Indrawati River

- Indrawati Diversion Project

  This corresponds to the Indrawati No. 3 project.

- Indrawati Storage Project

  This site will be submerged by the Sun Kosi No. 3 project and is therefore disregarded in this Master Plan Study.

Tama Kosi River

- Tama Kosi Diversion Project

  This diversion project intakes water from the Khimte Khola to the Tama Kosi River through a 10km headrace tunnel. This is disregarded on the basis of comparative study with the projects (Khimte Khola No. 1, No. 2) which have headrace tunnels on the Khimte Khola and powerhouse near the confluence of the Tama Kosi River. The Tama Kosi and Khimte Khola have been planned for independent development.

Likhu Khola

- The Project site is located between Likhu Khola No. 3 and No. 4.

Dudh Kosi River

- Dudh Kosi (1) Project

  This corresponds to the Dudh Kosi No. 6 project.

- Dudh Kosi (2) Project

  This corresponds to the Dudh Kosi No. 5 project.

- Dudh Kosi (3) Project

  This corresponds to the Dudh Kosi No. 3 and 4 projects.

- Dudh Kosi Diversion Project

  This is disregarded due to submergence by the Sun Kosi No. 1 dam.

3.6.6 Priority Schemes

(1) General

The Team selected 52 hydroelectric power schemes in the Kosi Basin and evaluated the same from the viewpoint of economic viability and other effects with values as described in 3.5.5 Selection of Priority Schemes. The results are shown in TABLE 3-6-29 and the top 13 schemes are tabulated below the capital costs of which include transmission/substation cost..

TABLE 3-6-30 TOP 13 HYDROPOWER SCHEMES

No.	Schemes	Evaluated Points	Installed Capacity (MW)	Construction Cost. including Access Road and Transmission/ Substation (10^6US$)	Remarks
1	Sapt Kosi	371	3,489	2,773	For Export
2	Arun No.3	336	240	307	
3	Arun No.2	331	239	326	
4	Sun Kosi No.1	315	1,357	1,093	For Export
5	Sun Kosi No.3	313	536	622	
6	Sun Kosi No.2	312	1,110	1,085	For Export
7	Arun No.1	307	146	294	
8	Bhote No.1	307	64	97	
9	Tama Kosi No.3	301	123	219	
10	Tamur No.1	301	696	890	
11	Tama Kosi No.2	299	196	278	
12	Khimte No.1	299	49	77	
13	Dudh Kosi No.1	295	228	476	

Among the top 13 schemes, the Team selected 3 export and 10 domestic priority schemes. Total capacities of priority schmes are 5,956MW for export, 2,517MW for domestic use and 8,473MW in total. These occupy 25% and 78% of the whole respectively in terms of number of schemes and capacity. Features and economic evaluations of the 13 priority schemes are presented in TABLE 3.6.31.

The economic evaluation for these 13 priority schemes power station, access road and transmission/substation as well as the firm capacity and firm and secondary energies for reference. The cost of structures for each scheme are shown in TABLE 3.6.32.

(2) Priority Schemes

1) Sapt Kosi High Dam

This scheme is planned as a reservoir type hydropower station with a 239m high dam and hydropower station located immediately downstream of the dam. The installed capacity is 3,489MW by the maximum discharge of 2,500m^3/s, with a firm capacity of 3,489MW. Annual generated energy is estimated to be 16,810GWh which will be exported to India.

This scheme was identified in 1946 by the Government of India, and a "Feasibility Report On Kosi High Dam Project" was prepared and submitted to HMW in 1981.

The project prepared by India consists of construction of a 269m high and 710.5m wide concrete gravity dam about 2km upstream of the sacred temple of Barakshetra. Installed capacity would be 3,000MW. The project also includes construction of a barrage 969.9m long, near Chatra, 8km downstream of the dam and canal system with three powerhouses with a capacity of 300MW along the irrigation canal as well as watershed management for the Basin.

A comparison of the above Feasibility Study and the Master Plan Study for the project is shown in TABLE 3.6.33. Cost in the Feasibility Study is converted into US$ at the rate of 1 US$ = 9 RP. and price levels in 1981. The annual cost is estimated on the basis of annual rate for capital cost with the following assumptions.

- Interest	8%
- Depreciation	1.7%
- Operative & Maintenance	1%
- General Reserve	0.5%

In the Master Plan Study, the optimization study to determine dam height and installed capacity was carried out by the same method and with the same accuracy as the other schemes due to unavailability of data for the downstream area, particulary in the Indian region. The optimization study reveals that a maximum discharge of 2,500m^3/s is optimum. The incremental benefit cost analysis was undertaken for varying dam heights ranging from 23.9m to 299m TABLE 3.6.34 shows that a larger dam height decreases the economic viability in terms of incremental benefit/cost ratio and energy cost. It should be noted that the optimization study in the Master Plan Study was carried out in consideration of hydropower planning only. Consequently, it should be reviewed in consideration of flood control and irrigation benefit anticipated in the Indian territory for the future implementation stage.

2) Sun Kosi River

Sun Kosi No.1 Scheme

This scheme is planned as a reservoir type hydropower station with a 147m high dam and hydropower station located immediately downstream of the dam. Installed capacity is 1,357MW by the maximum discharge of 1,400m^3/s, with a firm capacity of 555MW. Annual generated energy is estimated to be 4,640GWh which would be exported to India.

The dam site was investigated first by the Government of India and review in the "Feasibility Report on Kosi High Dam Project". Subsequently the site was investigated through the "Feasibility Study of Irrigation Development Project in Terai Plains" in 1972.

The site was selected about 10km downstream from the confluence of the Sun Kosi and Dudh Kosi rivers where the riverbed is about 130m wide, with thick deposit of sand and gravel. Maximum depth of these deposits is about 28m according to the above mentioned study. The foot of the left bank consists of exposed rock 10m high while the upper most slope is covered with thick table-like debris. According to the above study, the top layer of about 10-20m of formation rocks is considerably weathered or rich in cracks and fissures indicating a low seismic propagation velocity of 1.5 to 1.8km/s.

The right bank also has an exposed rock cliff several meters in height and the steep upper slope has a thin overburden. The thickness of weathered rocks seem to be 5 to 8m, under which lies a 10m layer with many cracks.

The dam was planned as a concrete gravity type taking into consideration the difficulties of flood diversion. For a concrete gravity dam, the overburden on debris should be completely removed, the weathered or cracked layer of rocks should be excavated and suitable foundation treatment should be applied such as grouting for consolidation and prevention of seepage.

Heavy sedimentation from the Sun Kosi River will flow into the reservoir at an annual rate of 45 $10^6 m^3$ which will decrease storage capacity annually from the capacity of 1,500 $10^6 m^3$ at the initial stage. The effective storage capcity was calculated and is shown in TABLE 3.6.35 together with Sun Kosi No.2, 3 and Tama No.1 schemes.

This scheme is planned as a hydropower development plan without consideration on the Sun Kosi Multipurpose scheme. Consequently acquirement of the same will be required in the next stage. As mentioned in APPENDIX V-3.5.1 the intake dam with H.W.L EL. 338m at Kurule for the Sun Kosi diversion is planned 480m downstream from the Sun Kosi No.1 Dam site.

If this hydropower scheme is considered for energy export it should be implemented before Sun Kosi Multipurpose scheme, thus the Sun Kosi No.1 Dam can be used as an intake dam for diversion. In this case, this hydropower plan will be re-planned for comprehensive development. On the other hand, if the Sun Kosi Multipurpose Scheme is implemented prior to the Sun Kosi No.1 Dam, this hydropower plan will also be re-planned considering the intake dam for diversion, tailrace water level and diversion water of the Sun Kosi Multipurpose Scheme.

One of the problems of this scheme as well as most other schemes is access road. The access road is planned across the Maharabat Mountain Range from the Terai with total length of 70km in which 40km crosses the mountain area.

Sun Kosi No.2 Scheme

This scheme is planned as a reservoir type hydropower station with a 166m high dam and hydropower station located directly downstream of the dam. Installed capacity is 1,110MW, with annual generated energy is estimated to be 4,760GWh which would be exported to India.

The dam site was selected in the area at where the dam site of Plan "c" (lower dam site) was proposed in the aforementioned "Feasibility Study of Irrigation Development Project in Terai". Chyakutar village is situated on the right bank downstream of the gorge where the dam site was proposed. The riverbed is about 120m wide, with thick deposits of sand and gravel. Maximum depth of deposits is about 30m according to the results of investigation, drilling and seismic prospecting.

Both banks consist of thin talus scattered along the slopes and upper, middle and lower weathered layers, and a hard foundation of schist. On the left bank, the middle and lower weathered layers are relatively thick ranging from 7-30m and 20-45m, respectively. Middle and lower weathered layers on the right bank are also thick ranging from 6-10m and 19-22m, respectively. According to the results of investigation, the above layers exhibit a seismic propagation velocity of 1.6-1.8 and 2.7-2.9km/s, respectively.

The dam is planned as a concrete gravity type taking into consideration the difficulties of flood diversion. For the concrete gravity dam, the talus deposit and weathered layer should be completely removed; however, removal of the lower layer should be carefully studied.

The lower weathered layer has a seismic propagation velocity of 2.7-2.9km/s and is classified as CM-CH rock which is considered a suitable foundation for a high concrete gravity dam. Appropriate foundation treatment should be applied such as grouting for consolidation and prevention of seepage.

The main difficulty in implementation of this scheme is the distance (107km) from Dolaghat along the Sun Kosi River. An access road must be constructed prior to construction of such works as diversion, dam and power station.

Sun Kosi No.3 Scheme

This scheme is planned as a reservoir type hydropower station with a 140m high dam and hydropower station located directly downstream of the dam. Installed capacity is 536MW, with a firm capacity of 376MW and annual generated energy, 2,070GWH will be utilized in Nepal.

The dam site was selected 5km downstream of Panchuwar Village, and the riverbed is about 130m wide, with thick deposits of sand and gravel. Maximum depth of deposits is about 44m according to the results of investigation, drilling and seismic prospecting.

The foot of the left bank consists of exposed rock 70m high while the upper most slope is almost gentle and covered with thick talus deposits. According to the investigation, the talus deposit on the top layer is about 15-20m under which there is a weathered layer of 13-16m. This weathered layer has a seismic propagation velocity of 2.7-2.9km/s. The right bank also has an exposed rock cliff and a steep upper slope with a thin talus deposit and upper and lower weathered layers of 9-13m and 13-18m thick, respectively.

The dam is planned as a concrete gravity type taking into consideration the difficulties of flood diversion. However a combined dam and fill dam on the left flat bank is also considered. For a concrete gravity dam the overburden of deposit should be completely removed and the weathered layer should be excavated to some extent according to dam height. Suitable foundation treatment should also be applied such as grouting for consolidation and prevention of seepage.

This site is only about 20km from the existing truck roads, near Dolaghat. The main difficulty in project implementation at this site is the deep river and talus deposit along the left bank. This scheme is considered as Phase II of the Sun Kosi Multipurpose Scheme.

3) Tamur River

Tamur No.1 Scheme

This scheme is planned as a reservoir type hydropower station with a 153m high dam and hydropower station located directly downstream of the dam. Installed capacity is 696MW by the maximum discharge of 650m^3/s, with a firm capacity of 493MW and expected annual generated energy is 2,750GWh which will be utilized in Nepal.

The dam site was selected about 45km upstream of the confluence of the Tamur and Sapt Kosi rivers. Both banks are high enough for a high dam, and rock outcrops occur. A dam height of 153m was selected to obtain available storage capacity against heavy sedimentaiton load, 5,000m^3/km^2/year.

Accessivility of this site is relatively good, although an access road of 25km is needed from Dhankuta. The main constraint of this site is the geological conditions which must be carefully investigated to determine possible dam height. The dam is planned as a concrete gravity type taking into consideration the difficulties of flood diversion. However, a fill type dam should also be studied because of the foundtion conditions.

4) Arun River

Arun No.1 Scheme

This scheme is planned as a SRR type hydropower station with intake weir, a 9.6km long headrace tunnel and a power-house upstream of the Sapt Kosi High Dam reservoir. The installed capacity is 146MW by the maximum discharge of 180m^3/s, with a firm capacity of 100MW. Annual generated energy is expected to reach 1,166GWh which is planned for Nepalese consumption.

The site for the intake weir with a silting basin was selected 5km upstream of Sankhuwa Khola, a tributary joining from the right bank, and the headrace tunnel is planned along the left bank to effectively utilize the river loop and allow easier access from Dhankuta. The powerhouse is planned about

9km downstream from Chyawalik Village, in the remaining undeveloped river course between the reservoir of Sapt Kosi High Dam where a large tributary converges on the left bank downstream.

The left bank consists of outcropped rock cliff, while the right bank consists of a gentle slope and a terrace formed by river deposits at the foot of the slope at a height of about 10-20m above the riverbed.

The height of the intake weir is planned at 20m and the headrace tunnel will be non-pressure type. The main difficulty foreseen at this site is the necessity for construction of a long access road (72km) from Dhankuta. Development of this scheme is therefore planned after completion of the more economical Arun No.3 and No.2 schemes.

Arun No.2 Scheme

This scheme is planned as a SRR type hydropower station with intake weir and 10.4km long headrace tunnel and powerhouse directly upstream of the intake weir for the Arun No.1 scheme. The installed capacity is 239MW by the maximum discharge of 160mx3/s, with a firm capacity of 185MW. Annual generated energy is estimated at 1,967GWh which is planned for Nepalese consumption.

The site for the intake weir with silting basin was selected directly downstream of the confluence of the Suki Khola which joins from the left and the headrace tunnel is planned along the left bank to effectively utilize the river loop and easier access from Dhankuta. The powerhouse is planned near Cauribate Village, directly upstream of the intake weir for Arun No.1 scheme. Planned height of the intake weir is 18m and the headrace is non-pressure type. The main difficulty envisioned with this site is the need for a long access road (85km) from Dhankuta. Development of this scheme is therefore planned after completion of the most economical scheme on the Arun River, ie. the Arun No.3 scheme planned directly upstream of this scheme.

Arun No.3 Scheme

This scheme is planned as a SRR type hydropower station with an intake weir, a 7.1km long headrace tunnel and a powerhouse directly upstream of the intake weir for the Arun No.2 scheme. The installed capacity is 240MW by the maximum discharge of 156m3/s, with a firm capacity of 176MW. Annual generated energy is estimated at 1,965GWh which is planned for domestic consumption.

The site for the intake weir with silting basin was selected directly upstream of Khokda Khola, a tributary joining from the left and the headrace tunnel is planned along the left bank to effectively utilize the river loop and easier access from Dhankuta. The powerhouse is planned directly upstream of the intake weir for the Arun No.2 scheme.

Both banks of the dam site consist of cliffs with hard rock outcrops. River width is about 70m at the riverbed. For the desilting basin, there is sufficient area on the left bank directly downstream of the intake weir. Planned intake weir height is 23m and the headrace tunnel is planned as a non-pressure type. The powerhouse site, located immediately upstream of the Menkhuwa Khola is the best site in this area in which vertical cliffs extend both upstream and downstream.

However, a PRR type hydropower station should be studied in the next stage of investigation as the power station has a planned plant factor of 93% which would generate very inexpensive energy. In the case of PRR type development, energy cost increases but loss of water resources decreases. Such a study must be carefully executed taking into consideration future demand, daily peak, annual peak, the electricity network in Nepal and the possibility of exporting surplus energy to India, etc.

The main difficulty envisioned is the need for a long access road (99km) from Dhankuta. Access road construction should therefore proceed prior to the construction work for

the intake weir, headrace tunnel, powerhouse, etc. Headrace tunnel works must be completed as soon as possible due to the critical path of the project.

5) Tama Kosi River

Tama Kosi No.2 Scheme

This scheme is planned as a SRR type hydropower station with an intake weir, a 9.9km long headrace tunnel and a powerhouse 5km upstream from the confluence of the Tama Kosi and Khimte rivers. The installed capacity is 196MW by the maximum discharge of 150m^3/s, with a firm capacity of 130MW. Annual generated energy is estimated at 1,013GWh which is planned for domestic consumption.

This scheme is planned in combination with the upstream Tama Kosi No.3 scheme, a PRR type scheme with a storage dam. Accordingly, Tama Kosi No.2 should be constructed after Tama Kosi No.3 and can be operated as a peak power station without high dam for storage.

The intake weir site with silting basin was selected about 1km directly downstream of the powerhouse for the Tama Kosi No.3 scheme. The headrace tunnel is planned along the left bank to effectively utilize the river loop and in consideration of the continuous hard rock on the left bank contrary to the right.

Planned intake weir height is 20m, and length is 150m and the headrace tunnel is planned as a non-pressure type. The powerhouse site has terrace-like river deposits about 10m deep with sufficient width. The penstock slope consists of outcropped foundation rock.

Accessibility to this site is good from Kathmandu through Charikot. The truck road runs to Jiri from Kathmandu and an iron bridge has been constructed on the Tama Kosi River. After the completion of the Tama Kosi No.3 scheme, access to the intake site will be easier and only a 15km road will be required for access to the power site.

Tama Kosi No.3 Scheme

This scheme is planned as a PRR type hydropower station with a 60m high dam, a 7km long headrace tunnel and a powerhouse located 5km downstream of the existing iron bridge on the Tama Kosi River on the way to Jiri from Kathmandu through Charikot. The dam is planned 2.4km upsream of the abovementioned bridge and 400m upstream of the existing Busti Gauging Station (No.647). The installed capacity is 123MW by the maximum discharge of 150m^3/s, with a firm capacity of 82MW and annual generated energy is estimated to be 603GWH which is planned for supply within Nepal.

The dam site is 60m wide at the riverbed and river deposits of sand and gravel 23m thick were confirmed by investigations, drilling and seismic prospecting. The right bank consists of a relatively gentle slope with a gradient of about 30° and is covered with 5m thick talus deposits. The upper, middle and lower weathered layers have thickness and seismic propagation velocities of 10m and 0.9-1.1km/s, 13m and 1.6-1.8km/s, 13m and 2.6-2.8km/s, respectively.

The left bank has the same degree of slope and thin talus deposits and outcrops are found at the foot. The upper, middle and lower weathered layers have thickness and seismic propagation velocities of 6-15m and 0.9-1.1km/s, 9-15m and 1.6-1.8km/s, 10-19m and 2.6-2.8km/s, respectively.

The dam is planned as a concrete gravity type taking into consideration dam height and function. The available storage can be maintained to flush sedimented sand and soil through the flush gate, and 10m high flush and spillway gates are planned on the concrete gravity dam. A diversion tunnel for large floods is also needed for the construction work of the dam. Dam height is moderate and excavation of lower weathered layers will not be necessary. However, foundation treatment should be applied such as grouting for consolidation and prevention of seepage. The headrace tunnel is planned as a pressure type. An access tunnel is therefore

planned at Khani Khola to shorten the construction period. The longest tunnel for construction work will be about 2.5km.

The most advantageous condition of this scheme is the location, which is easily accessible from Kathmandu by car on the truck road. Only a 6km access road will be needed to the dam site and powerhouse site. After completion of this scheme, the downstream Tama Kosi No.2 scheme can be developed as a peak power station without any high dam, and both power stations, combined with other cheap base-operated power stations as Arun No.3, No.2 schemes will greatly contribute to meeting fluctuating demand.

6) Khimte Khola

Khimte Khola No.1 Scheme

This scheme is planned as a SRR type hydropower station with intake weir, a 7.4km long headrace tunnel and a powerhouse 800m upstream of the confluence of the Tama Kosi and Khimte rivers. The installed capacity is 49MW by the maximum discharge of $10m^3/s$, with a firm capacity of 26MW. Annual generated energy is estimated to be 344GWh which is planned be supply the demand center (Kathtmandu) and districts near the scheme.

The site for the intake weir with silting basin was selected 11km upstream of the confluence of the Tama Kosi and Khimte rivers and the headrace tunnel is planned on the right bank in consideration of the river loop. The powerhouse site was selected by the Tama Kosi River in consideration of the cliffs extending along the Khime Khola. Penstock length is thus shortened and topographical and geological conditions at the site are favourable. Planned intake weir height is 20m high and the headrace tunnel is planned as a non-pressure type. An access road of 25km is needed to reach the powerhouse and intake dam sites from the aforementioned iron bridge on the Tama Kosi River.

This scheme is a relatively small scale power station; however, construction and energy costs are minimal.

Furthermore construction will be smoother after completion of Tama Kosi No.3 and No.2 schemes due to construction of the access road to the powerhouse site and transmission line to the demand center, Kathmandu.

7) Bhote Kosi River

Bhote Kosi No.1 Scheme

This scheme is planned as a SRR type hydropower station with an intake weir, a 10.9km long headrace tunnel, and a powerhouse near Bahrabise, at which Sun Kosi river joints the Bhote Kosi river from the left. The installed capacity is 64MW by the maximum discharge of 34mx3/s, with a firm capacity of 29MW and annual generated energy is estimated to be 444GWh which is planned for domestic consumption to the demand center, (Kathmandu) and districts near the scheme.

The site for the intake weir with silting basin was selected directly downstream of Kahule Khola in Tyathali and the headrace tunnel is planned on the left bank taking into consideration the river loop. The powerhouse site is planned in the remaining undeveloped river course downstream between the existing Sun Kosi Power Station to utilize the the Sun Kosi River which joins the site from the left.

Planned intake weir height is 24m and the headrace tunnel is planned as a non-pressure type. The most advantageous point of this scheme is that the truck road runs along the river from Kathmandu to Tibet and consequently no access road is needed. Moreover, access tunnels can be easily excavated to shorten the construction period of the long headrace tunnel.

This scheme is relatively small scale similar to the Khimte Khola No.1 scheme; and the construction and energy costs are inexpensive. As the distance from demand center, Kathmandu, is minimal, this scheme is expected to be developed to supply cheap energy to Kathmandu and districts near the scheme.

8) Dudh Kosi River

Dudh Kosi No.1 Scheme

This scheme is planned as a PRR type hydropower station with a 104m high dam, a 2.6km long headrace tunnel and a powerhouse. The dam site is located 28km upstream of the confluence of the Sun Kosi and Dudh Kosi rivers, to which the back water of the Sun Kosi No.1 dam reaches. The Rabuwa Bazar Gauging Station (No.670) is installed 2km upstream from dam site. The installed capacity is 228MW by the maximum discharge of 300m^3/s, with a firm capacity of 118MW and annual generated energy is estimated to be 978GWh which is planned for domestic supply.

The dam site is about 70m wide at the riverbed and river deposits of gravels occur. The right bank consists of a steep outcropped slope, while the left bank is relatively gentle with apparently talus deposits. Gross storage capacity is 162 $10^6 m^3$ which will enable annual regulation of natural river flow at the initial stage. However the effective period of the reservoir depends on the specific sedimentation load of the Dudh Kosi River for which no data were available. This scheme is therefore planned as a PRR type.

The dam is planned as a concrete gravity type taking into consideration the difficulties of flood diversion and dam function. Available storage capacity must be maintained to flush sedimented sand and soil, and accordingly 10m high flush and spillway gates are planned on the dam. Diversion tunnel and foundation treatment are needed for the construction. The headrace tunnel is planned as a pressure type with a surge tank on the right bank.

The main difficulty envisioned at this site is the long access road (177km) required from Dolaghat along the river. Accordingly, this scheme should be developed after the Sun Kosi No.1, No.2 and No.3 Schemes.

3.6.7 Implementation Schedule

ED proposed in 1983 to use their recently completed trend forecast (1982/83 to 2001/2002) without price elasticity and with potential export to India as the 1983 basic Forecast for all future generation planning studies. A long-term power demand forecast beyond 2001/2003 has been carried out under this Master Plan Study. However, recorded energy consumption and peak demand in 1982/83 are respectively 347GWh and 83.7MW including domestic use and export. The annual growth rate of energy consumption and peak demand from 1982/83 to 2005/06 are respectively 12.2% and 11.6%. Peak demand in 2005/06 is therefore estimated at 1,039.8MW.

To meet the rapidly increasing power demand, yearly development of hydropower stations is indispensible. Financial arrangement and manpower for continuous study and investigation at pre-Feasibility and Feasibility Study levels and for implementation is required. However, sources of funds and manpower necessary for execution are limited. Accordingly, it is important to formulate an implementation schedule through selection of priority schemes and sequence of implementation.

The most economical and attractive scheme among the 52 hydropower schemes in the Kosi Basin is the Arun No.3 hydropower scheme in view of its economic viability and subsequent schemes planned downstream on the same river. This Arun No.3 hydropower scheme can generate low-cost energy in spite of the long access road required and can contribute to regional development and energy consuming industrialization in the eastern area.

After completion of the Arun No.3 scheme, Arun No.2 and No.1 schemes can be easily and economically developed by use of the access road constructed for Arun No.3. The Arun River will thereby become a power center. Energy from these schemes can be supplied throughout Nepal via the planned Trans-Nepal transmission lines.

The above schemes are planned as SRR type; development by PRR type must be studied in the next stage of investigation. This means that surplus energy may occur in the rainy season. Possible surplus energy must be studied for energy export, inducement of energy consuming industries and combined operation with PRR and Reservoir type power stations. Therefore, alternative implementation and disbursement schedules were prepared and are given as TABLE 3.6.36 and 3.6.37, while brief of each alternative is given below.

(1) Alternative - 1

This alternative requires sequential development the Arun No.3, 2, 1 hydropower schemes along the Arun River and of the Tama Kosi No.3 scheme at the final stage while in the final stage, teh plant factor will be 80%. This alternatie will provide supply abundant and low-cost energy with a high plant factor. Plant factor after completion of Arun No.3, 2, 1 will be over 90%. At the final stage in 2005, the plant factor is still high at 85%. Carefull investigation of the demand and inducement of some energy consuming industries must be executed to effectively utilize surplus energy in rainy season.

(2) Alternative - 2

This alternative proposes the development of the must economical schemes of Arun No.3 and No.2 followed by Tama Kosi No.3 and No.2 to handle fluctualing demand and utilize surplus energy in the rainy season. In this alternative, abundant low-cost energy can be supplied in the first stage, while in the final stage, the plant factor will be 80%. This will contribute to industrialization by stimulating development of energy consuming factories in the Biratnagar Area. Subsequently, the Tama Kosi No.3 and No.2 schemes can be combined with Arun No.3 and No.2 to provide an overall transmission network in Nepal.

(3) Alternative - 3

This alternative provides a reasonable plant factor of 80% at the first stage by developing the Tama Kosi No.3 PRR power station immediately after development the Arun No.3 scheme. Energy costs at the first stage increases in comparison with Alternative - 2.

(4) Alternative - 4

This alternative proposes development the Sun Kosi No.3 reservoir type hydropower scheme and supply of energy by 2 power stations until 2005. This alternative provides a reasonable plant factor of 60 at the final stage; however, the low-cost energy of the Arun River can not be utilized until 2005.

Alternative - 2 is recommended as the early development of power station will generate low-cost energy and, after planned improvement of the transmission network, PRR type power stations can be added.

TABLE 3-2-1 INSTALLED GENERATION CAPACITY OF PUBLIC SECTOR

Development Region	Hydro Plant (MW)	Diesel Plant (MW)	Sub-total (MW)	Share (%)
1. Central Region	108.69 1/ (97.44) 2/	19.016 (18.17)	127.706 (115.61)	83.8
2 Western Region	18.318 (13.318)	2.222 (1.829)	20.54 (15.147)	13.4
3. Mid & Far Western Region	0.345 (0.115)	0.773 (0.72)	1.118 (0.835)	0.73
4. Eastern Region	0.240 (0.160)	3.692 (2.027)	3.932 (2.187)	2.57
Total	127.593 (111.033)	25.703 (22.746)	153.296 (133.779)	100.0

1/ Installed capacity in MW

2/ Firm capacity in MW

TABLE 3-2-2 INSTALLED GENERATION CAPACITY OF PUBLIC SECTOR

Development Region	Hydro Plant (MW)	Diesel and Steam Plant (MW)	Sub-total (MW)
1. Central Region	0.03 3/ (0.03) 4/	5.360 (4.100)	5.390 (4.130)
2. Western Region	0	1.080 (0.890)	1.080 (0.890)
3. Mid & Far Western Region	0	0.534 (0.450)	0.534 (0.450)
4. Eastern Region	0	3.979 (3.100)	3.979 (3.100)
Total	0.03 (0.03)	10.953 (8.540)	10.983 (8.570)

3/ Installed capacity in MW

4/ Firm capacity in MW

TABLE 3.2.3 INSTALLED GENERATION FACILITIES OF PUBLIC SECTOR
(1 of 5)

Location	Type	Ownership	Installed Capacity (Unit No. x Rating) (MW)		Firm Capacity (MW)	Year of Commissioning
I. Central Region						
(Hydro Plant)						
1) Trisuli	Hydro	NEC	21.0	(7 x 3.0)	18.0	1969/70
2) Sunkosi	Hydro	NEC	10.05	(3 x 3.35)	5.1	1972/73
3) Panauti	Hydro	NEC	2.4	(3 x 0.8)	2.4	1963/64
4) Sundarijai	Hydro	NEC	0.64	(2 x 0.32)	0.64	1934
5) Pharping	Hydro	NEC	0.50	(2 x 0.25)	0.50	1911
6) Kulekhani I	Hydro	NEC	60.0	(2 x30.0)	60.0	1982
7) Devighat	Hydro	NEC	14.1	(3 x 4.7)	10.8	1984
Sub-total			108.69		97.44	
(Diesel Plant)						
1) Mahendra	Diesel	NEC	1.696	(4 x 0.424)	1.4	1956
2) Hetauda	Diesel	NEC	10.0	(4 x 2.5)	10.0	1980/81
			4.47	(3 x 1.43)	4.47	1966
3) Janakpur	Diesel	NEC	0.832	(2 x 0.284) (1 x 0.264)	0.60	1961
4) Bharatpur	Diesel	NEC	0.528	(2 x 0.264)	0.50	1961
5) Patan	Diesel	NEC	1.49	(1 x 1.49)	1.2	1966
Sub-total			19.016		18.17	
Total			127.706		115.61	

TABLE 3.2.3 INSTALLED GENERATION FACILITIES OF PUBLIC SECTOR
(2 of 5)

Location	Type	Ownership	Installed Capacity (Unit No. x Rating) (MW)		Firm Capacity (MW)	Year of Commissioning
II. Western Region						
(Hydro Plant)						
1) Gandaki	Hydro	GOI/NEC	15.0	(3 x 5.0)	10.0	1979/80
2) Pokhara	Hydro	NEC	1.088	(2 x 0.288) (2 x 0.256)	1.088	1968/69
3) Butwal	Hydro	NEC	1.23	(2 x 0.4) (1 x 0.43)	1.23	1969 1974
4) Seti	Hydro	ED	1.0	(1 x 1.0)	1.0	1983
Sub-total			18.318		13.318	
(Diesel Plant)						
1) Pokhara	Diesel	NEC	1.038	(3 x 0.346)	0.982	1974/75
2) Tansen	Diesel	NEC	0.255	(2 x 0.112)	0.160	1956
3) Bhairawa	Diesel	NEC	0.528	(2 x 0.264)	0.500	1960/61
4) Taulihawa	Diesel	NEC	0.05	(1 x 0.05)	0.050	1973
5) Krishnanagar	Diesel	NEC	0.112	(1 x 0.112)	0.112	1956
6) Bahadurganj	Diesel	NEC	0.025	(1 x 0.025)	0.025	1956
7) Butwal	Diesel	NEC	0.225	(1 x 0.225)		Not in operation
Sub-total			2.222		1.829	
Total			20.54		15.147	

TABLE 3.2.3 INSTALLED GENERATION FACILITIES OF PUBLIC SECTOR
(3 of 5)

Location	Type	Ownership	Installed Capacity (Unit No. x Rating) (MW)	Firm Capacity (MW)	Year of Commissionin
III. Mid & Far Western Region					
(Hydro Plant)					
1) Surkhet	Hydro	ED	0.345 (3 x 0.115)	0.115	1977/78
Sub-total			0.345	0.115	
(Diesel Plant)					
1) Ghorahi	Diesel	ED	0.050 (1 x 0.05) 0.050 (1 x 0.05)	0.050 0.050	1982 1956
2) Tulsipur	Diesel	ED	0.050 (1 x 0.05) 0.025 (1 x 0.025)	0.050	1956
3) Surkhet	Diesel	ED	0.020 (1 x 0.020)	0.020	1973
4) Nepalgunj	Diesel	ED	0.528 (2 x 0.264)	0.500	1960/61
5) Dhangadi	Diesel	ED	0.025 (1 x 0.025)	0.025	1973
6) Mahendranagar	Diesel	ED	0.025 (1 x 0.025)	0.025	1973
Sub-total			0.773	0.72	
Total			1.118	0.835	

TABLE 3.2.3 INSTALLED GENERATION FACILITIES OF PUBLIC SECTOR
(4 of 5)

Location	Type	Ownership	Installed Capacity (Unit No. x Rating) (MW)		Firm Capacity (MW)	Year of Commissioning
IV. Eastern Region						
(Hydro Plant)						
1) Dhankuta	Hydro	NEC	0.240	(2 x 0.120)	0.160	1972/73
Sub-total			0.240		0.160	
(Diesel Plant)						
1) Ilam	Diesel	NEC	0.200	(2 x 0.100)	0.160	1961/1973 (Different set)
2) Bhadrapur	Diesel	NEC	0.346	(1 x 0.346)	0.240	1974/75
3) Dharan	Diesel	NEC	0.212	(2 x 0.106)	0.127	1964/65
4) Biratnagar	Diesel	NEC	2.934	(1 x 1.500) (1 x 1.028) (1 x 0.406)	1.50	1976/77 (Not in operation)
Sub-total			3.692		2.027	
Total			3.932		2.187	
Grand Total			153.296		133.779	
(Hydro Plant)			(127.593)		(111.033)	
(Diesel Plant)			(25.703)		(22.746)	

TABLE 3.2.3 INSTALLED GENERATION FACILITIES OF PRIVATE SECTOR

(5 of 5)

Location	Type	Ownership	Installed Capacity (MW)	Firm Capacity (MW)	Year of Commissioning
I. Central Region					
1) Birgunj	Steam	Birgunj Sugar Mill	2.400	1.9	1965/66
2) Birgunj	Diesel	Birgunj Sugar Mill	0.272	0.2	1965/66
3) Janakpur	Diesel	Janakpur Cigarette Factory	1.058	0.8	1965/66
4) Kathmandu	Diesel	Different small industries	1.630	1.2	1960-80
5) Godawari	Hydro	Agriculture Department	0.030	0.030	1969
Sub-total			5.390	4.130	
II. Western Region					
1) Western Region	Diesel	Different small industries	0.310	0.275	1963-80
2) Mahendra	Steam	Mahendra Sugar Mill	0.750	0.600	1966
3) Mahendra	Diesel	Mahendra Sugar Mill	0.020	0.015	1966
Sub-total			1.080	0.890	
III. Far & Mid Western Region					
1) Far Western Region	Diesel	Different small industries	0.534	0.450	1970-80
Sub-total			0.534	0.450	
IV. Eastern Region					
1) Biratnagar	Steam	Biratnagar Jute Mill	1.400	1.100	1941
2) Biratnagar	Diesel	Biratnagar Jute Mill	0.850	0.600	1963
3) Eastern Region	Diesel	Different captive plants and small industries	1.729	1.400	1960-80
Sub-total			3.979	3.100	
Total			10.983	8.570	

TABLE 3-2-4 **EXISTING TRANSMISSION LINE**

(66 kV and 132 kV)

	Route	Length (Km)	Conductor Size	Voltage (kV)	No. of Circuit	Type of Tower	Region
1.	Trisuli-Balaju	28.7	0.10 sq in	66	2	DC	Central
2.	Balaju-Siuchatar	7.0	0.15 sq in	66	2	DC	Central
3.	Hetauda-Birgunj	50.0	0.15 sq in	66	2	DC	Central
4.	Patan-Sunkosi	57.21	120 mm^2	66	1	SC	Central
5.	Siuchatar-Kulekhani I	29.0	0.15 sq in	66	2	DC	Central
6.	Kulekhani I-Hetauda	16.0	0.15 sq in	66	2	DC	Central
7.	Patan-Siuchatar	4.0	160 mm^2	66	1	SC	Central
8.	Devighat-Chabel	35.0	0.25 sq in	66	2	DC	Central
	Sub-total	226.91					
9.	Hetauda-Bharatpur	70.0	0.20 sq in	132	1	SC	Central
10.	Bharatpur-Dumkibas	52.0	0.20 sq in	132	1	SC	Western
11.	Dumkibas-Gandaki	32.0	0.20 sq in	132	1	SC	Western
12.	Bharatpur-Pokhara	85.0	0.15 sq in	132	1	SC	Central
	sub-total	239.0					
	Total	465.91					

TABLE 3-2-5 EXISTING SUBSTATION

Name of Substation	Voltage (kV/kV)	Unit Capacity (MVA)	No. of Unit	Commissioning Date	Region
1. Trisuli	6.6/66	3.750	2x3+1	1966-70	Central
2. Balaju I	66/11	3.750	2x3+1	1966-70	Central
3. Balaju II	66/11	6.0	1	1981	Central
4. Sunkosi	6.3/72.6	6.3	2	1972	Central
5. Patan	66/11	6.3	2	1972	Central
6. Gandaki	6.6/132	10.0	2	1979	Western
7. Bharatpur	132/11	10.0	1	1979	Central
8. Hetauda I	11/66	1.5	2	1966	Central
9. Hetauda II	66/132	10.0	1	1979	Central
10. Hetauda III	11/66	6.0	2	1981	Central
11. Kulekhani I	11/66	35.0	2	1982	Central
12. Siuchatar I	66/11	18.0	2	1982	Central
13. Patan II	66/11	18.0	1	1982	Central
14. Pokhara	132/11	6.0	1	1983	Western
15. Devighat	11/66	8.5	2	1984	Central
16. Chabel	66/11	8.5	2	1984	Central
	Total Capacity	295.2 MVA			

TABLE 3-2-6 HISTORICAL POWER SUPPLY AND CONSUMPTION IN NEPAL

(1973/74 - 1982/83)

Year	Domestic (MWh)	Industrial (MWh)	Commercial (MWh)	Street Light & Others (MWh)	Total Utilized Energy (MWh)	Losses (MWh)	Total Supplied Energy (MWh)	Annual Rate of Growth (%)	Generated Energy (MWh)	Imported Energy (MWh)	Exported Energy (MWh)	Peak Power Demand (MW)	Annual Rate of Growth (%)	Annual Load Factor (%)
1973/74	47,710	15,757	6,514	3,218	73,199	33,885	107,084	-	101,974	8,812	3,702	29.81	-	41.01
1974/75	54,090	21,397	7,897	3,816	87,200	36,995	124,195	15.98	114,182	14,634	4,621	36.17	21.32	39.20
1975/76	61,787	32,128	9,173	4,173	107,261	42,965	150,226	20.96	130,794	25,372	5,940	40.25	11.28	42.61
1976/77	65,768	39,036	10,405	4,382	119,591	45,789	165,380	10.09	142,355	29,141	6,116	45.58	13.26	41.42
1977/78	71,348	42,751	13,068	4,488	131,655	54,724	186,379	12.70	159,623	32,726	5,970	50.63	11.08	42.02
1978/79	77,221	47,827	18,020	5,895	148,963	62,988	211,951	13.72	177,485	40,626	6,160	52.36	3.42	46.21
1979/80	74,823	52,809	25,244	9,093	161,969	67,329	229,298	8.18	195,522	38,972	5,196	56.90	8.67	46.00
1980/81	78,980	53,775	32,202	8,226	173,183	66,254	239,437	4.42	198,639	44,560	3,762	58.48	2.78	46.74
1981/82	90,625	68,054	17,834	8,521	185,034	84,991	270,025	12.77	218,449	56,759	5,183	75.05	28.33	41.07
1982/83	119,147	82,494	21,342	8,497	231,480	109,517	340,997	26 28	283,693	63,290	5,986	83.70	11.53	46.51
Average Compound Growth Rate (%)	10.70	20.19	14.09	11.39	13.65	13.92	13.73		12.04	24.49	5.48	12.15		

Source: Electric Power Statistics of Nepal, Planning Evaluation, Electricity Department
Date : June 1984

TABLE 3-2-7 HISTORICAL POWER SUPPLY AND CONSUMPTION IN VARIOUS REGIONS OF NEPAL

Year	Power Supply and Consumption from 1975/76 to 1981/82 (GWh)										Peak Load (MW)	Losses (GWh) (%)	Annual Load Factor (%)	Import from India (GWh)	Export to India (GWh)
	Central Region		Western Region		Eastern Region		Mid & Far West. Region		Total Nepal						
	Supply	Consumption	Supply	Consumption	Supply	Consumption	Supply	Consumption	Supply	Consumption					
1975/76	118.9	81.5	7.9	6.1	20.3	17.0	3.2	2.7	150.3	107.3	40.2	43.0 (28.6%)	44.3	25.4	5.9
1976/77	129.3	87.4	10.1	8.0	21.9	20.7	4.1	3.4	165.4	119.5	45.6	45.9 (27.7%)	43.3	29.1	6.1
1977/78	144.1	95.4	11.2	9.6	24.8	21.5	6.2	5.1	186.3	131.6	50.6	54.7 (29.3%)	43.3	32.7	6.0
1978/79	160.6	105.3	13.8	10.8	30.8	27.1	6.7	5.7	211.9	148.9	52.4	63.0 (29.7%)	47.5	40.6	6.2
1979/80	179.2	120.8	15.9	12.0	26.4	23.6	7.1	5.5	228.6	161.9	56.9	66.7 (29.2%)	46.9	39.0	5.2
1980/81	177.5	118.8	14.6	12.9	31.1	25.5	8.2	6.6	231.4	163.8	58.9	67.6 (29.2%)	45.6	45.1	3.8
1981/82	202.4	130.4	17.4	13.5	40.1	32.5	10.0	8.4	269.9	184.8	72.9	85.1 (31.5%)	42.9	56.8	5.2

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-2-8 RECENT POWER GENERATION PATTERN OF C.N.P.S. FROM MARCH 1982 TO JULY 1983

Month	No. of Days	Total Generation (GWh)	Average Demand (MW)	Peak Load (MW)	Load Factor	Export 1/ to India (GWh)	Butwal 2/ Region (GWh)	Pokhara 3/ Region (GWh)	C.N.P.S 4/ (GWh)
Mar - Apr 1982	31	21.482	28.874	56.480	0.511	0.519	0.710	0	20.253
Apr - May 1982	31	20.392	27.409	56.360	0.486	0.444	1.050	0	18.898
May - Jun 1982	31	19.039	25.590	48.095	0.532	0.473	0.810	0	17.756
Jun - Jul 1982	31	19.515	26.230	49.920	0.525	0.470	1.040	0	18.005
Jul - Aug 1982	32	20.124	26.204	52.400	0.500	0.521	1.000*	0	18.603
Aug - Sep 1982	31	19.599	26.343	53.400	0.493	0.476	0.870	0	18.253
Sep - Oct 1982	31	22.241	29.895	59.800	0.500	0.504	1.100	0	20.637
Oct - Nov 1982	29	20.955	30.108	59.540	0.506	0.500	1.050*	0	19.405
Nov - Dec 1982	30	25.432	35.322	63.300	0.558	0.515	1.050*	0	23.867
Dec - Jan 1983	30	27.657	38.412	63.300	0.604	0.505	0.230	0	26.922
Jan - Feb 1983	29	27.292	39.212	66.020	0.594	0.476	1.240	0	25.576
Feb - Mar 1983	30	26.390	36.653	65.520	0.559	0.521	0.900*	0.522	24.447
Mar - Apr 1983	30	23.734	32.960	61.620	0.535	0.442	0.900*	0.600*	21.792
Apr - May 1983	31	23.090*	31.030*	62.070*	0.500*	0.520	0.900*	0.600*	21.070*
May - Jun 1983	31	21.820*	29.330*	58.660*	0.500*	0.520	0.900*	0.600*	19.800*
Jun - Jul 1983	32	22.740*	29.610*	59.220*	0.500*	0.520	0.900*	0.600*	20.720*
Sub-total Jul 1982 - Jun 1983		281.071	31.998	66.020	0.485 5/	6.020	11.040	2.922	261.089

Notes: "*" indicates estimated figures

1/ Export to India is committed exports to the Raxaul area. Future export of surplus generation may be higher than the estimates shown after May 1983.

2/ Power supply to the Butwal Region is provided through the 33 kV transmission line from Gandaki to Butwal that was commissioned in March 1982, and through an 11 kV line that serve local communities around Gandaki. The 33 kV line is currently constrained to a peak loading of about 2.5 MW, and is not able to supply all of the Butwal area load.

3/ The Pokhara Region was interconnected in Mid February 1983 with a 132 kV transmission line to Bharatpur.

4/ Estimated supply to The Central Nepal Power System(Bagmati and Narayani Zones) for April 1982 until June 1983 is based on the previous year's supply plus 11.5 %.

5/ Without the Pokhara Region load in 1982/83, the peak annual load would remain unchange and the annual load factor would be 48.0 %.

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-2-9 MONTHLY GENERATION RECORD OF C.N.P.S.

Date	Generation			Peak Demand	Minimum Demand	Average Demand	Load Factor	Min/Max Ratio
	Hydro (MWh)	Diesel (MWh)	Total (MWh)	(MW)	(MW)	(MW)		
1	861.620	0	861.620	57.200	22.240	35.901	0.628	0.389
2	924.450	0	924.450	60.810	24.660	38.519	0.633	0.406
3	948.210	0	948.210	61.910	24.160	39.509	0.638	0.390
4	967.620	0	967.620	61.810	23.740	40.318	0.652	0.384
5	995.110	0	995.110	62.200	24.860	41.463	0.667	0.400
6	952.040	0	952.040	60.500	27.360	39.668	0.656	0.452
7	955.710	0	955.710	62.550	27.360	39.821	0.637	0.437
8	879.120	0	879.120	58.700	24.940	36.630	0.624	0.425
9	948.990	0	948.990	62.500	25.160	39.541	0.633	0.403
10	957.670	0	957.670	61.800	26.260	39.903	0.646	0.425
11	921.060	0	921.060	60.600	20.660	38.378	0.633	0.341
12	928.740	0	928.740	59.100	24.060	38.698	0.655	0.407
13	976.810	0	976.810	61.500	25.460	40.700	0.662	0.414
14	963.180	0	963.180	64.400	25.540	40.133	0.623	0.397
15	806.580	0	806.580	59.100	21.840	33.608	0.569	0.370
16	913.280	0	913.280	62.320	23.740	38.053	0.611	0.381
17	954.820	0	954.820	63.520	25.040	39.784	0.626	0.394
18	971.880	0	971.880	65.400	23.440	40.495	0.619	0.358
19	965.680	0	965.680	66.020	24.540	40.237	0.609	0.372
20	959.400	0	959.400	65.720	25.140	39.975	0.608	0.383
21	980.820	0	980.820	65.820	25.840	40.868	0.621	0.393
22	906.100	0	906.100	62.220	26.240	37.754	0.607	0.422
23	971.300	0	971.300	65.720	25.240	40.471	0.616	0.384
24	977.120	0	977.120	63.820	24.340	40.713	0.638	0.381
25	986.540	0	986.540	63.520	25.140	41.106	0.647	0.396
26	957.200	0	957.200	63.360	24.840	39.883	0.629	0.392
27	968.000	0	968.000	63.820	27.440	40.333	0.632	0.430
28	901.700	0	901.700	58.920	26.940	37.571	0.638	0.457
29	891.100	0	891.100	61.320	23.760	37.129	0.605	0.387
Summary of the Month	27291.850	0	27291.850	66.020	20.660	39.212	0.594	0.313

Maximum demand of the month occurs on: 19 February 1983
Minimum demand of the month occurs on: 11 February 1983
Source: 1983 Electric Load Forecast for Period 1983-2001, Repot No.3/3/080883/1/6, Electricity Department

TABLE 3-3-1 SUMMARY OF PREVIOUS LOAD FORECASTS FOR INTEGRATED NEPAL POWER SYSTEM

YEAR	1981 DISAGGREGATE		1981 E.D.		1982 A.D.B.		1982 WORLD BANK	
	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)
1982/83	297.1	72.1	299.62	81.44	274	74	294.9	74.8
1983/84	358.5	82.1	341.99	92.95	300	81	334.6	84.9
1984/85	407.6	91.3	416.01	113.07	320	87	406.0	92.7
1985/86	559.7	123.1	591.70	157.08	350	93	530.2	121.1
1986/87	679.1	145.7	714.70	189.74	386	103	613.1	140.0
1987/88	792.4	166.4	815.84	216.59	426	113	708.3	161.7
1988/89	915.9	189.8	926.97	246.09	552	146	781.6	178.4
1989/90	1072.7	219.1	1077.49	286.05	715	190	851.8	194.5
1990/91			1212.61	314.60	898	233	925.4	211.3
1991/92			1357.45	352.18	1103	286		
1992/93			1511.41	392.13	1291	335		
1993/94			1674.74	434.50	1511	392		
1994/95			1847.32	479.28	1734	450		
1995/96			2034.32	516.06	2034	516		
1996/97			2236.50	567.35				
1997/98			2454.68	622.70				
1998/99			2689.66	682.31				
1999/00			2942.23	746.38				

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-3-2 FORECASTED ANNUAL GROWTH PARTES INCORPORATING THE SCHEER MODEL FOR VARIOUS REGIONS AND REGIONAL INFORMATION

Year	Forecasted Annual Growth Rates (%) Eastern	C.N.P.S.	Western	Mid-West.	Far-West.
1982/83	17.858	12.749	18.298	20.082	20.788
1983/84	17.497	12.567	17.907	19.626	20.297
1984/85	17.151	12.390	17.534	19.190	19.830
1985/86	16.819	12.219	17.176	18.775	19.385
1986/87	16.500	12.053	16.833	18.378	18.960
1987/88	16.194	11.892	16.504	17.999	18.555
1988/89	15.901	11.735	16.189	17.636	18.168
1989/90	15.618	11.583	15.886	17.288	17.797
1990/91	15.346	11.435	15.595	16.955	17.442
1991/92	15.084	11.292	15.315	16.635	17.102
1992/93	14.832	11.152	15.045	16.328	16.776
1993/94	14.588	11.016	14.786	16.033	16.463
1994/95	14.354	10.884	14.535	15.749	16.163
1995/96	14.127	10.755	14.294	15.476	15.874
1996/97	13.908	10.630	14.061	15.213	15.596
1997/98	13.696	10.508	13.836	14.960	15.328
1998/99	13.492	10.389	13.619	14.715	15.071
1999/00	13.294	10.273	13.409	14.480	14.822
2000/01	13.102	10.160	13.206	14.252	14.582
2001/02	12.916	10.050	13.010	14.032	14.351
2002/03	12.737	9.942	12.819	13.820	14.128

Regional Information

	Eastern	C.N.P.S	Western	Mid-West.	Far-West.
Population in 1981 (Million)	5.401	3.219	3.135	1.953	1.312
Population Growth Rate (%)	2.840	2.430	2.440	3.010	3.000

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-3-3 COMMITTED EXPORT TO BE USED LOAD FORECAST

Year	Maximum Export Load (MW)	Maximum Export Energy (GWh/year)
1983/84	5.0	22.0
1984/85	5.0	22.0
1985/86	5.0	22.0
1986/87	5.0	22.0
1987/88	5.0	22.0
1988/89	5.0	22.0
1989/90	5.0	22.0
1990/91	5.0	22.0
1991/92	5.0	22.0
1992/93	5.0	22.0
1993/94	5.0	22.0
1994/95	5.0	22.0
1995/96	5.0	22.0
1996/97	5.0	22.0
1997/98	5.0	22.0
1998/99	5.0	22.0
1999/00	5.0	22.0
2000/01	5.0	22.0
2001/02	5.0	22.0

TABLE 3-3-4 FORECASTED POTENTIAL EXPORTS

Year	Maximum Export Load (MW)	Maximum Export Energy (GWh/Year)
1983/84	5.0	22.0
1984/85	10.0	44.0
1985/86	10.0	44.0
1986/87	15.0	66.0
1987/88	20.0	88.0
1988/89	25.0	110.0
1989/90	25.0	110.0
1990/91	25.0	110.0
1991/92	25.0	110.0
1992/93	25.0	110.0
1993/94	25.0	110.0
1994/95	25.0	110.0
1995/96	25.0	110.0
1996/97	25.0	110.0
1997/98	25.0	110.0
1998/99	25.0	110.0
1999/00	25.0	110.0
2000/01	25.0	110.0
2001/02	25.0	110.0

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-3-5 EXPECTED INTERCONNECTION DATES FOR ISOLATED LOAD CENTERS

Name of Load Center	Region	Expected Interconnection Date
1. Janakpur	Central	June 1986
2. Gaur	Central	June 1986
3. Dhankuta	Eastern	June 1986
4. Biratnagar-Rajbiraj System	Eastern	June 1986
5. Siraha	Eastern	June 1986
6. Lahan	Eastern	June 1986
7. Tulsipur/Ghorahi	Mid Western	June 1987
8. Koilabas	Mid Western	June 1987
9. Surkhet	Mid Western	June 1987
10. Nepalgunj	Mid Western	June 1987
11. Gularia	Mid Western	June 1987
12. Ilam	Eastern	June 1989
13. Bhadrapur	Eastern	June 1989
14. Dhangadhi	Far Western	June 1990
15. Mahendranagar	Far Western	June 1990

TABLE 3-3-6 FORECASTED ANNUAL LOAD FACTOR

Year	Annual Load Factor (%)
1982/83	48.5
1983/84	48.4
1984/85	48.6
1985/86	48.8
1986/87	49.2
1987/88	49.4
1988/89	49.7
1989/90	49.9
1990/91	50.2
1991/92	50.4
1992/93	50.6
1993/94	50.9
1994/95	51.1
1995/96	51.4
1996/97	51.6
1997/98	51.8
1998/99	52.1
1999/00	52.3
2000/01	52.6
2001/02	52.8

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-3-7 RESULTS OF 1983 TREND FORECASTS

(INTEGRATED NEPAL POWER SYSTEM)

Year	Trend Without*1 Price Elasticity		Trend Without*2 Price Elasticity and Export (BASIC)		Trend With*1 Price Elasticity		Load Factor
	(GWH)	(MW)	(GWH)	(MW)	(GWH)	(MW)	
1982-83	284.9	67.8	284.8	67.8	284.9	67.8	0.483
1983-84	344.2	81.2	344.2	81.2	328.7	77.5	0.484
1984-85	385.5	90.6	407.5	95.7	366.3	86.1	0.486
1985-86	431.6	101.0	453.6	106.1	408.0	95.4	0.488
1986-87	569.6	132.2	613.6	142.1	535.5	124.2	0.492
1987-88	659.9	152.5	725.9	167.7	617.0	142.6	0.494
1988-89	742.4	170.5	830.4	190.7	693.6	158.6	0.497
1989-90	848.6	192.3	928.6	212.4	777.7	177.9	0.499
1990-91	961.5	218.7	1,049.5	238.6	884.9	201.2	0.502
1991-92	1,079.8	244.6	1,167.8	264.5	988.4	223.9	0.504
1992-93	1,211.4	273.3	1,299.4	293.1	1,102.9	248.8	0.506
1993-94	1,357.6	304.5	1,445.6	324.2	1,229.4	275.7	0.509
1994-95	1,520.0	339.6	1,608.0	359.2	1,376.2	307.4	0.511
1995-96	1,700.0	377.6	1,768.0	397.1	1,538.9	341.8	0.514
1996-97	1,899.4	420.2	1,987.4	439.7	1,719.2	380.3	0.516
1997-98	2,120.1	467.2	2,208.1	486.6	1,918.7	422.6	0.518
1998-99	2,364.0	518.0	2,452.0	537.2	2,139.1	468.7	0.521
1999-00	2,633.2	574.8	2,721.2	594.0	2,382.6	520.0	0.523
2000-01	2,930.2	635.9	3,013.2	655.0	2,651.0	575.3	0.526
2001-02	3,257.5	704.3	3,345.5	723.3	2,946.9	637.1	0.528

Note *1 : Including Committed export to India
*2 : Including potencial export to India
Source : ED Forecast Report,1983

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-3-8 1983 TREND FORECAST FOR VARIOUS REGIONS IN NEPAL

Year	Eastern Region		Central Region		Western Region		Mid-West Region		Far-West Region		Total NEPAL		
	(GWH)	(MW)	(GWH)	(MW)	(GWH)	(MW)	(GWH)	(MW)	(GWH)	(MW)	(GWH)	Load Factor	(MW)
1982-83	44.066	10.372	265.430	62.475	23.078	5.844	8.155	1.919	4.377	1.030	346.006	0.485	81.440
1983-84	51.776	12.212	299.000	70.522	28.272	6.668	9.755	2.301	5.266	1.242	394.069	0.484	92.944
1984-85	60.656	14.247	336.200	78.990	33.229	7.805	11.627	2.731	6.310	1.482	448.112	0.486	105.256
1985-86	70.858	16.575	377.656	88.343	38.936	9.108	13.810	3.231	7.533	1.762	508.793	0.488	119.019
1986-87	82.549	19.153	423.485	98.258	45.490	10.555	16.348	3.793	8.962	2.079	576.834	0.492	133.839
1987-88	95.918	22.165	474.194	100.578	52.908	12.247	19.201	4.458	10.624	2.455	653.025	0.494	150.903
1988-89	111.169	25.534	530.235	121.789	61.578	14.144	22.693	5.212	12.555	2.884	738.230	0.497	169.563
1989-90	128.532	29.404	592.094	135.452	71.360	16.325	26.616	6.089	14.789	3.383	833.391	0.499	190.653
1990-91	148.256	33.714	660.296	150.152	82.489	18.758	31.129	7.079	17.368	3.940	939.538	0.502	213.652
1991-92	170.619	38.645	735.408	166.569	95.122	21.545	36.307	8.223	20.339	4.607	1,057.795	0.504	239.589
1992-93	195.925	44.201	818.030	184.552	109.433	24.688	42.235	9.528	23.751	5.358	1,189.383	0.506	268.329
1993-94	224.507	50.351	908.845	203.830	125.613	28.172	49.007	10.991	27.661	6.204	1,335.633	0.509	299.547
1994-95	256.731	57.353	1,008.530	225.301	143.872	32.140	56.725	12.672	32.132	7.178	1,497.990	0.511	334.645
1995-96	292.900	65.073	1,117.852	248.266	164.437	36.520	65.503	14.548	37.233	8.269	1,678.024	0.514	372.676
1996-97	333.749	73.836	1,237.624	273.801	187.559	41.494	75.408	16.006	43.039	9.522	1,877.430	0.516	415.348
1997-98	378.460	83.624	1,368.719	301.634	213.510	47.053	86.758	19.119	40.637	10.039	2,008.084	0.518	462.369
1998-99	430.656	94.360	1,512.072	331.307	242.588	53.153	99.525	21.807	57.117	12.515	2,341.958	0.521	513.142
1999-00	487.906	106.495	1,668.686	364.224	275.117	60.050	113.035	24.869	65.583	14.315	2,611.227	0.523	569.053
2000-01	551.831	119.761	1,839.635	399.247	311.450	67.502	130.174	28.251	75.147	16.309	2,908.237	0.526	631.161
2001-02	623.108	134.718	2,026.068	438.042	351.968	76.007	148.440	32.003	85.031	18.579	3,235.515	0.528	699.528

Source: 1983 Electric Load Forecast for Period 1983-2001,
Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-3-9 INDUSTRIAL LOADS INCLUDED IN 1983 DISAGGREGATE LOAD FORECAST

Name of Factory	Location	Region	Source of Funds	Maximum Demand (kW)	Increment of Energy Requirement (Sales) (MWh) 1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
1. Nepal Vegetable Ghee Factory	Hetauda	Central	NIDC/Private	1,000	1,100	-	-	-	-	-	-	-	-
2. Himalaya Brewery	Kathmandu	Central	NIDC/Private	200	263	-	-	-	-	-	-	-	-
3. Dry Cell Battery Plant	Kathmandu	Central	NIDC/Union Carbide	320	840	-	-	-	-	-	-	-	-
4. Hetauda Cement Plant													
(i) Plant	Hetauda	Central	ADB/HMG	8,500	-	-	-	13,154	13,154	13,154	-	-	-
(ii) Quarry	Bhainse	Central	ADB/HMG	1,000	-	-	-	1,241	1,241	1,241	-	-	-
5. Magnesite Plant													
(i) Dead Burnt Mgn.	Lamosangu	Central	IFC	2,000	-	-	2,628	2,628	-	-	-	-	-
(ii) Refractory Brick	Birgunj	Central	IDBI (India)	1,000	-	-	-	-	1,414	1,314	-	-	-
(iii) Extraction Plant	Khairidhunga	Central	HMG	400	-	-	1,050	1,050	-	-	-	-	-
6. Paper Factory	Gaidakot	Western	Chaina/HMG	2,000	-	3,504	3,504	3,504	-	-	-	-	-
7. Lead & Zinc Mining Project	Rasuwa	Central	India/HMG/I.F.C.	2,000	-	-	-	-	-	-	2,628	2,628	-
8. Pilot Foundry Project	Patan	Central	UNIDO	1,000	-	-	1,314	1,314	-	-	-	-	-
9. Hulas Steel Industry (Pipes & Galvanizing, Etc)	Simra	Central	NIDC/Private	800	526	1,578	-	-	-	-	-	-	-
10. Balaju Textile Mill	Balaju	Central	NIDC/HMG	90	105	105	-	-	-	-	-	-	-
11. Brick Factory	Kathmandu	Central	NIDC/Private	188	-	275	275	275	-	-	-	-	-
12. Sound Equipment	Kathmandu	Central	Private	120	-	105	105	105	-	-	-	-	-
13. Beer Factory	Patan	Central	NIDC/Private	160	-	200	200	200	-	-	-	-	-
14. Paper Mill	Rupandehi	Western	NIDC/Private	2,000	-	2,750	2,450	2,450	-	-	-	-	-
15. Brown Sugar Mill	Parasi	Western	NIDC/Private	160	-	116	116	116	-	-	-	-	-
	Nawal Parasi	Western	NIDC/Private	160	-	116	116	116	-	-	-	-	-
16. Aluminium Conductor	Rupandehi	Western	NIDC/Private	160	-	186	186	186	-	-	-	-	-
17. Resin & Turpenting	Nepalgunj	Mid West.	Russia/HMG	170	-	100	100	100	-	-	-	-	-
18. Fruit Processing	Biratnagar	Eastern	NIDC/Private	80	-	-	-	58	58	58	-	-	-
19. Brown Sugar	Dhanusha	Eastern	NIDC/Private	160	-	-	-	116	116	116	-	-	-
	Sunsari	Eastern	NIDC/Private	160	-	-	-	116	116	116	-	-	-
20. Cement Factory 1/	Udaypur	Eastern	India/HMG	12,000	-	-	-	-	-	-	-	-	17,000

1/ Annual load increments of 17,000 MWh/year will also occur in 1992/93 and 1993/94 for this project.

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3.3.10 **NEW IRRIGATION LOADS INCLUDED IN 1983 DISAGGREGATE LOAD FORECAST**

Name of Project	Region	Source of Finance	Maximum Demand (kW)	Annual Load Factor (%)	Increment of Energy Requirement (Sales) (MWh)									
					1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
1. Narayani Lift Irrigation	Central	ADB/HMG	6,280	32.0	3,600	10,443	-	3,753	-	-	-	-	-	-
2. Lumbini I, II & III Phase (Ground Water)	Westren	IDA/HMG	3,200	30.0	1,168	1,168	2,336	2,336	-	-	-	-	-	-
3. Birgunj Ground Water (Rehabilitation)	Central	IDA/HMG	1,200	25.0	-	650	650	650	-	-	-	-	-	-
4. Rajbiraj Lift Irrigation 1/	Eastern	India	4,170	34.0	-	-	-	-	3,097	6,225	3,097	-	-	-
5. Janakpur Agriculture (Ground Water) 1/	Central	Japan/HMG	6,000	34.0	-	-	-	-	3,540	3,540	3,540	3,540	3,540	-
6. Sagarmatha Project (Ground Water) 1/	Eastern	ADB/HMG	5,610	34.0	-	-	-	-	3,340	3,340	3,340	3,340	3,340	-
7. Marchuar Lift Irrigation	Western	UNCDF	790	34.0	-	-	-	-	600	600	-	-	600	600
8. Kailali Ground Water 2/	Far Western	HMG	2,720	25.0	-	-	-	-	-	-	-	-	500	1,200

1/ The first in-service date for these projects depends on completion of the Hetauda- Biratnagar Transmission Line Project.

2/ The first in-service date of this project depends on completion of the Far-West Transmission Line Extension Project to Dhangadhi and Mahendranagar. Total energy demand will eventually grow to 6000 GWh/year

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/080883/1/6, Electricity Department

TABLE 3-3-11 RESULT OF 1983 DISAGGREGATE LOAD FORECAST

Year	Region	Domestic (GWh)	Industrial (GWh)	Commercial (GWh)	Irrigation & Water Supply (GWh)	Transport (GWh)	Street Light & Others (GWh)	Self Consumption (GWh)	Total Nepal Sales (GWh)	Losses As % of Total Sales (%)	Losses (GWh)	Total Requirement (GWh)	Integrated Proportion	Nepal Integrated Load (GWh)	Committed Exports (GWh)	Total Integrated Load (GWh)	Load Factor (%)	Total Peak Load (MW)
1981/82	Central	69.3	31.6	17.7	5.0	1.1	3.5	2.2	130.4	55.3	72.0	202.4	1.00	202.4				
	Western	6.5	5.0	0.1	0.6	-	0.4	0.9	13.5	28.9	3.9	17.4	0.20	3.6				
	Eastern	10.8	20.8	-	-	-	0.5	0.3	32.4	23.7	7.7	40.1	0	0				
	Mid & Far West.	4.0	3.9	-	-	-	0.3	0.1	8.3	20.0	1.7	10.0	0	0				
												270.0		206.7	5.2	211.2	42.7	56.5
1982/83	Central	87.6	41.6	21.0	5.4	1.5	2.9	2.5	162.5	60.7	98.6	261.1	1.00	261.1				
	Western	7.1	5.5	0.1	1.8	-	0.4	0.3	15.2	28.0	4.3	19.5	0.72	14.0				
	Eastern	11.8	21.8	-	-	-	0.8	0.7	35.1	23.0	8.1	43.2	0	0				
	Mid & Far West.	4.4	4.1	-	-	-	0.3	0.2	9.0	20.0	1.8	10.8	0	0				
												334.6		275.1	6.0	281.1	48.5	66.0
1983/84	Central	92.8	45.0	33.7	16.6	1.5	3.4	3.8	196.8	55.0	108.2	305.0	1.00	305.0				
	Western	8.0	6.1	0.1	3.1	-	0.4	0.4	18.1	26.0	4.7	22.8	0.80	18.2				
	Eastern	12.9	24.0	-	-	-	0.8	0.7	38.4	22.0	8.4	46.8	0	0				
	Mid & Far West.	4.8	4.5	-	-	-	0.3	0.2	9.8	19.5	1.9	11.7	0	0				
												386.3		323.2	22.0	345.2	48.4	81.4
1984/85	Central	100.2	53.0	37.1	18.1	1.5	3.6	4.4	217.9	50.0	109.0	326.9	1.00	326.9				
	Western	8.8	9.9	0.1	5.6	-	0.5	0.5	25.4	24.0	6.1	31.5	0.80	25.2				
	Eastern	14.1	26.4	-	-	-	0.9	0.8	42.2	21.0	8.9	51.1	0	0				
	Mid & Far West.	5.3	5.1	-	-	-	0.3	0.2	10.9	19.9	2.1	13.0	0	0				
												422.5		352.1	22.0	374.1	40.6	87.8
1985/86	Central	108.2	64.7	40.8	23.4	1.6	3.8	5.4	247.9	45.0	111.6	359.5	1.00	359.5				
	Western	9.7	13.8	0.1	8.2	-	0.5	0.7	33.0	22.0	7.3	40.3	1.00	40.3				
	Eastern	15.4	29.0	-	-	-	0.9	1.0	46.3	20.0	9.3	55.6	0	0				
	Mid & Far West.	5.8	5.7	-	-	-	0.3	0.2	12.0	18.5	2.2	14.2	0	0				
												469.6		399.8	22.0	421.8	48.8	98.7
1986/87	Central	116.8	90.4	44.9	24.6	1.7	4.0	6.0	288.4	40.0	115.4	403.8	1.00	403.8				
	Western	10.7	18.0	0.1	9.2	-	0.5	0.8	39.3	20.0	7.9	47.2	1.00	47.2				
	Eastern	16.8	36.0	-	10.0	-	1.0	1.4	65.2	19.0	12.4	77.6	0.95	73.7				
	Mid & Far West	6.4	6.4	-	-	-	0.4	0.2	13.4	18.0	2.4	15.8	0	0				
												544.4		524.7	22.0	546.7	49.2	126.8
1987/88	Central	126.1	110.6	49.4	25.8	1.8	4.2	6.7	324.6	35.0	113.6	438.2	1.00	438.2				
	Western	11.8	19.8	0.1	10.3	-	0.5	0.9	43.4	19.0	8.2	51.6	1.00	51.6				
	Eastern	18.4	39.5	-	23.6	-	1.1	1.8	84.4	18.0	15.2	99.6	0.95	94.6				
	Mid & Far West.	7.0	7.0	-	-	-	0.4	0.3	14.7	17.5	2.6	17.3	0.65	11.2				
												606.7		595.6	22.0	617.6	49.4	142.7
1988/89	Central	136.0	131.8	54.3	27.1	1.9	4.4	7.0	362.5	30.0	208.7	471.2	1.00	471.2				
	Western	12.9	21.8	0.2	10.8	-	0.6	1.0	47.3	18.0	8.5	55.8	1.00	55.8				
	Eastern	20.0	43.7	-	34.8	-	1.1	2.4	102.0	17.5	17.8	119.8	0.95	113.8				
	Mid & Far West.	7.6	7.7	-	-	-	0.5	0.3	16.1	17.5	2.8	18.9	0.65	12.3				
												665.7		653.1	22.0	675.1	49.7	155.1
1989/90	Central	146.7	141.0	59.7	28.5	2.0	4.6	7.6	390.1	25.0	97.5	487.6	1.00	487.6				
	Western	14.2	24.0	0.2	11.3	-	0.6	1.1	51.4	17.5	9.0	60.4	1.00	60.4				
	Eastern	21.8	48.1	-	43.4	-	1.2	3.0	116.5	17.5	20.6	138.1	1.00	138.1				
	Mid & Far West.	8.4	8.5	-	-	-	0.6	0.4	17.9	17.5	3.1	21.0	0.65	13.7				
												707.1		699.8	22.0	721.8	49.9	165.1
1990/91	Central	158.2	150.7	65.7	29.9	2.1	4.8	8.0	419.4	25.0	104.8	524.2	1.00	524.2				
	Western	15.5	26.4	0.2	12.5	-	0.6	1.2	56.4	17.5	9.9	66.3	1.00	66.3				
	Eastern	23.7	52.9	-	52.5	-	1.3	3.6	134.0	17.5	23.4	157.4	1.00	157.4				
	Mid & Far West.	9.1	9.4	-	0.5	-	0.6	0.5	20.1	17.5	3.5	23.6	1.00	23.6				
												771.5		771.5	22.9	793.5	50.2	180.4
1991/92	Central	170.5	158.2	72.3	31.4	2.2	5.0	8.4	448.0	25.0	112.0	560.0	1.00	560.0				
	Western	17.0	29.0	0.2	13.7	-	0.7	1.3	61.9	17.5	10.8	72.7	1.00	72.7				
	Eastern	25.8	75.2	-	55.1	-	1.4	4.2	161.7	17.5	28.3	190.0	1.00	190.0				
	Mid & Far West.	10.0	10.3	-	1.7	-	0.7	0.6	23.3	17.5	4.1	27.4	1.00	27.4				
												850.1		850.1	22.0	872.1	50.4	197.5

Source: 1983 Electric Load Forecast for Period 1983-2001, Report No. 3/3/0800883/1/6, Electricity Department

TABLE 3-3-12 LONG TERM POWER DEMAND FORECAST
(1983 - 2030)

Year	Demand (GWH)	Growth Rate (%)	Load Factor	Peak Load (MW)	
1982-83	284.8	20.86	0.488	67.8	Same as 1983 ED's Trend Forecast (Basic Forecast)
1983-84	344.2	18.39	0.484	81.2	
1984-85	407.5	11.31	0.486	95.7	
1985-86	453.6	35.27	0.488	106.1	
1986-87	613.6	18.30	0.492	142.1	
1987-88	725.9	14.40	0.494	167.7	
1988-89	830.4	11.83	0.497	190.7	
1989-90	928.6	13.02	0.499	212.4	
1990-91	1,049.5	11.27	0.502	238.6	
1991-92	1,167.8	11.27	0.504	274.5	
1992-93	1,299.4	11.25	0.506	293.1	
1993-94	1,445.6	11.23	0.509	324.2	
1994-95	1,603.0	11.19	0.511	359.2	
1995-96	1,788.0	11.15	0.514	397.1	
1996-97	1,987.4	11.10	0.516	439.7	
1997-98	2,208.1	11.05	0.518	486.6	
1998-99	2,452.0	10.98	0.521	537.2	
1999-00	2,721.2	10.91	0.523	594.0	
2000-01	3,018.2	10.84	0.526	655.0	
2001-02	3,345.4	10.61	0.528	723.3	
2002-03	3,700.3	10.34	0.533	792.5	
2003-04	4,082.9	10.15	0.536	869.6	
2004-05	4,497.3	9.93	0.540	950.7	
2005-06	4,945.9	9.72	0.543	1,039.8	
2006-07	5,426.6	9.51	0.547	1,132.5	
2007-08	5,942.7	9.30	0.551	1,231.2	
2008-09	6,495.4	9.10	0.554	1,338.4	
2009-10	7,086.5	8.90	0.558	1,449.7	
2010-11	7,718.1	8.71	0.562	1,567.7	
2011-12	8,390.3	8.52	0.566	1,692.2	
2012-13	9,105.2	8.34	0.570	1,823.5	
2013-14	9,864.6	8.16	0.573	1,965.3	
2014-15	10,669.5	7.98	0.577	2,110.9	
2015-16	11,521.9	7.81	0.581	2,263.8	
2016-17	12,421.8	7.64	0.585	2,423.9	
2017-18	13,370.8	7.48	0.589	2,591.4	
2018-19	14,370.9	7.31	0.592	2,771.1	
2019-20	15,421.4	7.15	0.596	2,953.8	
2020-21	16,526.8	7.00	0.600	3,144.4	
2021-22	17,683.7	6.89	0.600	3,364.5	
2022-23	18,902.1	6.79	0.600	3,596.3	
2023-24	20,185.5	6.68	0.600	3,840.5	
2024-25	21,533.9	6.58	0.600	4,097.0	
2025-26	22,950.1	6.48	0.600	4,366.5	
2026-27	24,437.3	6.38	0.600	4,649.4	
2027-28	25,996.4	6.28	0.600	4,946.0	
2028-29	27,628.9	6.19	0.600	5,256.6	
2029-30	29,339.2	6.09	0.600	5,582.0	
2030-31	31,119.8	6.00	0.600	5,920.8	

TABLE 3-3-13 HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

Name of Project	Name of River	Installed Capacity (MW)	Type	Expected Completion Date	Region
1. Devighat	Trisuli River	14.1MW(4.7MWx3)	run of river	January 1984 (Completed)	Central
2. Kulekhani No.2	Rapti River	32.0MW(16MWx2)	run of river	September 1986	Central
3. Marsyangdi	Marsyangdi River	66.0MW(22MWx3)	run of river	July 1988	Central
4. Sapt Gandaki	Kali Gandaki River	225MW(75MWx3)	run of river	July 1990(1st unit 75MW) July 1991(2nd unit 75MW) July 1992(3rd unit 75MW)	Central

Source: Electricity Department

TABLE 3-3-14 TRANSMISSION LINE EXPANSION PROGRAM

	Route	Length (Km)	Conductor Size	Voltage (KV)	No. of Circuit	Type of Tower	Expected Completion Date	Region
1.	Hetauda-Janakpur	137	0.25 sq in	132	1	DC	June 1986	Central
2.	Janakpur-Biratnagar	146	0.25 sq in	132	1	DC	June 1986	Central/Eastern
3.	Dumkibas-Butwal	45	0.25 sq in	132	1	DC	June 1986	Western
4.	Siuchater-Kulekhani (No.2 P/S)	36	240 mm^2	132	1	DC	Sept.1986	Central
5.	Kulekhani-Hetauda (No.2 P/S)	7	240 mm^2	132	1	DC	Sept.1986	Central
6.	Butwal-Shivpur	61	0.25 sq in	132	1	DC	June 1987	Western
7.	Shivpur-Lamahi	51	0.25 sq in	132	1	DC	June 1987	Mid West/Western
8.	Lamahi-Nepalgunj	96	0.25 sq in	132	1	DC	June 1987	Mid Western
9.	Marsyangdi-Bharatpur (P/S)	40	0.25 sq in	132	1	SC	July 1988	Central
10.	Marsyangdi-Balaju (P/S)	100	0.25 sq in	132	1	SC	July 1988	Central
11	Balaju-Siuchater	7	0.25 sq in	132	1	SC	July 1988	Central
12	Biratnagar-Anarmani	80	0.25 sq in	132	1	SC	June 1989	Eastern
13	Nepalgunj-Dhangadi	175	0.25 sq in	132	1	SC	June 1990	Far Western
14	Dhangadi-Mahendranagar	55	0.25 sq in	132	1	SC	June 1990	Far Western
15	Hetauda-Bharatpur	70	0.25 sq in	-	-	-	-	Central
16	Balaju-Chabel	8	160 mm^2	-	-	-	-	Central
	Total	1114						

Source: Electricity Department

TABLE 3-3-15 **SUBSTATION EXPANSION PROGRAM**

Name of Substation	Voltage (kV/kV)	Unit Capacity (MVA)	No. of Unit	Expected Completion Date	Region
1. Biratnagar	132/11	15.0	2	June 1986	Eastern
2. Janakpur	132/33/11	10.0	1	June 1986	Central
3. Butwal	132/33	10.0	1	June 1986	Western
4. Dumkibas	132/33	5.0	1	June 1986	Western
5. Hetauda	66/132	10.0	2	Sept. 1986	Central
6. Kulekhani IIA	11/132	18.0	2	Sept. 1986	Central
7. Kulekhani IIB	66/11	3.6	1	Sept. 1986	Central
8. Siuchatar	132/66	39.0	1	Sept. 1986	Central
9. Shivpur	132/33	5.0	1	June 1987	Western
10. Lamahi	132/33	5.0	1	June 1987	Mid Western
11. Nepalgunj	132/33	10.0	1	June 1987	Mid Western
12. Marsyangdi	11/132	10.0	3x3+1	July 1988	Central
13. Balaju	132/66	40.0/3	3x3+1	July 1988	Central
14. Anarmani	132/33/11	5.0	1	June 1989	Eastern
15. Dhangadi	132/33/11	5.0	1	June 1990	Far Western
16. Mahendranagar	132/33/11	5.0	1	June 1990	Far Western
	Total Capacity	328.6 MVA			

Source: Electricity Department

TABLE 3.4.1 GAUGING STATION AND DISCHARGE RECORD

Gauging Station			Catchment Area (km^2)	Annual Average Discharge ($m^3/S/100\ km^2$)	Available Period of Record (Year)
Code No.	Name	River			
610	Bahrabise	Bhote Kosi	2,410	3.1	1965-1978
620	Phalame Sangu	Balephi Khola	629	9.1	1964-1978*1
630	Panchuwar Ghat	Sun Kosi	4,920	4.8	1964-1975
640	Panauti	Rosi Khola	87	3.4	1964-1978
647	Busti	Tama Kosi	2,753	5.9	1971-1978
650	Rasnalu Village	Khimte Khola	313	8.9	1965-1978
652	Khurkot	Sun Kosi	10,000	5.6	1968-1978
660	Sangutar	Likhu Khola	823	6.5	1964-1978
670	Rabuwa Bazar	Dudh Kosi	4,100	5.4	1964-1975
680	Kampu Ghat	Sun Kosi	17,600	4.2	1966-1977
690	Mulghat	Tamur	5,640	6.1	1970-1978
695	Barakshetra	Sapt Kosi	61,000	2.7	1949-1978
604	Legwa Ghat	Arun	34,904	1.5	1979-1982*2
604.5	Turik Ghat (Tumlingtan)	Arun	33,766	1.3	1976-1983

*1 no data in 1968

*2 presently not active

TABLE 3.4.4 UNIT PRICE FOR COST ESTIMATE
(1 of 4)

Item		Unit Cost (US$)	Remarks
Compensation and Land Acquisition		6%: Reservoir 3%: PRR 2%: SRR	Percentage for the cost of Power House, Civil & Electric Works
Power House			
- Main Building	(m^3)	130 - 150	Building volume
- Attached Building	(%)	5%	Percentage of main building
Civil Structure			
I. Water Way			
1) Intake Dam			
- Excavation	(m^3)	12	
- Concrete	(m^3)	92	
- Others		30%	Percentage for the above
2) Intake			
- Excavation	(m^3)	12	
- Concrete	(m^3)	117	
- Reinforcement	(t)	750	
- Gate	(t)	4,170	
- Screen	(t)	2,540	
- Others	(t)	20%	Percentage for the above
3) Settling Basin			
- Excavation	(m^3)	12	
- Concrete	(m^3)	117	
- Reinforcement	(t)	750	
- Screen	(t)	2,540	
- Others		20%	Percentage for the above

TABLE 3.4.4 (2 of 4)

UNIT PRICE FOR COST ESTIMATE

Item		Unit Cost (US$)	Remarks
4) Headrace			
- Excavation	(m^3)	50	
- Concrete	(m^3)	130	
- Reinforcement	(t)	750	
- Grouting	(m)	230 - 1,000	
- Others		20%	Percentage for the above
5) Tank			
- Excavation (Surge Tank)	(m^3)	63	
- " (Head Tank)	(")	12	
- Concrete (Surge Tank)	(")	130	
- " (Head Tank)	(")	117	
- Reinforcement	(t)	750	
- Others		25%	Percentage for the above
6) Penstock			
- Excavation (Tunnel)	(m^3)	50	Percentage for the above
- " (Ground)	(m^3)	12	
- Concrete (Tunnel)	(")	117	
- " (Ground)	(")	117	
Reinforcement	(t)	750	
- Pipe		2,710	
- Others		20%	Percentage for the above
7) Tailrace		Same as Headrace	
8) Outlet		Same as Intake	
9) Miscellaneous		5%	Percentage for water way

TABLE 3.4.4 (3 of 4) UNIT PRICE FOR COST ESTIMATE

Item		Unit Cost (US$)	Remarks
II. Reservoir or Pondage			
1) Dam (Concrete)			
- Excavation	(m^3)	12	
- Concrete	(")	80	
- Gate	(t)	4,170	
- Others		25%	Percentage for the above
2) Dam (Fill)			
- Excavation	(m^3)	8	
- Embankment	(")	7	
- Others		25%	Percentage for the above
3) Spillway (Fill)			
- Excavation	(m^3)	12	
- Concrete	(")	117	
- Reinforcement	(")	750	
- Gate	(t)	4,170	
- Others		20%	Percentage for the above
4) Miscellaneous		4% of Reservoir and Pondage	
III. Power Plant			
1) Foundation			
- Excavation	(m^3)	12	
- Concrete	(")	117	
- Reinforcement	(t)	750	
- Others		20%	Percentage for the above
IV. Miscellaneous		3% of Civil Works	
V. Temporary Facilities		20%: Reservoir 10%: PRR&SRR	Percentage for civil works

TABLE 3.4.4 UNIT PRICE FOR COST ESTIMATE
(4 of 4)

Item		Unit Cost (US$)	Remarks
Electric Equipment		L.S.	International Market Price
Administrative and Engineering Consultant Cost		L.S.	10% of the above total
Sub-Total			
Contingency		L.S.	10% of the above total
Access Road	(m)	310	
Grand Total			

TABLE 3.5.1 PROJECT PRIORITY EVALUATING SYSTEM
(1 of 3)

Evaluating Items	Weightage	Priority Grade
I. Economic Viability		
1) Unit Cost of Power	10	5 for less than 3.0 c/kKW 4 for 3.0 - 4.9 3 for 5.0 - 6.9 2 for 7.0 - 7.9 1 for more than 8
2) B/C Ratio	10	1 for less than 1.0 2 for 1.0 - 1.9 3 for 2.0 - 2.5 4 for 2.6 - 2.9 5 for greater than 3.0
3) Compliance to National Need (Size of Project)	6	5 for 100 - 499 MW 4 for 50 - 99 MW 3 for 500 - 699 MW or less than 50 MW 3 for greater than 1000 MW
4) Employment Opportunities (Long Term Basis)	3	5 for big contribution, such as creation of more than 3,000 jobs expected 3 for fair amount expected 1 for almost negligible
5) Multiplier Effects	3	5 for substantial contribution to rural development, such as supporting farm industry and others 3 for some effect 1 for negligible effect
II. Infrastructure for Construction		
1) Accessibility	5	5 for les than 50 km 4 for 50 - 69 km 3 for 70 - 89 km 2 for 90 - 110 km 1 for greater than 110 km
2) Logistics	3	5 for favorable location in obtaining manpower and material supplies 3 for relatively easy 1 for not easy

TABLE 3.5.1 (2 of 3) PROJECT PRIORITY EVALUATING SYSTEM

Evaluating Items	Weightage	Priority Grade
3) Construction Period	7	5 for less than 4 years 3 for 5 - 10 years 1 for greater than 10 years
4) Transmission Line	3	5 for less than 50 km 3 for 50 - 100 km 1 for greater than 110 km
5) Construction Camp	2	5 for good location easily found 3 for relatively easy 1 for not easy
6) Permanent Community	1	5 for large community within 25 km 3 for within 26 - 50 km 1 for greater than 51 km
III. Resettlement		
1) Existing Population and Land Use to be Effected	3	5 for minimal effect, such as SRR type development 3 for PRR type development 1 for Reservoir type development
2) Compensation or Resettlement Site Selection	3	5 for SRR type 3 for PRR type 1 for Reservoir type
IV. Effects on Downstream Reaches		
1) Flood Control	1	5 for substantial contribution 3 for some 1 for negligible
2) Soil Conservation Effect 3) Sedimentation	3) 6	5 for Reservoir type 3 for PRR type 1 for SRR type
4) Fisheries Resources	3	5 for negligible negative effect, such as SRR type 3 for PRR type 1 for Reservoir type

TABLE 3.5.1 PROJECT PRIORITY EVALUATING SYSTEM
(3 of 3)

Evaluating Items	Weightage	Priority Grade
V. Innundation Zone		
1) Agricultural Capabilities (Negative Effect)	5	5 for negligible negative effect, such as SRR type 3 for PRR type 1 for Reservoir type
2) Contribution to Fisheries Development	3	5 for Reservoir type 3 for PRR type 1 for SRR type
3) Water Quality	2	5 for SRR type 3 for PRR type 1 for Reservoir type
VI. Development Impacts		
1) Effects on the Basin (Land Use & Transportation)	5	5 for great contribution expected 3 for some amount 1 for negligible amount
2) Reservoir Resource Potentials (Multipurpose Effects Including Irrigation Development)	3	5 for great effect 3 for fair effect 1 for negligible effect
3) Regional Resource Potentials	5	5 for great contribution 3 for fair contribution 1 for negligible effect

TABLE 3.6.1 MONTHLY AVERAGE DISCHARGE RECORDS AT GAUGING STATION

(Unit: m^3/S)

Gauging Station			JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Annual Average
Code No.	Name (River)	Catchment Area (km^2)													
610	Bharabise (Bhote Kosi)	2,410	19.52	16.37	15.76	20.25	32.38	98.75	187.41	216.48	159.47	80.15	41.03	26.50	76.62
620	Dhalame Sangu (Balephi)	629	12.14	10.01	9.53	11.16	16.02	61.60	136.57	174.44	120.31	61.46	27.42	16.69	55.57
630	Panchuwar Ghat (Sun Kosi)	4,920	57.98	47.51	46.48	54.71	75.29	265.83	637.68	772.13	541.98	264.84	128.77	81.28	249.53
640	Panauti (Rosi)	87	1.38	1.18	1.02	0.88	1.05	2.45	5.95	7.62	5.39	4.11	2.03	1.57	2.99
647	Busti (Tama Kosi)	2,753	30.88	24.87	23.59	30.87	64.13	195.19	405.01	464.86	319.98	159.20	72.21	43.39	153.91
650	Rasnalu Village (Khimte)	313	5.45	4.66	4.28	4.90	8.52	37.25	82.28	81.60	53.89	22.61	10.91	6.92	27.13
652	Khurkot (Sun Kosi)	10,000	115.19	93.19	84.53	96.99	142.73	514.07	1294.08	1677.38	1231.12	577.38	281.73	161.90	526.08
660	Sangutar (Likhu)	823	14.42	11.76	10.61	11.55	17.65	55.43	133.90	161.36	121.74	65.82	32.07	19.92	55.03
670	Rabuwa Bazar (Dudh Kosi)	4,100	48.52	38.53	37.23	44.81	76.06	287.30	621.16	678.52	448.01	255.13	107.98	66.42	227.43
680	Kampu Ghat (Sun Kosi)	17,600	186.56	160.26	147.90	159.72	210.65	658.94	1810.00	2294.25	1506.00	724.17	325.70	230.00	706.80
690	Malghat (Tamur)	5,640	64.93	52.23	48.03	80.44	185.23	488.52	877.65	897.95	680.57	328.55	140.41	87.44	329.73
604	Legwa Ghat (Arun)	34,904	134.60	152.75	183.49	283.6	446.08	738.75	1096.72	1239.69	933.43	656.09	367.1	172.48	533.65
604.5	Turik Ghat (Arun)	33,766	124.71	124.91	143.50	186.91	279.55	608.44	983.83	1032.91	810.16	406.26	219.88	425.16	458.47
695	Barak-shelra (Sapt Kosi)	61,100	400.3	357.0	351.9	418.1	715.8	1976.1	4008.3	4712.6	3389.3	1739.6	824.3	529.8	1632.7

TABLE 3.6.2 DURATION OF DISCHARGE RECORDED AT GAUGING STATION

(Unit: m^3/S)

Gauging Station			Maximum Discharge	35-Day Discharge	95-Day Discharge	185-Day Discharge	275-Day Discharge	355-Day Discharge	Minimum Discharge	Average Discharge
Code No.	Name (River)	Catchment Area (km^2)								
610	Bharabise (Bhote Kosi)	2,410	348.10	198.40	121.82	34.49	19.33	14.98	14.26	76.62
620	Phalame Sangu (Balephi)	629	326.80	158.60	86.15	20.14	11.40	9.02	8.73	55.57
630	Parchuwar Ghat (Sun Kosi)	4,920	1,627.50	716.25	362.12	96.49	54.86	43.27	41.27	249.53
640	Panauti (Rosi)	87.2	30.68	7.50	3.50	1.68	0.96	0.55	0.45	2.99
647	Busti (Tama Kosi)	2,753	732.00	434.75	242.00	64.21	29.96	22.35	21.26	153.91
650	Rasnalu Village (Khimte)	313	243.48	77.13	37.14	8.59	5.19	3.91	3.70	27.13
652	Khurkot (Sun Kosi)	10,000	3,243.75	1,533.75	774.37	188.00	104.37	77.95	72.19	526.08
660	Sangutar (Likha)	823	295.90	150.20	84.41	23.18	13.06	9.63	7.84	55.03
670	Rabuwa Bazar (Dudh Kosi)	4,100	1,471.00	625.10	337.90	87.98	45.57	34.47	32.32	227.43
680	Kampu Ghat (Sun Kosi)	17,600	4,176.00	2,058.00	1,030.20	266.10	175.00	141.20	137.40	714.14
690	Mulghat (Tamur)	5,640	2,340.00	901.56	536.11	138.22	63.92	42.81	40.21	341.43
604	Legwa Ghat (Arum)	34,904	2,136	1,211	838	364	174	122	110	533.65
604.5	Turik Ghat (Arum)	33,766	1,921	999	650	234	144	117	109	458.47

TABLE 3.6.3 THE CATCHMENT AREA OF THE DAMS AND ADOPTED GAUGING STATIONS

River	Name of Hydroelectric Power Scheme	Catchment Area (km^2)	Type of Scheme	Gauging Station No.	Gauging Station Catchment Area (km^2)	Remarks
SUN KOSI	Sun Kosi No.1	16,200	Reservoir	680	17,600	
	" No.2	10,396	"	652	10,000	
	" No.3	5,520	"	630	4,920	
	" No.4	3,100	S.R.R.	630	4,920	
DUDH KOSI	Dudh Kosi No.1	4,100	P.R.R.	670	4,100	
	" No.2	3,625	S.R.R.	"	"	
	" No.3	3,200	"	"	"	
	" No.4	2,300	"	"	"	
	" No.5	2,200	"	"	"	
	" No.6	2,150	"	"	"	
	" No.7	2,070	"	"	"	
	" No.8	1,900	"	"	"	
	" No.9	1,860	"	"	"	
	" No.10	1,790	"	"	"	
LIKHU KHOLA	Likhu Khola No.1	823	S.R.R.	660	823	
	" No.2	750	"	"	"	
	" No.3	670	"	"	"	
	" No.4	620	"	"	"	

TABLE 3.6.3 THE CATCHMENT AREA OF THE DAMS AND ADOPTED GAUGING STATIONS

(2 of 3)

River	Name of Hydroelectric Power Scheme	Catchment Area (km^2)	Type of Scheme	Gauging Station No.	Gauging Station Catchment Area (km^2)	Remarks
MAULUNG KHOLA	Maulung Khola	330	S.R.R.	660	823	
TAMA KOSI	(Tama Kosi No.1)	3,630	P.R.R.	647	2,753	Disregarded
	Tama Kosi No.2	3,010	S.R.R.	"	"	
	" No.3	2,753	P.R.R.	"	"	
	" No.4	2,540	"	"	"	
	" No.5	1,950	S.R.R.	"	"	
	" No.6	1,900	"	"	"	
KHIMTE KHOLA	Khimte Khola No.1	360	S.R.R.	650	313	
	" No.2	313	"	"	"	
BHOTE KOSI	Bhote Kosi No.1	2,320	S.R.R.	610	2,410	
	" No.2	2,170	"	"	"	
BALEPHI	Balephi	490	S.R.R.	620	629	
ROSI KHOLA	Rosi Khola No.1	490	S.R.R.	640	87.2	
	" No.2	420	"	"	"	
	" No.3	260	"	"	"	
	" No.4	190	"	"	"	
INDRA-WATI	Indrawati No.1	980	P.R.R.	620	629	
	" No.2	750	S.R.R.	"	"	
	" No.3	370	"	"	"	

TABLE 3.6.3 THE CATCHMENT AREA OF THE DAMS AND ADOPTED GAUGING STATIONS

River	Name of Hydroelectric Power Scheme	Catchment Area (km^2)	Type of Scheme	Gauging Station No.	Gauging Station Catchment Area (km^2)	Remarks
TAMUR	Tamur No.1	5,085	Reservoir	690	5,640	
	(" No.2)	4,400	P.R.R.	"	"	Disregarded
	" No.3	4,000	"	"	"	
	" No.4	3,140	S.R.R.	"	"	
	" No.5	2,560	"	"	"	
	" No.6	2,490	"	"	"	
	" No.7	2,420	"	"	"	
KABELI NADI	Kabeli Nadi No.1	580	S.R.R.	690	5,640	
	" No.2	320	"	"	"	
	" No.3	180	"	"	"	
ARUN	Arun No.1	32,998	S.R.R.			
	" No.2	32,881	"			
	" No.3	32,332	"	640.5	33,766	
	" No.4	32,023	"	690	5,640	
	" No.5	31,974	"			
	" No.6	31,398	"			

TABLE 3.6.4 THE RIVER DISCHARGE AT EACH DAM SITE

(1 of 4) (Unit: m^3/S)

River	Name of Hydro-electric Power Scheme	Catch-ment Area (km^2)	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Annu-al Ave-age
	SUN KOSI														
	No.1	16,200	171.7	147.5	136.1	147.0	193.9	606.5	1,666	2,112	1,386	666.6	299.8	211.7	650.6
SUN	No.2	10,396	119.8	96.88	87.88	100.8	148.4	534.4	1,345	1,744	1,280	600.2	292.9	168.3	546.9
KOSI	No.3	5,520	65.05	53.30	52.15	61.38	84.47	298.2	715.4	866.3	608.1	297.1	144.5	91.19	280.0
	No.4	3,100	36.53	29.94	29.29	34.47	47.44	167.5	401.8	486.5	341.5	166.9	81.14	51.21	157.2
	DUDH KOSI														
	No.1	4,100	48.52	38.53	37.23	44.81	76.06	287.3	621.2	678.5	448.0	255.1	108.0	66.49	227.4
	No.2	3,625	42.90	34.07	32.92	39.62	67.25	254.0	549.2	599.9	396.1	225.5	95.49	58.79	201.1
	No.3	3,200	37.87	30.07	29.06	34.97	59.36	224.2	484.8	529.6	349.7	199.1	84.29	51.89	177.5
DUDH	No.4	2,300	27.22	21.61	20.89	25.14	42.67	161.2	348.5	380.6	251.3	143.1	60.59	37.30	127.6
KOSI	No.5	2,200	26.03	20.67	19.98	24.04	40.81	154.2	333.3	364.1	240.4	136.9	57.95	35.68	122.0
	No.6	2,150	25.44	20.20	19.52	23.50	39.89	150.7	325.8	355.8	234.9	133.8	56.63	34.87	119.3
	No.7	2,070	24.50	19.45	18.80	22.62	38.40	145.1	313.6	342.6	226.4	128.8	54.53	33.57	114.8
	No.8	1,900	22.48	17.86	17.25	20.77	35.25	133.1	287.9	314.4	207.6	118.2	50.05	30.81	105.4
	No.9	1,860	22.01	17.48	16.89	20.33	34.51	130.3	281.8	307.8	203.2	115.7	49.00	30.16	103.2
	No.10	1,790	21.18	16.82	16.25	19.56	33.21	125.4	271.2	296.2	195.6	111.4	47.15	29.03	99.29

TABLE 3.6.4 THE RIVER DISCHARGE AT EACH DAM SITE

(2 of 4) (Unit: m^3/S)

River	Name of Hydro-electric Power Scheme	Catch-ment Area (km^2)	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Annu-al Ave-age
	LIKHU KHOLA														
LIKHU KHOLA	No.1	823	14.42	11.76	10.61	11.55	17.65	55.43	133.9	161.4	121.7	65.82	32.07	19.92	55.03
	No.2	750	13.14	10.72	9.67	10.53	16.08	50.51	122.0	147.1	110.9	59.98	29.23	18.15	50.15
	No.3	670	11.74	9.57	8.64	9.40	14.37	45.13	109.0	131.4	99.08	53.58	26.11	16.22	44.80
	No.4	620	10.86	8.86	7.99	8.70	13.30	41.76	100.9	121.6	91.68	49.58	24.16	15.01	41.46
MAU-LUNG KHOLA	MAULUNG KHOLA	330	5.78	4.72	4.25	4.63	7.08	22.23	53.69	64.72	48.80	26.39	12.86	7.99	22.07
	TAMA KOSI														
	No.1	3,630	40.72	32.79	31.10	40.70	84.56	257.4	534.0	612.9	421.9	209.9	95.21	57.21	202.9
	No.2	3,010	33,76	27.19	25.79	33.75	70.12	213.4	442.8	508.3	349.9	174.1	78.95	47.44	168.3
TAMA	No.3	2,753	30.88	24.87	23.59	30.87	64.13	195.2	405.0	464.9	320.0	159.2	72.21	43.39	153.9
KOSI	No.4	2,540	28.49	22.95	21.76	28.48	59.17	180.1	373.7	428.9	295.2	146.9	66.62	40.03	142.0
	No.5	1,950	21.87	17.62	16.71	21.87	45.42	138.3	286.9	329.3	226.6	112.8	51.15	30.73	109.0
	No.6	1,900	21.31	17.16	16.28	21.31	44.26	134.7	279.5	320.8	220.8	109.9	49.84	29.95	106.2
	KHIMTE KHOLA														
KHIMTE	No.1	360	6.27	5.36	4.92	5.64	9.80	42.84	94.64	93.85	61.98	26.01	12.55	7.96	31.20
	No.2	313	5.45	4.66	4.28	4.90	8.52	37.25	82.28	81.60	53.89	22.61	10.91	6.92	27.13
BALE-PHI	BALEPHI KHOLA	490	9.46	7.80	7.42	8.69	12.48	47.99	106.4	135.9	93.72	47.88	21.36	13.00	43.29

TABLE 3.6.4 THE RIVER DISCHARGE AT EACH DAM SITE

(3 of 4) (Unit: m^3/S)

River	Name of Hydro-electric Power Scheme	Catch-ment Area (km^2)	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Annu-al Ave-age
	BHOTE KOSI														
BHOTE KOSI	No.1	2,320	18.79	15.76	15.17	19.49	31.17	95.06	180.4	208.4	153.5	77.16	39.50	25.51	73.76
	No.2	2,170	17.58	14.74	14.19	18.23	29.16	88.92	168.7	194.9	143.6	72.17	36.94	23.86	68.99
	ROSI KHOLA														
	No.1	490	7.77	6.65	5.74	4.96	5.91	13.80	33.51	42.92	30.36	23.15	11.43	8.84	16.80
ROSI	No.2	420	6.66	5.70	4.92	4.25	5.07	11.83	28.72	36.79	26.02	19.84	9.80	7.58	14.40
	No.3	260	4.12	3.53	3.05	2.63	3.14	7.32	17.78	22.77	16.11	12.28	6.07	4.69	8.92
	No.4	190	3.01	2.58	2.23	1.92	2.29	5.35	12.99	16.64	11.77	8.98	4.43	3.43	6.51
	INDRAWATI														
INDRA-	No.1	980	18.91	15.60	14.85	17.39	24.96	95.97	212.8	271.8	187.4	95.76	42.72	26.00	86.58
WATI	No.2	750	14.48	11.94	11.36	13.31	19.10	73.45	162.8	208.0	143.5	73.28	32.69	19.90	66.26
	No.3	370	7.14	5.89	5.61	6.56	9.42	36.24	80.33	102.67	70.77	36.15	16.13	9.82	32.69
	TAMUR														
	No.1	5,805	58.54	47.09	43.30	72.52	167.0	440.4	791.3	809.6	613.6	296.2	126.6	78.84	307.8
	No.2	4,400	50.65	40.75	37.47	62.75	144.5	381.1	684.7	700.5	530.9	256.3	109.5	68.22	266.4
	No.3	4,000	46.05	37.04	34.06	57.05	131.4	346.5	622.4	636.8	482.7	233.0	99.58	62.01	242.1
TAMUR	No.4	3,140	36.15	29.08	26.74	44.78	103.1	272.0	488.6	499.9	378.9	182.9	78.17	48.68	190.1
	No.5	2,560	29.47	23.71	21.80	36.51	84,08	221.7	398.4	407.6	308.9	149.1	63.73	39.69	155.0
	No.6	2,490	28.67	23.06	21.20	35.51	81.78	215.7	387.5	396.4	300.5	145.1	61.99	38.60	150.7
	No.7	2,420	27.86	22.41	20.61	34.51	79.48	209.6	376.6	385.3	292.0	141.0	60.25	37.52	146.5

TABLE 3.6.4 THE RIVER DISCHARGE AT EACH DAM SITE

(4 of 4)

(Unit: m^3/S)

River	Name of Hydro-electric Power Scheme	Catch-ment Area (km^2)	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Annu-al Ave-age
	KABELI NADI														
KABELI	No.1	580	6.68	5.37	4.94	8.27	19.05	50.24	90.25	92.34	69.99	33.79	14.44	8.99	35.11
	No.2	320	3.68	2.96	2.73	4.56	10.51	27.72	49.80	50.95	38.61	18.64	7.97	4.96	19.37
	No.3	180	2.07	1.67	1.53	2.57	5.91	15.59	28.01	28.66	21.72	10.49	4.48	2.79	10.90
	ARUN														
	No.1	32,998	121.1	123.0	140.3	184.6	270.9	580.5	880.1	996.2	748.1	403.6	220.2	153.4	405.1
	No.2	32,881	119.7	121.9	139.3	182.9	267.0	570.4	861.9	977.6	733.9	396.8	217.3	151.6	398.0
ARUN	No.3	32,332	113.4	116.8	134.6	175.1	249.0	522.8	776.5	890.2	667.7	364.8	203.6	143.1	364.8
	No.4	32,023	109.8	113.9	132.0	170.7	238.9	496.0	728.4	841.0	630.4	346.8	195.9	138.3	346.1
	No.5	31,974	109.3	113.5	131.6	170.0	237.2	491.8	720.8	833.2	624.5	343.9	194.7	137.5	343.1
	No.6	31,398	102.6	108.2	126.6	161.8	218.3	441.9	631.2	741.5	555.0	310.4	180.3	128.6	308.3
SAPT KOSI	SAPT KOSI HIGH DAM	61,000	400.3	357.0	351.9	418.1	715.8	1976.1	4008.3	4712.6	3389.3	1739.6	824.3	529.8	1632.7

TABLE 3.6.5 DURATION OF DISCHARGE AT EACH DAM SITE

(1 of 4)

(Unit: m^3/S)

River	Name of Hydro Electric-Power Scheme	Catchment Area (km^2)	Maximum Discharge	35-day Discharge	95-day Discharge	185-day Discharge	275-day Discharge	355-day Discharge	Minimum Discharge	Average Discharge
	SUN KOSI									
	No.1	16,200	3,844	1,894	948.3	244.9	161.1	130.0	126.5	657.3
SUN KOSI	No.2	10,396	3,372	1,594	805.0	195.4	108.5	81.04	75.05	546.9
	No.3	5,520	1,826	803.6	406.3	108.3	61.55	48.55	46.30	280.0
	No.4	3,100	1,025	451.3	228.2	60.80	34.57	27.26	26.06	157.2
	DUDH KOSI									
	No.1	4,100	1,471	625.1	337.9	87.98	45.57	34.47	32.32	227.43
	No.2	3,625	1,301	552.7	298.8	77.79	40.29	30.48	28.58	201.1
	No.3	3,200	1,148	487.9	263.7	68.67	35.57	26.90	25.23	177.5
	No.4	2,300	825.2	350.7	189.6	49.35	25.56	19.34	18.13	127.6
DUDH KOSI	No.5	2,200	789.3	335.4	181.3	47.21	24.45	18.50	17.34	122.0
	No.6	2,150	771.4	327.8	177.2	46.14	23.90	18.08	16.95	119.3
	No.7	2,070	742.7	315.6	170.6	44.42	23.01	17.40	16.32	114.8
	No.8	1,900	681.7	289.7	156.6	40.77	21.12	15.97	14.98	105.4
	No.9	1,860	667.3	283.6	153.3	39.91	20.67	15.64	14.66	103.2
	No.10	1,790	642.2	272.9	147.5	38.41	19.90	15.05	14.11	99.29

TABLE 3.6.5 DURATION OF DISCHARGE AT EACH DAM SITE

(2 of 4)

(Unit: m^3/S)

River	Name of Hydro Electric-Power Scheme	Catchment Area (km^2)	Maximum Discharge	35-day Discharge	95-day Discharge	185-day Discharge	275-day Discharge	355-day Discharge	Minimum Discharge	Average Discharge
	LIKHU KHOLA									
	No.1	823	295.9	150.2	84.41	23.18	13.06	9.63	7.84	55.03
LIKHU KHOLA	No.2	750	269.7	136.9	76.92	21.12	11.90	8.78	7.14	50.15
	No.3	670	240.9	122.3	68.72	18.87	10.63	7.84	6.38	44.80
	No.4	620	222.9	113.2	63.59	17.46	9.84	7.25	5.91	41.46
MAULUNG KHOLA	MAULUNG KHOLA	330	118.6	60.23	33.85	9.29	5.24	3.86	3.14	22.07
	TAMA KOSI									
	No.1	3,630	965.2	573.3	319.1	84.66	39.50	29.47	28.03	202.9
	No.2	3,010	800.3	475.4	264.6	70.20	32.76	24.44	23.24	168.3
TAMA KOSI	No.3	2,753	732.0	434.8	242.0	64.21	29.96	22.35	21.26	153.91
	No.4	2,540	675.4	401.2	223.3	59.24	27.64	20.62	19.62	142.0
	No.5	1,950	518.5	308.0	171.4	45.48	21.22	15.83	15.06	109.0
	No.6	1,900	505.2	300.1	167.0	44.31	20.68	15.42	14.67	106.2
KHIMTE KHOLA	KHIMTE KOLA									
	No.1	360	280.1	88.71	42.72	9.88	5.97	4.50	4.26	31.20
	No.2	313	243.5	77.13	37.14	8.59	5.19	3.91	3.70	27.13
BALEPHI	BALEPHI KHOLA	490	254.6	123.6	67.11	15.69	8.88	7.03	6.80	43.29

TABLE 3.6.5 DURATION OF DISCHARGE AT EACH DAM SITE

(3 of 4) (Unit: m^3/S)

River	Name of Hydro Electric-Power Scheme	Catchment Area (km^2)	Maximum Discharge	35-day Discharge	95-day Discharge	185-day Discharge	275-day Discharge	355-day Discharge	Minimum Discharge	Average Discharge
	BHOTE KOSI									
BHOTE KOSI	No.1	2,320	335.1	191.0	117.3	33.20	18.61	14.42	13.73	73.76
	No.2	2,170	313.4	178.6	109.7	31.06	17.41	13.49	12.84	68.99
	ROSI KHOLA									
	No.1	490	172.4	42.14	19.67	9.44	5.39	3.09	2.53	16.80
ROSI	No.2	420	147.8	36.12	16.86	8.09	4.62	2.65	2.17	14.40
	No.3	260	91.48	22.36	10.44	5.01	2.86	1.64	1.34	8.92
	No.4	190	66.85	16.34	7.63	3.66	2.09	1.20	0.98	6.51
	INDRAWATI									
INDRAWATI	No.1	980	509.2	247.1	134.2	31.38	17.76	14.05	13.60	86.58
	No.2	750	389.7	189.1	102.7	24.01	13.59	10.76	10.41	66.26
	No.3	370	192.2	93.29	50.68	11.85	6.71	5.31	5.14	32.69
	TAMUR									
	No.1	5,085	2,110	812.8	483.4	124.6	57.63	38.60	36.25	307.8
	No.2	4,400	1,826	703.3	418.2	107.8	49.87	33.40	31.37	266.4
	No.3	4,000	1,660	639.4	380.2	98.03	45.33	30.36	28.52	242.1
TAMUR	No.4	3,140	1,303	501.9	298.5	76.95	35.59	23.83	22.39	190.1
	No.5	2,560	1,062	409.2	243.3	62.74	29.01	19.43	18.25	155.0
	No.6	2,490	1,033	398.0	236.7	61.02	28.22	18.90	17.75	150.7
	No.7	2,420	1,004	386.8	230.0	59.31	27.43	18.37	17.25	146.5

TABLE 3.6.5 DURATION OF DISCHARGE AT EACH DAM SITE

(4 of 4)

(Unit: m^3/S)

River	Name of Hydro Electric-Power Scheme	Catchment Area (km^2)	Maximum Discharge	35-day Discharge	95-day Discharge	185-day Discharge	275-day Discharge	355-day Discharge	Minimum Discharge	Average Discharge
	KABELI NADI									
KABELI	No.1	580	240.6	92.71	55.13	14.21	6.57	4.40	4.14	35.11
	No.2	320	132.8	51.15	30.42	7.84	3.63	2.43	2.28	19.37
	No.3	180	74.68	28.77	17.11	4.41	2.04	1.37	1.28	10.90
	ARUN									
	No.1		1,753	938.2	610.2	231.1	142.7	111.9	102.4	405.1
	No.2		1,705	919.5	599.1	228.3	141.4	111.0	101.6	398.0
ARUN	No.3	32,332	1,477	831.7	546.9	214.8	135.2	106.8	97.7	364.8
	No.4		1,349	782.3	517.5	207.2	131.7	104.5	95.5	346.1
	No.5		1,328	774.5	512.9	206.0	131.1	104.1	95.1	343.1
	No.6		1,089	682.4	458.1	191.9	124.6	99.7	91.0	308.3

TABLE 3.6.6 RUN-OFF COEFFICIENT AT EACH GAUGING STATION

Gauging Station			Annual Average Discharge at G.S.	Annual Average Rainfall	Annual Average Run-off	Run-off Coefficient
Code No.	Name (River)	Catchment Area (km^2)	(m^3/S)	(mm)	(m^3/S)	
610	Bharabise (Bhote Kosi)	2,410	76.62	1,683	128.62	0.60
620	Dhalame Sangu (Balephi)	629	55.57	3,593	71.66	0.78
630	Panchuwar Ghat (Sun Kosi)	4,920	249.53	2,186	341.04	0.73
640	Panauti (Rosi)	87	2.99	1,548	4.27	0.70
647	Busti (Tama Kosi)	2,753	153.91	1,802	157.31	0.98
650	Rasnalu Village (Khimte)	313	27.13	2,128	21.12	1.28
652	Khurkot (Sun Kosi)	10,000	526.08	2,035	645.29	0.82
660	Sangutar (Likhu)	823	55.03	1,642	42.85	1.28
670	Rabuwa Bazar (Dudh Kosi)	4,100	227.43	1,401	182.14	1.25
680	Kanpu Ghat (Sun Kosi)	17,600	714.14	1,760	982.24	0.73
690	Mulghat (Tamur)	5,640	341.43	1,909	341.41	1.00

TABLE 3.6.7 PEAK FLOOD DISCHARGE RECORDED AT GAUGING STATION

(Unit: m3/S)

Year	Gauging Station	No. 630 Panchuwar Ghat (Sun Kosi)	No. 652 Khurkot (Sun Kosi)	No. 670 Rabuwa Bazar (Dudh Kosi)	No. 680 Kampu Ghat (Sun Kosi)	No. 690 Mulghat (Tamur)	No. 695 Baraks-hetra
1948		-	-	-	-	-	13,547
49		-	-	-	-	-	11,203
50		-	-	-	-	-	9,646
51		-	-	-	-	-	7,257
52		-	-	-	-	-	8,677
53		-	-	-	-	-	5,420
54		-	-	-	-	-	24,217
55		-	-	-	-	-	7,079
56		-	-	-	-	-	5,437
57		-	-	-	-	-	7,532
58		-	-	-	-	-	10,562
59		-	-	-	-	-	5,975
60		-	-	-	-	-	7,192
61		-	-	-	-	-	8,297
62		-	-	-	-	-	10,505
63		-	-	-	-	-	7,645
64		1,210	-	1,540	-	-	10,760
65		1,260	-	1,480	3,910	-	6,654
66		2,240	-	1,580	5,940	-	10,816
67		1,760	1,890	1,150	4,280	-	8,835
68		1,150	5,000	1,450	9,390	-	25,853
69		1,250	2,660	1,590	3,460	-	8,136
70		1,935	6,600	2,450	7,360	3,900	13,869
71		1,660	5,550	2,000	5,500	2,450	12,176
72		3,410	3,850	1,760	4,600	4,100	10,709
73		3,770	3,310	1,900	3,830	4,400	9,850
74		5,100	5,000	2,700	5,460	5,450	11,420
75		-	-	-	4,890	2,400	9,201
76		-	-	-	3,620	2,400	9,481
77		-	-	-	3,340	3,020	7,777
78		-	-	-	-	3,400	9,829

* Above data were provided from Electricity Department.

TABLE 3.6.10

HYDROPOWER POTENTIAL IN THE KOSI BASIN

Name of River	Capacity (MW)	Generated Energy (GWh)	Construction Cost (10^6 US$)	Cost per kw (US$/kW)	Annual Surplus Benefit (10^6 US$)	Annual Cost per kWh (¢/kWh)
Sapt Kosi	3,489	16,810	2,721	780	932	2.7
Sun Kosi (No.1 - 4)	3,029	11,651	2,733	902	620	4.0
Dudh Kosi (No.1 - 10)	812	5,615	1,075	1,324	216	3.2
Likhu Khola (No.1 - 4)	94	652	203	2,160	12	5.3
Maulung Khola	13	92	79	6,077	-6.9	14.6
Tama Kosi (No.2 - 6)	660	3,541	920	1,394	124	4.4
Khimte Khola (No.1, 2)	71	498	91	1,282	20	3.0
Bhote Kosi (No.1, 2)	133	924	182	1,368	34	3.4
Balephi Khola	34	233	69	2,029	4.9	5.0
Rosi Khola (No.1 - 4)	51	307	145	2,843	-1.5	8.0
Indrawati (No.1 - 3)	116	655	267	2,302	5	6.9
Tamur (No.1 - 7)	1,180	5,647	1,556	1,319	206	4.7
Kabeli Nadi (No.1 -3)	42	295	126	3,000	-1	7.2
Arun (No.1 - 6)	1,185	9,644	1,424	1,202	401	2.5
Total	10,909	56,564	-	-	-	-

*Construction cost includes access road cost assuming independent development of each river but excluding transmission/substation cost.

TABLE 3.6.11
(1 of 4)

LIST OF HYDROPOWER SCHEMES

River	Name	Catchment Area (km^2)	Type	Intake Water Level EL (m)	Tail Water Level EL (m)	Dam Height (m)	Tunnel Length (km)	Maxmum Discharge (m^3/s)	Installed Capacity (MW)	Construction Cost (10^6 US$)	Generated Energy (GWH)	Cost per KW (US$)	Energy Cost (cent/KWH)	Access Road (km)	B/C	B-C
Sun Kosi	Sun Kosi No. 1	16,200	Reservoir	424.6 (424.6)	304.8	147 V=2270x10^3	--	1,400	1,357	1,033	4,640	737	3.76	70	2.63	2.85
	Sun Kosi No. 2	10,396	"	555.3 (575.0)	424.6	166 V=3070x10^3	--	1,050	1,110	1027	4,760	925	3.65	107	2.41	244
	Sun Kosi No. 3	5,520	"	691.3 (700.0)	575.0	140 V=1930x10^3	--	570	536	582	2,070	1,086	4.75	20	1.95	93
	Sun Kosi No. 4	3,100	SRR	774.2	700.0	20	12.7	53	26	117	181	4,500	10.92	9	0.65	-7
Dudh Kosi	Dudh Kosi No. 1	4,100	PRR	521.2 (524.2)	424.6	104	2.60	300	228	449	978	1,969	7.76	177	1.13	10
	Dudh Kosi No. 2	3,625	SRR	746.7	524.2	18	9.50	50	87	166	690	1,908	4.07	197	1.65	18
	Dudh Kosi No. 3	3,200	"	883.9	746.7	20	5.80	45	48	129	381	2,688	5.72	203	1.17	4
	Dudh Kosi No. 4	2,300	"	1,066.8	883.9	20	5.80	32	46	123	367	2,674	5.66	209	1.18	4
	Dudh Kosi No. 5	2,200	"	1,371.6	1,066.8	20	7.50	30	73	140	580	1,918	4.08	220	1.65	15
	Dudh Kosi No. 6	2,150	"	1,524.0	1,371.6	20	5.80	30	36	119	286	3,306	7.03	226	0.95	-1
	Dudh Kosi No. 7	2,070	"	1,904.9	1,524.0	20	5.30	29	89	146	704	1,640	3.50	231	1.92	23
	Dudh Kosi No. 8	1,900	"	2,346.9	1,904.9	20	3.80	26	93	140	740	1,505	3.20	236	2.10	26
	Dudh Kosi No. 9	1,860	"	2,651.7	2,346.9	20	6.60	26	63	141	501	2,238	4.76	243	1.41	10
	Dudh Kosi No. 10	1,790	"	2,895.5	2,651.7	20	3.90	25	49	124	388	2,531	5.40	248	1.24	5

* The Construction Cost, Cost per kW and Energy Cost include the access roads cost planned independently.

TABLE 3.6.11
(2 of 4)

LIST OF HYDROPOWER SCHEMES

River	Name	Catchment Area (km^2)	Type	Inteke Water Level EL (m)	Tail Water Level EL (m)	Dam Height (m)	Tunnel Length (km)	Maxmum Discharge (m^3/s)	Installed Capacity (MW)	Construction Cost (10^6 US$)	Generated Energy (GWH)	Cost per KW (US$)	Energy Cost (cent/KWH)	Access Road (km)	B/C	B-C
Likhu Khola	Likhu Khola No. 1	823	SRR	542.5	424.6	20	7.90	23	21	84	145	4,000	9.79	126	0.72	-3.9
	Likhu Khola No. 2	750	"	649.2	542.5	20	7.60	21	17	81	118	4,765	11.60	135	0.61	-5.4
	Likhu Khola No. 3	670	"	853.4	649.2	20	7.70	19	31	88	213	2,839	6.98	143	1.02	0
	Likhu Khola No. 4	620	"	1,036.3	853.4	20	3.80	17	25	75	176	3,000	7.20	147	0.98	0
Maulung Khola	Maulung Khola	330	SRR	609.6	424.6	20	9.30	9	13	79	92	6,077	14.60	154	0.48	-6.9
Tama Kosi	Tama Kosi No. 2	3,010	SRR	773.0	597.0	20	9.90	150	196	245	1,013	1,250	4.05	15	1.98	40
	Tama Kosi No. 3	2,753	PRR	880.9 (883.9)	773.0	60	7.00	150	123	206	603	1,675	5.77	6	1.42	15
	Tama Kosi No. 4	2,540	"	1,002.8 (1,005.8)	883.9	75	8.10	140	126	263	624	2,087	7.12	15	1.15	7
	Tama Kosi No. 5	1,950	SRR	1,219.2"	1,005.8	20	7.30	60	102	114	615	1,118	3.13	30	2.39	27
	Tama Kosi No. 6	1,900	"	1,463.0	1,219.2	20	6.30	98	113	113	686	1,000	2.78	36	2.68	32
Khimte Khola	Khimte Khola No. 1	360	SRR	1,200.00	597.0	20	7.40	10	49	66	344	1,347	3.26	25	2.14	12.8
	Khimte Khola No. 2	313	"	1,524.0	1,219.2	20	3.90	9	22	33	154	1,500	3.62	30	1.94	5.3

* The Construction Cost, Cost per kW and Energy Cost include the access roads cost planned independently.

TABLE 3.6.11
(3 of 4)

LIST OF HYDROPOWER SCHEMES

River	Name	Catchment Area (km^2)	Type	Intake Water Level EL (m)	Tail Water Level EL (m)	Dam Height (m)	Tunnel Length (km)	Maxmum Discharge (m^3/s)	Installed Capacity (MW)	Construction Cost (10^6 US$)	Generated Energy (GWH)	Cost per KW (US$)	Energy Cost (cent/KWH)	Access Road (km)	B/C	B-C
Bhote Kosi	Bhote Kosi No. 1	2,320	SRR	1,066.8	827.0	24	10.9	34	64	89	444	1,388	3.38	0	2.09	16
	Bhote Kosi No. 2	2,170	"	1,341.1	1,066.8	20	10.8	32	69	93	480	1,348	3.27	0	2.16	18
Balephi	Balephi	490	SRR	1,066.8	808.3	20	11.9	17	34	69	233	2,029	5.00	24	1.42	4.9
Rosi Khola	Rosi Khola No. 1	490	SRR	734.6	575.0	20	8.10	13	16	42	97	2,625	7.32	6	1.02	0.1
	Rosi Khola No. 2	420	"	883.9	734.6	20	6.20	11	13	43	76	3,308	9.56	16	0.79	-1.5
	Rosi Khola No. 3	260	"	1,112.5	883.9	20	8.40	7	12	44	73	3,667	10.19	27	0.73	-2.0
	Rosi Khola No. 4	190	"	1,371.6	1,112.5	20	6.00	5	10	31	61	3,100	8.59	28	0.87	-0.7
Indrawati	Indrawati No. 1	980	PRR	771.2 (774.2)	700.0	45	6.50	110	58	161	249	2,776	10.93	20	0.80	-5.0
	Indrawati No. 2	750	SRR	960.1	774.2	20	12.6	23	33	74	234	2,242	5.34	43	1.31	4.0
	Indrawati No. 3	370	"	1,219.2	960.1	20	7.90	12	25	42	172	1,680	4.13	51	1.72	5.1
Tamur	Tamur No. 1	5,085	Reservoir	476.0 (487.6)	344.4	153	--	650	696	846	2,750	1,216	5.20	25	1.76	109

* The Construction Cost, Cost per kW and Energy Cost include the access roads cost planned independently.

TABLE 3.6.11
(4 of 4)

LIST OF HYDROPOWER SCHEMES

River	Name	Catchment Area (km2)	Type	Inteke Water Level EL (m)	Tail Water Level EL (m)	Dam Height (m)	Tunnel Length (km)	Maxmum Discharge (m3/s)	Installed Capacity (MW)	Construction Cost (10^6 US$)	Generated Energy (GWH)	Cost per KW (US$)	Energy Cost (cent/KWH)	Access Road (km)	B/C	B-C
Tamur	Tamur No. 3	4,000	PRR	560.9 (563.9)	487.6	65	--	310	186	194	812	1,043	4.04	89	2.15	38
	Tamur No. 4	3,140	SRR	661.4	563.9	20	6.40	67	51	122	356	2,392	5.79	103	1.22	4.0
	Tamur No. 5	2,560	"	822.9	661.4	20	6.00	55	70	129	489	1,843	4.46	109	1.58	13
	Tamur No. 6	2,490	"	1,005.8	822.9	20	7.40	53	76	127	535	1,671	4.01	116	1.75	16
	Tamur No. 7	2,420	"	1,249.7	1,005.8	20	6.30	52	101	138	705	1,366	3.31	122	2.13	26
Kabeli Nadi	Kabeli Nadi No. 1	580	SRR	731.5	563.9	20	10.4	12	15	71	109	4,733	11.01	105	0.63	-4.4
	Kabeli Nadi No. 2	320	"	1,005.8	731.5	20	10.0	7	15	68	105	4,533	10.94	115	0.64	-4.1
	Kabeli Nadi No. 3	180	"	1,371.6	1,005.8	20	5.50	4	12	56	81	4,667	11.68	122	0.61	-3.7
Arun	Arun No. 1	32,998	SRR	420.0	311.0	23	9.60	180	146	277	1,166	1,897	4.03	72	1.66	31
	Arun No. 2	32,881	"	616.0	420.0	18	10.4	160	239	292	1,967	1,222	2.49	85	2.65	81
	Arun No. 3	32,332	"	810.0	616.0	23	7.10	156	240	268	1,965	1,119	2.29	99	2.91	86
	Arun No. 4	32,023	"	914.4	810.0	20	8.70	154	120	244	982	2,033	4.18	115	1.59	24
	Arun no. 5	31,974	"	1,082.0	914.4	20	5.70	153	202	255	1,650	1,262	2.61	135	2.56	67
	Arun No. 6	31,398	"	1,280.1	1,082.0	20	5.70	151	238	265	1,914	1,113	2.35	151	2.84	83
Sapt Kosi	Sapt Kosi	61,000	Reservoir	289.8 (304.8)	119.3	239 V=7680x10^3	--	2,500	3,489	2,721	16,810	780	2.74	0	3.03	932

TABLE 3.6.12
(1 of 8)

FEATURES OF IDENTIFIED HYDROPOWER SCHEMES

River	Unit	Sun Kosi River				Dudh Kosi River		
Scheme		No.1	No.2	No.3	No.4	No.1	No.2	No.3
Power Generation								
Intake Water Level	EL m	424.6	555.3	691.3	774.2	521.2	746.7	883.9
Tail Water Level	"	304.8	424.6	575.0	700.0	424.6	524.2	746.7
Gross Head	m	119.8	130.7	116.3	74.2	96.6	222.5	137.2
Maximum Discharge	m^3/s	1,400	1,050	570.0	53.0	300.0	50.0	45.0
Installed Capacity	MW	1,357	1,110	536	26	228	87	48
Structures of Power Station								
Headrace	m	-	-	-	12,700	2,600	9,500	5,800
Penstock	m	200.0	230.0	210.0	230.0	250.0	375.0	420.0
Tailrace	m	-	-	-	20.0	20.0	20.0	20.0
Dam Type	-	Gravity	Gravity	Gravity	Weir	Gravity	Weir	Weir
Dam Height	m	147.0	166.0	140.0	20.0	104.0	18.0	20.0
Dam Length	m	500.0	530.0	470.0	60.0 200.0	300.0	200.0	50.0
Reservoir & Pondage								
H.W.L.	EL m	424.6	575.0	700.0	-	524.2	-	-
L.W.L.	"	423.0	516.0	674.0	-	514.2	-	-
Gross Storage Capacity	10^6m^3	1,500	4,370	1,220	-	162	-	-
Available Storage Capacity	"	40	3,040	550	-	40	-	-
Available Depth	m	-	59.0	26.0	-	10.0	-	-
Design Flood	$10^3m^3/s$	22.5	17.3	11.6	-	9.8	-	-
Type of Generation	-	Reservoir	Reservoir	Reservoir	SRR	PRR	SRR	SRR
Catchment Area	km^2	16,200	10,396	5,520	3,100	4,100	3,625	3,200
Gauging Station	-	Kampu Ghat	Khuikot	Panchusual Ghat	Panchusual Ghat	Rabuwa Bazar	Rabuwa Bazar	Rabuwa Bazar

TABLE 3.6.12
(2 of 8)

FEATURES OF IDENTIFIED HYDROPOWER SCHEMES

River	Unit	Dudh Kosi River						
Scheme		No.4	No.5	No.6	No.7	No.8	No.9	No.10
Power Generation								
Intake Water Level	EL m	1,066.8	1,371.6	1,524.0	1,904.9	2,346.9	2,651.7	2,895.5
Tail Water Level	"	883.9	1,066.8	1,371.6	1,524.0	1,904.9	2,346.9	2,651.7
Gross Head	m	182.9	304.8	152.4	380.9	442.0	304.8	243.8
Maximum Discharge	m^3/s	32.0	30.0	30.0	29.0	26.0	26.0	25.0
Installed Capacity	MW	46	73	36	89	93	63	49
Structures of Power Station								
Headrace	m	5,800	7,500	5,800	5,300	3,800	6,600	3,900
Penstock	m	540.0	650.0	470.0	780	740	840	520
Tailrace	m	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Dam Type	-	Weir	Weir	Weir	Weir	Weir	Weir	Weir
Dam Height	m	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Dam Length	m	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Reservoir & Pondage								
H.W.L.	EL m	-	-	-	-	-	-	-
L.W.L.	"	-	-	-	-	-	-	-
Gross Storage Capacity	10^6m^3	-	-	-	-	-	-	-
Available Storage Capacity	"	-	-	-	-	-	-	-
Available Depth	m	-	-	-	-	-	-	-
Design Flood	$10^3m^3/s$	-	-	-	-	-	-	-
Type of Generation	-	SRR	SRR	SRR	SRR	SRR	SRR	SRR
Catchment Area	km^2	2,300	2,200	2,150	2,070	1,900	1,860	1,790
Gauging Station	-	Rabuwa Bazar	Rabuwa Bazar	Rabuwa Bazar	Banbuwa Bazar	Banbuwa Bazar	Banbuwa Bazar	Banbuwa Bazar

TABLE 3.6.12
(3 of 8)

FEATURES OF IDENTIFIED HYDROPOWER SCHEMES

River	Unit	Bhote Kosi River		Rosi Khola			
Scheme		No.1	No.2	No.1	No.2	No.3	No.4
Power Generation							
Intake Water Level	EL m	1,066.8	1,341.1	734.6	883.9	1,112.5	1,371.6
Tail Water Level	"	827.0	1,066.8	575.0	734.6	883.9	1,112.5
Gross Head	m	239.8	274.3	159.6	149.3	228.6	259.1
Maximum Discharge	m^3/s	34.0	32.0	13.0	11.0	7.0	5.0
Installed Capacity	MW	64	69	10	13	12	10
Structures of Power Station							
Headrace	m	10,900	10,800	8,100	6,200	8,400	6,000
Penstock	m	440	730	370	700.0	1,000.0	450.0
Tailrace	m	20.0	20.0	20.0	20.0	20.0	20.0
Dam Type	-	Weir	Weir	Weir	Weir	Weir	Weir
Dam Height	m	24.0	20.0	20.0	20.0	20.0	20.0
Dam Length	m	80.0	100.0	100.0	130.0	100.0	60.0
Reservoir & Pondage							
H.W.L.	EL m	-	-	-	-	-	-
L.W.L.	"	-	-	-	-	-	-
Gross Storage Capacity	10^6m^3	-	-	-	-	-	-
Available Storage Capacity	"	-	-	-	-	-	-
Available Depth	m	-	-	-	-	-	-
Design Flood	$10^3m^3/s$	-	-	-	-	-	-
Type of Generation	-	SRR	SRR	SRR	SRR	SRR	SRR
Catchment Area	km^2	2,320	2,170	490	420	260	190
Gauging Station	-	Bahrabise	Bahrabise	Panauti	Panauti	Panauti	Panauti

TABLE 3.6.12
(4 of 8)

FEATURES OF IDENTIFIED HYDROPOWER SCHEMES

River	Unit	Indrawati River			Likhu Khola			
Scheme		No.1	No.2	No.3	No.1	No.2	No.3	No.4
Power Generation								
Intake Water Level	EL m	771.2	960.1	1,219.2	542.5	649.2	853.4	1,036.3
Tail Water Level	"	700.0	774.2	960.1	424.6	542.5	649.2	853.4
Gross Head	m	71.2	185.9	259.1	117.9	106.7	204.2	182.9
Maximum Discharge	m^3/s	110.0	23.0	12.0	23.0	21.0	19.0	16.0
Installed Capacity	MW	58	33	25	21	17	31	25
Structures of Power Station								
Headrace	m	6,500	12,600	7,900	7,900	7,600	7,700	3,800
Penstock	m	250.0	480.0	480.0	570.0	250.0	550.0	340.0
Tailrace	m	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Dam Type	-	Gravity	Weir	Weir	Weir	Weir	Weir	Weir
Dam Height	m	45.0	20.0	20.0	20.0	20.0	20.0	20.0
Dam Length	m	350.0	100.0	50.0	50.0	50.0	50.0	50.0
Reservoir & Pondage								
H.W.L.	EL m	774.2	-	-	-	-	-	-
L.W.L	"	764.2	-	-	-	-	-	-
Gross Storage Capacity	$10^6 m^3$	31	-	-	-	-	-	-
Available Storage Capacity	"	15	-	-	-	-	-	-
Available Depth	m	10.0	-	-	-	-	-	-
Design Flood	$10^3 m^3/s$	4.1	-	-	-	-	-	-
Type of Generation	-	PRR	SRR	SRR	SRR	SRR	SRR	SRR
Catchment Area	km^2	980	750	370	823	750	670	620
Gauging Station	-	Phalame Sangu	Phalame Sangu	Phalame Sangu	Sangutar	Sangutar	Sangutar	Sangutar

TABLE 3.6.12
(5 of 8)

FEATURES OF IDENTIFIED HYDROPOWER SCHEMES

River	Unit	Maulung Khola	Tama Kosi River				
Scheme		-	No.2	No.3	No.4	No.5	No.6
Power Generation							
Intake Water Level	EL m	609.6	773.0	880.9	1,022.8	1,219.2	1,463.0
Tail Water Level	"	424.6	597.0	773.0	883.9	1,005.8	1,219.2
Gross Head	m	185.0	176.0	107.9	118.9	213.4	243.8
Maximum Discharge	m^3/s	9.0	150.0	150.0	140.0	60.0	58.0
Installed Capacity	MW	13	196	123	126	102	113
Structures of Power Station							
Headrace	m	9,300	9,900	7,000	8,100	7,300	6,300
Penstock	m	390.0	270.0	210.0	280.0	500.0	560.0
Tailrace	m	20.0	20.0	20.0	20.0	20.0	20.0
Dam Type	-	Weir	Weir	Gravity	Gravity	Weir	Weir
Dam Height	m	20.0	20.0	60.0	75.0	20.0	20.0
Dam Length	m	50.0	150.0	200.0	250.0	100.0	50.0
Reservoir & Pondage							
H.W.L.	EL m	-	-	883.9	1,005.8	-	-
L.W.L.	"	-	-	873.9	995.8	-	-
Gross Storage Capacity	10^6m^3	-	-	24	24	-	-
Available Storage Capacity	"	-	-	8	11	-	-
Available Depth	m	-		10.0	10.0	-	-
Design Flood	$10^3m^3/s$	-	-	7.6	7.2	-	-
Type of Generation	-	SRR	SRR(PRR)	PRR	PRR	SRR	SRR
Catchment Area	km^2	330	3,010	2,753	2,540	1,950	1,900
Gauging Station	-	Sangutar	Busti	Busti	Busti	Busti	Busti

TABLE 3.6.12
(6 of 8)

FEATURES OF IDENTIFIED HYDROPOWER SCHEMES

River	Unit	Khimte Khola		Balephi Khola	Tamur River		
Scheme		No.1	No.2	-	No.1	No.2	No.3
Power Generation							
Intake Water Level	EL m	1,200.0	1,524.0	1,066.8	476.0	560.9	661.4
Tail Water Level	"	597.0	1,219.2	808.3	344.4	487.6	563.9
Gross Head	m	603.0	304.8	258.5	131.6	73.3	97.5
Maximum Discharge	m^3/s	10.0	9.0	17.0	650.0	310.0	67.0
Installed Capacity	MW	49	22	34	696	186	51
Headrace	m	7,400	3,900	11,900	-	-	6,400
Penstock	m	1,400.0	690.0	1,030.0	200.0	120.0	150.0
Tailrace	m	20.0	20.0	20.0	-	20.0	20.0
Dam Type	-	Weir	Weir	Weir	Gravity	Gravity	Weir
Dam Height	m	20.0	20.0	20.0	153.0	65.0	20.0
Dam Length	m	90.0	50.0	50.0	600.0	300.0	150.0
Reservoir & Pondage							
H.W.L.	EL m	-	-	-	487.6	563.9	-
L.W.L.	"	-	-	-	460.0	553.9	-
Gross Storage Capacity	10^6m^3	-	-	-	1,890	46	-
Available Storage Capacity	"	-	-	-	760	17	-
Available Depth	m	-	-	-	27.6	10.0	-
Design Flood	$10^3m^3/s$	-	-	-	11.1	9.6	-
Type of Generation	-	SRR	SRR	SRR	Reservoir	PRR	SRR
Catchment Area	km^2	360	313	490	5,085	4,000	3,140
Gauging Station	-	Rasnalo Village	Rasnalo Village	Phalame Sangu	Mulghat	Mulghat	Mulghat

TABLE 3.6.12
(7 of 8)

FEATURES OF IDENTIFIED HYDROPOWER SCHEMES

River	Unit	Tamur River			Kabeli Nadi			Arun River
Scheme		No.5	No.6	No.7	No.1	No.2	No.3	No.1
Power Generation								
Intake Water Level	EL m	822.9	1,005.8	1,249.7	731.5	1,005.8	1,371.6	420.0
Tail Water Level	"	661.4	822.9	1,005.8	563.9	731.5	1,005.8	311.0
Gross Head	m	161.5	182.9	243.9	167.6	274.3	365.8	109.0
Maximum Discharge	m^3/s	55.0	53.0	52	12	7	4	180
Installed Capacity	MW	70	76	101	15	15	12	146
Stuructures of Power Station								
Headrace	m	6,000	7,400	6,300	10,400	10,000	5,500	9,600
Penstock	m	900.0	480.0	610	480	1,040	770	170
Tailrace	m	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Dam Type	-	Weir	Weir	Weir	Weir	Weir	Weir	Weir
Dam Height	m	20.0	20.0	20.0	20.0	20.0	20.0	23.0
Dam Length	m	150.0	150.0	200.0	100.0	50.0	50.0	150.0
Reservoir & Pondage								
H.W.L.	EL m	-	-	-	-	-	-	-
L.W.L.	"	-	-	-	-	-	-	-
Gross Storage Capacity	10^6m^3	-	-	-	-	-	-	-
Available Storage Capacity	"	-	-	-	-	-	-	-
Availabel Depth	m	-	-	-	-	-	-	-
Design Flood	$10^3m^3/s$	-	-	-	-	-	-	-
Type ofGeneraiton	-	SRR	SRR	SRR	SRR	SRR	SRR	SRR
Catchment Area	km^2	2,560	2,490	2,420	580	320	180	32,998
Gauging Station	-	Mulghat	Mulghat	Mulghat	Mulghat	Mulghat	Mulghat	Tarik Ghat

TABLE 3.6.12
(8 of 8)

FEATURES OF IDENTIFIED HYDROPOWER SCHEMES

River	Unit	Arun River					Sapt Kosi River
Scheme		No.2	No.3	No.4	No.5	No.6	-
Power Generation							
Intake Water Level	EL m	616.0	810.0	914.4	1,082.0	1,280.1	289.8
Tail Water Level	"	420.0	616.0	810.0	914.4	1,082.0	119.3
Gross Head	m	196.0	194.0	104.4	167.6	198.1	170.5
Maximum Discharge	m^3/s	160.0	156.0	154.0	153.0	151.0	2,500
Installed Capacity	MW	239	240	120	202	238	3,489
Sturctures of Power Station							
Headrace	m	10,400	7,100	8,700	5,700	5,700	-
Penstock	m	300	300.0	170.0	380.0	400.0	240.0
Tailrace	m	20.0	20.0	20.0	20.0	20.0	-
Dam Type	-	Weir	Weir	Weir	Weir	Weir	Gravity
Dam Height	m	18.0	23.0	20.0	20.0	20.0	239.0
Dam Length	m	100.0	120.0	100.0	150.0	100.0	640.0
Reservoir & Pondage							
H.W.L.	EL m	-	-	-	-	-	304.8
L.W.L.	"	-	-	-	-	-	259.0
Gross Storage Capacity	10^6m^3	-	-	-	-	-	8,500
Available Storage Capacity	"	-	-	-	-	-	4,420
Available Depth	m	-	-	-	-	-	45.8
Design Flood	$10^3m^3/s$	-	-	-	-	-	42.4
Type of Generation	-	SRR	SRR	SRR	SRR	SRR	Reservoir
Catchment Area	km^2	32,881	32,332	32,023	31,974	31,398	61,000
Gauging Station	-	Turik Ghat	Turik Ghat	Turik Ghat	Turik Ghat	Turik Ghat	Barakshetra

TABLE 3.6.13 FEATURES OF DAM AND RESERVOIR OF ALTERNATIVE SUN KOSI NO.1, 2, 3

Dam	Item Case	HWL (m)	Gross Storage Capacity (10^6m^3)	Available Storage Capacity (10^6m^3)	Dam Height (m)	Dam Crest Length (m)	Dam Volume (10^3m^3)	Dam Site	Remarks
Sun Kosi No.1	1-1	424.6	1,500	40	147	500	2,200		A,D,H
	1-2	447	2,320	510	169	620	3,100	I	B,E,F,G
	1-3	475	3,650	1,660	195	690	4,900		C,I,J
	1-4	475	2,720	860	160	440	2,600	I'	K
	2-1	524.2	1,640	470	115	430	1,500		A
	2-2	550	2,840	1,270	141	490	2,300	II	D
	2-3	575	4,370	3,040	166	530	3,500		H
	2-4	524.2	1,100	100	92	550	1,400		B
Sun Kosi No.2	2-5	550	2,100	880	118	650	2,500	III	F
	2-6	575	3,500	2,120	143	700	4,000		G
	2-7	593	4,520	3,200	163	750	4,800		E
	2-8	524.2	500	30	60	370	430		C
	2-9	550	1,120	130	85	410	940	IV	I
	2-10	575	2,000	810	110	450	1,700		J
	2-11	625	4,800	3,480	180	750	5,600		K
	3-1	670.5	940	310	131	500	2,200		A,B,C,D,F
	3-2	700	1,750	1,050	156	670	3,400	V	
	3-3	720	2,250	1,840	181	640	4,900		
Sun Kosi No.3	3-4	670.5	620	70	110	400	1,300		G,H,J,I
	3-5	700	1,200	550	140	470	2,100	VI	
	3-6	720	1,800	1,100	160	540	3,200		
	3-7	670.5	570	30	86	360	870	VII	E
	3-8	774.2	2,690	2,080	170	800	5,000	VIII	K

TABLE 3.6.14
(1 of 3)

COMPARISON OF Vg/Vc

Sun Kosi No.1 (HWL 424.6)	Sun Kosi No.2	Sun Kosi No.3	Total Vg/Vc	Remarks
Case 1-1 Vg=1,500x10^{6}m^3 Vc=2,200x10^{3}m^3 H =147 m	Case 2-1 Vg = 1,640x10^6 Vc = 1,500x10^3 H = 115 m	Case 3-1 Vg = 940x10^6 Vc = 2,200x10^3 H = 131	Vg = 4,080x10^6 Vc = 5,900x10^3 Vg/Vc =692	A
		Case 3-2 Vg = 1,740x10^6 Vc = 3,400x10^3 H = 156	Vg = 4,880x10^6 Vc = 7,100x10^3 Vg/Vc = 687	
		Case 3-3 Vg = 2,250x10^6 Vc = 4,900x10^3 H = 181	Vg = 5,390x10^6 Vc = 8,600x10^3 Vg-Vc = 627	
	Case 2-2 Vg = 2,840x10^6 Vc = 2,300x10^3 H = 141 m	Case 3-1	Vg = 5,280x10^6 Vc = 6,700x10^3 Vg/Vc = 788	D
		Case 3-2	Vg = 6,080x10^6 Vc = 7,900x10^3 Vg/Vc = 770	
		Case 3-3	Vg = 6,590x10^6 Vc = 9,400x10^3 Vg/Vc = 701	
	Case 2-3 Vg = 4,370x10^6 Vc = 3,500x10^3 H = 166 m	Case 3-4 Vg = 620x10^6 Vc = 1,300x10^3 H = 110	Vg = 6,490x10^6 Vc = 7,000x10^3 Vg/Vc = 927	H
		Case 3-5 Vg = 1,220x10^6 Vc = 2,100x10^3 H = 140	Vg = 7,090x10^6 Vc = 7,800x10^3 Vg/Vc = 909	
		Case 3-6 Vg = 1,800x10^6 Vc = 3,200x10^3 H = 160	Vg = 7,670x10^6 Vc = 8,900x10^3 Vg/Vc = 862	

TABLE 3.6.14 (2 of 3)

COMPARISON OF Vg/Vc

Sun Kosi No.1 (HWL 447.0)	Sun Kosi No.2	Sun Kosi No.3	Total Vg/Vc	Remarks
		Case 3-1 Vg = 940x10^6 Vc = 2,200x10^3 H = 131	Vg = 4,360x10^6 Vc = 6,700x10^3 Vg/Vc = 651	B
	Case 2-4 Vg = 1,100x10^6 Vc = 1,400x10^3 H = 92	Case 3-2 Vg = 1,740x10^6 Vc = 3,400x10^3 H = 156	Vg = 5,160x10^6 Vc = 7,900x10^3 Vg/Vc = 653	
		Case 3-3 Vg = 2,250x10^6 Vc = 4,900x10^3 H = 181	Vg = 5,670x10^6 Vc = 9,400x10^3 Vg/Vc = 603	
Case 1-2 Vg=2,320x10^{6}m^3 Vc=3,100x10^{3}m^3 H =169 m		Case 3-1	Vg = 5,360x10^6 Vc = 7,800x10^3 Vg/Vc = 687	F
	Case 2-5 Vg = 2,100x10^6 Vc = 2,500x10^3 H = 118	Case 3-2	Vg = 6,160x10^6 Vc = 9,000x10^3 Vg/Vc = 684	
		Case 3-3	Vg = 6,670x10^6 Vc = 10,500x10^3 Vg/Vc = 635	
		Case 3-4 Vg = 620x10^6 Vc = 1,300x10^3 H = 110	Vg = 6,340x10^6 Vc = 8,400x10^3 Vg/Vc = 755	G
	Case 2-6 Vg = 3,400x10^6 Vc = 4,000x10^3 H = 143	Case 3-5 Vg = 1,220x10^6 Vc = 2,100x10^3 H = 140	Vg = 6,940x10^6 Vc = 9,200x10^3 Vg/Vc = 754	
		Case 3-6 Vg = 1,800x10^6 Vc = 3,200x10^3 H = 160	Vg = 7,520x10^6 Vc = 10,300x10^3 Vg/Vc = 730	
	Case 2-7 Vg = 4,520x10^6 Vc = 4,800x10^3 H = 163	Case 3-7 Vg = 570x10^6 Vc = 870x10^3 H = 86	Vg = 7,410x10^6 Vc = 8,770x10^3 Vg/Vc = 845	E

TABLE 3.6.14
(3 of 3)

COMPARISON OF Vg/Vc

Sun Kosi No.1 (HWL 475.0)	Sun Kosi No.2	Sun Kosi No.3	Total Vg/Vc	Remarks
		Case 3-1 Vg = 940x10^6 Vc = 2,200x10^3 H = 131	Vg = 5,090x10^6 Vc = 7,530x10^3 Vg/Vc = 676	C
	Case 2-8 Vg = 500x10^6 Vc = 430x10^3 H = 60	Case 3-2 Vg = 1,740x10^6 Vc = 3,400x10^3 H = 156	Vg = 5,890x10^6 Vc = 8,730x10^3 Vg/Vc = 675	
		Case 3-3 Vg = 2,250x10^6 Vc = 4,900x10^3 H = 181	Vg = 6,400x10^6 Vc = 10,230x10^3 Vg/Vc = 626	
Case 1-3 Vg=3,650x10^{6}m^3 Vc=4,900x10^{3}m^3 H =195 m		Case 3-1	Vg = 5,710x10^6 Vc = 8,040x10^3 Vg/Vc = 710	I
	Case 2-9 Vg = 1,120x10^6 Vc = 940x10^3 H = 85	Case 3-2	Vg = 6,510x10^6 Vc = 9,240x10^3 Vg/Vc = 705	
		Case 3-3	Vg = 7,020x10^6 Vc = 10,740x10^3 Vg/Vc = 654	
		Case 3-4 Vg = 620x10^6 Vc = 1,300x10^3 H = 110	Vg = 6,270x10^6 Vc = 7,900x10^3 Vg/Vc = 794	J
	Case 2-10 Vg = 2,000x10^6 Vc = 1,700x10^3 H = 110	Case 3-5 Vg = 1,220x10^6 Vc = 2,100x10^3 H = 140	Vg = 6,870x10^6 Vc = 8,700x10^3 Vg/Vc = 790	
		Case 3-6 Vg = 1,800x10^3 Vc = 3,200x10^3 H = 160	Vg = 7,450x10^6 Vc = 9,800x10^3 Vg/Vc = 760	
Case 1-4 Vg=2,720x10^{6}m^3 Vc=2,600x10^{3}m^3 H =160 m	Case 2-11 Vg = 4,800x10^6 Vc = 5,600x10^3 H = 180	Case 3-8 Vg = 2,690x10^6 Vc = 5,000x10^3 H = 170	Vg = 10,210x10^6 Vc = 13,200x10^3 H = 510	K

TABLE 3.6.15
(1 of 3)

FEATURES OF HYDROELECTRIC POWER SCHEME COMBINATION

Scheme / Dam Site / Combination	Unit	Sun Kosi No.1				Sun Kosi No.2			
		I	I	I	I'	II	III	IV	II
		1-1 (Optimum, Adopted)	1-2	1-3	1-4	2-1	2-4	2-8	2-3 (Optimum, Adopted)
Power Generation									
Intake Water Level	EL m	424.6	442.3	462.7	469.0	519.8	523.1	524.2	555.3
Tail Water level	"	304.8	304.8	304.8	334.8	424.6	447.0	475.0	424.6
Gross Head	m	119.8	137.5	157.9	134.2	95.2	76.1	49.2	130.7
Maximum Discharge	m^3/s	1,400	1,400	1,400	1,400	1,050	1,050	1,050	1,050
Installed Capacity	MW	1,257	1,557	1,789	1,520	809	647	418	1,110
Structures Power Station									
Headrace	m	-	-	-	-	-	-	-	-
Penstock	m	200.0	240.0	260.0	240.0	185.0	160.0	120.0	230.0
Tailrace	m	-	-	-	-	-	-	-	-
Dam Type	-	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity
Dam Height	m	147.0	169.0	195.0	160.0	115.0	92.0	60.0	166.0
Dam Length	m	500.0	620.0	690.0	440.0	430.0	550.0	370.0	530.0
Reservoir and Pondage									
H.W.L.	EL m	424.6	447.0	475.0	475.0	524.2	524.2	524.2	575.0
L.W.L.	"	423.0	433.0	438.0	456.0	511.0	521.0	522.0	516.0
Gross Storage Capacity	10^6m^3	1,500	2,320	3,650	2,720	1,640	1,100	500	4,370
Available Capacity	"	40	510	1,660	860	470	100	30	3,040
Available Depth	"	-	14.0	37.0	19.0	13.2	3.2	-	59.0
Design Flood	$10^3m^3/s$	22.5	22.5	22.5	22.5	17.3	17.2	17.1	17.3
Type of Generation	-	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir
Catchment Area	km^2	16,200	16,200	16,200	16,150	10,396	10,281	10,136	10,396
Gauging Station	-	Kampu Ghat	Kampu Ghat	Kampu Ghat	Kampu Ghat	Khurkot	Khurkot	Khurkot	Khurkot
Remarks	-	H	E	J	K				H

TABLE 3.6.15
(2 of 3)

FEATURES OF HYDROELECTRIC POWER SCHEME COMBINATION

Scheme		Sun Kosi No.2				Sun Kosi No.3			
Dam Site		IV	III	III	IV	V	V	VI	VII
Combination	Unit	2-10	2-5	2-7	2-11	3-1	3-1	3-4 (Optimum)	3-7
Power Generation									
Intake Water Level	EL m	567.3	542.7	573.7	600.0	664.7	664.7	668.7	670.5
Tail Water Level	EL m	475.0	447.0	447.0	475.0	524.2	550.0	575.0	595.0
Gross Head	m	92.3	95.7	126.7	125.0	140.5	114.7	93.7	75.5
Maximum Discharge	m^3/s	1,050	1,050	1,050	1,050	570.0	570.0	570.0	570.0
Installed Capacity	MW	784	813	1,076	1,060	648	529	432	348
Power Station Structures									
Headrace	m	-	-	-	-	-	-	-	-
Penstock	m	180.0	185.0	230.0	230.0		210.0	180.0	150.0
Tailrace	m	-	-	-	-	-	-	-	-
Dam Type	-	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity
Dam Height	m	110.0	118.0	163.0	180.0	131.0	131.0	110.0	86.0
Dam Length	m	450.0	650.0	750.0	750.0	500.0	500.0	360.0	350.0
Reservoir and Pondage									
H.W.L.	EL m	575.0	550.0	595.0	625.0	670.5	670.5	670.5	670.5
L.W.L.	"	552.0	528.0	531.0	552.0	653.0	653.0	665.0	668.0
Gross Storage Capacity	10^6m^3	2,000	2,100	4,520	4,800	940	940	620	570
Available Capacity	"	810	880	3,200	3,480	310	310	70	30
Available Depth	"	23.0	22.0	64.0	73.0	17.5	17.5	5.5	-
Design Flood	$10^3m^3/s$	17.1	17.2	17.2	17.1	11.6	11.6	11.6	11.6
Type of Generation	-	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir
Catchment Area	km^2	10,136	10,281	10,281	10,136	5,520	5,520	5,520	5,520
Gauging Station	-	Khurkot	Khurkot	Khurkot	Khurkot	Panchwar Ghat	Panchwar Ghat	Panchwar Ghat	Panchwar Ghat
Remarks	-	J		E	K			H, J	E

TABLE 3.6.15 FEATURES OF HYDROELECTRIC POWER SCHEME COMBINATION
(3 of 3)

Scheme / Dam Site / Combination	Unit	Sun Kosi No.3 VI 3-5 (Adopted)	Sun Kosi No.3 VIII 3-11
Power Generation			
Intake Water Level	EL m	691.3	751.0
Tail Water Level	"	575.0	625.0
Gross Head	m	116.3	126.0
Maximum Discharge	m^3/s	570.0	570.0
Installed Capacity	MW	536	580
Power Station Structure			
Headrace	m	-	-
Penstock	m	210.0	230.0
Tailrace	m	-	-
Dam Type	-	Gravity	Gravity
Dam Height	m	140.0	170.0
Dam Length	m	470.0	800.0
Reservoir and Pondage			
H.W.L.	EL m	700.0	774.2
L.W.L.	"	674.0	705.0
Gross Storage Capacity	$10^6 m^3$	1,220	2,690
Available Capacity	"	550	2,080
Available Depth	m	26.0	69.2
Design Flood	$10^3 m^3/s$	11.6	10.7
Type of Generation	-	Reservoir	Reservoir
Catchment Area	km^2	5,520	4,730
Gauging Station	-	Panchuwar Ghat	Panchuwar Ghat
Remarks	-		

TABLE 3.6.16 ECONOMIC EVALUAITON OF COMBINATION OF SUN KOSI NO. 1, 2 AND 3

Item	Combination	H	J	E	K
Dam Height (m)	Sun Kosi No.1	147	195	169	160
	" No.2	166	110	163	180
	" No.3	110	110	86	170
Gross Storage Capacity ($10^6 m^3$)	Sun Kosi No.1	1,500	3,650	2,320	2,720
	" No.2	4,370	2,000	4,520	4,800
	" No.3	620	620	570	2,960
	Total	6,490	6,270	7,410	10,210
Available Storage Capacity ($10^6 m^3$)	Sun Kosi No.1	40	1,660	510	860
	" No.2	3,040	810	3,200	3,480
	" No.3	70	70	30	2,080
	Total	3,150	2,540	3,740	6,420
Installed Capacity (MW)	Sun Kosi No.1	1,357	1,789	1,557	1,520
	" No.2	1,110	784	1,076	1,060
	" No.3	432	432	348	580
	Total	2,899	3,005	2,981	3,160
Benefit (B/C)		2.51	2.32	1.23	1.97
Benefit-Cost (B-C) (10^6US$)		619	607	590	557
Energy Cost (cent/KWh)		2.74	4.04	4.14	4.70

Note: Cost is calculated excluding access roads and transmission lines.

TABLE 3.6.17 ECONOMIC EVALUATION OF COMBINATION H
(1 of 4)

Case	Item \ Power Station[1/]	Sun Kosi No.1 Case 1-1	Sun kosi No.2 Case 2-3	Sun Kosi No.3 Case 3-4	Total
H	Maximum Discharge (m^3/s)	1,400	1,050	570	-
	Installed Capacity (MW)	1,357	1,110	432	2,899
	Construction Cost (10^6 US$)	1,001	992	427	2,420
	Annual Cost, C (10^6 US$)	169	168	72	409
	Annual Generated Engergy (10^6 KWH)	4,640	4,760	1,550	10,950
	Annual Benefit, B (10^6 US$)	460	418	150	1,028
	B/C	2.72	2.49	2.07	2.51
	B-C (10^6 US$)	291	250	77	619
	Energy Cost (¢/KWH)	3.65	3.52	4.66	2.69

[1/] The costs of access road and transmission/substation are excluded.

TABLE 3.6.17 ECONOMIC EVALUATION OF COMBINATION J
(2 of 4)

Case	Item \ Power Station[1/]	Sun Kosi No.1 Case 1-3	Sun kosi No.2 Case 2-10	Sun Kosi No.3 Case 3-4	Total
J	Maximum Discharge (m^3/s)	1,400	1,050	570	--
	Installed Capacity (MW)	1,789	784	432	3,005
	Construction Cost (10^6 US$)	1,635	665	427	2,727
	Annual Cost, C (10^6 US$)	276	112	72	460
	Annual Generated Energy (10^6 KWH)	6,900	2,950	1,550	11,400
	Annual Benefit, B (10^6 US$)	640	277	150	1,067
	B/C	2.32	2.47	2.07	2.32
	B-C (10^6 US$)	364	165	77	607
	Energy Cost (¢/KWH)	4.00	3.81	4.66	4.04

[1/] The costs of access road and transmission/substation are excluded.

TABLE 3.6.17 ECONOMIC EVALUATION OF COMBINATION E
(3 of 4)

Case	Item / Power Station 1/	Sun Kosi No.1 Case 1-2	Sun kosi No.2 Case 2-7	Sun Kosi No.3 Case 3-7	Total
E	Maximum discharge (m^3/s)	1,400	1,050	570	--
	Installed Capacity (MW)	1,557	1,076	348	2,981
	Construction Cost (10^6 US$)	1,294	1,196	338	2,828
	Annual Cost, C (10^6 US$)	219	202	57	478
	Annual Generated Energy (10^6 KWH)	5,730	4,620	1,190	11,540
	Annual Benefit, B (10^6 US$)	545	405	118	1,068
	B/C	2.49	2.00	2.08	2.23
	B-C (10^6 US$)	326	203	61	590
	Energy Cost (¢/KWH)	3.82	4.37	4.77	4.14

1/ The costs of access road and transmission/substation are excluded.

TABLE 3.6.17 ECONOMIC EVALUATION OF COMBINATION K
(4 of 4)

Case	Item \ Power Station 1/	Sun Kosi No.1 Case 1-4	Sun kosi No.2 Case 2-11	Sun Kosi No.3 Case 3-11	Total
K	Maximum discharge (m^3/s)	1,400	1,050	570	--
	Installed Capacity (MW)	1,520	1,060	580	3,160
	Construction Cost (10^6 US$)	1,086	1,289	1,037	3,412
	Annual Cost, C (10^6 US$)	184	218	175	577
	Annual Generated Energy (10^6 KWH)	5,590	4,550	2,130	12,720
	Annual Benefit, B (10^6 US$)	532	399	203	1,134
	B/C	2.89	1.83	1.16	1.97
	B-C (10^6 US$)	348	181	28	557
	Energy Cost (¢/KWH)	3.29	4.79	8.22	4.70

1/ The costs of access road and transmission/substation are excluded.

TABLE 3.6.18 FEATURES OF SUN KOSI NO. 1, 2, 3

Sun Kosi

		No. 1	No. 2	No. 3
Location		KURULE BESI	J. JANAKAPUR D. SINDHULI, V.P. DUDVHANG CHAYAKUTAR	JAKHADI PURANA GAON
HWL of Reservoir (m)		424.6	575.0	700.0 (675.5)
Dam Height (m)		147	166	140 (110)
Gross Reservoir Capacity ($10^6 m^3$)		1,500	4,370	1,220 (620)
Effective Reservoir Capacity ($10^6 m^3$)		40	3,040	560 (90)
Power	Maximum Discharge (m^3/s)	1,400	1,050	570 (570)
	Installed Capacity (MW)	1,357	1,110	541 (432)

Note: Value in ( ) of Sun Kosi No. 3 indicates the optimum case taking into account hydropower only.

TABLE 3.6.20
(1 of 2)

EVALUATION OF EACH SCHEME (CASE I)

Item	Unit	Tamur No.1	Tamur No.2	Tamur No.3	Tamur No.4	Tamur No.5	Tamur No.6	Tamur No.7	Total
Maximum Discharge	m^3/s	650	-	310	67	55	53	52	-
Installed Capacity	MW	696	-	186	51	70	76	101	1,180
Construction Cost	10^6US$	838	-	166	90	95	91	100	1,380
Annual Cost, C	"	142	-	28	15	16	15	17	233
Annual Generated Energy	10^6KWH	2,750	-	812	356	489	535	705	5,647
Annual Benefit, B	10^6US$	252	-	71	25	35	38	50	471
B/C	-	1.78	-	2.51	1.64	2.14	2.44	2.93	2.02
B-C	10^6US$	110	-	42	10	18	22	33	238
Energy Cost	$\frac{\text{Cent}}{\text{KWH}}$	5.15	-	3.46	4.29	3.30	2.88	2.41	4.13

TABLE 3.6.20
(2 of 2)

ECONOMIC EVALUATION OF EACH SCHEME (CASE II)

Item	Unit	Tamur No.1	Tamur No.2	Tamur No.3	Tamur No.4	Tamur No.5	Tamur No.6	Tamur No.7	Total
Maximum Discharge	m^3/s	390	340	310	67	55	53	52	-
Installed Capacity	mw	155	120	287	51	70	76	101	860
Construction Cost	10^6US$	202	144	410	90	95	91	100	1,132
Annual Cost,C	"	34	24	69	15	16	15	17	190
Annual Generated Energey	10^6kwh	683	527	1,258	356	489	535	705	4,553
Annual Benefit, B	10^6US$	59	46	109	25	35	38	50	362
B/C	-	1.73	1.88	1.58	1.64	2.14	2.44	2.93	1.91
B-C	10^6US$	25	21	40	10	18	22	33	172
Energy Cost	Cent / kwh	5.00	4.62	5.51	4.29	3.30	2.88	2.41	4.20

TABLE 3.6.21

FEATURES OF TAMUR RIVER SCHEMES

Scheme / Case	Unit	Tamur No.1 I	Tamur No.1 II	Tamur No.2 II	Tamur No.3 I	Tamur No.3 II	Tamur No.4 I, II	Tamur No.5 I, II	Tamur No.6 I, II	Tamur No.7 I, II
Power Generation										
Intake Water Level	EL m	476.0	393.2	439.0	560.9	560.9	661.4	822.9	1,005.8	1,249.7
Tail Water level	"	344.4	344.4	396.2	487.6	442.0	563.9	661.4	822.9	1,005.8
Gross Head	m	131.6	48.8	42.8	73.3	118.9	97.5	161.5	182.9	243.9
Maximum Discharge	m^3/s	650.0	390.0	340.0	310.0	310.0	67.0	55.0	53.0	52.0
Installed Capacity	MW	696	155	120	186	287	51	70	76	101
Structures										
Headrace	m	-	-	-	-	5,100	6,400	6,000	7,400	6,300
Penstock	m	200.0	80.0	100.0	120.0	260.0	150.0	900.0	480.0	610
Tailrace	m	-	-	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Dam Type	-	Gravity	Gravity	Gravity	Gravity	Gravity	Weir	Weir	Weir	Weir
Dam Height	m	153.0	65.0	55.0	65.0		20.0	20.0	20.0	20.0
Dam Length	m	600.0	320.0	200.0	300.0		150.0	150.0	150.0	200.0
Reservoir and Pondage										
H.W.L.	EL m	487.6	396.2	442.0	563.9		-	-	-	-
L.W.L.	"	460.0	386.2	432.0	553.9		-	-	-	-
Gross Storage Capacity	10^6m^3	1,890	160	49	46		-	-	-	-
Available Storage Capacity	"	760	70	20	17		-	-	-	-
Available Depth	m	27.6	10.0	10.0	10.0		-	-	-	-
Design Flood	$10^3m^3/s$	11.1	11.1	10.2	9.6		-	-	-	-
Type of Generation	-	Reservoir	PRR	PRR	PRR		SRR	SRR	SRR	SRR
Catchment Area	km^2	5,085	5,085	4,400	4,000		3,140	2,560	2,490	2,420
Gauging Station	-	Mulghat	Mulghat	Mulghat	Mulghat		Mulghat	Mulghat	Mulghat	Mulghat

TABLE 3.6.23

FEATURES OF ARUN SCHEMES

Scheme / Case	Unit	Arun No.1 I	Arun No.1 II	Arun No.2 -	Arun No.3 -	Arun No.4 -	Arun No.5 -	Arun No.6 -
Power Generation								
Intake Water Level	EL m	420.0	399.0	616.0	810.0	914.4	1,082.0	1,280.1
Tail Water Level	"	311.0	304.8	420.0	616.0	810.0	914.4	1,082.0
Gross Head	m	109.0	94.2	196.0	194.0	104.4	167.6	198.1
Maximum Discharge	m^3/s	180	180	160.0	156.0	154.0	153.0	151.0
Installed Capacity	MW	146	127	239	240	120	202	238
Power Station Structures								
Headrace	m	9,600	7,300	10,400	7,100	8,700	5,700	5,700
Penstock	m	170	270	300	300.0	170.0	380.0	400.0
Tailrace	m	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Dam Type	-	Weir	Gravity	Weir	Weir	Weir	Weir	Weir
Dam Height	m	23.0	68.0	18.0	23.0	20.0	20.0	20.0
Dam Length	m	150.0	250.0	100.0	120.0	100.0	150.0	100.0
Reservoir and Pondage								
H.W.L.	EL m	-	402.3	-	-	-	-	-
L.W.L.	"	-	392.3	-	-	-	-	-
Gross Storage Capacity	$10^6 m^3$	-	52	-	-	-	-	-
Available Storage Capacity	"	-	16	-	-	-	-	-
Available Depth	m	-	10.0	-	-	-	-	-
Design Flood	$10^3 m^3/s$	-	35.0	-	-	-	-	-
Type of Generation	-	SRR	PRR	SRR	SRR	SRR	SRR	SRR
Catchment Area	km^2	32,998	32,998	32,881	32,332	32,023	31,974	31,398
Gauging Station	-	Turik Ghat	Turik Ghat	Turik Ghat	Turik Ghat	Turik Ghat	Turik Ghat	Turik Ghat

TABLE 3.6.24 COMPARISON OF ALTERNATIVE DAM HEIGHTS

Dam Height-(m) / Maximum Discharge(m^3/s)		Unit	239 2,500 (Adopted)	269 2,500	299 2,500
Cost					
Total Construction Cost	Ct	$x10^6$US$	2,721	3,400	4,220
Annual Cost	C=0.169xCt	"	459.8	574.6	713.2
Benefit					
Maximum Output	P	MW	3,489	3,897	4,307
Annual Energy Output	W	$x10^6$KWH	16,810	20,483	24,147
Benefit	B=Px191.8(US$/KW) +Wx0.043(US$/KWH)	$x10^6$US$	1,392	1,628	1,864
B / C	-	-	3.03	2.83	2.61
B - C	-	$x10^6$US$	932	1,053	1,151
Construction Cost					
Per KW	Ct/P	US$/KW	780	872	980
Per KWH	Ct/w	US$/KWH	0.162	0.166	0.175
Energy Cost		Cent/KWH	2.74	2.81	2.95
Plant Factor		%	55	60	64
River Water Factor		%	84	92	98

TABLE 3.6.25 FEATURES OF ALTERNATIVES

Scheme		Sapt Kosi		
Site		Approx.2km Upstream from Barakshetra		
Case (Dam Height)	Unit	239m	269m	299m
Power Generation				
Intake Water Level	EL m	289.8	309.8	320.8
Tail Water Level	"	119.3	119.3	119.3
Gross Head	m	170.5	190.5	201.5
Maximum Discharge	m^3/s	2,500	2,500	2,500
Installed Capacity	MW	3,489	3,897	4,307
Power Station Structures				
Headrace	m	-	-	-
Penstock	m	240.0	260.0	280.0
Tailrace	m	-	-	-
Dam Type	-	Gravity	Gravity	Gravity
Dam Height	m	239.0	269.0	299.0
Dam Length	m	640.0	710.5	790.0
Reservoir and Pondage				
H.W.L.	EL m	304.8	334.8	364.8
L.W.L.	"	259.0	259.0	259.0
Gross Storage Capacity	10^6m^3	8,500	13,450	19,500
Available Storage Capacity	"	4,420	9,370	15,420
Available Depth	m	45.8	75.8	105.8
Design Flood	$10^3m^3/s$	42.4	42.4	42.4
Type of Generation	-	Reservoir	Reservoir	Reservoir
Catchment Area	km^2	61,000	61,000	61,000
Gauging Station	-	Barakshetra	Barakshetra	Barakshetra

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI No.1 SCHEME (Case 1-1, Adopted)

(1 of 31)

Item	Maximum Discharge (m^3/s)		560	880	(1,400)	2,160
Cost						
Total Construction Cost	Ct	$x10^6$US$	693	815	1,001	1,262
Annual Cost	C=0.169xCt	"	117	138	169	213
Benefit						
Maximum Output	P	MW	543	853	1,357	2,094
Annual Energy Output	W	$x10^6$KWH	2,810	3,660	4,640	5,500
Benefit	B=Px191.8(US$/KW) +Wx0.043(US$/KWH)	$x10^6$US$	225	321	460	638
B / C	-	-	1.92	2.33	2.72	2.99
B - C	-	$x10^6$US$	107.9	183.3	291	411
Construction Cost						
Per kw	Ct/P	US$	1,276	955	738	603
Per kwh	Ct/W	US$	0.247	0.223	0.216	0.229
Energy Cost		¢	4.17	3.76	3.65	3.88
Plant Factor		%	59	49	39	30
River Water Factor		%	50	64	82	96
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI No.1 SCHEME (Case 1-2)

(2 of 31)

Item	Maximum Discharge (m^3/s)		560	880	(1,400)	2,160
Cost						
Total Construction Cost	Ct	$x10^6$US$	953	1,087	1,294	1,649
Annual Cost	C=0.169xCt	"	161	184	219	279
Benefit						
Maximum Output	P	MW	623	979	1,557	2,403
Annual Energy Output	W	$x10^6$kwh	3,440	4,370	5,730	6,530
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	267	376	545	742
B / C	-	-	1.66	2.05	2.49	2.66
B - C	-	$x10^6$US$	106	192	326	463
Construction Cost						
Per kw	Ct/P	US$	1,530	1,103	831	686
Per kwh	Ct/W	US$	0.277	0.249	0.226	0.253
Energy Cost		¢	4.68	4.20	3.82	4.27
Plant Factor		%	63	51	42	31
River Water Factor		%	50	64	82	96
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI No.1 SCHEME (Case 1-3)

(3 of 31)

Item	Maximum Discharge (m^3/s)		560	880	(1,400)	2,160
Cost						
Total Construction Cost	Ct	$x10^6$US$	1,267	1,410	1,635	2,018
Annual Cost	C=0.169xCt	"	214	238	276	341
Benefit						
Maximum Output	P	MW	715	1,124	1,789	2,760
Annual Energy Output	W	$x10^6$kwh	4,320	5,420	6,900	7,500
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	323	449	640	852
B / C	-	-	1.51	1.88	2.32	2.50
B - C	-	$x10^6$US$	109	210	364	511
Construction Cost						
Per kw	Ct/P	US$	1,772	1,254	914	731
Per kwh	Ct/W	US$	0.293	0.260	0.237	0.270
Energy Cost		¢	4.96	4.40	4.00	4.55
Plant Factor		%	69	55	44	31
River Water Factor		%	50	64	82	96
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI No.2 SCHEME (Case 2-3,Adopted)
(4 of 31)

Item	Maximum Discharge (m^3/s)		400	630	(1,050)	1,650
Cost						
Total Construction Cost	Ct	$x10^6$US$	725	826	992	1,241
Annual Cost	C=0.169xCt	"	123	140	168	210
Benefit						
Maximum Output	P	MW	423	666	1,110	1,745
Annual Energy Output	W	$x10^6$kwh	3,150	3,790	4,760	4,890
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	217	291	418	545
B / C	-	-	1.77	2.08	2.49	2.60
B - C	-	$x10^6$US$	94.1	151	250	335
Construction Cost						
Per kw	Ct/P	US$	1,714	1,240	894	711
Per kwh	Ct/W	US$	0.230	0.218	0.208	0.254
Energy Cost		¢	3.89	3.68	3.52	4.29
Plant Factor		%	85	65	49	32
River Water Factor		%	45	59	78	94
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI NO.2 SCHEME (Case 2-10)

(5 of 31)

Item	Maximum Discharge (m^3/s)		400	630	1,050	1,650
Cost						
Total Construction Cost	Ct	$x10^6$US$	414	505	665	891
Annual Cost	C=0.169xCt	"	70.0	85.3	112	151
Benefit						
Maximum Output	P	MW	299	470	784	1,232
Annual Energy Output	W	$x10^6$kWh	1,730	2,220	2,950	3,350
Benefit	B=Px191.8(US$/kW) +Wx0.043(US$/kWh)	$x10^6$US$	132	186	277	380
B / C	-	-	1.88	2.17	2.47	2.53
B - C	-	$x10^6$US$	61.8	100.3	164.8	230
Construction Cost						
Per kw	Ct/P	US$	1,385	1,074	848	723
Per kwh	Ct/W	US$	0.239	0.227	0.225	0.266
Energy Cost		¢	4.04	3.84	3.81	4.49
Plant Factor		%	66	54	43	31
River Water Factor		%	45	59	78	94
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI No.2 SCHEME (Case 2-7)
(6 of 31)

Item	Maximum Discharge (m^3/s)		400	630	(1,050)	1,650
Cost						
Total Construction Cost	Ct	$x10^6$US$	928	1,029	1,196	1,445
Annual Cost	C=0.169xCt	"	157	174	202	244
Benefit						
Maximum Output	P	MW	410	646	1,076	1,691
Annual Energy Output	W	$x10^6$kwh	3,020	3,680	4,620	4,740
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	208	282	405	528
B / C	-	-	1.33	1.62	2.00	2.16
B - C	-	$x10^6$US$	52	108	203	284
Construction Cost						
Per kw	Ct/P	US$	2,263	1,593	1,112	855
Per kwh	Ct/W	US$	0.307	0.280	0.259	0.305
Energy Cost		¢	5.19	4.73	4.37	5.15
Plant Factor		%	84	65	49	32
River Water Factor		%	45	59	78	94
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI No.3 SCHEME (Case 3-4)
(7 of 31)

Item	Maximum Discharge (m^3/s)		230	350	(570)	870
Cost						
Total Construction Cost	Ct	$x10^6$US$	305	355	427	561
Annual Cost	C=0.169xCt	"	51.5	60.0	72.2	94.8
Benefit						
Maximum Output	P	MW	174	265	432	660
Annual Energy Output	W	$x10^6$kWh	930	1,160	1,550	1,790
Benefit	B=Px191.8(US$/kW) +Wx0.043(US$/kWh)	$x10^6$US$	73.4	101.0	150	204
B / C	-	-	1.42	1.68	2.07	2.15
B - C	-	$x10^6$US$	21.8	40.7	77.3	108.7
Construction Cost						
Per kw	Ct/P	US$	1,753	1,340	988	850
Per kwh	Ct/W	US$	0.328	0.306	0.275	0.313
Energy Cost		¢	5.54	5.17	4.66	5.30
Plant Factor		%	61	50	41	31
River Water Factor		%	50	64	82	95
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI No.3 SCHEME (Case 3-7)
(8 of 31)

Item	Maximum Discharge (m^3/s)		230	350	(570)	870
Cost						
Total Construction Cost	Ct	$x10^6$US$	214	259	338	450
Annual Cost	C=0.169xCt	"	36.2	43.8	56.8	76.1
Benefit						
Maximum Output	P	MW	140	214	348	531
Annual Energy Output	W	$x10^6$kwh	736	937	1,190	1,400
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	58.5	81.3	118	162
B / C	-	-	1.62	1.86	2.08	2.13
B - C	-	$x10^6$US$	22.3	37.6	61.1	86.0
Construction Cost						
Per kw	Ct/P	US$	1,529	1,210	966	847
Per kwh	Ct/W	US$	0.291	0.276	0.282	0.321
Energy Cost		¢	4.91	4.67	4.77	5.43
Plant Factor		%	60	50	39	30
River Water Factor		%	50	64	82	95
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI No.3 SCHEME (Case 3-5)

(9 of 31)

Item	Maximum Discharge (m^3/s)		230	350	(570)	870
Cost						
Total Construction Cost	Ct	$x10^6$US$	444	492	576	690
Annual Cost	C=0.169xCt	"	75.0	83.1	97.3	117
Benefit						
Maximum Output	P	MW	216	329	536	819
Annual Energy Output	W	$x10^6$kwh	1,290	1,590	2,070	2,300
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	96.9	131	192	256
B / C	-	-	1.29	1.58	1.97	2.20
B - C	-	$x10^6$US$	21.9	48.3	94.5	139.4
Construction Cost						
Per kw	Ct/P	US$	2,056	1,495	1,075	842
Per kwh	Ct/W	US$	0.344	0.309	0.278	0.300
Energy Cost		¢	5.82	5.23	4.70	5.07
Plant Factor		%	68	55	44	32
River Water Factor		%	50	64	82	95
Remarks		-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF SUN KOSI NO.4 SCHEME

(10 of 31)

Item	Maximum Discharge (m^3/s)		27	39	53	73	109	(53)
Cost								
Total Construction Cost	Ct	$x10^6$US$	79.6	100.6	126	155	211	114
Annual Cost	C=0.169xCt	"	13.5	17.0	21.3	26.2	35.7	19.3
Benefit								
Maximum Output	P	MW	21	30	40	57	85	26
Annual Energy Output	W	$x10^6$kwh	178.8	234.5	279.0	346.2	437.4	181
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	11.7	15.8	19.7	25.8	35.1	12.8
B / C	-	-	0.87	0.93	0.92	0.99	0.98	0.66
B - C	-	$x10^6$US$	-1.8	-1.2	-1.6	-0.4	-0.5	-6.5
Construction Cost								
Per kw	Ct/P	US$	3,795	3,353	3,150	2,719	2,482	4,385
Per kwh	Ct/W	US$	0.446	0.429	0.452	0.448	0.482	0.630
Energy Cost		¢	7.53	7.25	7.63	7.57	8.15	10.64
Plant Factor		%	97	89	79	69	59	79
River Water Factor		%	21	26	33	39	50	33
Remarks		-	Preliminary Comparison (H.W.L. of Sun Kosi No.3 is 670.5m)					Adopted

TABLE 3.6.26
(11 of 31)

OPTIMIZATION STUDY OF DUDH KOSI NO.1 SCHEME

Item	Maximum Discharge (m^3/s)		60	80	120	180	300	470	(300) (Restudy)
Cost									
Total Construction Cost	Ct	$x10^6$US$	174	190	226	271	369	503	394
Annual Cost		"	29.4	32.1	38.2	45.8	62.4	85.0	66.6
Benefit									
Maximum Output	P	MW	46	61	92	138	230	360	228
Annual Energy Output	W	$x10^6$kwh	358.6	432.8	564.1	722.8	986.4	1,238.8	978
Benefit	B=Px(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	24.2	30.3	41.9	57.5	86.5	122.3	85.8
B / C	-	-	0.82	0.94	1.10	1.26	1.39	1.44	1.29
B - C	-	$x10^6$US$	-5.2	-1.8	3.7	11.7	24.2	37.3	19.2
Construction Cost									
Per kw	Ct/P	US$	3,783	3,115	2,457	1,964	1,604	1,397	1,728
Per kwh	Ct/W	US$	0.485	0.439	0.401	0.375	0.374	0.406	0.403
Energy Cost		¢	8.20	7.42	6.77	6.34	6.32	6.86	6.81
Plant Factor		%	89	81	70	60	49	39	49
River Water Factor		%	23	28	37	48	65	82	65
Remarks		-			Preliminary Comparison				Adopted

TABLE 3.6.26 OPTIMIZATION STUDY OF DUDH KOSI No.2 SCHEME
(12 of 31)

Item	Maximum Discharge (m^3/s)		40	(50)	80	110	170
Cost							
Total Construction Cost	Ct	$x10^6$US$	90.4	105	151	199	286
Annual Cost	C=0.169xCt	"	15.3	17.7	25.5	33.6	48.3
Benefit							
Maximum Output	P	MW	70	87	139	191	296
Annual Energy Output	W	$x10^6$kwh	580.9	689.6	946.9	1,155.3	1,510.5
Benefit	B=Px191.8(US$/kW) +Wx0.043(US$/kWh)	$x10^6$US$	38.4	46.3	67.4	86.3	121.7
B / C	-	-	2.51	2.61	2.64	2.57	2.52
B - C	-	$x10^6$US$	23.1	28.6	41.9	52.7	73.4
Construction Cost							
Per kW	Ct/P	US$	1,291	1,207	1,086	1,042	966
Per kWh	Ct/W	US$	0.156	0.152	0.159	0.172	0.189
Energy Cost		¢	2.63	2.57	2.70	2.91	3.20
Plant Factor		%	97	90	78	69	58
River Water Factor		%	19	23	30	38	49
Remarks		-	-	Adopted	-	-	-

TABLE 3.6.26 OPTIMIZATION STUDY OF LIKHU KHOLA No.1 SCHEME

(13 of 31)

Item	Maximum Discharge (m^3/s)		12	16	(23)	34	50
Cost							
Total Construction Cost	Ct	$x10^6$US$	30.2	36.2	45.3	58.0	76.3
Annual Cost	C=0.169xCt	"	5.10	6.12	7.66	9.90	12.9
Benefit							
Maximum Output	P	MW	11	14	21	31	45
Annual Energy Output	W	$x10^6$kWh	92.0	114.1	145.0	184.5	232.3
Benefit	B=Px191.8(US$/kW) +Wx0.043(US$/kWh)	$x10^6$US$	6.06	7.59	10.26	13.9	18.6
B / C	-	-	1.19	1.23	1.34	1.40	1.44
B - C	-	$x10^6$US$	0.96	1.47	2.61	3.98	5.73
Construction Cost							
Per kw	Ct/P	US$	2,745	2,586	2,157	1,890	1,696
Per kwh	Ct/W	US$	0.328	0.317	0.312	0.318	0.328
Energy Cost		¢	5.55	5.36	5.28	5.37	5.55
Plant Factor		%	95	93	79	68	59
River Water Factor		%	22	27	34	42	52
Remarks		-	-	-	Adopted	-	-

TABLE 3.6.26 OPTIMIZATION STUDY OF TAMA KOSI No.3 SCHEME
(14 of 31)

Item	Maximum Discharge (m^3/s)		50	100	(150)	200	250
Cost							
Total Construction Cost	Ct	$x10^6$US$	107	150	204	276	349
Annual Cost	C=0.169xCt	"	18.1	25.4	34.5	46.6	59.0
Benefit							
Maximum Output	P	MW	41	82	123	163	204
Annual Energy Output	W	$x10^6$kWh	299.0	466.9	603.0	714.0	804.2
Benefit	B=Px191.8(US$/kW) +Wx0.043(US$/kWh)	$x10^6$US$	20.7	35.8	49.5	62.0	73.7
B / C	-	-	1.15	1.41	1.44	1.33	1.25
B - C	-	$x10^6$US$	2.6	10.5	15.0	15.3	14.7
Construction Cost							
Per kw	Ct/P	US$	2,610	1,829	1,659	1,693	1,711
Per kwh	Ct/W	US$	0.358	0.321	0.338	0.387	0.434
Energy Cost		¢	6.05	5.43	5.72	6.53	7.33
Plant Factor		%	83	65	56	50	45
River Water Factor		%	27	43	55	66	75
Remarks		-	-	-	Adopted	-	-

TABLE 3.6.26 OPTIMIZATION STUDY OF TAMA KOSI No.4 SCHEME
(15 of 31)

Item	Maximum Discharge (m^3/s)		50	75	120	190	280	(140) (Restudy)
Cost								
Total Construction Cost	Ct	$x10^6$US$	146	177	234	339	498	258
Annual Cost	C=0.169xCt	"	24.7	29.9	39.5	57.3	84.2	43.6
Benefit								
Maximum Output	P	MW	45	68	108	171	253	126
Annual Energy Output	W	$x10^6$kwh	318.7	415.5	558.5	738.2	914.4	624
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	22.3	30.9	44.7	64.5	87.8	51.0
B / C	-	-	0.91	1.03	1.13	1.13	1.04	1.17
B - C	-	$x10^6$US$	(-)2.33	1.0	5.2	7.2	3.7	7.4
Construction Cost								
Per kw	Ct/P	US$	3,244	2,603	2,167	1,982	1,968	2,048
Per kwh	Ct/W	US$	0.458	0.426	0.419	0.459	0.545	0.413
Energy Cost		¢	7.74	7.20	7.08	7.76	9.20	6.99
Plant Factor		%	81	70	59	49	41	57
River Water Factor		%	30	38	50	67	92	56
Remarks		-			Preliminary Comparison			Adopted

TABLE 3.6.26 OPTIMIZATION STUDY OF TAMA KOSI No.5 SCHEME
(16 of 31)

Item	Maximum Discharge (m^3/s)		20	28	40	(60)	90
Cost							
Total Construction Cost	Ct	$x10^6$US$	49.2	61.0	78.5	105.3	147.7
Annual Cost	C=0.169xCt	"	8.31	10.3	13.3	17.8	25.0
Benefit							
Maximum Output	P	MW	34	47	68	102	152
Annual Energy Output	W	$x10^6$kwh	286.4	369.1	472.5	615.3	794.1
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	18.8	24.9	33.4	46.0	63.3
B / C	-	-	2.27	2.41	2.51	2.59	2.54
B - C	-	$x10^6$US$	10.5	14.6	20.1	28.2	28.3
Construction Cost							
Per kw	Ct/P	US$	1,447	1,298	1,154	1,032	972
Per kwh	Ct/W	US$	0.172	0.165	0.166	0.171	0.186
Energy Cost		¢	2.90	2.79	2.81	2.89	3.14
Plant Factor		%	96	90	79	69	60
River Water Factor		%	18	23	29	38	49
Remarks		-	-	-	-	Adopted	-

TABLE 3.6.26 OPTIMIZATION STUDY OF KHIMTE KHOLA No.1 SCHEME

(17 of 31)

Item	Maximum Discharge (m^3/s)		6	7	(10)	14	22
Cost							
Total Construction Cost	Ct	$x10^6$US$	40.9	45.2	58.0	74.6	105
Annual Cost	C=0.169xCt	"	6.91	7.64	9.80	12.6	17.7
Benefit							
Maximum Output	P	MW	29	34	49	68	107
Annual Energy Output	W	$x10^6$kwh	248.2	277.7	344.0	418.0	553.6
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	16.2	18.5	24.2	31.0	44.3
B / C	-	-	2.34	2.42	2.47	2.46	2.50
B - C	-	$x10^6$US$	9.29	10.9	14.4	18.4	26.6
Construction Cost							
Per kw	Ct/P	US$	1,410	1,329	1,184	1,097	981
Per kwh	Ct/W	US$	0.165	0.163	0.169	0.178	0.190
Energy Cost		¢	2.78	2.75	2.85	3.01	3.20
Plant Factor		%	97	93	80	70	59
River Water Factor		%	19	22	27	33	42
Remarks		-	-	-	Adopted	-	-

TABLE 3.6.26 OPTIMIZATION STUDY OF BHOTE KOSI No.1 SCHEME
(18 of 31)

Item	Maximum Discharge (m^3/s)		18	24	(34)	48	71
Cost							
Total Construction Cost	Ct	$x10^6$US$	57.1	69.1	88.8	113	156
Annual Cost	C=0.169xCt	"	9.65	11.7	15.0	19.1	26.4
Benefit							
Maximum Output	P	MW	33	45	64	90	134
Annual Energy Output	W	$x10^6$kwh	284.4	846.2	444.3	550.2	686.7
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	18.6	23.5	31.4	40.9	55.2
B / C	-	-	1.93	2.01	2.09	2.14	2.09
B - C	-	$x10^6$US$	8.95	11.8	11.4	21.8	28.8
Construction Cost							
Per kw	Ct/P	US$	1,730	1,536	1,388	1,256	1,164
Per kw	Ct/W	US$	0.201	0.200	0.200	0.205	0.227
Energy Cost		¢	3.39	3.38	3.38	3.47	3.84
Plant Factor		%	97	88	79	70	59
River Water Factor		%	24	30	37	46	57
Remarks		-	-	-	Adopted	-	-

TABLE 3.6.26 OPTIMIZATION STUDY OF ROSI KHOLA No.1 SCHEME
(19 of 31)

Item	Maximum Discharge (m^3/s)		10	13	18	13 (Restudy)	(13) (Restudy)
Cost							
Total Construction Cost	Ct	$x10^6$US$	27.3	31.5	38.6	43.1	40.1
Annual Cost	C=0.169xCt	"	4.61	5.32	6.52	7.28	6.78
Benefit							
Maximum Output	P	MW	12	16	22	21	16
Annual Energy Output	W	$x10^6$kWh	84.0	97.3	114.2	126	96.7
Benefit	B=Px191.8(US$/kW) +Wx0.043(US$/kWh)	$x10^6$US$	5.91	7.25	9.13	9.45	7.23
B / C	-	-	1.28	1.36	1.40	1.30	1.07
B - C	-	$x10^6$US$	1.30	1.93	2.61	2.16	0.45
Construction Cost							
Per kW	Ct/P	US$	2,275	1,969	1,755	2,052	2,506
Per kWh	Ct/W	US$	0.325	0.324	0.338	0.342	0.415
Energy Cost		¢	5.49	5.47	5.71	5.78	7.01
Plant Factor		%	80	69	59	69	69
River Water Factor		%	45	55	63	55	55
Remarks		-	Preliminary Comparison			Layout	Adopted
		-	(H.W.L. of Sun Kosi No.2 is 524.2m)			Changed	

TABLE 3.6.26 OPTIMIZATION STUDY OF INDRAWATI NO.1 SCHEME

(20 of 31)

Item	Maximum Discharge (m^3/s)		32	45	70	110	175	110 (Restudy)
Cost								
Total Construction Cost	Ct	$x10^6$US$	102	121	158	216	313	220
Annual Cost	C=0.169xCt	"	17.2	20.4	26.7	36.5	52.9	37.2
Benefit								
Maximum Output	P	MW	24	34	53	83	133	81
Annual Energy Output	W	$x10^6$kwh	169.2	208.2	271.0	355.8	462.1	344
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kWh)	$x10^6$US$	11.9	15.5	21.8	31.2	45.4	30.3
B / C	-	-	0.69	0.76	0.82	0.86	0.86	0.82
B - C	-	$x10^6$US$	$-4.9	$-3.0	$-0.9	$-0.3	$+0.5	$-0.9
Construction Cost								
Per kw	Ct/P	US$	4,250	3,559	2,981	2,602	2,353	2,716
Per kwh	Ct/W	US$	0.603	0.581	0.583	0.607	0.677	0.640
Energy Cost		¢	10.19	9.82	9,85	10.26	11.45	10.81
Plant Factor		%	80	70	58	49	40	49
River Water Factor		%	29	36	46	61	82	61
		-	Preliminary Comparison					Adopted

TABLE 3.6.26 OPTIMIZATION STUDY OF INDRAWATI No.2 SCHEME
(21 of 31)

Item	Maximum Discharge (m^3/s)		32	45	70	110	175	110 (Restudy)
Cost								
Total Construction Cost	Ct	$x10^6$US$	56.3	67.0	85.8	113		
Annual Cost	C=0.169xCt	"	9.51	11.32	14.5	19.1		
Benefit								
Maximum Output	P	MW	24	33	48	71		
Annual Energy Output	W	$x10^6$kwh	191.5	233.7	296.8	373.6		
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	12.8	16.4	22.0	29.7		
B / C	-	-	1.35	1.45	1.52	1.55		
B - C	-	$x10^6$US$	3.32	5.06	7.5	10.6		
Construction Cost								
Per kw	Ct/P	US$	2,346	2,030	1,788	1,592		
Per kwh	Ct/W	US$	0.294	0.287	0.289	0.302		
Energy Cost		¢	4.97	4.85	4.89	5.11		
Plant Factor		%	91	81	71	60		
River Water Factor		%	24	29	36	46		
Remarks		-	-	Adopted	-	-		

TABLE 3.6.26 OPTIMIZATION STUDY OF TAMUR No.1 SCHEME (Case 1)
(22 of 31)

Item	Maximum Discharge (m^3/s)		250	410	(650)	970
Cost						
Total Construction Cost	Ct	$x10^6$US$	612	696	838	979
Annual Cost	C=0.169xCt	"	103	118	142	165
Benefit						
Maximum Output	P	MW	268	439	696	1,038
Annual Energy Output	W	$x10^6$kwh	1,660	2,160	2,750	2,890
Benefit	B=Px191.8(US$/kw) +Wx0.043(US$/kwh)	$x10^6$US$	123	177	252	323
B / C	-	-	1.19	1.51	1.78	1.95
B - C	-	$x10^6$US$	19.4	59.5	110	158
Construction Cost						
Per kw	Ct/P	US$	2,284	1,585	1,204	943
Per kwh	Ct/W	US$	0.369	0.322	0.305	0.339
Energy Cost		¢	6.23	5.45	5.15	5.72
Plant Factor		%	71	56	45	32
River Water Factor		%	50	64	82	95
Remarks		-	-	-	Adopted	-