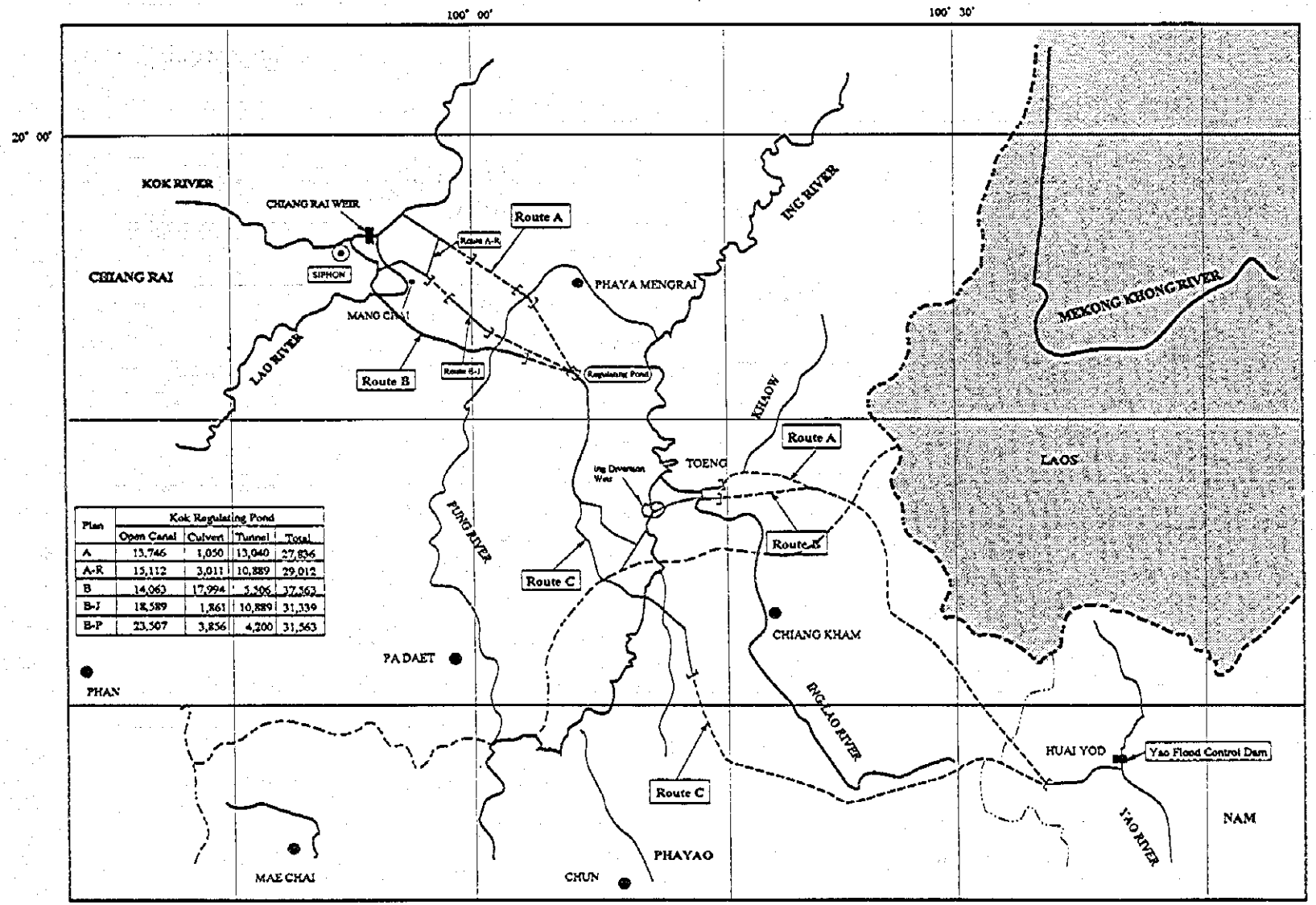
CHAPTER 2 RECOMMENDATIONS

Finally, it will be concluded that the Environmental Impact Assessment (EIA) be indispensable in the next stage of the study, focusing on the above-mentioned issues. In the EIA study, the activities of the public relations in association with social environmental impacts induced by the Project and the proposal of the enhancement/mitigation programs to facilitate rural development under people's participation, both of which are closely related to each other, should be given high priority.

The Kok-Ing-Nan Water Diversion Plan should be really a strategic development plan. Therefore, the Project should be planned and implemented to meet the above development concepts, that is, to maximise the benefit of the people affected/people related and facilitate people's participation in the whole project cycle of planning, implementation, monitoring and evaluation. Furthermore, to secure the sustainable environmental development, the co-operation /collaboration among government agencies concerned and provincial governments will be strongly required.



Plan	Kok Regulating Pond			
	Open Canal	Culvert	Tunnel	Total
A	13,746	1,050	13,040	27,836
A-R	15,112	3,011	10,889	29,012
B	14,063	17,994	5,506	37,563
B-J	18,589	1,861	10,889	31,339
B-P	23,507	3,856	4,200	31,563

Alternative Diversion Routes

Chart - 1 **Flow Conditions before and after water Diversion in Kok & Ing Rivers**

Unit : MCM

Kok River	Present Situation			Proposed Scheme	After Project
	Run off	Volume to be used for irrigation development	Avaialble Flow	Diverted Flow	Remaining (Residual) Flow
Proposed Diversion Site	3,800 MCM/year (Wet 2,944 / Dry 851)	1,200 MCM/year	2,600 MCM/year (Wet 2,248 / Dry 358)	1,100 MCM/year (55%) (125 m³/sec)	1,500 MCM/year (Wet 1,210 MCM / Dry 290 MCM)

Ing River	Present Situation			Proposed Scheme	After Project
	Run off	Volume to be used for irrigation development	Avaialble Flow	Diverted Flow	Remaining (Residual) Flow
Proposed Diversion Site	1,730 MCM/year (Wet 1,588 / Dry 145)	680 MCM/year	1,050 MCM/year (Wet 1,011 / Dry 41)	900 MCM/year (45%)	150 MCM/year (Wet 115 MCM / Dry 35 MCM)

Yao/Nan Rivers					
				2,000 MCM/year (175 m³/sec)	

Chart— 2 Influence of Water Diversion on Flow Conditions of Kok, Ing and Mekong Rivers

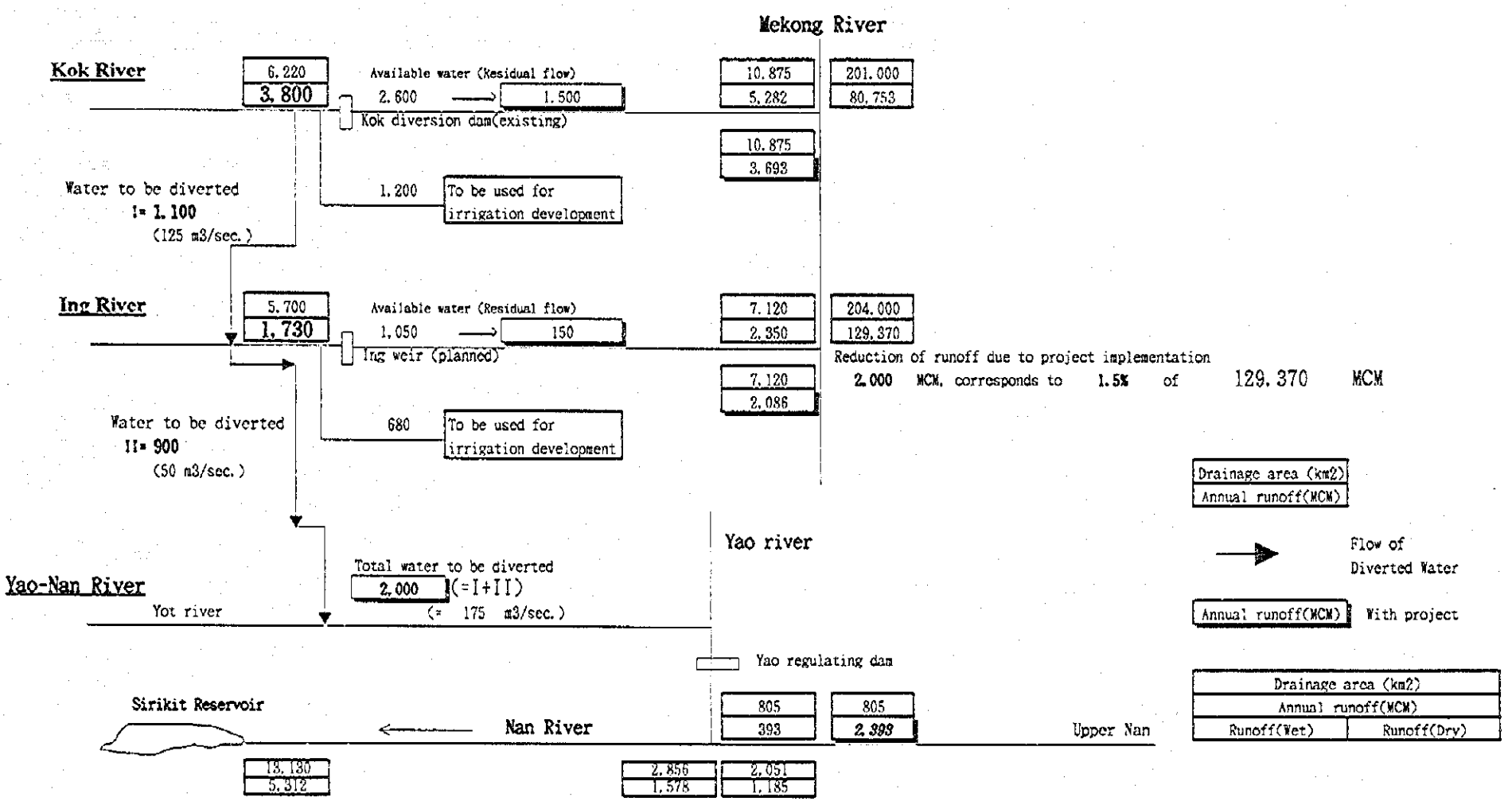


Chart - 3 Summary of Initial Environmental Examination

Diversion route/Problems	Further study	Government Agencies Concerned
① Kok Diversion Dam		
1-1. Construction of a new diversion dam (A route) – Operation under RID's control is possible, but the canal inevitably passes through DEDP's project area	• Confirmation of "People's Irrigation" netwater • Reconfirmation of the irrigation plan of DEDP	Discussion between RID and DEDP. Discussion among RID, Chiang Rai province and DEDP.
1-2. Utilization of the existing diversion dam (B route) – Permission of water use from DEDP. – Operation under RID's control is not possible		
② Kok Diversion Dam – Ing Diversion		
2-1. Land acquisition and Compensation – Due consideration to People's irrigation(A and B routes) Split of community – All routes, particulary in B route with a width of 60~100m	• Topographic survey and confirmation of existing canal and its rights	• Discussion among Chiang Rai province, RID and village community.
2-2. Resettlement – Approximate 20 households will be required for Routes A and (A–B)	• Route selection and detail investigation of current situation of affected villages(land ownership and economic situation etc.)	• Discussion among Chiang Rai province, RID and affected village community.
2-3. Influence on Wotland – Effective utilization and conservation (Eco-tourism) of Nong Luang Wetland. (B route)	• Detail survey of vegetation and aquatic ecology of Nong Luang and detail survey of economic activities of the surrounding villages.	• Discussion among RID Chiang Rai province, DOF, RFD and village community
2-4. Tunnel construction and safety measure.– geological situation	• Detail geological survey.	
2-5. The security of open canal and culvert construction – Excavation depth - 20 to 25 m (B route) in association with culvert construction – Excavation volume - 18 million m³ (B route) (Treatment of dewatering during construction, disposal of a large amount of excavated soils and safety measures)	• Detail topographic survey. • Re-study of route selection in due consideration if construction method.	• Discussion among RID, Chiang Rai province and village community
③ Ing Diversion Dam		
3-1. Influence for Wetland – Impacts on ecosystem of fluctuation in water level and change in inundation period by construction of weir and dyke – Contribution to alleviation of flood damage in paddy field by construction of weir and dyke	• Environmental impacts on aquatic ecology and wildlife habitat by construction of dyke.	Discussion among RID, RFD and village community (Establishmont of development concept by people's participation aiming at construction of dyke and conservation of wetland including eco-turism)
④ Ing Diversion Canal – Ing/Yot Tunnel		
4-1. Safety of open canal construction – Excavation with a depth of 40 m (designed by local consultant) ↓ Changed to tunnel (JICA Study Team)		• Topographic and geological survey.
⑤ Ing – Yot Tunnel		
5-1. Tunnel construction and safety – Treatment and effective utilization of excavated rock (6 - 7 million m³) meter – Adverse affects on neighboring villages caused by passage of truck – Effective utilization of excavated rock and soils in terms of quantity and construction schedule (Construction material for canal/dyke embankment and concrete cygregates, etc.)		Discussion among Chiang Rai, Phayao,RID, and RFD regarding treatment and effective utilization of excavated rock
5-2. Inlet/outlet of tunnel, shaft and access road – National Forest Reserve – National Park (under establishment) – Watershed Classification – Reforestation	• Detail survey of social impacts on surrounding community villages during construction • Detail site survey of watershed management and reserved forest regulation in association with an access road from the existing road to tunnel shafts and inlet/outlet of tunnel	Discussion among RID, RFD, village community and OEPP
5-3. Hilltribe issue – Consideration for hilltribe (Yao)of shaft No.4.		Discussion among RID, RFD, Yao hilltribes and NGOs
⑥ Flood Control Dam (Yao river)		
6-1. Dam construction – Watershed Classification and National Forest Reserve – Reforestation plan – Alleviation of flood damage in Yao river – Social impacts on 5 villages (312 households) – Effective utilization of reservoir * Irrigation in dry season	Detail study of existing situation about watershed management/reserved forests regulations for forest resources affected by impounding	Discussion among RID, RFD and Nan province Discussion among RID, DOF, Nan Province, and village community (Study of effective utilization of reservoir)
⑦ Yao River Training		
7-1. River training – Impacts on ecosystem of river bank by river training that secure the discharge capacity of river flow (150~200m³/sec) – Social impacts on 13 villages (1,662 households) along the river by river training (40 km) * Water supply for fish ponds (River/ponds are used for community villages not only for crop cultivation but also for security of aquaculture which is a main suply source of protein in rural community.)	• Detail survey of current socio-economic activities of the affected community villages • Due consideration to ripons aquatic ecology and to socio-economic activities of the affected community villages after river training • Explanation to and public hearings from representatives of the affected community villages about river training	Discussion among RID, village community (chief of villages, chief of women' association, etc.), Nan province and environmental specialist (NGOs inclusive).

Chart 4 Route conditions from Kok diversion to Ing reguiating dike

	A	A-R	B-J	B	B-P (Pump)
Location of intake	New weir 4 km downstream of Existing Diversion Dam	New weir 4 km downstream of Existing Diversion Dam	2 km downstream of Existing Diversion Dam	Intake 2 km downstream of Existing Diversion Dam	Intake 2 km downstream of Existing Diversion Dam
Canal route	Canal passes through the project area of DEDP	Canal passes through the project area of DEDP	Canal doesn't pass through the project area of DEDP	Canal doesn't pass through the project area of DEDP Canal is planned to pass through Nong Luang Wetland	Canal doesn't pass through the project area of DEDP
Natural environment	Fertile paddy field (Likely dominated by people's irrigation)	Fertile paddy field (Likely dominated by people's irrigation)	Paddy field and orchard (Less dominated by people's irrigation)	Paddy field and orchard (Less dominated by people's irrigation)	Paddy field and orchard (Less dominated by people's irrigation)
Social environment	Ban San Salit 20 households affected Canal passes near Ban Wiang Thong	Ban San Salit 20 households affected Canal passes near Ban Wiang Thong	No household affected [2/] Canal passes near Ban Mai Don Kuang	No household affected [2/] Canal passes 5 km south of Ban Mai Don Kuang	No household affected [2/] Canal passes 5 km south of Ban Mai Don Kuang
Geology along tunnel	Poor	Better than A route	Better than A route	Better than "B-J"	Better than "B-J"
Land area for compensation	6,823 rais	6,823 rais	5,801 rais	8,741 rais	8,741 rais
Compensation cost (excl, houses and crops)	732 M.Baht	732 M.Baht	886 M.Baht	1,234 M.Baht	1,234 M.Baht
Unit price for official land compensation	0.04-0.5 M.Baht/rai (1.0-12.5 US$/m^2)	0.04-0.5 M.Baht/rai (1.0-12.5 US$/m^2)	0.04-3.0 M.Baht/rai (1.0-75 US$/m^2)	0.04-3.0 M.Baht/rai (1.0-75 US$/m^2)	0.04-3.0 M.Baht/rai (1.0-75 US$/m^2)
Forest condition	Low hill covered mostly with degraded forest but designated as "National forest Reserve (C)"				
Canal					
Length					
Open canal	12.65	18.12	17.31	13.70	26.55
Culvert	-	-	-	12.85 [1/]	-
Tunnel	14.69	10.89	14.03	4.20	4.20
Total Length	27.25	29.01	31.33	30.75	30.75
Excavation					
Depth (m)	4			25 - 30	
Volume (m^3)	2 million			18 million	

Remark: [1/] Deep excavation with a depth of 25-30 m.
[2/] No. of household affected will be increase at the time of project implementation due to expansion of urbanization in Chiang Rai.

Chart - 5 Investigation Items for the Impacts induced by Tunnel Construction

(Watershed Management)

1 Clarification of boundary and area along the diversion route and its surroundings

National Forest Reserves (including National Park under establishment)

Watershed Classification

2 Topographical and geological conditions of the watershed by tributary sub-basin

2-1 Variation in ground elevation with surface slope along the tunnel route

2-2 Transversal section of the mountain along the tunnel route (tunnel and shafts)

2-3 Examination of topographical and geological conditions at the inlet and the outlet of tunnel and shafts from environmental/engineering viewpoints such as ground surface slope, vegetation, depth of overburden layer, stream/river flow conditions near the site

2-4 Identification of fault zone

- Groundwater variation in wet and dry seasons
- Stream/river flows conditions in wet and dry seasons, if exists near the site.

2-5 Farmland use (grassland, field crops, paddy, fruit tree, etc.)

3 Forest and vegetation conditions in watershed along the tunnel route

- Classification of the area by forest type, tree density, vegetation, etc.
- Tree species and size
- Principal vegetation in wet and dry seasons

4 Watershed management

- Division of watershed based on watershed boundary
- Area and landform in watershed
- Headwater conditions such as headwater type(stream/river), tributary density, stream and river gradient, etc.
- Discharge condition in wet and dry seasons
- Present utilization of stream and river flow (particularly water use by hilltribes)

Social study focusing on water use in the watershed

Quality and quantity of water from the viewpoint of public health

- Location of existing ponds and reservoirs
- Location of existing public/private facilities such as road, power line, villages, etc.

Chart - 6 Villages to be Affected

The profile of adversely-affected villages by Yao river training

Village	Household	Population	Male	Female	Average Household Income (Bath/Year)
Song Khwae	167	739	363	376	28,970
Mai Song Khwae	37	162	77	85	22,330
Hang Thung	74	398	212	186	35,636
Pak Puk	186	821	400	421	24,345
Nam Mong	125	449	230	219	19,756
Pang Sa	123	525	266	259	13,701
Wang Phang	49	285	137	148	25,498
Haen & Tut	214	952	480	472	21,789
Wang Hid	55	333	149	184	15,673
Na Nun	213	587	273	314	14,487
Pu Kha	197	794	401	393	33,665
Sop Yao	222	624	273	351	29,551
Total	1,662	6,669	3,261	3,408	

(Source: Technical Service and Planning Division, the Community Development Department, Ministry of Interior, December 1992)

The profile of adversely-affected village by constructing a flood control dam

Village	Household	Population	Male	Female	Household Income (Bath/Year)
Huai Lao	67	298	164	134	4,509
Wang Sao	77	328	169	159	4,690
Sop Phang	33	154	81	73	4,850
Pang Kom	74	321	161	160	4,700
Nam Pan	61	383	205	178	5,000
Total	312	1,484	780	704	

(Source: Technical Service and Planning Division, the Community Development Department, Ministry of Interior, December 1992)