6 / Regional Cooperative Development for the Salween River

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INTRODUCTION

Unlike its 'big brother' the Mekong, the Salween river, or the Than Lwin river as it is called in Myanmar, is relatively untouched and has not been much talked about as an international river. It is much smaller (in any terms) and its basin shared by a fewer countries. The Salween river, however, seems to pose a challenge to development consultants and planners because of the unique location and morphology of its basin, as well as the socio-economic, environmental and political implications of its development.

Despite its relatively low profile as an international river, the early development of the Salween river is an outcome of international cooperation. The Baluchaung dam and hydropower development was planned in the early 1950s near the confluence of the Baluchaung river with the Nam Pawn river (a major tributary of the Salween), separately by two international firms. Based on the Nippon Koei plan, the project was selected as one of the first post-war reparation projects of the Japanese government.

The Baluchaung project is aimed at developing a total power of 244 MW, with the annual energy generation of 1682 GWh by a cascade development, with three power stations harnessing the total water head of 654 m available at the Lawpita Falls. The Baluchaung No. 2 power station was implemented in two stages: the first stage was completed in 1960, and the second stage in 1974, each with a capacity of 84 MW. Much later in 1987, the construction work for the No. 1 power station started upstream. The No. 3 power station downstream is now at an advanced stage of pre-construction work.

In parallel with the stage-wise development of the tributary, development of the main stream of the Salween river has been put on the agenda for international cooperation in the past two decades. Most recently, the

Union of Myanmar and Thailand have been discussing the joint development of the hydropower potential of their border rivers including the Salween. In June 1989, a Thai government delegation visited Yangon, Myanmar, and it was agreed to establish a joint working group to discuss the issue. The Myanmar Electric Power Enterprise (MEPE) and the Department of Energy Affairs (the former National Energy Administration, NEA) of Thailand constituted the principal working groups in the respective countries. Two dams and hydropower schemes on the Salween mainstream were studied among others by the NEA and the Electric Power Development Company (EPDC) of Japan at a preliminary level.

This chapter reviews these and other past efforts for the development of the Salween river. The purpose of the discussion is not only to outline the technical aspects of the Salween river development, but more importantly to clarify the socio-economic, environmental and political dimensions of the development and opportunities for international cooperation broadly related to this unique international river.

With this aim, the characteristics of the Salween river are first outlined, emphasizing its uniqueness. Second, the potential opportunities for development of the Salween are described, based mainly on past technical studies. Broad regional development opportunities related to the Salween river are also pursued. Realization of such potential opportunities will call for international cooperation to resolve conflicts, coordinate development activities, and make financial, institutional and other arrangements. These issues would have to be addressed one by one towards realizing the joint development of the river. As the first step, this chapter tries to clarify some typical issues involved and present some principles and frameworks for cooperative development of the Salween river. An approach to regional cooperative development of the Salween river and some initial actions are proposed.

CHARACTERISTICS OF THE SALWEEN RIVER

Physical Characteristics

The Salween river, originating in the Tanghla range of the Tibetan plateau, drains a total basin area of about 320,000 km^2 (Figure 6.1). It flows along a stretch of 2400 km before it drains into the Gulf of Martaban near Moulmein, Myanmar. Dividing the catchment area by the total length, the average width of the basin is calculated at 133.3 km to make the length–width ratio 18.0. Only a few major rivers in the world have a length–width ratio as high as this (Table 6.1).

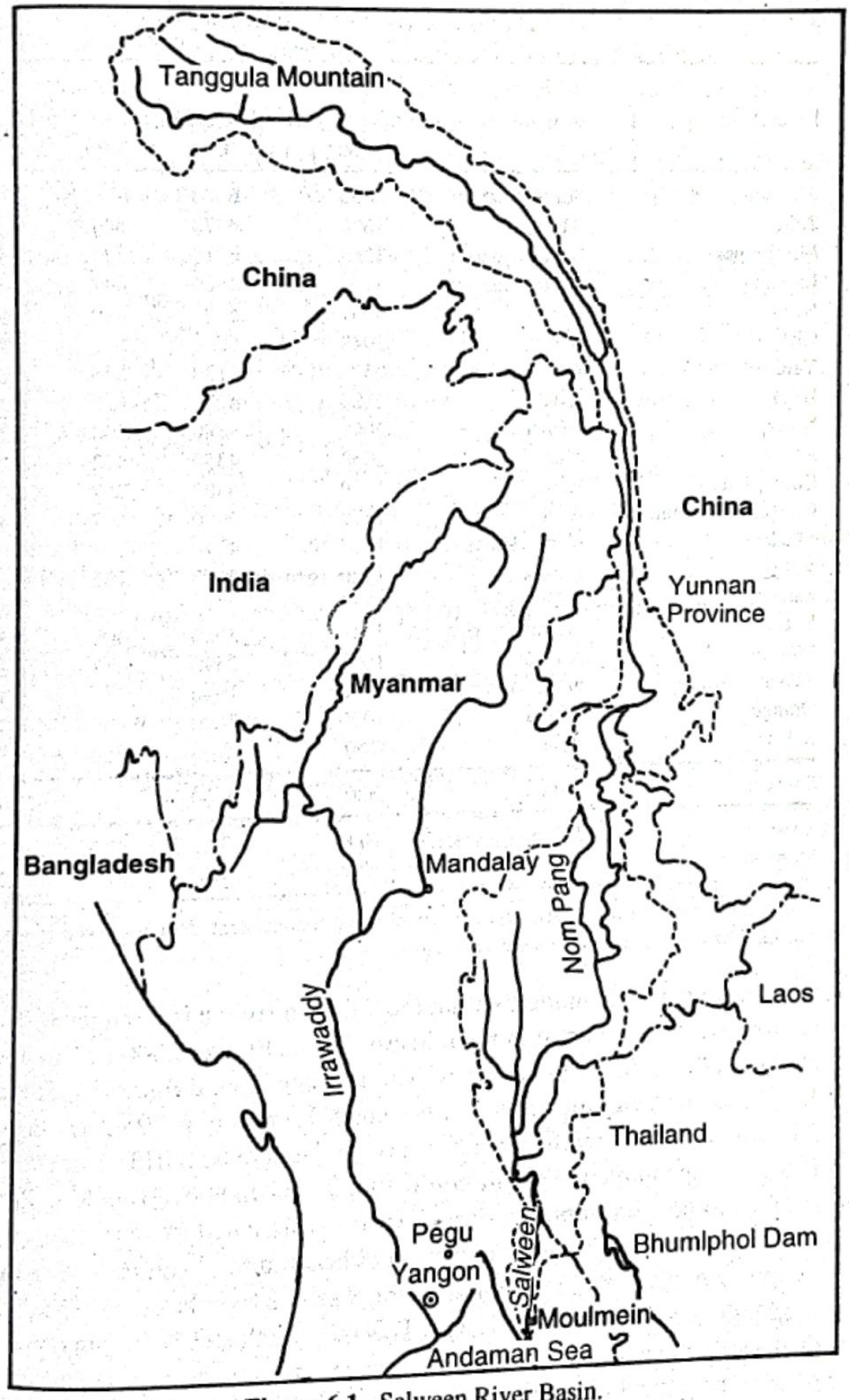

Figure 6.1. Salween River Basin.

Table 6.1. Major rivers of the world

River	Region	A Drainage area (10^3 km^2)	L Length (km)	W = A/L (km)	L/W
Amazon	South America	7050	6300	1119	5.6
Zaire	Africa	3690	4370	844	5.2
Mississippi	North America	3248	6210	523	11.9
La Plata	South America	3104	4800	647	7.4
Nile	Africa	3007	6690	449	14.9
Ob	Asia	2948	5200	567	9.2
Yenisey	Asia	2592	4130	628	6.6
Lena	Asia	2384	4270	558	7.7
Niger	Africa	2092	4180	500	8.4
Amur	Asia	2052	4350	472	9.2
Chang Jiang	Asia	1809	6300	287	22.0
Ganges-Brahmaputra	Asia	1730	2900	597	4.9
Mackenzie	North America	1668	4240	394	10.8
Volga	Europe	1420	3690	385	9.6
Zambezi	Africa	1330	2740	485	5.6
St Laurence	North America	1248	3060	408	7.5
Murray	Australia	1081	2590	417	6.2
Saskatchewan	North America	1080	1940	557	3.5
Orange	Africa	1020	2090	488	4.3
Indus	Asia	760	2900	262	11.1
Salween	Asia	320	2400	133	18.0
Tone	Japan	16.8	322	52.3	6.2
Shinano	Japan	12.1	367	32.8	11.2

Source: Compiled from a few sources which give inconsistent data for some rivers, especially for those in arid or semi-arid regions.

The annual precipitation within the Salween river basin ranges widely from around 1200 mm in the midstream area to over 2000 mm in upstream and the downstream areas. The average annual discharge at the Ban Mae Pua gauging station with a catchment area of 295,270 km^2 is 3880 m^3/sec. The specific discharge is calculated to be 0.013 m^3/sec/km. If the average annual precipitation within the basin above Ban Mae Pua is taken to be 1400 mm, the run-off ratio is calculated to be 0.30.

The specific discharge is a function of basin rainfall and run-off ratio. Despite the relatively high rainfall in the Salween river basin, the specific discharge of Salween is not so large. This is due to the relatively small run-off ratio.

These physical characteristics have implications for the development and use of the Salween river. The long and narrow catchment tends to

make flood peaks higher and travel time of flood water from the upstream longer. The narrow catchment makes the diversion work for dam construction more difficult, and diversion by tunnels may be an inevitable option. High flood peaks would require a large tunnel capacity. All in all, the diversion work could become quite costly. The narrow catchment, on the other hand, may make trans-basin water diversion a more attractive option.

The relatively low overall run-off ratio is partly due to the existence of distinct dry seasons. Some 90 per cent of the annual precipitation concentrates in the south-west tropical monsoon period from June to October, while the north-east monsoon from the continent brings dry air with little rainfall from November to April (Table 6.2). Early rains after a dry season are effectively absorbed by the terrestrial system. Another factor for the low run-off ratio may be the relatively undisturbed upper catchment areas. Reflecting this, past studies assumed low sediment yield, typically at 0.22 mm/year or 286 ton/km^2 at 1.30 ton/m^3. This, of course, is an important factor for dam planning.

The river profile affects the storage efficiency of dams and the developable hydropower potential as well as flow rate. In this respect, the Salween river seems to be more favourable than other rivers of comparable basin area and flow.

Table 6.2. Monthly rainfall at selected meteorological stations

	Meteorological stations			
	Lashio	Taunggyi	Kengtung	Loikaw
January	3	11	16	6
February	8	4	7	2
March	8	13	18	4
April	62	42	47	43
May	149	162	157	123
June	205	223	176	154
July	229	223	240	149
August	275	311	231	203
September	182	282	168	188
October	143	176	115	101
November	83	74	90	52
December	19	10	25	11
Total	1365	1530	1290	1035
No. of years of rainfall data	23	43	24	23

Source: Nippon Koei Co., Ltd., Preliminary Study of Hydroelectric Power Development Project in the Middle Reaches of the Than Lwin River, September 1993.

Socio-economic and Geo-political Characteristics

The Salween river basin is comparatively less developed with relatively small population within the basin. Although reliable statistics for the basin are generally lacking, population data in Myanmar by state and distribution of larger population centres indicate that some 2 million people live in the Myanmar portion of the catchment. The average population density seems to be around 15 per km^2. Significant economic activities are limited to the production of and trade in rice and rice products, and wood and wood products.

There exist many ethnic minorities in and around the Salween river basin. In fact, Shan and Kayan in Myanmar are minorities. Many of these people are still engaged in shifting cultivation.

The Salween river basin is shared by three countries. Of the total catchment area of 320,000 km^2, 53 per cent is in China, 42 per cent in Myanmar, and only 5 per cent in Thailand. Of the total length of 2400 km, the uppermost portion of 1370 km up to the China-Myanmar border flows through the Yunnan province of the People's Republic of China (PRC). The midstream portion is entirely within Myanmar. Only a small portion along the lower reaches is in Thailand: the main stream of the Salween constitutes the Myanmar-Thai border for a stretch of just 120 km downstream, before entering Myanmar once again and finally flowing into the Gulf of Martaban.

Areas in and around the Salween river basin inhabited by ethnic minorities have been considered socio-politically unstable with insurgency problems. The midstream river basin is close to the three-way border between Myanmar, Laos and Thailand. This border area has been known as the golden triangle for drug production and trafficking. Border crossing by people between the three countries is quite usual, leading to the spread of undesirable habits and diseases. It is reported that in Lashio, Myanmar, just outside the Salween river basin, 40 per cent of all the drug users are HIV positive (Far Eastern Economic Review, 21 July 1994). The ratio is high even in northern Thailand.

POTENTIAL AND OPPORTUNITIES FOR SALWEEN RIVER DEVELOPMENT

Hydropower Potential

Theoretical Potential

Hydropower potential in Myanmar was comprehensively studied first for the Burma Umbrella Project financed by the International Bank for Reconstruction and Development (IBRD). The Power Development

Survey for the project was conducted by NEWJEC, a Japanese firm, covering eight rivers: Salween, Bilin, Sittang, Pegu, Irrawaddy, Tamathi, Lemro and Kaladan (NEWJEC, 1978). The total hydropower potential was estimated at 108,000 MW power and 946,000 GWh annual energy. These are clearly overestimates. More plausible estimates, compiled recently (Water Power & Dam Construction, August 1992), are the gross theoretical hydropower potential of 366,000 GWh and the technically feasible hydropower capability of 160,000 GWh.

On the same basis, a reasonable estimate of theoretical hydropower potential on the Salween river is 27,670 MW with 242,000 GWh annual energy. Of this total, 16,800 MW with 1,47,000 GWh is in the upstream entirely within the PRC. The theoretical hydropower potential on the Salween river downstream is 11,570 MW with 101,000 GWh, accounting for 27.6 per cent of the total potential in Myanmar.

Of this total potential in the Myanmar portion of the Salween river, 7520 MW is in the midstream between the border with the PRC and the confluence with the Nam Pawn river, 3350 MW in the downstream, and 700 MW in the tributaries, mainly the Nam Pawn (NEWJEC, 1978).

Developable Potential

More than a few studies have been carried out since the late 1970s to evaluate the developable hydropower potential on the Salween river particularly within Myanmar. Two lines of development may be identified for these studies. Following the early development of the Baluchaung dam and hydropower schemes, Nippon Koei has conducted a series of independent studies for and in cooperation with the Myanmar Electric Power Enterprises (MEPE). Another line of development is a series of studies carried out by or for power generating agencies (NEA and EGAT) of Thailand. Dam and hydropower schemes proposed on the Salween mainstream and tributaries are summarized in Table 6.3.

A Nippon Koei study in 1981 identified three potential dam sites in the Myanmar portion of the Salween mainstream. As seen from Figure 6.2, available heads are almost fully utilized and the reservoir to be created by the uppermost dam is still entirely within Myanmar. The total effective storage volume of the reservoirs to be created by the three dams is 27.7 billion m^3, while the storage required to regulate fully the flow of Salween is considered to be some 32 billion m^3. Of course, developable hydropower potentials depend on effective heads and degree of flow regulation. It is considered, therefore, the Nippon Koei plan with the three dams would allow utilization of almost the full hydropower potential on the Salween river mainstream within Myanmar.

Table 6.3. Dam and hydropower schemes proposed on the Salween mainstream and tributaries

Mainstream

No.	Study organisation and year	Proposed dam site Latitude	Longitude	Catchment area (km²)	Installed capacity (MW)
1.	NEA, 1979	17°56′	97°42′	295,270	5850
2.	SMEC, 1980	18°15′	97°42′	295,000	2550
3.	EGAT, 1981	18°20′	97°35′	293,100	5376
4. (a)	NK, 1981	22°10′	98°45′	193,000	3200
(b)	NK, 1981	20°55′	98°35′	205,000	3600
(c)	NK, 1981	17°50′	97°45′	295,000	6000
5. (a)	MEPE, 1995	19°11′	97°32′	265,000	3500
(b)	MEPE, 1995	17°56′	97°42′	295,270	6000
(c)	MEPE, 1995	17°36′	97°42′	300,130	10,000
6. (a)	EDPC, 1991	18°20′	97°35′	293,200	4540
(b)	EDPC, 1991	18°05′	97°42′	294,500	792
7.	NK, 1993	20°20′	98°40′	207,000	3600

Tributaries

No.	Project	Sub-basin	Installed capacity (MW)	Annual energy (Gwh)	Status
1.	Baluchaung No. 1	Nam Pawn	28	177	To be operational in 1988
2.	Baluchaung No. 2	Nam Pawn	168	1080	In Operation since 1962
3.	Baluchaung No. 3	Nam Pawn	48	327	Feasibility study
4.	Yunzalin	Yunzalin	530	1540	Desk study
5.	Moei 1	Nam Moei	110	244	Preliminary study
6.	Moei 2	Nam Moei	230	523	Preliminary study
7.	Moei 3	Nam Moei	288	630	Preliminary study

Source: MEPE, Hydropower Development on the Than Lwin River and Tributaries, 30 January 1995.

According to the 1981 Nippon Koei plan, the total installed capacity of the three hydropower plants is 12,800 MW, while the annual mean power output is 8400 MW as compared with the theoretical potential of 10,870 MW (Table 6.4). The annual energy output is estimated at 73,500 GWh with an overall plant factor of 65 per cent.

A Nippon Koei study in 1993 reviewed the 1981 study and further elaborated the middle reach scheme. Limited site investigations were conducted in cooperation with MEPE, and reservoir operation was simulated by varying high and low water levels. With the optimal plan, the installed

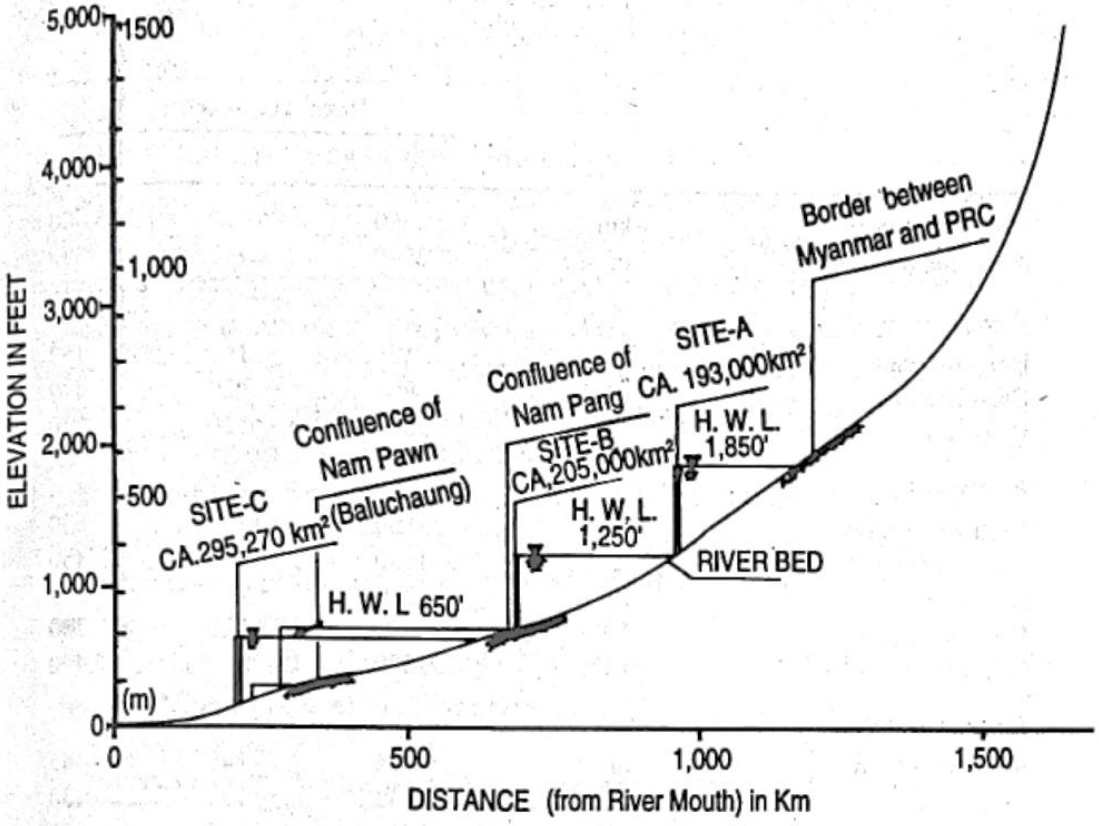

Figure 6.2. Profile of Salween river mainstream and dam schemes planned by Nippon Koei.

capacity remains the same at 3600 MW, but the total annual energy is 22,100 GWh with a plant factor of 70 per cent.

A Thai version of the Salween project was initiated by NEA in 1979. Although several variants have been studied since then, it is a multi-purpose dam project in the reach along the border between Myanmar and Thailand. The original NEA plan was to locate a dam about 10 km upstream of the confluence with the Moei river to produce 22,500 GWh annual energy with an installed capacity of 6400 MW with a plant factor of 40 per cent and to allow double cropping of paddy downstream. The Snowy Mountain Engineering Corporation (SMEC) of Australia presented an alternative plan in 1980 with an installed capacity of 2550 MW and a firm annual energy of 13,400 GWh with a plant factor of 60 per cent, taking account of the drought period of 1957–58 (SMEC, 1980).

An alternative dam site was proposed by EGAT in 1981 at about 65 km upstream of the NEA site. Based on a limited geological investigation, EGAT concluded tentatively that rocks at the new site comprising silt

Table 6.4. Features of three dam schemes proposed by 1981 Nippon Koei Study

	Unit	Three dam schemes		
		A	B	C
Drainage area	km^2	1,93,000	2,05,000	2,95,000
Available discharge	m^3 sec	2540	2700	3880
Dam				
Height of dam	m	175	160	162
Crest length	m	800	920	470
Dam volume (concrete)	10^3m^3	5000	6120	3500
Reservoir				
High water level	ft.	1850	1250	650
Low water level	ft.	1630	1100	450
Drawdown	ft.	220	150	200
Gross storage	10^6m^3	10,500	14,200	13,700
Effective storage	10^6m^3	7500	7800	12,400
Power generation				
Maximum head	m	164	145	145
Mean head	m	140	130	130
Mean firm output	MW	1700	1900	2500
Annual mean output	MW	2400	2400	3600
Installed capacity	MW	3200	3600	6000
Firm energy output	GWh	14,800	16,600	21,900
Secondary energy output	GWh	6200	4400	9600
Total energy output	GWh	21,000	21,000	31,500
Construction and power cost				
Construction cost	10^6 US$	2820	3050	3010
Power cost at power house*	US cent/kWh	1.32	1.36	1.08
Power cost at receiving substation*	US cent/kWh	2.18	2.09	1.58

*Divided by only the firm energy output excluding the secondary energy.

Source: Nippon Koei Co. Ltd., Report on Possible Development Plan of Salween River, October 1981.

stone and sandstone would be more suitable for a high dam than rocks at the NEA site comprising limestone interbedded with argillaceous rock and sandstone.

The EGAT plan also proposed to combine the high dam with a regulating dam further downstream. The proposed site for the latter is close to the lowermost dam site proposed by Nippon Koei. Three alternative schemes

were presented by EGAT as shown in Table 6.5. The medium alternative is to install 4186 MW at the high dam and 1190 MW at the regulating dam to produce the annual energy of 26,900 GWh and 7900 GWh, respectively.

At the third meeting of the Myanmar-Thai joint working group held in Yangon in March 1991, it was agreed that NEA should request EPDC to undertake a preliminary study of the five hydropower schemes on the rivers bordering the two countries, including the combination scheme on the Salween mainstream proposed by EGAT. The upstream high dam site was adopted by EDPC and planned as the Upper Salween scheme with an installed capacity of 4540 MW and annual energy of 29,300 GWh. A site for the regulating dam, now called the Lower Salween scheme, was changed to avoid limestone areas and a fault zone. The site proposed by EPDC is located 35 km upstream of the confluence with the Moei river. The Lower Salween scheme was planned with an installed capacity of 792 MW and annual energy of 5400 GWh.

In sum, the total developable hydropower potential on the Salween river in Myanmar seems to be in the range of 75,000–80,000 GWh. This

Table 6.5. Features of Salween project proposed by EGAT

	Alternative high water levels (m)					
	200		220		280	
	High dam	Regulating dam	High dam	Regulating dam	High dam	Regulating dam
Power generation						
Installed capacity (MW)	2880	938	4186	1190	7470	1600
Turbine type	Francis	Kaplan	Francis	Kaplan	Francis	Kaplan
No. of units	5	5	7	7	12	8
Firm power (MW)	1913	938	2522	1190	4717	1600
Average annual energy (GWh)	19,845	6697	26,941	7943	40,497	8844
Annual firm energy (GWh)	17,173	5937	21,233	6363	32,718	7140
Irrigation						
Service area (million ha)						
—Wet season	0.64		1.20		1.92	
—Dry season	0.19		0.48		0.88	

Source: EGAT, Salween Multi-purpose Project—Conceptual Plan, September 1981.

corresponds to more than 75 per cent of the theoretical hydropower potential. Along the lower reaches of the Salween river, the combination of the Upper Salween and the Lower Salween schemes proposed by EGAT/EPDC may generate slightly larger annual energy than the lowermost dam proposed by Nippon Koei. In the midstream, two other dams proposed by Nippon Koei would allow utilization of almost the full hydropower potential.

Opportunities for Trans-basin Water Diversion

The Salween river seems to have potentially favourable conditions for trans-basin water diversion. Before discussing these specific conditions, it may be useful to first discuss trans-basin water diversion in general terms.

Diversion of river water from one basin to another becomes an issue when there exists a need for augmentation of water availability in one basin for water supply, irrigation, hydropower generation or low flow augmentation, or for the exploitation of higher effective heads for hydropower generation, or for the discharge of excess water to reduce floods in the origin river basin, or a combination of any of these purposes. Conditions which determine the viability of water transfer generally include the demand for water in the neighbouring basin, the morphology of the river basins, and the total availability and seasonal distribution of river discharges.

Conditions for Water Diversion from Salween

Positive conditions on the supply side for water diversion from the Salween river may be the following. First, the Salween river basin is relatively less developed with a small population and limited economic activities, so that water demand is low within the basin and more water can be made available to neighbouring basins. Second, relatively high flood peaks of the Salween river indicate that the diversion would be beneficial. Third, the narrow basin makes diversion easier within a short distance and thus less costly.

There exist at least two broad opportunities for trans-basin diversion from the Salween river: one upstream to the Mekong river basin in the PRC, and the other midstream to the Chao Phraya river basin in Thailand. The Salween river upstream within the PRC has a very narrow basin and water demand in this area is quite small, which makes water diversion appear promising. This option, however, is not realistic as the flow in Mekong is much larger. A more decisive factor against this option is that

the runoffs in the two rivers are highly correlated. EGAT analysed the run-offs of the Mekong river observed at Luang Prabang with the catchment area of 268,000 km^2 and their correlation with those of the Salween river at Ban Mae Pua. The following relationship was established with the correlation coefficient of 0.96:

$Q_s = 8.05\ Q_m^{0.745}$,

where Q_m represents run-offs of the Mekong,

and Q_s represents run-offs of the Salween.

Water diversion to the Chao Phraya from the midstream of the Salween appears to be more meaningful in view of the high water demand in the Chao Phraya river basin. There are two major EGAT dams and hydropower plants on the tributaries of the Chao Phraya river: Bhumibol and Sirikit. It is reported that the reservoirs of these dams contain less than 2000 million m^3 of water early in the dry season, while their normal storage is 13,500 million m^3 for Bhumibol and 9500 million m^3 for Sirikit (Water Power & Dam Construction, March 1994). These falling storage levels affect not only regulation and availability of water for irrigation systems but also navigation channels in the central plain and the water supply system for Bangkok. The Chao Phraya flows fall so low that river pollution and seawater intrusion upstream towards the capital's potable water supply pose growing problems.

Possible Scheme for Diversion to Chao Phraya

Diversion of water in the Salween river to Thailand has been discussed for several years, but a specific proposal was recently presented by the World Impex Co. Ltd. of Myanmar (April 1992). The main objective of the proposed scheme was to develop hydropower on the Salween by a BOOT (build-own-operate and transfer) scheme. The proposal was based on the assumed cooperation of Myanmar, Thai and Japanese firms as well as the governments of Myanmar and Thailand.

The water diversion was proposed only as an option to provide further incentive for the Thai government to participate in the project as expressed in the proposal.

To encourage the Thai government as the only buyer of the power produced, to be the guarantor, the government of Myanmar may have to agree to divert 30% of the Than Lwin (Salween) river water into the source of the Chao Phraya river. This water will discharge to the Me Ping river and further to Chao Phraya through Ayudhaya.

As benefits of the diversion, water supply to Ayudhaya and flushing out of pollution in the Bangkok area are mentioned. To justify it from the Myanmar point of view, reduction of flow rate is stated to make river navigation easier.

The proposal led to the Nippon Koei study in 1993 to elaborate the idea and formulate a specific plan with preliminary engineering. Specifically, the middle reach dam identified by the Nippon Koei study in 1981 was examined. The main objective was still hydropower development, but water diversion to Thailand was also envisaged. Although this diversion option was 'abandoned' later due to insufficiency of data and information, results of the study are useful to indicate the possibilities of this option.

The Nippon Koei study assumed the water diversion only during the dry season, from November to April, for a constant 100 m^3/sec or 1564 million m^3/year. The proposed diversion system consists of a 30-km-long headrace tunnel, a surge tank, pump station, regulating pond, a 15-km-long conveyance canal, another tunnel of 40 km length and other associated facilities. The water diverted from the Salween river will be discharged into the Mae Hkok river, the uppermost tributary of the Mae Ping river, at the border between Myanmar and Thailand.

Costs involved in this diversion scheme were estimated by the study. The total construction cost was estimated to be US $1858 million at mid-1993 prices, including direct construction costs, contingencies, land acquisition and compensation, administration and engineering, and interest during construction. The diversion requires pumping up of water over the basin boundaries by some 250 m difference in elevation. The required pumping capacity is estimated at 350 MW. The annual operating cost of the diversion system consists mainly of electricity costs for pumping.

The unit cost of water to be diverted was calculated at US cent 18/ m^3, based on amortized construction costs and annual operation and maintenance costs. This unit cost is still relatively low, compared with current water charges in ASEAN countries.

Irrigation Potential

Irrigation Potential in Myanmar

A few studies in the recent past examined the Salween river development as a multi-purpose project with irrigation. The original NEA plan in 1979 was to allow double cropping of paddy downstream for the potential area of 2.46 million ha. The potential irrigation area is found along the lower reaches of the Salween but mostly outside its basin: large plains in Kya-in, Shwebun, Hlaingbwe, Thaton and Martaban.

The EGAT study in 1981 further elaborated the irrigation component of the Salween multipurpose project. Alternative cropping patterns were proposed, including double cropping of rice, field crops such as millet, wheat, corn, maize and cotton, and year round cultivation of sugarcane and vegetables. Irrigation water requirements were estimated by month for a combination of these cropping patterns, and irrigable area was calculated for different high water levels of the Upper Salween scheme. The maximum irrigable area corresponding to the highest water level examined is 1.92 million ha during the wet season and 0.88 million ha during the dry season.

Using the same irrigation water requirements, the maximum irrigation potential from a viewpoint of water availability is calculated at 3 million ha, assuming 50 per cent irrigation efficiency and if the flow in the Salween is fully regulated and used for irrigation. A more realistic estimate of irrigable area may be 1.6 million ha as presented recently by NEA.

Irrigation Potential in Thailand

The water to be diverted to Thailand may be used for irrigation. Additional irrigation areas may be developed along the Mae Ping river, or the diverted water may benefit the existing irrigation system in the central plains along the Chao Phraya river by assuring the second rice crop which is presently under threat.

Under the diversion scheme studied by Nippon Koei, water is diverted at 100 m^3/sec during the dry season. If this is devoted entirely to irrigation, some 7000 ha area may be newly irrigated throughout the year under the same cropping patterns assumed above for Myanmar with proper storage and regulation of the water.

More reasonable use of the diverted water would be for the existing irrigation system during the dry season. At present, water in the Chao Phraya river is diverted at the Chai Nat dam to feed the irrigation system in the Chao Phraya delta. The amount of diverted water is 4200 million m^3 during the dry season (JICA, 1990). Thus the diversion from Salween at 100 m^3/sec during the dry season or 1564 million m^3 annually would be a significant contribution to assuring the second rice crop in the Chao Phraya irrigation system.

Regional Development Opportunities

As noted earlier the Salween river basin has a relatively small population and limited economic activities. Due to its narrow basin and mountainous topography, opportunities for sizeable settlements and agricultural activities are quite limited, especially along upstream and midstream reaches.

On the other hand, the Salween river has a huge developable hydropower potential, and also considerable irrigation potential along its lower reaches as outlined above. Opportunities for trans-basin water diversion are also noted. Effective realization of these opportunities would call for a broad regional perspective. Owing to its unique location and morphology, the Salween river basin may represent a case where the 'one river basin–one plan' principle may not be applicable.

Regional Links for Economic Interactions

The technical assistance (TA) project by the Asian Development Bank for Subregional Economic Cooperation among Cambodia, Lao People's Democratic Republic, Myanmar, Thailand, Vietnam and the Yunnan province of the PRC has identified important transportation links to promote economic cooperation among these countries (ADB, August 1993). Of particular relevance to the Salween river development are the Kunming–Ruili–Lashio system and the Kunming–Keng Tung link identified during phase I of the TA (Figure 6.3). The former crosses the Salween river upstream within the PRC. The latter links Kunming in the PRC and Keng Tung in Myanmar near the eastern basin boundary of the Salween. The road, extending to the west from Keng Tung, crosses the Salween river in the midstream within Myanmar and links to Meiktila on the Yangon–Mandalay road.

These alternative links have different implications for broad regional cooperation and the Salween river development. The Kunming–Dali–Lashio link may promote the development of the upstream and midstream reaches through, for instance, increased logging for processing in Kunming and the supply of consumer goods from Kunming. Construction of dams upstream may become realistic possibilities due to improved access and increased local demand for water and power. On the whole, this link would contribute more to the integration of economies within the PRC, although Myanmar would also benefit from the stronger link with the economies of Yunnan province.

The Kunming–Keng Tung–Meiktila link provides an alternative artery connecting Myanmar and Yunnan province of the PRC, but implications of this link go beyond the bilateral relationship. The Kunming–Keng Tung section passes close to the borders of these two countries with Laos and Thailand. This section links to Chiang Rai in Thailand either directly or through Laos. This alternative artery, therefore, is preferable for Yunnan province as well, since it would facilitate access to the much larger market of Thailand. Another recent study proposes a new north–south artery for

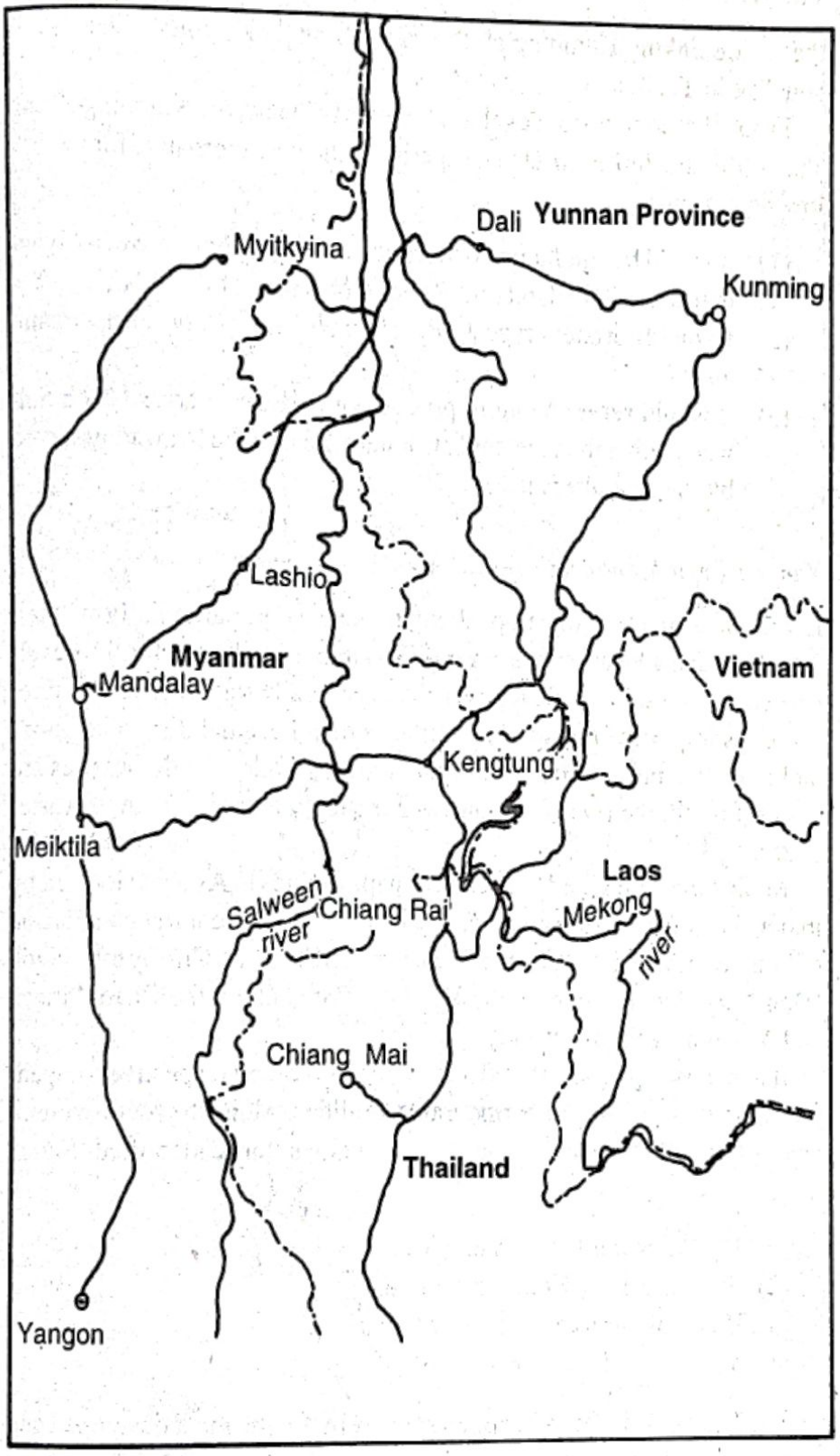

Figure 6.3. Important transport links between Yunnan province and Myanmar/ Thailand/Laos related to Salween river development.

the region linking Kunming all the way to Bangkok through Chiang Rai and Tak in Thailand (AITCJ, 1994).

From a broad regional development point of view, the Kunming–Keng Tung–Meiktila link seems to be superior to the first alternative for the following reasons:

(1) it would be conducive to more active interactions between Myanmar, Laos, Thailand and Yunnan province of the PRC;
(2) it would not encourage the development of the Salween upstream; and
(3) it would serve the more productive midstream areas of the Salween rather than the upper tributary areas of the Irrawaddy served by the first alternative.

Yangon-Pegu-Moulmein Coastal Area Development

Large cities tend to develop along major rivers, particularly at their mouths. Such a location has several favourable conditions for the development of cities. First, the topography is generally flat. Second, the river serves as important transportation means to collect and distribute goods and move people. Third, links to other areas, markets and countries are easier. Fourth, the river facilitates water supply and discharge of wastewater.

Many large cities, and indeed most capital cities in Asia, are located by major rivers. Several cases are easily identified in the continental portion of Southeast Asia: Hanoi by the Red river, Ho Chi Minh City by the Saigon (Don Nai), Phnom Penh by the Mekong, Bangkok by the Chao Phraya, and Yangon by the Irrawaddy.

It is interesting to note that all these cities have their respective companion cities with sea ports of considerable facilities. Along the south-western coast of Southeast Asia, four such pairs of cities can be identified (Figure 6.4):

(1) Ho Chi Minh City—Vung Tau,
(2) Phnom Penh—Kompong Saom,
(3) Bangkok—Eastern Seaboard, and
(4) Yangon—Moulmein.

The Bangkok-Eastern Seaboard area is by far the most developed and constitutes in fact a large urban complex, which may develop into a huge conurbation. The area is served by the ports of Bangkok, Laem Chabang and Map Thaput. Ho Chi Minh City together with Bien Hoa and Vung Tau,

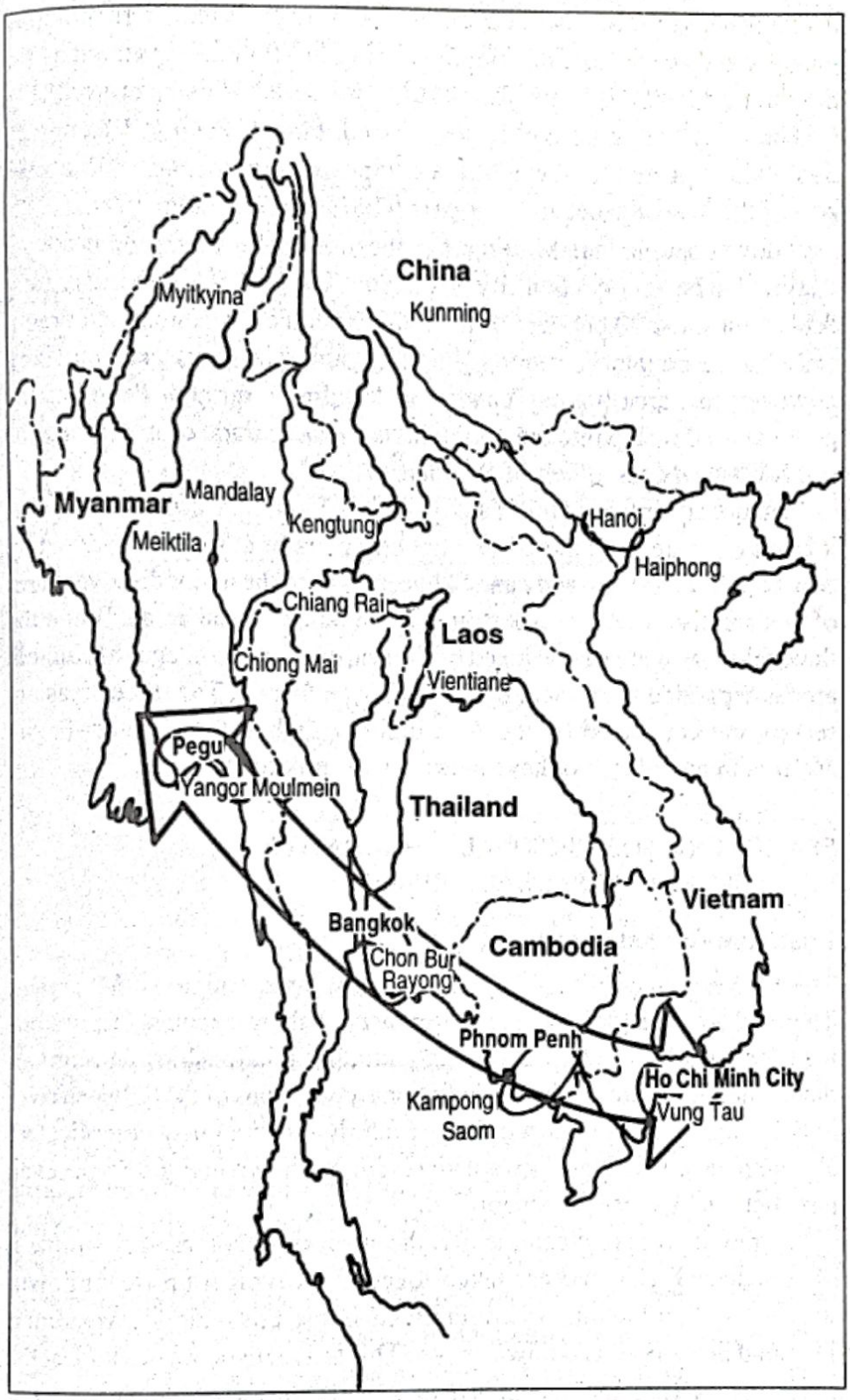

Figure 6.4. Industrial and trade centres along south-western coastal belt of Southeast Asia

is identified as the southern economic focal area in Vietnam for complementary and accelerated development. Ho Chi Minh City is served by the Saigon port, and the Vung Tau port is considered as its outer port.

The other two areas are less developed. Phnom Penh and Kompong Saom are expected to develop in a complementary manner with a river port of the Mekong and an outer port. The Yangon-Moulmein area is the least developed. In fact, Moulmein at the mouth of the Salween is not yet qualified to be a companion city of Yangon. The port of Yangon at present deals with some 90 per cent of the total exports of Myanmar and practically all the country's imports. Just like other city pairs or complexes, however, this area linking Yangon to Moulmein through Pegu has the potential to develop into one of the industrial and trade centres along the south-western coastal belt of Southeast Asia.

A major advantage of this Yangon–Pegu–Moulmein coastal area is that it is the only area, compared to other city pairs or complexes, served by two major rivers: Irrawaddy and Salween. One of the major disadvantages of this area is a weak transport link to the other coastal areas. While the three other areas are easily linked by the sea, the Yangon–Pegu–Moulmein area is separated from them by the Malay peninsula. The three areas are served and connected by the Asia highway, while the Yangon–Pegu–Moulmein area does not have a direct road link to Bangkok.

FRAMEWORK FOR REGIONAL COOPERATIVE DEVELOPMENT OF SALWEEN RIVER

Upstream-downstream Issues

The Salween river basin is shared by only three countries: Myanmar, Thailand and the PRC (Yunnan province). Taking account of possibilities for trans-basin water diversion and other relationships with immediately neighbouring basins, jurisdictional conditions of the Salween river may be classified as shown in Figure 6.5. It appears fairly complicated, although only three countries are involved. As shown in Figure 6.5, seven jurisdictional patterns are identified.

Despite its apparent complexity, the situation becomes very simple if Myanmar and Thailand are taken together. A typical upstream-downstream 'conflict' setting arises: the PRC in the upstream vs. Myanmar/Thailand in the mid- and downstream. This is a realistic way to look at the situation. As Thailand occupies only a small portion of the basin downstream, she has a strong incentive to work closely with Myanmar.

In general, upstream-downstream conflicts arise from the following:

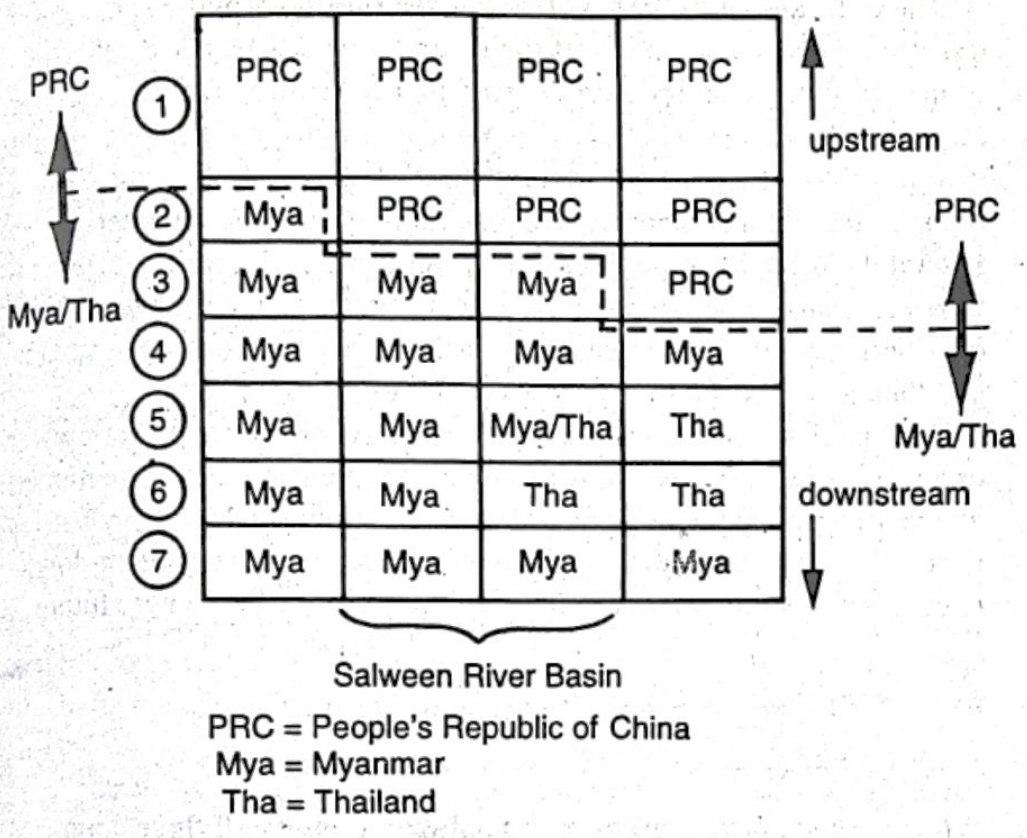

Figure 6.5. Jurisdictional conditions of Salween river basin and its immediate vicinities.

(1) consumptive use of water in the upstream, typically for irrigation and trans-basin water diversion,
(2) physical transformation of water and land regimes upstream such as deforestation, improper soil management, and construction of dams and other structures, and
(3) discharge of wastewater or disposal of wastes upstream.

These conditions do not seem to become serious in the Salween river basin, at least not in the near future. As noted earlier, irrigation opportunities are very limited upstream due to the narrow basin with mountainous topography, and massive settlements are unlikely to develop due to steep slopes. Also noted is that the trans-basin water diversion to the Mekong flowing side by side with the Salween in the east/north-east is unrealistic, as the flow in the Mekong is much larger and has a seasonal distribution similar to that in Salween. The diversion to the Tibet plateau in the west/south-west is even less likely. Thus, the consumptive use of water in the Salween upstream would not be an issue.

The water and land regimes of the Salween upstream may be physically transformed by construction of dams, extensive logging and other improper land uses. As for dam construction for hydropower generation, there is little reason to believe that Yunnan province of the PRC would give priority to the Salween rather than the Mekong. In fact, the PRC is reported to have a comprehensive plan for the upper Mekong basin with several dams for hydropower and flow regulation. Hydropower generation represents a non-consumptive use of water, and the changes in flow distribution would be more marginal in the case of the Mekong upstream, and thus more acceptable for downstream interests.

Serious changes in water quality arising from discharge of wastewater or disposal of wastes upstream are unlikely for the same reason mentioned above. Extensive logging and establishment of pulp and paper industries are not foreseen. All in all, it is quite unlikely that serious upstream-downstream issues would be raised for the Salween river in the near future.

Myanmar-Thailand Cooperation

Realistic Setting

While the joint development of the Salween river by all three countries is not an immediate possibility, Myanmar-Thai cooperation is a realistic issue. Opportunities exist for joint hydropower development by Myanmar and Thailand, with an option to divert water in the Salween river to the Chao Phraya river in Thailand. As described earlier, several schemes have been proposed and studied on rivers bordering Myanmar and Thailand, including the Salween and its tributary, the Moei.

The Myanmar government attaches priority to development schemes which fall entirely within its territory for socio-political and security reasons. From a technical point of view, the trans-basin water diversion seems most feasible from the midstream where a proposed dam site is close to the border with Thailand and the river flow can be most effectively regulated. The Nippon Koei study in 1993 took this view and examined the middle reach dam in more detail. Although the trans-basin diversion option was tentatively 'abandoned' due to insufficient data, this scheme seems to be still the most promising one for joint development between Myanmar and Thailand, since the dam and the reservoir would be entirely within Myanmar and access to the dam site is relatively easy. Also, this dam site would allow the largest water storage for most effective flow regulation as clarified by the Nippon Koei study.

Opportunities for Benefit Sharing

A prerequisite for any joint development is that it should benefit all the participants. In the case of joint development of the Salween river for hydropower generation and trans-basin water diversion, benefits to Thailand are clear. Power benefits alone would justify the active participation of Thailand in the joint development.

In 1992 the total power demand in Thailand at the generation end was 8877 MW, with the annual energy generation of 56021 GWh. Both peak power and energy generation had grown at annual rates much higher than 10 per cent since 1987. The average annual growth during 1981–92 was 11.9 per cent for peak power and 12.1 per cent for energy. The total installed capacity of the EGAT system serving the whole of Thailand was 11,033 MW in 1992, consisting of 2429 MW hydropower, 5507 MW oil/gas and lignite-fired thermal, 2860 MW combined cycle and 238 MW gas turbine. In addition, EGAT purchases energy from the Nam Ngum dam and hydro-power plant in Laos. The EGAT power supply system is planned to be connected with a plant of 300 MW in Malaysia for completion in 1997.

Water to be diverted to the Chao Phraya river system would benefit Thailand in several ways as indicated earlier. It would certainly increase the output of existing hydropower plants and allow the second rice crop in the existing Chao Phraya irrigation system. It may improve navigation conditions in the central plain and also the water supply system for Bangkok through the alleviation of water pollution and seawater intrusion caused by the drawdowns of the Chao Phraya flow levels.

The benefits of joint development from the Myanmar point of view are less pronounced. Power demand in Myanmar is smaller by one order of magnitude than that in Thailand, and other potential benefits due to flow regulation are more subtle.

The total installed capacity of MEPE was 670 MW in 1993, consisting of 278 MW hydropower, 60 MW steam turbine and 332 MW gas turbine. The MEPE power supply system generated 2320 GWh in the year 1987–88.

The middle-reach dam planned by Nippon Koei would increase the dry season discharge of the Salween by some 500 m^3/sec. The lowest natural discharge of 760 m^3/sec at this dam site can be increased to 1260 m^3/sec. The increased discharge can benefit Myanmar in different ways. It would improve navigation conditions on the Salween river. If the increased discharge is devoted entirely to irrigation, some 500,000 ha may be irrigated

in the Moulmein plain. The increased discharge would make the trans-basin water transfer a realistic option from the Myanmar point of view as well. Even if the water is diverted at 100 m^3/sec during the dry season, as examined by the Nippon Koei study in 1993, sufficient benefits would also accrue to Myanmar.

Another potential benefit of the middle-reach dam is flood control. Storage of flood water in the dam reservoir would allow reduction of flood peaks and volume of flood water discharged downstream. The flood control benefit would depend on development levels of the areas susceptible to flooding along the lower reaches of the Salween, which would in turn depend on the development and use of the river.

The basic idea of the trans-basin water diversion is to store flood water during the wet season for use during the dry season. Therefore, the amount of water diverted should not affect the reduction of flood peaks or volume of flood water discharged downstream. If water diversion is also allowed during the wet season, however, flood peaks and volume of flood water may be further reduced and additional benefits derived for Myanmar.

In sum, opportunities for benefit sharing related to the joint development of the Salween river are presented by (1) generation and allocation of hydropower, and (2) regulation of river flow itself by the dam. The former are explicit and straightforward. Benefits related to the latter are more complicated. Benefits due to low flow augmentation can be shared between Myanmar and Thailand. Benefits of flood control in Myanmar would depend on benefit sharing for low flow augmentation and these are interrelated by the trans-basin water diversion (Figure 6.6).

Principles for Cost Allocation

Proper benefit sharing is only a necessary condition for successful joint development. Other than solving socio-political and institutional problems as well as technical problems, a sufficient condition for the joint development to be successful is that costs involved in the development would be allocated to participants in a mutually satisfactory way.

Problems of cost allocation have been studied rather extensively in the past, particularly those related to water resources development, and principles applicable have been well examined (e.g. Young et al., 1982 and Hashimoto, 1982). In particular, two well-established principles may be described as follows:

(1) 'Separable' costs involved in a project for multiple uses (purposes) should be allocated to respective users.

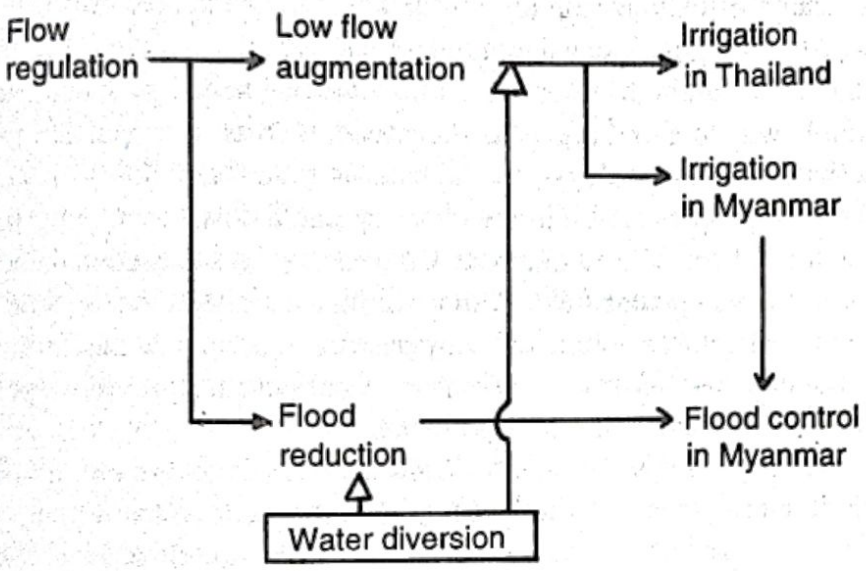

Figure 6.6. Interactions of irrigation and flood control benefits through trans-basin water diversion.

(2) 'Joint' costs of the project after allocation of the separable costs should be allocated to different uses in proportion to some acceptable measure of benefits associated with respective uses.

These principles are explained first, based on the present case of the Salween river development. Costs involved in facilities for trans-basin water diversion such as a conveyance tunnel/canal, surge tank and pump station are 'separable' as those facilities are used exclusively for this purpose. These costs should be naturally borne by the user/beneficiary of the water diversion. This is only a part of 'separable' costs. 'Separable' costs used in the above context are in fact *marginal* costs of adding this particular use to the project after the project has been planned first for all other uses. Suppose the Salween river development is planned for hydropower generation, irrigation and flood control without the trans-basin water diversion. If the water diversion were to require additional regulation of the river flow and thus additional storage capacity, incremental costs associated with a higher dam would constitute a part of 'separable' costs to be borne by the water diversion.

Charging separable or marginal costs to each use would not usually add up to the total cost because of the scale economy involved in large-scale water resources development. 'Joint' costs represent the difference between the total project cost and the sum of separable costs allocated to respective uses. A straightforward application of the second principle is to allocate the joint costs in proportion to estimated benefits of different uses. Here a pragmatic consideration is in order. This method of cost allocation may result in the allocated costs exceeding benefits for some uses. A simple way to avoid this is to allocate joint costs in proportion to the benefits minus separable costs. The latter is called 'remaining' benefits.

These principles are built in for the separable-costs–remaining-benefits method of cost allocation, most widely accepted and used in the water resources development field. Although this cost allocation method has inherent problems, as pointed out by past studies, such as the definition of remaining benefits and the estimate of benefit itself, it provides a practical method to solve real world problems.

It may be useful here to use the Salween river development to further clarify the principles. Addition of trans-basin water diversion to the project may make additional storage available for flood control, or given the same flood control level, the dam height may be reduced. This means that the joint costs of the project would be reduced. In reality, this would not be the case. Given the same levels of benefits for other uses, the water diversion would call for additional storage to further regulate the river flow, and hence additional costs. The point is that flood control and water diversion (or more generally low flow augmentation) are complementary to each other so that separable or marginal costs to be incurred for respective uses are smaller than in the case where only one of these uses is involved in the project. The other side of the story is that since the marginal costs decrease with the presence of the other use, allocation of joint costs would remain a more critical problem.

Water Pricing for Trans-basin Diversion

Under the middle-reach dam scheme, the dam and the reservoir would be entirely within Myanmar. Except the upstream catchment area within the PRC, even the catchment area of the dam is entirely within Myanmar. In other words, any drop of water in excess of the flow at the border between Myanmar and the PRC belongs to Myanmar. It seems reasonable then that the water to be diverted should be properly priced. Application of the principles of cost allocation may provide a basis for this water pricing.

For simplicity, a dual purpose development is examined here with

hydropower generation and trans-basin water diversion. Cost allocation between Myanmar and Thailand is analysed with and without water diversion. The case without water diversion represents a single use development in the sense, discussed above, so it seems that there exist no separable costs. Joint costs or in fact the total project cost, may be allocated to the two countries in proportion to the energy that they would agree to allocate. However, to be precise, there exist separable costs even in this case. For instance, costs involved in transmission systems for respective countries should be accounted for separately.

Alternatively, the energy use in Myanmar may be taken separately from the energy use in Thailand to define this development as a project with two uses. Separable or marginal costs of satisfying respective energy uses can be calculated by assuming alternative methods for the two countries to satisfy their respective energy needs. Joint costs after allocating the marginal costs to respective uses may be allocated in proportion to the agreed energy uses.

The results obtained by the two ways applied to the same method would be different. While the first way of application is more simple and straightforward, there is no theoretical ground to call one method better than the other. Selection would be based on practical considerations, depending, among other things, on the bargaining positions of the two countries. However, since neither Myanmar nor Thailand can implement the project alone for different reasons, bargaining on theoretical possibilities can and should be avoided.

If development with water diversion is considered, separable or marginal costs for hydropower generation and water diversion can be estimated. The separable costs for hydropower generation can be allocated to Myanmar and Thailand in the way discussed above. The separable cost for water diversion should be borne exclusively by Thailand. They consist of costs associated with facilities used exclusively for water diversion and a portion of the costs involved in common facilities, mainly the dam.

Joint costs would remain to be allocated. First, the joint costs can be allocated between the uses: hydropower generation and water diversion. A simple way is to allocate the joint costs in proportion to estimated benefits of hydropower and diverted water. The portion of the joint costs allocated to hydropower should be further divided between Myanmar and Thailand using the same method as used for the allocation of separable costs for hydropower. The remaining joint costs allocated to water diversion should be borne by Thailand.

Situations are illustrated in Figure 6.7 for the with and the without water

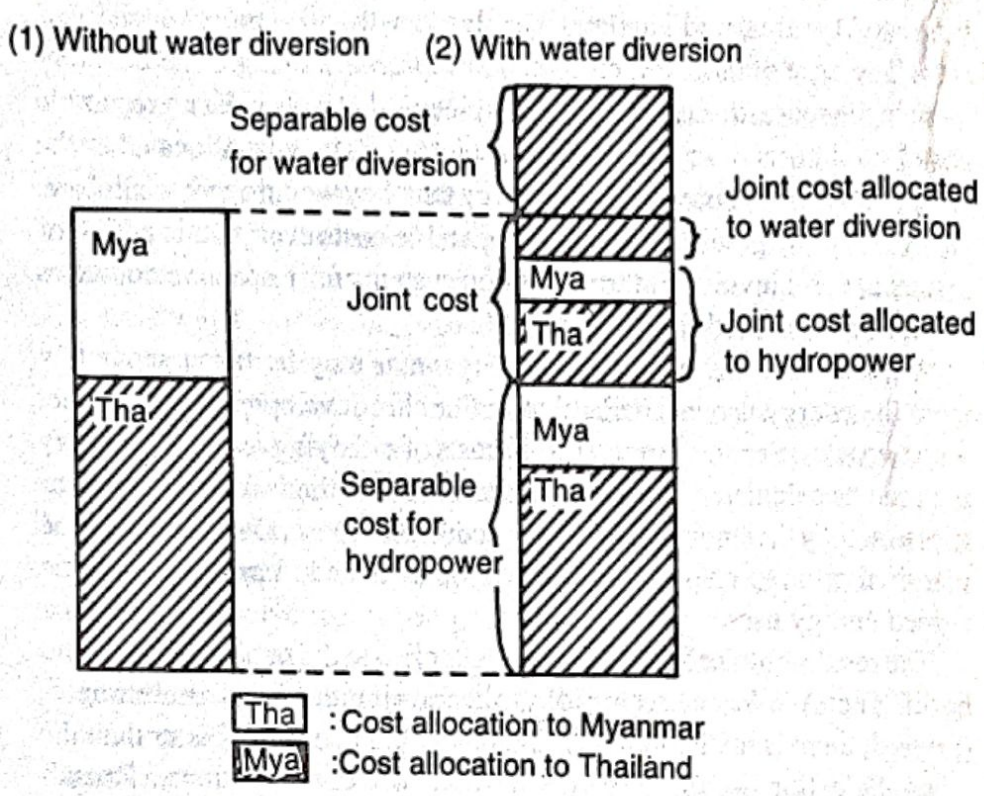

Figure 6.7. Cost allocation to Myanmar and Thailand for dual purpose development with hydropower generation and water diversion.

diversion cases. As shown, the portion of joint costs to be allocated to water diversion use would provide a basis for proper water pricing. The separable costs for water diversion to be borne by Thailand consist not only of the costs of facilities used exclusively for water diversion but also a portion of dam costs.

According to the Nippon Koei study in 1993, costs of the dam and hydropower plant would not increase in practice, even if water diversion is added to the project. If this is the case, as illustrated in Figure 6.7, the total cost to be allocated to Myanmar would be slightly reduced by addition of the water diversion. In addition to the separable or marginal costs for water diversion, Thailand would be expected to support this use through water pricing.

Broad Regional Cooperation

Regional Links

Regional cooperative development of the Salween river was examined above from two perspectives: (1) upstream-downstream issues (the PRC

vs. Myanmar/Thailand), and (2) Myanmar-Thailand cooperation. The regional transport links described earlier add another dimension to the situation.

As already mentioned, the Kunming–Ruili–Lashio link would contribute more to the integration of economies within Yunnan Province. This, in fact, would increase potential conflicts with the downstream countries. On the other hand, the Kunming–Keng Tung link would contribute more to the integration of economies of Myanmar, Laos, Thailand and Yunnan province of the PRC. This may expand opportunities for regional cooperative development related to the Salween river. Thus, the planning for the Salween river development would have to take account of links with Yunnan province, the Chao Phraya river basin in Thailand and even Laos. This point is further clarified below, focusing on the development of the mid-to downstream areas of the Salween.

South-western Coastal Development with Water Diversion

Justification of the possible trans-basin water diversion from the Salween river within Myanmar to Thailand raises a classic issue of 'water to people or people to water'. The only difference here is that the water source and the recipient are in different countries. In general, it is more natural and sound to try to develop a region with plenty of water resources rather than bringing costly water to a megalopolis by artificial means. In the present case of water diversion from the midstream of Salween, however, there seem to exist a few practical reasons to favour the option of 'water to people'.

First, as a basic premise, regional cooperative development of the Salween would need continued growth of the Thai economy. Thailand would have to provide a large market for the economies of neighbouring countries to justify the proposed regional transport links. Thailand is expected to provide the financial as well as technical cooperation necessary to realize the planned development.

Second, the continued growth of the Thai economy depends critically on the Chao Phraya river basin, where the most productive agricultural areas, most viable industrial areas and the capital of the kingdom are all located. The Chao Phraya river basin faces serious water shortages that would constrain the further development of the Thai economy. Typical problems, already mentioned, are the low water levels in reservoirs for hydropower generation, insufficient irrigation water, pollution of river water and seawater intrusion. The latter two problems pose serious problems in the water supply for Bangkok.

All in all, the Chao Phraya river needs additional sources of water. There

are only two options available: Mekong and Salween. Water diversion from the Mekong would involve more difficult negotiations with downstream countries: Laos, Cambodia and Vietnam; water diversion from the Salween would involve in principle only bilateral negotiations with Myanmar. In fact, since Thailand has such a small territorial claim within the Salween river basin, she does not have any other option than working closely with Myanmar for joint development of the Salween.

Third, on the Myanmar side, the water demand along the mid-to downstream reaches of the Salween is quite limited and will remain so in the foreseeable future. Irrigation development in the midstream area is constrained by the topography. The irrigation potential downstream may be 1.6 million ha, while theoretically up to 3 million ha can be irrigated if the Salween river flow is fully regulated.

The demand for domestic and industrial water may expand rapidly in Myanmar, especially along the coastal area. As indicated earlier, the Yangon–Pegu–Moulmein area may become another industrial and trade centre along the south-western coastal belt of Southeast Asia. As also noted, compared with the other industrial and trade centres, the Yangon–Pegu–Moulmein area is the only area served by two major rivers. Water supply to this area from either the Irrawaddy on the Salween would be technically quite easy.

The population of the Yangon–Pegu–Moulmein area is at present probably about 5.5 million, while the population in the Bangkok–Eastern Seaboard area exceeds 10 million. The average annual discharge of Chao Phraya is 960 m^3/sec, while the Salween river alone has a 3880 m^3/sec annual discharge. The average annual discharge of the Irrawaddy is about 12,700 m^3/sec. All of these conditions indicate that trans-basin water diversion from Salween to Thailand deserves serious consideration.

Some Principles

For joint development of the Salween by multiple countries, certain principles need to be observed. They are summarized here, based on the issues discussed above, from a broad perspective of regional cooperative development.

The following basic principle seems to be indisputable:

(1) Planning for the Salween river development should be conducted within a broad regional development framework, reflecting transportation links with areas outside the basin for increased economic interactions and trans-basin water diversion as well as sharing of hydroelectric energy.

More specifically, the following factors apply to individual cases of development:

(2) Myanmar and Thailand need to be consulted in advance in case of consumptive use of water by the PRC.
(3) Construction of dams and other structures upstream by the PRC, which could change the flow regime, should be planned and discussed by the three countries, considering complementary operation with downstream structures and facilities.
(4) Water diversion from the Salween to Thailand should be planned not only to reflect its effects on water uses in Myanmar but also to promote overall regional development and to optimize benefit sharing among countries concerned.

In the case of hydropower development, the following may be established as a matter of principle:

(5) Development of hydropower potential existing within Myanmar is a matter to be decided first by Myanmar; joint development with Thailand requires prior agreement on cost allocation as well as benefit sharing (i.e. allocation of generated energy).

Cost allocation and pricing of water to be diverted should be guided by the following principles:

(6) Separable or marginal costs of multi-purpose development should in principle be allocated to respective purposes/uses; this consists not only of costs of facilities used exclusively for a particular use (e.g. water diversion) but usually also a portion of costs of common facilities (e.g. multi-purpose dam).
(7) In the case of joint development with a single purpose, the total cost would better be allocated simply in proportion to expected benefits to different participants.
(8) Water to be diverted from the Salween river to Thailand should be properly priced, based on the joint costs of the multi-purpose development allocated to this purpose/use after separable costs are accounted for by respective uses/countries.

SOME PROPOSALS

General Perception and Proposals

The potential and opportunities for the Salween river development have already been described, and some typical issues involved in the joint

development of Salween have also been clarified from the three interrelated viewpoints: upstream-downstream issues, Myanmar-Thai cooperation, and broad regional cooperation. The present situation of the Salween river development may be perceived from these preceding discussions and summarized as follows.

First, the joint development of the Salween river by Myanmar and Thailand is not a remote possibility. Thailand needs water as much as hydropower. Myanmar is ready to enter the international arena, and improvement of various infrastructure would provide the means and opportunities for Myanmar to interact with external economies.

Second, serious upstream-downstream conflicts through the development of the Salween upstream by the PRC are not likely yet, but links with Yunnan province are important factors to be considered in the development of the Salween river basin. At present, the most popular link between Myanmar and the PRC is the Kunmin–Lashio–Mandalay link which crosses the upstream basin of the Salween within the PRC. Most recently, new railway construction was initiated by a Chinese firm to link Mandalay and Myitkyina, which may be linked to Kunming crossing the Salween further upstream (Economist, 14 October 1994). Another link from Kun-ming to Keng Tung near the eastern boundary of the Salween river should be looked into more carefully in the light of regional development integrating the economies of Myanmar, Yunnan province, Laos and Thailand.

Thus, the joint development of the Salween river is already real, if a broad regional development perspective is taken. It is therefore recommendable that the three riparian countries should soon establish a joint committee or forum to discuss regional cooperative development related to the Salween. Technical issues for individual developments may not be on the agenda for the committee/forum. Rather, principles for regional cooperative development should be discussed and agreed upon by the three countries.

Discussions at the committee/forum would take place among various unforeseeable events, which could not be settled even through a long series of meetings. One agreed outcome, therefore, should be to establish a permanent body to monitor and evaluate activities taking place in and around the Salween river basin. Past studies of the Salween covered only engineering and economic analyses. Socio-cultural and environmental aspects have been almost totally neglected. The proposed monitoring and evaluation system would deal mainly with these aspects.

Proposed Approach

The proposed committee/forum of the three riparian countries would be for discussion and resolution of guiding principles. Planning for specific development activities should be conducted separately by a participatory approach. Participatory development is an idea that has become increasingly popular among development consultants and others. The first step of participatory development is to involve the local communities likely to be affected by any planned development, in the planning process. Local communities are likely to be more active in the implementation of any development planned by themselves. The implemented development would be monitored also by the local communities, and monitored results reflected in future planning. Since the planning process ideally is continuous with such a feedback mechanism, participation in planning is the basic form of participatory development.

Several ethnic groups can be identified in and around the Salween river basin. Existing ethnic problems should be seen as an advantage rather than obstacles for the joint development of Salween. Ethnicity does not observe national boundaries. Communication among .local people between Myanmar and Yunnan province of the PRC, and between these countries and Laos and Thailand could be fostered. It is essential for the successful implementation of any development project that local communities in general, and ethnic groups in particular, should be involved in the planning at an early stage.

Participation cannot take place in a vacuum. The middle-reach dam and hydropower development project with the water diversion option is taken here as an example. The technical and economic viability of this project has been established by preliminary studies, but socio-cultural and environmental aspects have not been examined. A few main issues need to be addressed here. First, the habitat of the Shan people, dominant in the mid-river basin of the Salween, extends beyond the basin boundaries to the east and the west. The Shan people are ethnically closer to the Siam and the Lao people. Second, the trans-basin diversion of the Salween waters to Chao Phraya would certainly involve the transfer of some biota, as well as other environmental effects due to changes in flow regimes. Third, relocation/resettlement and livelihood development of original inhabitants as a result of water impoundment need to be planned as an essential part of the project.

The first step to prepare for an early implementation of the project

would be to conduct a comprehensive environmental inventory and impact analysis, covering not only the natural but also the social environment. As a body to oversee this environmental study, as well as further project planning and implementation, a tripartite system should be created consisting of the concerned governments, local communities and other experts. The environmental monitoring and evaluation system would provide an effective medium for local participation.

In this tripartite system, international aid organizations could participate as facilitators. An important function of these facilitators would be to finance tripartite meetings and provide additional technical inputs necessary for studies and project development. Proper government agencies and international experts would also be invited to clarify ongoing activities, deal with technical aspects involved in development and identify possible financial sources including the private sector. The optimal scheme to implement the project should be worked out through a series of dialogues under this system, supported by broad expertise and social agreement.

Proposals for Subsequent Actions

Since the regional cooperative development of the Salween is a real possibility, some issues will need to be addressed in the near future, particularly related to the middle-reach dam and hydropower development project with the water diversion option. These issues include (1) benefit sharing and cost allocation, (2) technical options for water diversion, (3) complementary development of the Yunnan province of the PRC, the Salween river basin, and the Chao Phraya river basin in Thailand, and (4) stage-wise development schemes.

Benefit Sharing and Cost Allocation

Consistent formulae need to be established and agreed upon between the riparian countries for benefit sharing and cost allocation. Basic concepts should be clarified first, related to separable or marginal costs, joint costs and allocation proportional to benefits as discussed earlier. This does not mean, however, that pragmatic aspects should be neglected, e.g. the shouldering of allocated costs by a third party.

Another point to be clarified is the proprietary issue related to resources. Direct application of territorial jurisdiction should not be taken for granted. If the net usable amount of water increases by construction of a dam, supported by another country undertaking joint development, who can claim proprietary use of these newly 'developed' resources? This

issue also has its pragmatic aspect. If a larger portion of the net increase is allocated to Myanmar, larger irrigation benefits would be realized by Myanmar. This would in turn increase flood control benefits in the future as well. If the principle of cost allocation proportional to benefits is applied, Myanmar would have to bear larger costs.

A related issue is how to estimate benefits to begin with. Since any cost allocation method uses some kind of measure for benefits as a vehicle of allocation, this issue is unavoidable. Even population can be used as a surrogate for benefits, if participants agree. The key is, of course, a consistency in benefit estimates accepted by all the participants.

Technical Options for Water Diversion

As clarified by the Nippon Koei study in 1993, trans-basin water diversion is very costly, although the calculated unit cost of the diverted water is smaller than prevailing water charges. The high costs are due to the long distance over which water has to be conveyed and pumped up over hilly terrain. Conveyance of water over many kilometres is less uncommon than pumping up by 200–300 m. The latter would demand large electricity costs continuously during operation.

An option is to use more extensive tunnel sections for conveyance. This would increase the construction costs but the operation cost would be much reduced. The tunnels, however, would become highly strategic objects, and may not be acceptable. Another option may be to change the dam site slightly to optimize water diversion at the cost of hydropower generation or flow regulation efficiency.

Complementary Development of Economic Spheres

As discussed earlier, the economies of the Yunnan province in the PRC, the Salween river basin in Myanmar and the Chao Phraya river basin in Thailand are interrelated, and the water resource development in the Salween river and transportation links are the main linking factors to strengthen these interrelationships. Conversely, if complementary aspects of development of these economic spheres are recognized from a broad regional development perspective with division of work/functions, decisions by these countries may be different on how to allocate water resources and which transport links should be strengthened.

In particular, the development of the Yangon–Pegu–Moulmein industrial and trade centre may be planned better in relation to the Bangkok–Eastern Seaboard development to identify particular industries to be located and some specialized functions to be satisfied in the downstream

areas of Irrawaddy and Salween. The decisions by Myanmar may change in favour of the trans-basin water diversion, in return for increased technical and financial cooperation by Thailand for the establishment of this new industrial and trade centre, especially when the ethnic relationships in and around the Salween river basin support the water diversion (Figure 6.8).

State-wise Development Schemes

The middle-reach dam and hydropower development project is a large-scale undertaking with huge construction costs. As such, it is not amenable to any stage-wise development scheme. However, full exploitation of physical potential is already not a popular idea. There may be possibilities to reduce the scale of the initial development, and compensate partially for the reduced output by development at a later stage.

Despite many studies in the recent past, the Salween river development has not been studied taking a river-basin approach. In parallel with the

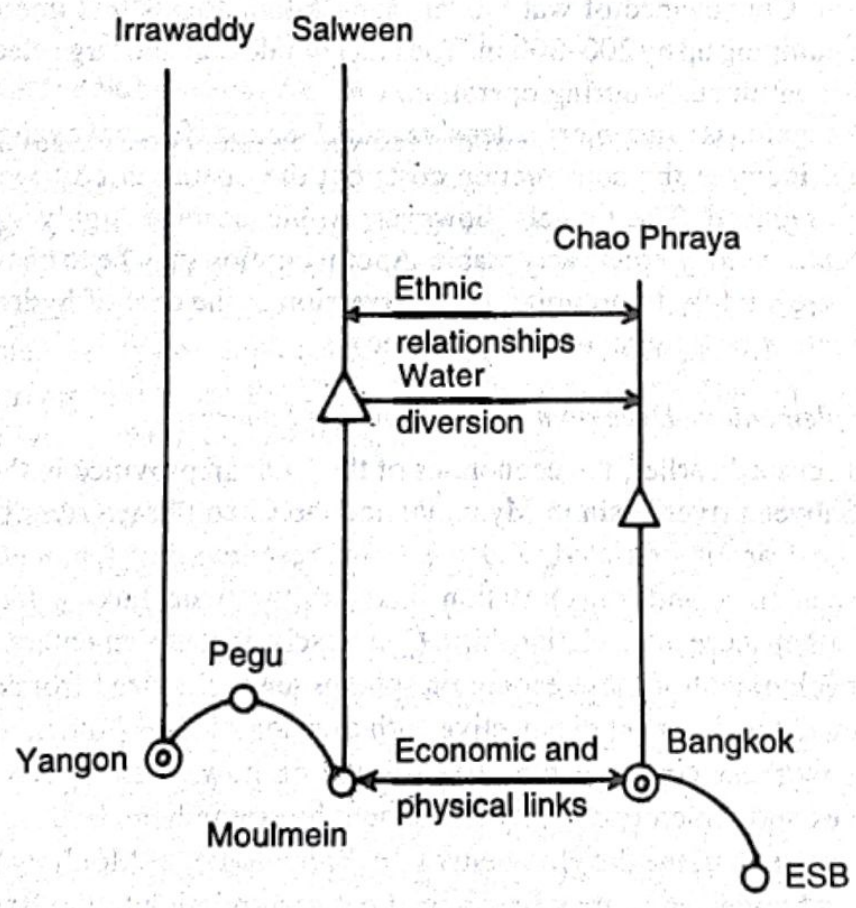

Figure 6.8. Complementary development of economic spheres with water diversion from Salween to Chao Phraya.

environmental study mentioned above, it may be meaningful to prepare a comprehensive development plan for the Salween river basin with a constraint on the scale of initial development. Or, after such a basin plan is prepared, more parties may be convinced that the initial development on a full scale would be viable not only technically and economically but also socio-culturally and environmentally.

CONCLUSIONS

The joint development of the Salween river is a realistic project, particularly if a broad regional development perspective is taken. It should then be seen as symbolizing large-scale water resources development in a new era in certain meaningful ways.

First, it should be conducive to further promotion of economic interactions between Myanmar, the PRC and Thailand by supporting various production and trade activities taking place increasingly, regardless of the political borders.

Second, the joint development of the Salween should embody the environmental concerns not only of these riparian countries but also of the international community. It would be more than appropriate for Myanmar to re-enter international society with a clear expression of her concerns on the environment.

Third, social issues should be properly addressed for any development activities related to the Salween. This would certainly mean more than the relocation/resettlement of people to be displaced by the development and compensation for them. Infrastructure development is only the means to realize social development; it is not an end by itself.

To incorporate these concerns and needs into the Salween river development, a participatory approach is highly recommended. This may sound unrealistic, even if the world is moving rapidly in favour of participatory development, given the commanding state initiative in the development plans of all the three riparian countries. On the other hand, an effective participatory approach can be taken only under strong administrations and stable socio-political conditions.

Participatory development appears to be tedious, when there exist urgent needs for power and water supply. However, even the most promising scheme for the initial development of the Salween would take twelve years for completion, according to the 1993 Nippon Koei study. This period would easily double if local opposition is encountered. Successfully establishing and building in a participatory mechanism from the

beginning of the planning process will make a real difference in the long run.

A participatory approach needs to be complemented by a broad regional development approach. While the former would assure better satisfaction of social needs in areas immediately influenced by any development activities, it would tend to miss other opportunities outside, which would in fact also contribute to social development. By taking a broad regional development approach, economic activities in different areas and countries may be planned in a complementary manner. It may happen, for instance, that the development of the Chao Phraya river basin with additional water supply from the Salween river would benefit economies of the Yangon–Pegu–Moulmein area in Myanmar. Socio-economic activities of the Shan people within and outside the Salween river basin may be integrated for realization of social benefits at a higher level.

A participatory approach would certainly draw attention and invite support from organized communities and the environmental movements internationally. This would help to assure the incorporation of social interests and environmental concerns in the planning and implementation of the Salween river development project.

Some people are sceptical about the intentions of organized communities and the environmental movements. They are often seen as anti-development and anti-mega infrastructure projects. These, in turn, represent the scepticism on the part of the organized communities and the environmental movements about state initiatives for infrastructure development, which in the past have often resulted in environmental degradation and social disruption.

The scepticism can be overcome on both sides with proper planning and involvement. It would be highly commendable if the joint development of the Salween river should turn out to be one of the first successful cases of regional cooperative development to serve social needs and environmental concerns as well as economic interests, rather than one of the last cases of state command development, sacrificing social values and environmental quality in favour of national economic interests.

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