangla to the extent of about 200 MW by enhancing per unit capacity from 50 MW to 70 MW by raising its minimum operative head from 1040 to 1090 SPD.

CONCLUSION.

Peak Power Generation (Fig. IV) which is based on the studies so far done of Tarbela (1–14) Kalabagh and Basha and some subsequent conceptual planning, graphically depicts the proposed medium term hydroelectric power development strategy – for the next two decades. It is subject to a proper optimisation study for the conjunctive operation of reservoirs. Nevertheless, it adequately demonstrates the effects of various future proposed or conceptual developments on the peak power generation scenario. On the one hand, it incorporates medium sized low gestation schemes into the large development of Kalabagh and Basha; on the other, it overcomes the shortcomings of seasonal variation in river flows to a great extent. Although it falls short of presenting a classical example of firming up hydel power completely with hydel, but it makes the peak hydel power reasonably consistant round the year except for the month of January. The shortage of power generation in January can be filled by creation downstream re-regulation reservoirs in Thal, Chutiari as proposed above or elsewhere. It will only be then that the requirement of thermal generation for meeting the seasonal deficiency though unavoidable could be minimized and the system will have the optimum benefit of cheaper hydel generation.

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5. Inventory & Ranking of Hydroelectric Schemes BY MECO

TABLE – A **

GENERATION PROGRAMME

Sr. No.	Station Name	Unit No.	Installed Capacity (MW)	Date of Commissioning
1.	KESC Steam	INTERLINK	875	Jun. 1985
2.	KESC Gas	INTERLINK	180	Jun. 1985
3.	Kanupp	INTERLINK	137	Jun. 1985
4.	Guddu Gas Turbines	1	100	Jan. 1986
5.	Guddu Gas Turbines	2	100	Feb. 1986
6.	Guddu Steam	4	210	Feb. 1986
7.	Guddu Gas Turbines	3	100	Mar. 1986
8.	Guddu Gas Turbines	4	100	Apr. 1986
9.	Kot Addu Comb. Turbines	1 & 2	200	Nov. 1985
10.	Kot Addu Comb. Turbines	3 & 4	200	Jan. 1987
11.	C.C. At Guddu	5	100	Dec. 1987
12.	C.C. At Guddu	6	100	Jan. 1988
13.	Kot Addu Comb. Turbines	5	100	Nov. 1988
14.	Kot Addu Comb Turbines	6	100	Dec. 1988
15.	Jamshoro Oil Fired	1	250	Dec. 1988
16.	Kot Addu Comb. Turbines	7	100	Jan. 1989
17.	Kot Addu Comb. Turbines	8	100	Feb. 1989
18.	KESC Steam	D–3	210	Feb. 1989
19,	Multan	REHABILIATION	*	Jun. 1989
20	Faisalabad	”	*	Jun. 1989
21.	Guddu Steam	”	*	Jun. 1989
22.	Sukkur	”	*	Jun. 1989
23.	Quetta	”	*	Jun. 1989
24.	Shahdra	”	*	Jun. 1989
25.	Faisalabad	”	*	Jun. 1989
26.	Kotri	”	*	Jun. 1989
27.	Quetta	”	*	Jun. 1989
28.	C.C. at Kot Addu	9 & 10	200	Jun. 1989
29.	KESC Steam	D–4	210	Sep. 1989
30.	Mangla	9 & 10	200	Sep. 1989

* Re-habilitation is to the tune of 126 MW.

** Power Development Plan for Elimination of Load Shedding by 1990. WAPDA–March–1986

Sr. No.	Station Name	Unit No.	Installed Capacity (MW)	Date of Commissioning
31.	KESC Steam	D–5	210	Dec. 1989
32.	Jamshoro Oil Fired	2&3	420	Dec. 1989
33.	Addl. Comb. Turbines	1&2	200	Dec. 1989
34.	Tarbela	11	432	Jan. 1990
35.	C.C. At Faisalabad	9 & 10	80	Feb. 1990
36.	C.C. AT Kotri	7 & 8	40	Feb. 1990
37.	Tarbela	12	432	May. 1990
38.	Tarbela	13	432	Sep. 1990
39.	Multan	1	210	Oct. 1990
40.	Low Head Hydels	CHASHMA	200	Dec. 1990
41.	Tarbela	14	432	Jan. 1991
42.	Multan	2	210	Apr. 1991
43.	Multan	3	210	Oct. 1991
44.	Low Head Hydels	TAUNSA	110	Dec. 1991
45.	Jamshoro Oil Fired	4	300	Dec. 1991
46.	Lakhra Coal	1	300	Mar. 1992
47.	Lakhra Coal	2	300	Dec. 1992
48.	Low Head Hydels	JINNAH	110	Dec. 1992
49.	Jamshoro Oil Fired	5	300	Sep. 1993
50.	Thermal On IMP. Coal	1	400	Dec. 1993
51.	Jamshoro Oil Fired	6	300	Dec. 1993
52.	Kalabagh.	1	300	Sep. 1994
53.	Kalabagh	2	300	Oct. 1994
54.	Kalabagh	3	300	Nov. 1994
55.	Tarbela	15	400	Dec. 1994
56.	Thermal On IMP. Coal	2	400	Mar. 1995
57.	Kalabagh	4	300	Apr. 1995
58.	Tarbela	16	400	Jun. 1995
59.	Kalabagh	5	300	Sep. 1995
60.	Thermal On IMP. Coal	3	400	Dec. 1995
61.	Tarbela	17	400	Dec. 1995

TABLE–B*

EFECT OF KALABAGH AND BASHA ON TARBELLA

Sr. No.	Month	Reservior Level– With Kala–Bagh	With Basha & Kala–bagh.	Peak Power (MW) With Kala–Bagh	With Basha & Kala–bagh.	Energy Total (GWH) With Kala–bagh	With Basha
1.	July	1503	1527	3037	3390	729	814
2.		1517	1527	3219	3402	773	816
3.		1523	1528	3314	3400	871	897
1.	August	1531	1534	3379	3423	811	822
2.		1537	1535	3457	3463	830	831
3.		1542	1539	3521	3497	930	865
1.	September	1548	1546	3567	3525	804	692
2.		1550	1550	3595	3526	703	552
3.		1550	1550	3598	3599	517	496
1.	October	1550	1550	3599	3604	348	348
2.		1550	1550	3597	3597	274	274
3.		1550	1550	3597	3597	262	262
1.	November	1546	1548	3594	3598	269	324
2.		1540	1546	3567	3589	295	314
3.		1532	1544	3518	3576	289	294
1.	December	1524	1542	3452	3560	303	288
2.		1516	1540	3376	3542	262	275.
3.		1512	1540	3133	3533	185	239
1.	January	1507	1540	3279	3533	197	226
2.		1502	1540	3198	3531	175	213
3.		1495	1539	3171	3518	216	249
1.	February	1480	1534	3060	3503	329	311
2.		1462	1525	2887	3451	324	357
3.		1449	1519	2696	3388	241	287
1.	March	1436	1514	2567	3337	238	299
2.		1420	1509	2343	3187	256	315
3.		1410	1508	2199	3155	204	277
1.	April	1407	1510	2023	3108	149	226
2.		1407	1514	2096	3229	139	249

Sr. No.	Month	Reservior Level– With Kala–Bagh	Reservior Level– With Basha & Kala–bagh.	Peak Power (MW) With Kala–Bagh	Peak Power (MW) With Basha & Kala–bagh.	Energy Total (GWH) With Kala–bagh	Energy Total (GWH) With Basha
3.		1407	1513	2044	3281	213	363
1.	May	1397	1509	2084	3254	226	475
2.		1394	1508	2044	3220	292	511
3.		1399	1513	2055	3233	437	682
1.	June	1413	1513	2156	3260	503	778
2.		1446	1518	2408	3286	523	766
3.		1480	1524	2757	3342	646	802

This table is a combination of table 3.14 and 3.15 Tarbela 11–14 Report C.T. Main.

TABLE – C

GENESIS OF COST PER KWH OF SOME OF THE HYDEL AND THERMAL POWER STATIONS

(1984 – 85)

(Paisa/Kwh)

Item of Expenditure		Name of Power Station						
		Tarbela	Mangla	Guddu	Multan	F/Abad Steam	Faisala-bad Gas Tur-bine	Kotri Gas Turbines
1.	Interest charges	3.42	1.49	11.19	0.02	0.61	4.04	13.09
2.	Deprecation charges	2.04	1.14	3.73	0.76	1.37	2.70	6.32
3.	Average Cost of Feul	–	–	11.91	33.79	38.28	58.61	98.67
	a. Gas	–	–	11.91	26.88	30.49	41.30	47.24
	b. Furnace Oil	–	–	–	55.53	47.65	–	–
	c. H.S.D.	–	–	–	–	–	175.89	196.28
4.	Total Establishment Charges	0.17	0.29	2.02	1.44	1.56	2.07	3.91
5.	Total Maintenance Charges (excluding establishment charges)	0.40	0.26	1.83	5.02	1.56	1.83	2.94
	Total Average Cost	6.03	3.18	30.68	41.03	43.34	69.25	124.93

*WAPDA Power System Statistics – Tenth Edition. Table 1.21 Page 22.

TABLE – D*

COST OF GENERATION (STATION–WISE)

(Paisa/Kwh)

Sr. No.	Power Station	1973–74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82–83	83–84	84–85
A.	**HYDEL POWER STATIONS**												
1.	Tarbela	–	–	–	–	2.24	2.09	2.04	2.06	2.37	4.61	4.76	6.03
2.	Mangla	–	1.50	1.50	1.28	1.64	1.47	1.51	2.20	1.56	2.04	2.53	3.18
3.	Warsak	4.97	6.47	6.25	8.88	8.22	6.40	7.53	8.44	3.31	4.65	5.77	6.28
4.	Dargai	1.99	0.35	2.18	2.86	2.33	2.70	2.26	2.16	2.27		2.64	5.13
5.	Malakand	0.20	0.24	0.32	0.49	0.68	0.51	0.70	0.73	0.62	0.76	1.00	
6.	Rasul	6.78	6.84	20.49	11.92	9.72	13.77	16.04	8.59	N.A.	4.54		6.16
7.	Shadiwal	8.06	8.88	10.77	11.29	9.48	4.74	4.44	4.94	5.80	9.21	7.20	9.38
8.	Nandipur	9.26	8.21	9.52	10.44	11.87	14.02	13.33	13.86	5.24	9.65	8.98	11.06
9.	Chichoki Mallian	6.02	5.36	6.30	7.54	6.60	7.79	8.40	10.47	6.64	10.71	5.06	5.81
10.	Kurram Garhi	2.81	2.99	4.54	63.67	4.98	5.29	4.83	7.57	6.17	6.53	6.88	7.04
11.	Renala	4.02	4.14	6.91	5.92	6.20	7.23	7.71	26.11	8.80	30.87	13.99	28.61
B.	**THERMAL POWER STATIONS**												
1.	Multan Steam	6.40	9.02	11.80	11.24	16.38	18.60	16.79	25.75	44.39	29.74	35.67	41.03
2.	Guddu Steam	16.85	16.85	21.32	14.15	13.63	15.00	15.14	17.80	21.18	26.38	28.00	30.68
3.	Shahdara Gas Turbines	22.49	33.60	56.35	54.68	48.21	90.00	68.70	185.72	162.55	340.00	235.51	236.10
4.	Kotri Gas Turbines	15.93	33.50	20.32	33.44	27.77	27.00	27.62	29.42	107.33	161.53	189.83	144.47
5.	Faisalabad Thermal	26.78	26.78	49.16	75.40	85.92	345.00	–	111.70	129.16	149.59	173.14	212.14
6.	Sukkur Steam	9.6	13.56	17.20	18.85	19.95	22.46	25.46	25.34	28.40	34.65	51.28	58.79
7.	Hyderabad Thermal	13.5	17.30	21.93	24.19	25.76	35.89	29.28	28.79	N.A.	38.69	55.81	96.68
8.	Quetta Thermal	34.0	59.97	61.30	72.00	108.00	129.00	115.73	133.01	156.44	160.26	177.92	173.40
9.	Faisalabad Gas Turbines	–	9.82	47.02	17.08	50.80	77.00	36.17	48.90	48.49	60.82	82.53	69.25
10.	Faislabad Steam	5.55	8.53	10.10	13.72	21.06	31.81	16.50	19.57	24.84	29.06	40.44	43.34
11.	MESCO	–	–	–	–	–	–	–	–	–	31.99	42.86	49.00
12.	REPCO	–	–	–	–	–	–	–	–	–	–	–	141.83

* WAPDA Power System Statistics – Tenth Issue Table 1.20 Page 21.

Fig. I

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WAPDA PRESENT HYDEL GENERATION

1986

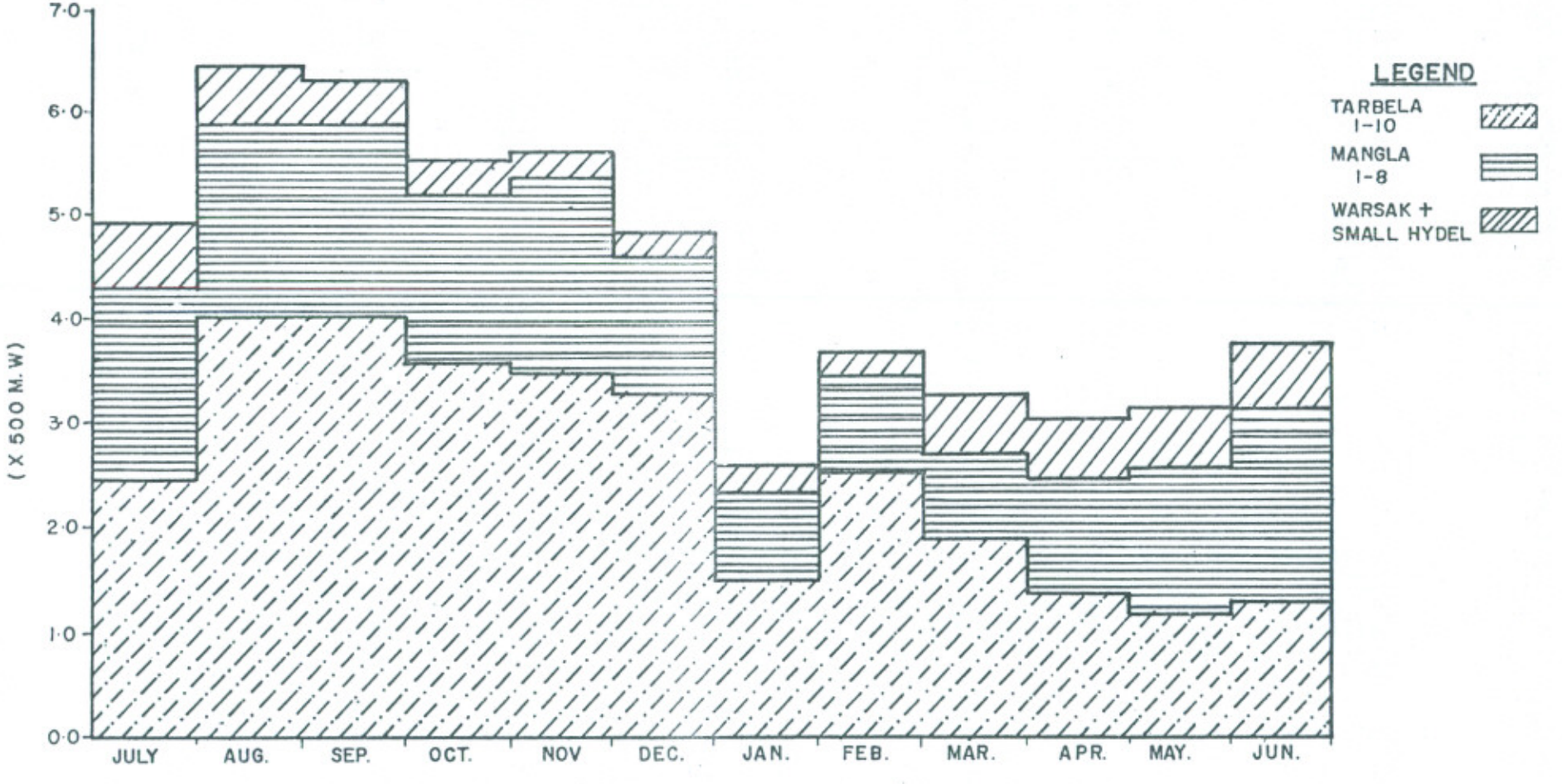
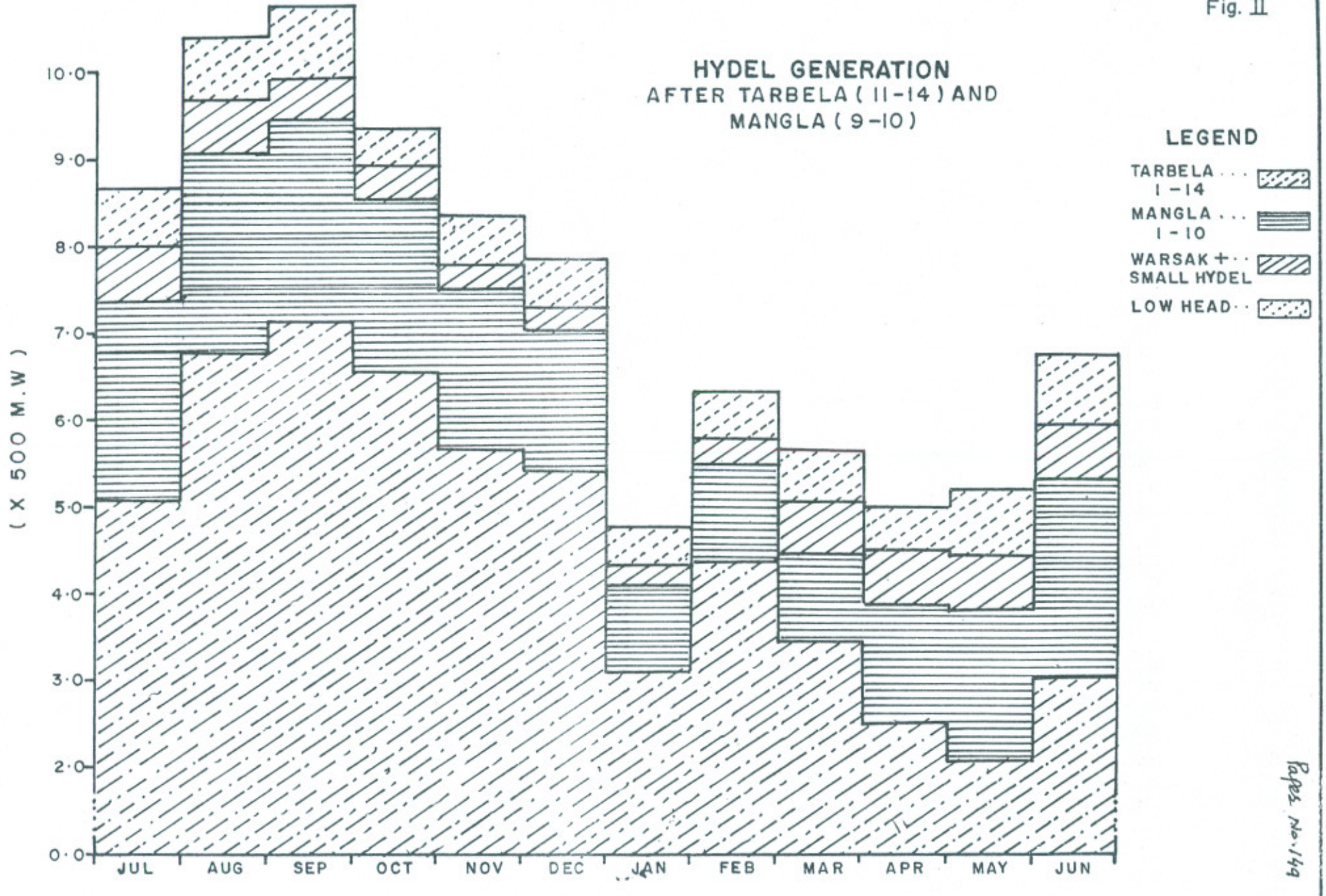


Fig. II

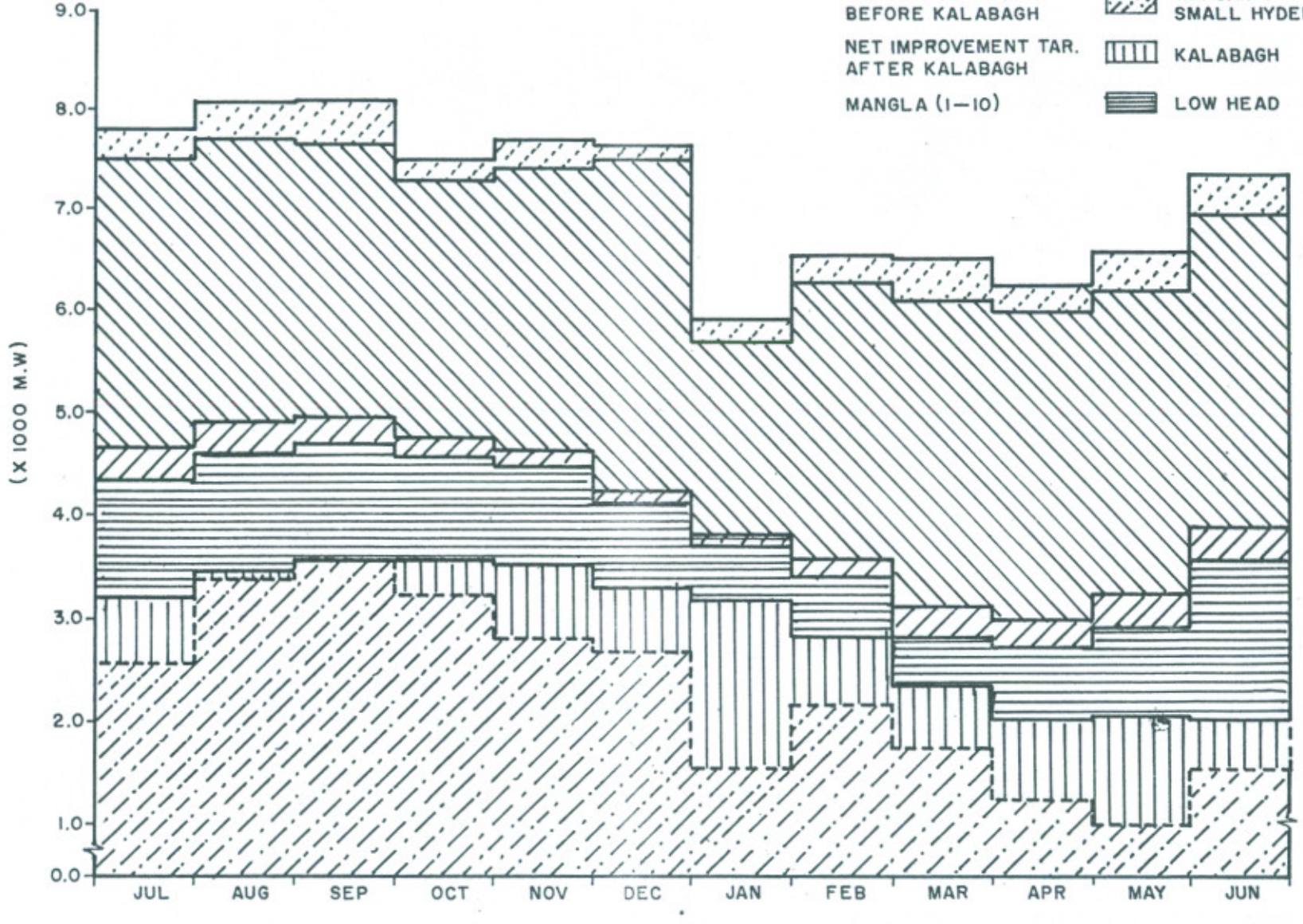


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Fig. III

PEAK HYDEL GENERATION

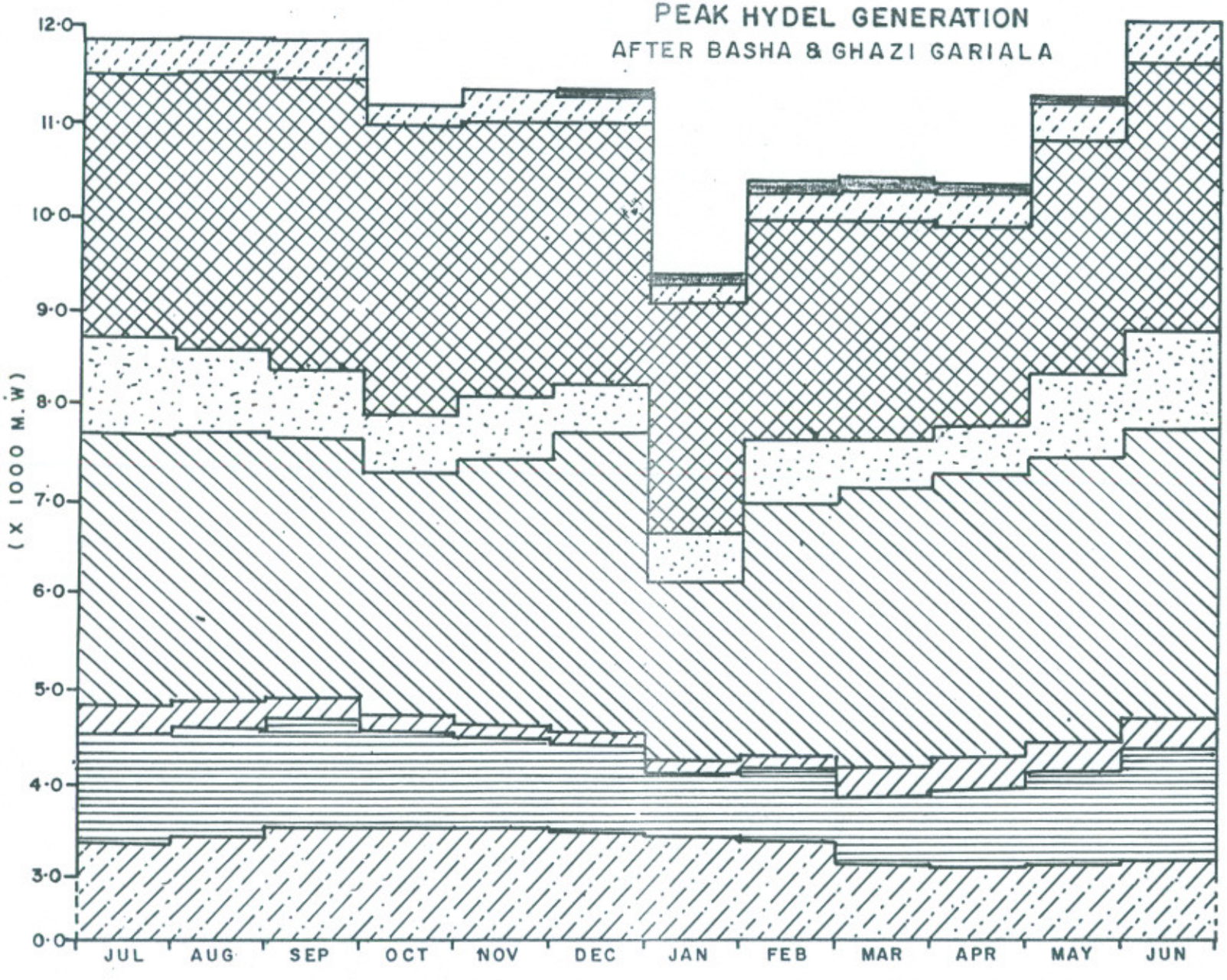
AFTER KALABAGH



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Fig. IV

PEAK HYDEL GENERATION
AFTER BASHA & GHAZI GARIALA



LEGEND

- TARBELA . . . (1-14)
- MANGLA . . . (1-10)
- WARSAK + ... SMALL HYDEL
- KALABAGH . . . .
- GHAZI GARIALA
- BASHA . . . . .
- LOW HEAD . . . .
- EFFECT OF. . . KUNHAR RESER-VOIR ON MANGLA
- KUNHAR VALLEY HYDEL DEVELOP-MENT — *Not Shown*
- EFFECT OF THAL/ CHUTIARI RESER-VOIR — *Not Shown*

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