

### **3.5 Water Agreement and Other Related Topics**

#### **(1) Water Agreement**

In the Agreement on the Cooperation for the sustainable Development of the Mekong River Basin, the Article 5 for Reasonable and Equitable Utilization and Article 6 for Maintenance of Flows on the Mainstream declare;

#### **Article 5:**

To utilize the waters of the Mekong River system in a reasonable and equitable manner in their respective territories, pursuant to all relevant factors and circumstances, the Rules for Water Utilization and Inter-basin Diversion provided for under Article 26 and the provisions of A and B below:

- A. On tributaries of the Mekong River, including Tonle Sap, intra-basin uses and inter basin diversions shall be subject to notification to the Joint Committee.
- B. On the mainstream of the Mekong River:
  - 1. During the wet season:
    - a) Intra-basin use shall be subject to notification to the Joint Committee.
    - b) Inter-basin diversion shall be subject to prior consultation which aims at arriving at an agreement by the Joint Committee.
  - 2. During the dry season:
    - a) Intra-basin use shall be subject to prior consultation which aims at arriving at an agreement by the Joint Committee.
    - b) Any inter-basin diversion project shall be agreed upon by the Joint Committee through a specific agreement for each project prior to any proposed diversion. However, should there be a surplus quantity of water available in excess of the proposed uses of all parties in any dry season, verified and unanimously confirmed as such by the Joint Committee, an inter-basin diversion of the surplus could be made subject to prior consultation.

## **Article 6:**

To cooperate in the maintenance of the flows on the mainstream from diversions, storage releases, or other actions of a permanent nature; except in the cases of historically severe droughts and/or floods:

- A. Of not less than the acceptable minimum monthly natural flow during each month of the dry season;
- B. To enable the acceptable natural reverse flow of the Tonle Sap to take place during the wet season; and,
- C. To prevent average daily peak flows greater than what naturally occur on the average during the flood season.

The Joint Committee shall adopt guidelines for the locations and levels of the flows, and monitor and take action necessary for their maintenance as provided in Article 26.

## **Article 26**

In addition, the Article 26 for Rules for Water Utilization and Inter-Basin Diversions states that; The Joint Committee shall prepare and propose for approval of the Council, inter alia, Rules for Water Utilization and Inter-basin Diversion pursuant to Articles 5 and 6, including but not limited to: 1) establishing the time frame for the wet and dry seasons; 2) establishing the location of hydrological stations, and determining and maintaining the flow level requirements at each station; 3) setting out criteria for determining surplus quantities of water during the dry season on the mainstream; 4) improving upon the mechanism to monitor intra-basin use; and, 5) setting up a mechanism to monitor inter-basin diversions from the mainstream.

## **Definition of Terms**

For the purpose of this Agreement, it shall be understood that the following meanings to the underlined terms shall apply except where otherwise inconsistent with the context:

**Agreement** under Article 5: A decision of the Joint Committee resulting from **prior consultation** and evaluation on any **proposed use** for inter-basin diversions during the

wet season from the mainstream as well as for intra-basin use or inter-basin diversions of these waters during dry season. The objective of this agreement is to achieve an optimum use and prevention of waste of the waters through a dynamic and practical consensus in conformity with the Rules for Water Utilization and Inter-Basin Diversions set forth in Article 26.

**Acceptable minimum monthly natural flow:** The acceptable minimum monthly natural flow during each month of the dry season.

**Acceptable natural reverse flow:** The wet season flow level in the Mekong River at Kratie that allows the reverse flow of the Tonle Sap to an agreed upon optimum level of the Great Lake.

**Basin Development Plan:** The general planning tool and process that the Joint Committee would use as a blueprint to identify, categorize and prioritize the projects and programs to seek assistance for and to implement the plan at the basin level.

**Environment:** The conditions of water and land resources, air, flora, and fauna that exists in a particular region.

**Notification:** Timely providing information by a riparian to the Joint Committee on its proposed use of water according to the format, content and procedures set forth in the Rules for Water Utilization and Inter-Basin Diversions under Article 26.

**Prior Consultation:** Timely notification plus additional data and information to the Joint Committee as provided in the Rules for Water Utilization and Inter-Basin Diversions under Article 26, that would allow the other member riparians to discuss and evaluate the impact of the proposed use upon their uses of water and any other affects, which is the basis for arriving at an agreement. Prior consultation is neither a right to veto the use nor unilateral right to use water by any riparian without taking into account other riparians' rights.

**Proposed use:** Any proposal for a definite use of waters of the Mekong River system by any riparian, excluding domestic and minor uses of water not having a significant impact on mainstream flows.

**(2) Notification of Two Tributaries Projects of Thailand**

The proposed Kok-Ing-Nan water diversion project was officially notified to the Joint Committee at the special session held on 20-21 November 1995 in Ho Chi Minh city of Vietnam for its commencement of the feasibility study.

# MINUTES OF THE SPECIAL SESSION

of the

## THE JOINT COMMITTEE

20-21 November 1995, Ho Chi Minh City, Viet Nam

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### A. GENERAL

#### A.1 The Meeting

1. The Joint Committee, at its second meeting held on 25 and 26 September 1995 in Bangkok, agreed to hold its Special Session (hereinafter referred to as the *Meeting*) in Ho Chi Minh City, Viet Nam, on 20-21 November 1995 at the Hotel Majestic. In conjunction with the Session, the Donors' Meeting and the Exploratory Meeting with representatives of the Governments of the People's Republic of China and the Union of Myanmar were planned to be organized on 22 November, for different objectives and aims (see the overall Programme: Appendix 1).

2. The Meeting was attended by some 40 participants, including the 20 delegates and six observers from Thailand and Viet Nam, the UNDP Deputy-Resident Representative in Hanoi, officers and staff from the Viet Nam National Mekong Committee and the MRC Secretariat (see the list of participants in Appendix 2).

3. H.E. Dr Phen Sy Ky, the Chairman, presided over the Meeting. The MRC Secretariat headed by Mr Yasunobu Matoba, Chief Executive Officer (CEO), provided the Meeting with the secretarial services. In addition, the Viet Nam National Mekong Committee provided logistic and other related support, with the assistance from UNDP Viet Nam. Mr Samran Chooduangngern of the Secretariat served as the Rapporteur.

#### A.2 Opening statements

4. The Chairman, in his opening statement, extended his warm welcome to all the Heads of Delegations including the representative from UNDP, the distinguished delegates and other participants at the Meeting, including the staff of the Secretariat. He highlighted features of the Special Session, emphasizing the importance of the Donors' Meeting and the Exploratory Meeting on 22 November for which cooperation from all the Members and participants was called for to ensure their success.

5. The Chairman referred to several pending issues from the second meeting in Bangkok which require further discussions and/or decisions by the Meeting. Among them were the adoption of the Work Programme 1996 which has been approved earlier by the Joint Committee but, with improvements to be made; the work of the Sub-Committee on Venue... which still required further consideration by the Joint Committee and the Terms of Reference of the Sub-Committee on Article 26. In addition he noted with satisfaction the reports of other Sub-Committees and the Task Force on the Donor Consultative Group which have been established by the Joint Committee (see his statement in Appendix 3.a) to be presented later to the Meeting.

6. The CEO expressed his sincere appreciation of the kind words made by the Chairman and then gave an introductory report on the progress made by the Secretariat during the last two months after the second Joint Committee meeting. He informed the Meeting that the 22 new programme and project proposals have duly been completed and the Work Programme 1996 was improved. Its main features would be presented to the Meeting, for possible acceptance accordingly. He further informed the Meeting of recent contacts and exchanges between the MRC Secretariat and the donor community and his plan to visit Sida and DANIDA Headquarters in December, at their invitations. It was the view of the CEO that gestures from all the donors on their continued cooperation and increased assistance to the Mekong River Commission have been positive.

7. The CEO then informed about the preparatory work carried out by the Secretariat for the Donors' as well as the Exploratory Meetings. He sought, however, further guidance from the Meeting on the way in which the Meetings should be handled to ensure the success and fruitful results (see the CEO statement in Appendix 3.b).

### A.3 Adoption of agenda

8. The draft Agenda (Appendix 4) was reviewed by the Meeting and subsequently adopted without amendment.

## B. MATTERS FOR CONSIDERATION

### B.1 Work Programme 1996 (Rev. 1)

9. At the request of the Chairman, the CEO presented features of the Work Programme 1996 (Rev. 1) which has been revised, *inter alia*, on the basis of the comments obtained from the second Joint Committee meeting in Bangkok. He referred to the newly completed 22 project proposals being incorporated in the Work Programme, which have been circulated earlier to the countries for review and invited the Meeting to comment further.

10. As part of the general comments, the Meeting welcomed the improved Work Programme which continued to focus on basinwide projects. It commended the excellent efforts which have been made by the CEO and the Secretariat in this respect. The Meeting expressed its interest in knowing further funding status of investment projects or projects of construction nature. In addition, it urged the Secretariat to take steps to complete "proposals" for those pipeline projects in a timely manner.

11. The Meeting provided specific comments on the following projects and directed the Secretariat to:

- a) Delete "water quality aspects" of the study on project 1.1.23/95, as two separate programmes for "water quantity" and "water quality" will be carried out in due time;
- b) Re-instate the three environment related forestry projects in the Mekong delta of Viet Nam;
- c) Item 2 of the pipeline projects (page 119 of the Work Programme) be incorporated in project 3.5.40/92; and
- d) Update the summary sheet of the BDP project.

12. The improvements which have been made to the Work Programme 1996 and approved by the Joint Committee in September were accepted by the Meeting of the Special Session. On the basis of the additional comments obtained, the MRC Secretariat was entrusted to undertake another minor revision soonest.

13. As for future Mekong Work Programmes, the Cambodian Delegation emphasized their priority for a study on the Chadomouk area while the Lao Delegation did so for the Houay Phaling Basin Development and Survey of Rapids and Difficult Passages (all are pipeline projects). The Thai Delegation, on the other hand, suggested that efforts should be made to bring in projects which have already been studied at "feasibility level" for implementation, considering as well the possibility of financing the projects through "independent private-sector producers (IPP)". The Meeting noted the comments with appreciation and requested the Secretariat to take actions as appropriate and feasible.

14. Lastly, it was agreed by the Meeting that the projects 1.1.22/95 (on the Basin Development Plan) and 1.1.23/95 (related to implementation of Article 26) be considered as high "priority projects" which will be communicated to the Donors' Meeting on 22 November.

## B.2 Donors' Meeting

15. The CEO reported on the background of the scheduled Donors' Meeting, emphasizing that it was meant to be organized only for this year with a view to securing in time the financial support for the Work Programme 1996 from our major donors pending the eventual establishment of the Donor Consultative Group. He pointed out that there would be a large number of donors' representatives attending the Meeting and with the consent of the Joint Committee, the Secretariat would be ready to make the presentation of the Work Programme just adopted. He then invited the Meeting to review the draft Agenda of the Donors' Meeting which was subsequently endorsed (Appendix 5).

16. The Chairman of the Joint Committee brought to the attention of the Meeting that H.E. Mr Ing Kieth, Chairman of the Council, would be present at the Donors' Meeting and in view of this, he announced that H.E. Mr Ing Kieth would be invited accordingly to chair the Meeting. The Secretariat was requested to prepare in advance the opening and closing statements for the Council Chairman.

### B.3 Exploratory Meeting with China and Myanmar

17. The CEO reported to the Meeting the recent contacts which had been made with the Embassies of the People's Republic of China and the Union of Myanmar in Bangkok and their positive responses which have made it clear that three representatives and officers from China and two from Myanmar will be participating in the Exploratory Meeting planned for the afternoon of 22 November. He invited the Meeting to review the draft Agenda (Attachment 6.a) which was adopted without change.

18. On the basis of the adopted Agenda, the Meeting at the suggestion of the Chairman, agreed to ask the CEO to introduce the Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin in accordance with the outline given in the "Briefing Note" (Attachment 6.b).

19. While the way in which the Meeting should be handled was left for further consultation with the representatives from China and Myanmar, the Meeting considered the scope of discussions as drafted by the Thai Delegation and finally agreed on the revised version as shown in Attachment 6.c. The Meeting also agreed to entrust Mr Krit Kraichitti, member of the Thai Delegation, to present to the representatives of China and Myanmar the Commission's views on the objectives, format and activities of the proposed dialogue along the line with the said discussion paper.

20. With regards to the participation at the Exploratory Meeting, it was agreed that the MRC delegates and representatives from the Secretariat would be participating in it. The Secretariat would also assist in preparing "records" of the meeting, if agreeable to all. The meeting would then be followed by a reception dinner to be hosted by Chairman of the Joint Committee.

21. UNDP noted that, if requested, it was ready to explore the possibility of providing assistance to foster the dialogue with China and Myanmar. Such assistance could be similar to UNDP's support leading to the formation of the Mekong River Commission.

### B.4 Guidance to Sub-Committee on Venue...

22. Mr Nguyen Nhan Quang, Member of the Sub-Committee, was asked to brief the Meeting once again on the work already accomplished as well as the matters that the Sub-Committee would like to be brought up for consideration. Mr Quang referred also to the previous decisions of the Joint Committee on this subject at its second meeting in Bangkok (see Appendix 7).

23. Based on the Thai Foreign Minister's statement appeared in the Nation Newspaper on 9 November 1995 and the Radio of Thailand as well, the Lao Delegation took the opportunity to express its sincere thanks and profound gratitude to the Thai Government for its kind positive vis-a-vis the venue of the MRC to Vientiane.



24. The Meeting discussed extensively the issue and felt that the subject on "venue" is a delicate matter which requires decision at the policy level. It, therefore, agreed to submit the case to the Council for its consideration and decision at its forthcoming meeting in January 1996.

#### 8.5 Report of the Task Force on Donor Consultative Group (DCG)

25. The CEO reported on the meeting of the Task Force on DCG which has been established in accordance with the decision made by Joint Committee at its second meeting in Bangkok. He then referred to the report of meeting of the Task Force (Appendix 8.a) which has incorporated its suggestions on several matters for endorsement of the Joint Committee, including requests for its guidance.

26. The Meeting reviewed the Report and adopted the following:

- a) *The objectives* of having the DCG to be slightly improved, as shown (Appendix 8.b);
- b) *Participants* to attend the DCG meeting need further consideration by the Council at its second meeting while the participants from each country at the Inauguration Meeting of DCG could be limited to three, i.e., to include one member from the Council and two from the Joint Committee;
- c) *Timing* of the Inauguration Meeting be in May 1996;
- d) *Regular/annual Meeting* of the DCG be held in October, back-to-back to the Council Meeting.

27. In connection with the timing of the various meetings to be organized in 1996 and future years and in view of the fact that the proposed dates for DCG meetings require adjustments to the Rules of Procedures of the Joint Committee and the Council, the Secretariat, at the request of the Meeting, proposed the following:

- a) For 1996
  - January Council Meeting (PNH)
  - March JC Plenary Session (VN)
  - May Inaugural Meeting of DCG (BKK)
  - July JC Meeting (BKK)
  - October Council Meeting cum DCG Meeting (VTE).
- b) For future years
  - July (of previous year) JC Meeting (Working Session)
  - March JC Meeting (Plenary)
  - October Council cum DCG Meeting

28. The Meeting agreed to the proposal and decided to submit it to the Council for its endorsement and approval. Similarly, the Report of the Task Force, with the agreed amendments, will be submitted to the Council for its approval.

#### B.6 Report of the Sub-Committee on Article 26

29. The CEO reported on the findings of the Sub-Committee (Appendix 9) to the Meeting, for its consideration. After deliberations, the Joint Committee:

- a) approved the Terms of Reference of the Sub-Committee as proposed;
- b) agreed that the project proposal revised by the Sub-Committee (MKG/R 95062/Rev.1, October 1995) to focus on the water quantity aspects and that the water quality aspects would need to be studied in the context of another project proposal to be prepared by the Secretariat aiming at implementing *Article 3* of the Agreement; and
- c) approved the programme of work (section 2.f, page 3 of the minutes of the first meeting of the Sub-Committee) submitted.

30. The Joint Committee also took note of the expressed interest of the Government of Japan in providing support to the implementation of Article 26.

#### B.7 Report of the Sub-Committee on Article 33 (On riparian technical staff)

31. The CEO summarized the Report of the Sub-Committee (Appendix 10) which had met in Bangkok on 14 November 1995. On the basis of its recommendations which included, among others, the effective date of implementation, definitions of the terms of "equal basis" being understood as equal number plus/minus one (relative quantity) and "riparian technical staff".

32. The Meeting adopted the definitions proposed by the Sub-Committee and agreed on the following:

- a) The effective date for implementation of Article 33 is 5 April 1995,
- b) The principle of two 3-year terms to be applied to all the riparian technical staff;
- c) Application of the decision b) shall be placed on the following conditions:
  - c.1 Staff who have completed continuously services for over 20 years (at the date when their current contracts will expire) will be considered for a contract of one year only;
  - c.2 Staff who have completed continuously services for less than 20 but more than 15 years (at the date when their current contracts will expire) will be considered for one 3-year term contract; and
  - c.3 Staff who have completed continuously services for less than 15 years (at the date when their current contracts will expire) will be given a maximum of two 3-year terms contracts.

33. It should be noted however that the Meeting gave a due consideration to the importance of competency and efficiency of the Secretariat in performing its functions and in this connection, it agreed in principle that there should still be a flexibility in implementing the above (para. 32). Additional consideration on a case-by-case basis would still be required subject to consultation between the CEO and the Joint Committee.

34. The Vietnamese Delegation reserved its comments of different view particularly on c.1 (para. 32) and wished to have this matter discussed again at the Joint Committee meeting in March 1996.

#### B.8 Operational budget of the MRC Secretariat

35. Mr Fischer presented to the Meeting the operational budget of the MRC and its Secretariat (Appendix 11) for 1996, with an estimated revenue of US\$ 2.085 million against the estimated expenditure of approximately US\$ 2.277 million resulting in a projected shortfall of US\$ 192,000.

36. The Meeting reviewed the detailed estimates with a suggestion that measures be adopted to save some expenditures. It then, adopted the operational budget for 1996 of the Secretariat, as presented.

#### B.9 Operational Agreement

37. Mr Fischer, then, presented to the Meeting current situation and problems related to the operational aspects of the Secretariat (Appendix 12) which require assistance from the Joint Committee in pursuing the matter with the respective riparian Governments.

38. The Meeting considered the Secretariat's request and concurred that the conclusion of the Operational Agreement between MRC and member Governments would take a lot of time, particularly if it includes provisions on immunities which might require enabling legislations. It is therefore advisable that a Memorandum of Understanding (MOU) be first made between MRC and member Governments to provide legal framework for specific matters of urgent requirements, namely, the tax exemption for officials and representatives and visa facilitation. In this regards, the Secretariat was asked to prepare a draft MOU as advised by the Meeting and to submit it to the Joint Committee in due course, for endorsement and assistance.

### E. MATTERS FOR INFORMATION

#### E.1 Scheduled meeting with Officials from MDBC

39. The CEO informed the Meeting of the scheduled dinner reception cum meeting with Messrs Millington and Blackmore from the Murray-Darling Basin Commission (MDBC), on 12 December 1995 at Bangkok, at which the Members and/or representatives from the Joint Committee who are attending the Chulabhorn Congress on the same day, also invited to attend. Exchange of views of the participants on future collaboration between MRC and MDBC is expected

and, the Joint Committee's members duly accepted the invitation to attend the event.

## E.2 Draft Headquarters Agreement

40. The CEO further informed the Meeting that copies the draft Headquarters Agreement revised by the ad hoc Working Group at the second Joint Committee meeting have been circulated to the countries for their review. Members of the Working Group supplemented that the draft with additional editorial work and inputs on definition of the "riparian staff" from the Secretariat, should be acceptable now for using as a basis for future negotiation with the "host" Government of the MRC Secretariat. The Meeting took note of this development with appreciation.

## E.3 Government contributions from member countries

41. Mr Fischer reported the Meeting of the contributions received so far from the riparian country, particularly from Thailand. Delegates from the remaining countries agreed to help follow up the case for the Secretariat, to ensure an early transfer of the contributions.

## E.4 Notification of two tributaries projects of Thailand

42. Dr Prathes Sutabutr, Head of the Thai Delegation, on the basis of Article 5 of the Agreement and in a spirit of goodwill and cooperation, notified the Joint Committee on two tributary projects being implemented by Thailand, namely, the Kok-Ing-Nan and Lamtakhong. The former is a feasibility study project involving a diversion plan of water to the Chao Phraya river basin. The latter is a hydropower project on the Lamtakhong river, a tributary of the Mun river, involving the use of water from the existing Lamtakhong reservoir for generating electricity by means of pump-storage. The Joint Committee acknowledged the notification by Thailand with great appreciation.

43. With a view to facilitating notification by the riparian countries as stipulated in the Agreement, the Meeting requested the Sub-Committee on Article 26 to prepare the details of "format", "content" and "procedures" for the purpose and, to submit to the Joint Committee for its consideration.

## D. OTHER BUSINESS

### D.1 Meeting of the Council

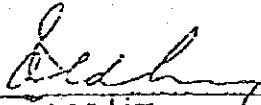
44. The Meeting confirmed that the next meeting of the Council should be in January 1996, in Phnom Penh. Due to the limited time for preparation, the Cambodian Delegation was requested to inform the Secretariat soonest of the dates and time.

## D.2 Plenary Session of the Joint Committee

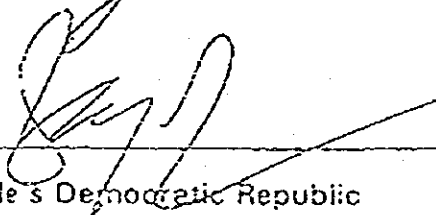
45. The Joint Committee agreed to have its Plenary Session held in March 1996, in Viet Nam. The exact dates and venue of the meeting, however, will be notified by the Viet Nam National Mekong Committee in due time.

## E. ADOPTION OF THE MINUTES OF THE MEETING

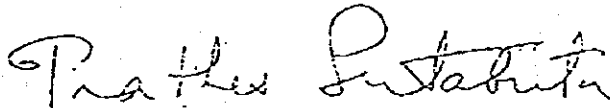
46. The Joint Committee adopted the Minutes of the Meeting as presented on 21 November 1995, in Ho Chi Minh City.



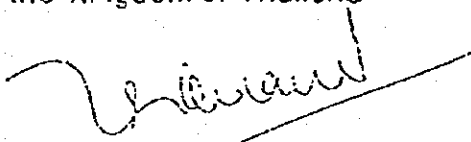
H.E. Mr Khy Taing Lim  
For the Kingdom of Cambodia



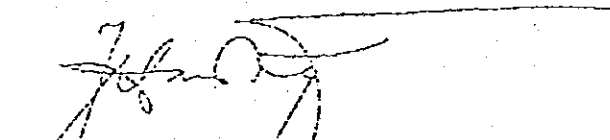
Mr Saykham  
For the Lao People's Democratic Republic



Dr Prathes Sutabutr  
For the Kingdom of Thailand



Mr Hoang Trong Quang  
For the Socialist Republic of Viet Nam



H.E. Dr Phan Sy Ky  
Chairman of the Joint Committee  
Mekong River Commission

**(3) Master Plan for Medium & Large Scale Construction Projects**

The Master Plan for Medium & Large Scale Construction Projects covering the period of the 8th National Economic and Social Development Plan from 1997 to 2001 has been prepared by RID for approval of NESDB. The proposed Kok-Ing-Nan water diversion project has been nominated as the project whose detailed design work is to be commenced in the year 2000. A part of this master plan is given hereinafter;

**CONCLUSION**

**FOR**

**ADJUSTMENT PLAN NO. 1/2539**

**MASTER PLAN FOR MEDIUM & LARGE SCALE  
CONSTRUCTION PROJECTS**

**A.C. (1997 - 2001)  
ROYAL IRRIGATION DEPARTMENT**

**NATIONAL ECONOMICS AND SOCIAL PLAN  
DEVELOPMENT  
NO. 8 (BE. 2540 - 2544)**

**Conclusion for Adjustment Plan No. 1/2539**  
**Master Plan for Medium and Large Scale Construction Projects**  
**National Economics and Social Plan Development No. 8 B.E. 2540 - 2544**

- \* Total for the whole country 224 projects will divided into
  - \* Medium Scale 174 projects
  - \* Medium Scale (Large Scale Div. Incharge) 24 projects
  - \* Large Scale 26 projects
  
- 1. After adjustment plan, in the year 2540 there are 27 projects  
(previous plan = 40 projects)
  - \* Medium scale 17 projects
  - \* Medium scale (Large Scale Div. Incharge) 9 projects
  - \* Large Scale 2 projects
  
- 2. After adjustment plan, in the year 2541 there are 45 projects  
(previous plan = 49 projects)
  - \* Medium Scale 31 projects
  - \* Medium Scale (Large Scale Div. Incharge) 12 projects
  - \* Large Scale 2 projects
  
- 3. After adjustment plan, in the year 2542 there are 51 projects  
(previous plan = 40 projects)
  - \* Medium Scale 43 projects
  - \* Large Scale 9 projects
  
- 4. After adjustment plan, in the year 2543 there are 47 projects  
(previous plan = 44 projects)
  - \* Medium Scale 34 projects
  - \* Medium Scale (Large Scale Div. Incharge) 3 projects
  - \* Large Scale 10 projects
  
- 5. After adjustment plan, in the year 2544 there are 54 projects  
(previous plan = 53 projects)
  - \* Medium Scale 50 projects
  - \* Medium Scale 4 projects



## Adjustment Plan No. 1/2539

## Master Plan for Medium and Large Scale Construction Projects

National Economics and Social Plan Development No. 8 B.E. 2540 - 2544

No.	Region	Year of Construction	Project	Type of		Headwork			Project Efficiency			Remarks
				Project	Report	Amphoe	Changwat	Basins	Capacity MCM	Irrigable area (rai)	Construction Cost (M.B)	
B.E. 2543									3,831.19	982,850	8,642.87	
Medium Scale Irrigation Project												
1	1	43	Mae Cham Weir	WI	RR/38	Mae Meay	Chiang Mai	Ping		6,900	78	Royal Project Mar. 6, 35
2	1	43	Huai Mae Kom System	I	RR/39	Chiang Dao	Chiang Mai	Ping	4.00	2,500	126	
3	2	43	Mae Oon 2 Reservoir	SI		Ngoy	Lampang	Wang	1.80	8,000		Royal Project Feb. 10, 35
4	2	43	Huai Mae Phar Reser.	SI	RR/37	Jairhom	Lampang	Wang	10.18	1,600	118	Royal Project Mar. 7, 36
5	2	43	Mae Lang Reservoir	SI		Long	Phrae	Yom	10.00	12,000	85	Royal Project Jun. 6, 34
6	3	43	Mae Klong Kai Reser.	SI	RR/37	Ban Danlarnhoi	Sukhothai	Yom	7.70	5,300	104	Royal Project Mar. 19, 36
7	3	43	Khlong Nam Lai Reser.	SI	RR/37	Khlong Lam	Kamphangphet	Ping	15.00	2,000	217	2538
8	3	43	Huai Maechuy Reservoir	SI	PR/29	Muang	Uttaradit	Nan	4.00	350	64.4	
9	3	43	Huai Tark Reservoir	SI	RR/37	Ban Tark	Tak	Ping	16	8,700	184	
10	3	43	Phaya Wang Weir	WI	SR	Pbothalae	Pichit	Yom				
11	3	43	Nun Fuar Reservoir	SI	PR/35	Nakornthai	Phitsanulok	Nan		2,500	114.00	
12	3	43	Huai Sadaung Yai Res.	SI	FS/11C	Lomsak	Phetchabun	Pasak	15.00	34,700		
13	3	43	Huai Chalorn Reser.	SI	RR/37	Ban Tak	Tak	Ping	15.20	8,400	182	
14	3	43	Huai Mae Rumpun Res.	SI	RR/37	Ban Danlarnhoi	Sukhothai	Yom	8	5,800	97	
15	4	43	Kangrawar Reservoir	SI	RR/37	Ban Phai	Khon Kaen	Chi	36.00	25,000		Royal Project
16	4	43	Huai Thuan Reservoir	SI	PR/18	Ban Dung	Udon Thani	Chi	7.19	Consum.		
17	4	43	Huai Takhong Yai Res.	SI		Nam Soam	Udon Thani	Khong				Royal Project Dec. 1, 35
18	5	43	Huai Krachur System	I		Kudbark	Sakbon Nakhon	Khong	11	16,500		

Adjustment Plan No. 1/2539

Master Plan for Medium and Large Scale Construction Projects

National Economics and Social Plan Development No. 8 B.E. 2540 - 2544

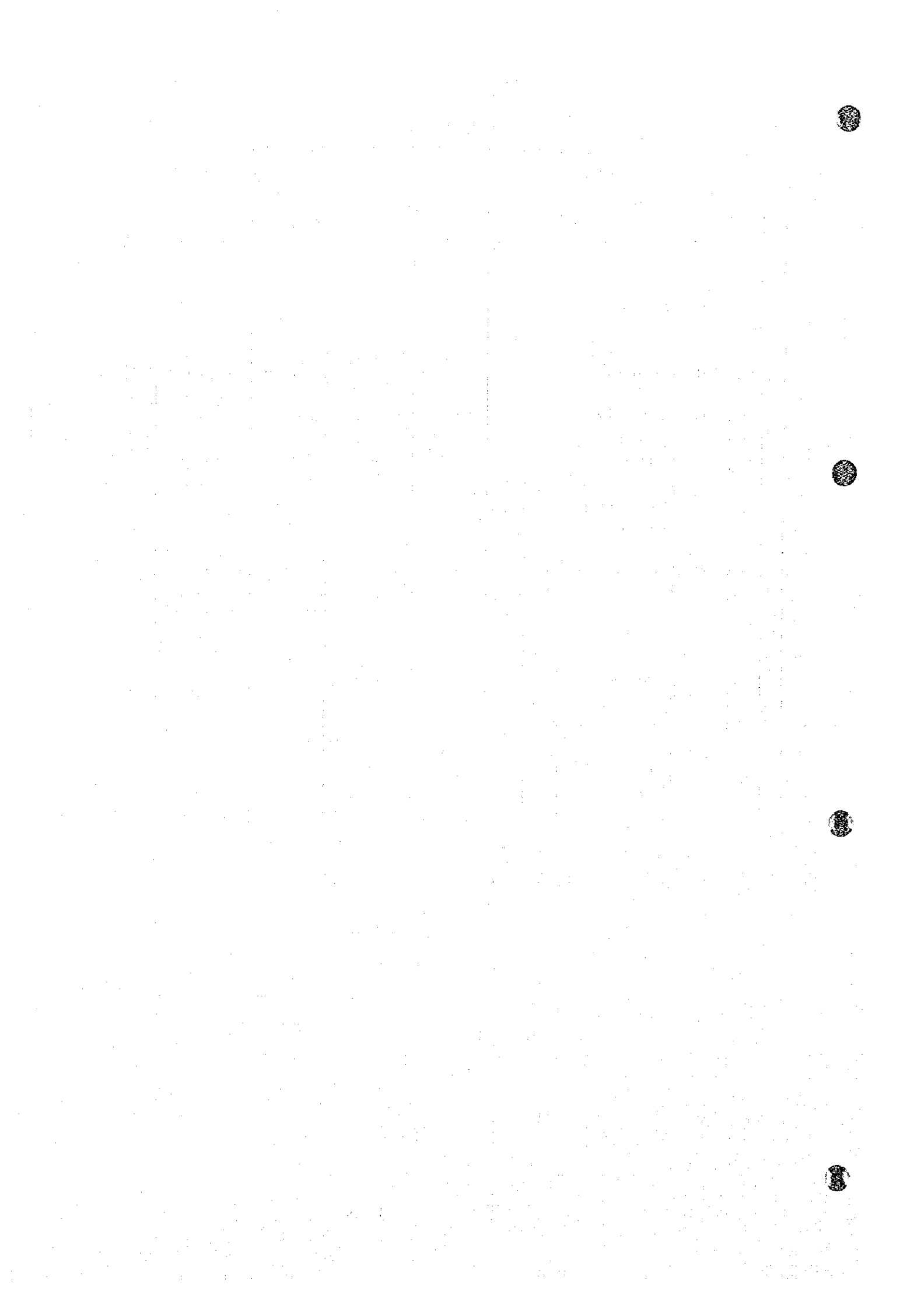
No.	Region	Year of Construction	Project	Type of		Headwork			Project Efficiency			Remarks
				Project	Report	Amphoe	Changwat	Basins	Capacity MCM	Irrigable area (rai)	Construction Cost (M.B)	
19	5	43	Huai Pungyai System	I	PR	Noong Poke	Roi Et	Chi	6.90	2,700	53.3	
20	7	43	Huai Khun Kaew	I		Lam Sak	Uthai Thani	Sakae Krung	80.00	35,000		
21	8	43	Huai Hin System	I		Chaibadam	Lop Buri	Pasak	2.25	2,400	30	
22	9	43	Khlong Pakad Reservoir	SI	FS/38	Kanghang	Chanthaburi	East Coast	60.20	22,300		
23	10	43	Huai Thakuy System	I	PR/38	Svanphung	Ratchaburi	Mae Klong	23.40	1,000	100	
24	10	43	Huai Lurusai Reservoir	SI	RR/29	Muang	Kamchanaburi	Mae Klong	13.90	24,000		
25	10	43	Khlong Loai Reservoir	SI	RR/33	Bang Saphan	Prachuap Khiri Khan	West Coast	6.27	5,000	79.2	
26	10	43	Huai Saingai System	I		Hua Hin	Prachuap Khiri Khan	Phetchaburi	21.00	4,000		
27	10	43	Huai Mongkon Reser.	SI	RR/27	Hua Hin	Prachuap Khiri Khan	Phetchaburi	5.00	7,300		Royal Project 2532
28	10	43	Lam Tapum System	I		Dan Chang	Suphan Buri	Mae Klong	50.00	34,000		Royal Project
29	11	43	Khlong Hank Reservoir	SI	RR/36	Khao Phanom	Krabi	Tapi	7.60	4,500	86	
30	11	43	Khlong Phanwa Reser.	SI	RR/36	Thasae	Chumporn	South-East	13.70	12,300	134	
31	11	43	Khlong Krai Reservoir	SI	RR/35	Tha Sala	Nakhonsithammarat	South - East	60.00	65,000	180	
32	12	43	Khlong Lumsang Res.	SI	RR/35	Ratphum	Songkhla	Thalaysarp	5.80	4,100	63.72	
33	12	43	Khlong Panun Reservoir	SI	PR/39	Kvankaloong	Satun	South - West	28.27	40,000	308.446	
34	12	43	Khlong Tha-ngue System	I	RR/37	Huai Yord	Trung	South - West	17.00	12,000		
Medium Scale Irrigation Project												
35	5	43	Huai Phalao Reservoir	SI	SR/36	Muang	Umnartcharoen	Khong	5.83	4,000		
36	5	43	Huai Wangyai Canal System	SI		Nam Yern	Ubon Ratchathani	Khong				Dec. 1, 38
37	11	43	Water Resources Devel. Project in Phuket		FS/38		Phuket	South - West				

Adjustment Plan No.1/2539

Master Plan for Medium and Large Scale Construction Projects

National Economics and Social Plan Development No. 8 B.E. 2540 - 2544

No.	Region	Year of Construction	Project	Type of		Headwork			Project Efficiency			Remarks
				Project	Report	Amphoe	Changwat	Basins	Capacity MCM	Irrigable area (rai)	Construction Cost (M.B)	
Medium Scale Irrigation Project												
38	1	43	Kok-Ing-Nan Diversion Project	SI			Chiang Rai - Phrae	Kek	2,700.00	16,800		
39	3	43	Mae Wong Project	SI	FS/28		Nakorn Sawan	Sakae Krung	250	291,900	4,509.80	
40	5	43	Lara Dome Yai Project	S			Ubon Ratchathani	Khong				
41	5	43	Yang Nadee Dam Proj.				Chaiyaphum	Chi	70.00	165,300	1,729	
42	9	43	Bang Pakong - Right Bank Project				Chachoengsao	Bang Pakong				
43	9	43	Lower Khlong Raboon	S		Samut Sakhon	Chachoengsao	Bang Pakong				
44	9	43	Luruphayatharn Reservoir	BF	RR/14		Prachin Buri	East Coast	243.00	89,000		
45	10	43	Lower Tha Chin River Barrage Project	BF	FS/38		Nakhon Pathom Samut Sakhon	Tha Chin	15.00	2,000	217	2538
46	11	43	Ban Namhuk Barrage	S			Surat Thani	Tapi				
47	12	43	Songkhla Lake Devel. Project	D			Songkhla	Thalaysarp				



### **3.6 Necessity of Kok-Ing-Nan Water Diversion Project**

Socio-economic necessity of the project is studied as in the followings;

#### **(1) Agricultural Policy of the Government**

In the 7<sup>th</sup> National Economic and Social Development Plan (1992-1996), three objectives are put forward, namely 1) maintain economic growth rates, 2) redistribute income and development benefits to the regions and 3) develop human resources. To maintain economic growth rate, 7 quantitative targets are put up. The target growth rate of the agricultural sector is placed in the No. 3 position. It is an ambitious one with no less than 3.4% per year.

To attain the target the restructuring of the agricultural sector towards the increase of productivity and the production of high value added products having high market demand is proposed. Specifically, it is emphasized that the cultivation system and farming methods must be improved, together with promotion of highly priced field crops, fisheries and livestock. The government notices that the share of the agricultural sector in GDP has declined to only 11.5%, but it knows at the same time that the share of the agricultural employment remains as high as 64% of total employment.

In the subsequent 8<sup>th</sup> National Economic and Social Development Plan (1997-2001), the government comes up with 7 development objectives. Out of them the important ones are 1) human development, 2) development of social environment, 3) building the development potentials of regional and rural area to enrich the quality of life of people, 4) developing economic support for the development of people and quality of life and 5) natural resources and environmental management.

In the 8<sup>th</sup> plan emphasis is placed more on the aspects of human development and the quality of life than on the quantitative economic targets. Nevertheless, the importance of the strengthening of the economy continues to be stressed in the objective No. 4. The objective No. 4 comprises the policy to strengthen the economy to achieve growth with stability, to restructure production to cope with changes in global market and to enhance the quality of life of Thai people and so forth.

Regarding production restructuring, the plan makes it clear that building a strong long-term production base requires the maintenance of the agricultural sector as an important production base in the country and the enhancement of the potentials of Thailand in being the food production source for the domestic population as well as an important agricultural goods exporter in the world market.

To build a stable production base it is proposed to adjust the structure of agricultural land use towards increased diversification of production, using rice growing land for other crops. The attainment of such a target and objective is possible only if sufficient water is available for irrigation, fisheries and livestock in the dry season especially in the Chao Phraya Basin in light of its vast flat land of fertile soil and its agriculturally favorite climatic conditions.

## **(2) Agricultural Position of the Study Area and Proposal for the Future**

The position and trend of major crops and livestock in the Study Area was examined based on the Table 3.8.2. They are an excerpt from "Agricultural Statistics of Thailand, Crop Year 1994/95".

As crops second rice, major rice, maize, sugar cane, mungbean, soybean and groundnut were selected, while as livestock buffalo, cattle and swine were picked up. The production of the second rice or dry season rice for the Study Area was 2.6 million tons in 1995. It accounted for 86.6% of 2.9 million tons or the total production of the crop in the same year. The share of the Study Area for the crop is increasing in the last four years. However, one cannot determine whether the production of the crop is on the increase or not both for the whole country and the Study Area based on the four year data.

The production of the major rice or wet season rice for the Study Area was 8.0 million tons in 1995. It accounted for 44.1% of 18.2 million tons or the total production of the crop in the same year. The share of the Study Area for the crop appears to be fluctuating between 42% and 44% in the last four years. One cannot determine whether the production of the crop is on the increase or not both for the whole country and the Study Area based on the four year data. When the production of the second and major rice is added together, one gets 10.6 million tons and 21.1 million tons for the Study Area and for

the country respectively. The former occupies 50.0% of the latter.

2.3 million tons of maize was produced in the Study Area in 1995, accounting for 58.3% of 4.0 million tons or the national production. The production of the crop both in the Study Area and the country is fluctuating for these four years. Also, the share of the Study Area is fluctuating. 22.3 million tons of sugar cane was produced in the Study Area in 1995, which accounts for 44.0% of 50.6 million ton or the national production. The production of the crop in both the Study Area and the country is fluctuating for these four years. The share of the Study Area seems to be decreasing.

The Study Area produced 224,000 tons of mungbean in 1995, occupying 87.8% of 256,000 tons the country produced. The production of the crop seems to be decreasing in both the Study Area and the country for the last four years. The share of the Study Area maintains more or less the same level. The Study Area produced 400,000 tons of soybean in 1995, occupying 75.8% of 528,000 tons the country produced. The production of the crop is on the rise in both the Study Area and the country for the last four years. The share of the Study Area maintains more or less the same level. The groundnut production of the Study Area was 78,000 tons in 1995, representing 51.7% of that of the country or 150,000 tons. The production of the crop appears to be decreasing for these four years in both the Study Area and the country. The share of the Study Area is fluctuating.

The number of buffaloes in the Study Area was 788,000 in 1993, sharing 16.6% of 4,754,000 heads in the whole country. The number of this livestock is decreasing both in the Study Area and the country in the last three years. At the same time, the share of the Study Area is decreasing. The cattle in the Study Area counted 2.3 million heads in 1993, sharing 36.5% of 6.4 million heads in the country. The number of this livestock is increasing both in the Study Area and the country in the last three years. The share of the Study Area is also increasing.

In 1993 swine numbered 2.2 million in the Study Area, while it numbered 5.0 million in the kingdom. Thus, the share of the Study Area comes to 44.2%. The number of this animal is fluctuating in both the Study Area and the kingdom in these three years. The share of the Study Area appears to be decreasing.

Taking into account of the above-mentioned statistics and supplementing other data and information, the following conclusion can be drawn:

(Existing Conditions)

The agricultural position of the Study Area in the whole kingdom may be around 50%. This fact shows that one cannot speak about agricultural development of the country without taking up agricultural development of the Study Area. The annual production of rice seems to be more or less constant: around 10 million tons in the Study Area, and around 20 million tons in the whole country. Among field crops the production of soybean is increasing. It may be because of a higher productivity of the crop as well as a higher demand for the crop compared with other field crops.

Among livestock the number of cattle is increasing. It may have something to do with the increasingly higher standard of living and the resultant change of life style.

Production of fruits is increasing for the last 9 years 1985/86 to 1994/95 at the average annual rate of 9.1%. (Especially, production of mango, longan, durian and mangosteen is increasing at a higher rate than that of other fruits.) This may be because they usually have a higher productivity than other types of crops and also because external demand for them is increasing every year.

Production of fresh water fish has increased during the 9 years 1983 to 1992 at the average annual rate of 13.1%. (Especially, in terms of value, production of snake-head fish, tilapia, local carp and cat fish are more popular than other species.) This may be firstly because fresh water fish culture is more productive than other primary sector activities, secondly because external demand is increasing year by year, and thirdly because domestic demand is also increasing every year.

(Proposal for the Future)

Without referring to the Study Area embracing the spacious fertile Chao Phraya Basin no one can discuss about the agricultural development of the country. At the present moment fifty percent of agricultural activities are concentrated in this area. With an additional water to be made available through the implementation of this project, the role and functions of the Study Area are expected to be further fortified and expanded. To make economically an effective and efficient use of additional water, optimum varieties of crops and fish should be selected in terms of:



- (i) Productivity
- (ii) Export demand
- (iii) Domestic demand

Productivity is determined by yield and input cost per unit area. It is evident that a higher yield and a less input cost push up productivity. In this connection, local climatic and soil conditions must be taken into consideration. In general, the growing of fruits, the culture of fresh water fish and the cultivation of vegetables are more productive than other agricultural and related activities. Along with export demand, the tendencies of domestic demand should be carefully observed, analyzed and forecasted. As the standard of living goes up, life style of people will change. As life style of people changes, so preference for food will change. This is actually happening in Thailand.

Regarding protein food sources, fresh water fish is recommended more than livestock. It is because the former is better than the latter in respect of the quality of protein, and also because the former is much cheaper than the latter in respect of input cost to produce unit quantity of meat. With more water to be made available, with more emphasis on the cultivation of fish, fruits and vegetables using that precious water and by selecting optimum kinds and varieties from among them, the agricultural position of the Study Area will get even more pronounced than now, and along with it the people of the Study Area and the whole kingdom will get richer and happier.

### **(3) Important Position of Fisheries (Incl. Fresh Water Fisheries) in Thailand**

The agricultural sector of the country grew for the last 10 years at the average annual rate of 3.2%. On the other hand, the fisheries sub-sector grew during the same period at the average annual rate of 6.6%. That is to say, fisheries are growing at the rate more than double that of agriculture as a whole. Indeed, fisheries are the fastest growing industry among all agricultural industries. The sub-sector with the GDP of baht 36,200 million at the 1988 constant prices occupied 12.5% of the primary sector in 1993 and the share is getting bigger every year.

Exports of agricultural goods grew at the average annual rate of 10.7% for the last 5 years. The growth rate of exports of fisheries products during the same period was even greater with 16.2%. This rate is the highest among all types of agricultural exports. Now,

with the annual value of baht 105,000 million fisheries account for 31.3% of the total agricultural exports and it is expected that the share will rise more in the future. The imports of fisheries products were as little as 17.2% of the exports of the same products in 1994. Furthermore, they are decreasing these years.

The annual catches of fresh water fish was 274,000 tons in 1992. It accounted for only 8.5% of the total annual fish catches in the same year. However, fresh water fisheries are growing at the average annual rate of 6.5%. It is by 80% higher than 3.7%, the growth rate of marine water fisheries.

Four types of fresh water fish culture farms exist in Thailand, namely paddy fields, ditches, cages and ponds. The area of ponds is growing at the average annual rate of 13.1%, while the area of other farms are all decreasing. Production of pond cultured fish is climbing at the steep rate of 17.5% per annum on average for the last 10 years. As a result, with 111,000 tons it occupied 78.1% of the entire production of fresh water cultured fish in 1992.

There are eight most popular kinds of fresh water fish, namely pla nil (tilapia), pla tapian (local carp), pla chon (snake head), pla duk (catfish), sepat sian, pla nai (common carp), pla swai (catfish) and pla mo (climbing perch). Out of them, pla nil or tilapia is No. one not only in terms of the magnitude of demand with baht 1,164 million and 84,800 tons in 1992, but also in terms of the growth of demand with the average annual growth of 26.4% and 29.2% in value and tons respectively. Moreover, it is the cheapest with baht 14 per kg. Fresh water culture fisheries are the most profitable undertaking among all types of agricultural activities with the expected average net production value of around baht 50,000 per ha.

Both the per capita consumption of fish and the per capita exports of fisheries products are growing at the very high rate of around 10% per annum. The rate is even greater than 8%, the average growth rate of per capita GDP in recent years. It means that the Thai people are eating more and more fish and at the same time foreign people are demanding more and more Thai fisheries products.

**Table 3.6.1 Water Demand in the Chao Phraya Basin**

**1. Existing and Future Water Demand**

Unit: MCM

Area	1993			2016		
	Irrigation	Urban	Total	Irrigation	Urban	Total
(1) Nan Basin	2,871	103	2,974	4,360	139	4,499
(2) Yom Basin	859	69	928	2,066	93	2,159
(3) Wang Basin	487	21	508	813	26	839
(4) Ping Basin	2,428	129	2,557	4,344	190	4,534
(5) Pasak Basin	835	96	931	1,114	148	1,262
(6) Sakae Krang Basin	1,161	8	1,169	1,161	16	1,177
(7) Chao Phraya Delta	11,620	4,610	16,230	13,500	5,360	18,860
Total	20,261	5,036	25,297	27,358	5,942	33,300

Source: NESDB and JICA

**2. Existing and Future Per Capita Water Demand**

Unit: lcd

Area	1993			2006		
	Irrigation	Urban	Total	Irrigation	Urban	Total
Chao Phraya Delta	2,533	382	2,915	2,756	604	3,360
Chao Phraya Basin	2,519	271	2,790	2,786	367	3,153
Kingdom	2,141	180	2,321	2,336	223	2,559

Source: JICA

Table 3.6.2(1) Position and Trend of Major Crops and Livestock in the Study Area

1. Second Rice

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Nakhon Sawan	122,416	115,601	57,830	94,267	-8.34
Petchabun	564	107	-	-	-
Uthai Thai	6,841	6,584	4,640	4,840	-10.90
Kamphaeng Phet	127,279	82,072	69,385	101,851	-7.16
Tak	1,970	436	-	118	-69.52
Phichit	194,279	128,740	106,310	204,609	1.74
Phitsanulok	177,495	116,350	48,436	168,615	-1.70
Nan	1,813	981	460	699	-27.22
Phrae	268	13	-	-	-
Lampang	2,229	1,545	1,876	1,506	-12.25
Sukhotahai	27,021	33,257	40,159	39,172	13.18
Uttaradit	46,915	35,391	4,688	29,537	-14.29
Chiang Mai	15,501	23,362	4,369	4,829	-32.21
Chiang Rai	4,861	23,712	11,159	9,310	24.19
Lamphun	6,852	3,625	1,721	2,232	-31.19
Phayao	439	676	1,353	2,630	81.62
Lop Buri	6,147	426	259	36,482	81.05
Saraburi	13,938	1,385	485	13,352	-1.42
Chai Nat	114,827	126,046	71,173	227,174	25.54
Nakhon Pathom	224,645	232,708	226,253	244,675	2.89
Nonthaburi	110,723	105,586	129,155	105,389	-1.63
Pathum Thani	176,270	204,581	157,861	176,193	-0.15
Ayutthaya	138,142	138,449	119,371	157,362	4.44
Sing Buri	28,649	24,125	12,939	61,408	28.94
Suphan Buri	332,674	450,549	321,511	526,548	16.54
Ang Thong	23,261	25,573	9,185	56,926	34.46
Bangkok Met.	24,552	38,287	29,885	52,815	29.09
Kanchanaburi	8,931	5,940	7,379	7,609	-5.20
Chachoengsao	267,819	159,916	195,699	197,969	-9.58
Samut Prakan	27,479	26,470	19,805	17,927	-13.27
Samut Sakhon	19,435	9,887	8,755	8,254	-24.83
TOTAL (A)	2,254,236	2,122,380	1,662,101	2,555,046	4.26
National Total (B)	2,881,528	2,614,834	1,964,597	2,949,999	0.79
A/Bx100	78.2	81.2	84.6	86.6	-

2. Major Rice

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Nakhon Sawan	700,644	723,542	594,785	740,258	1.85
Petchabun	353,759	348,972	229,597	493,677	11.75
Uthai Thai	88,218	77,541	76,274	105,744	6.23
Kamphaeng Phet	524,646	663,449	420,599	563,395	2.40
Tak	31,168	33,817	44,352	40,931	9.51
Phichit	490,108	522,502	426,689	483,205	-0.47
Phitsanulok	415,328	435,385	363,204	486,279	5.40
Nan	89,050	82,806	91,370	79,242	-3.82
Phrae	136,166	122,133	105,753	104,256	-8.52
Lampang	158,664	152,104	153,440	208,303	9.50
Sukhotahai	197,277	283,913	282,583	268,213	10.78
Uttaradit	149,025	183,955	169,284	213,659	12.76
Chiang Mai	270,714	240,654	307,633	276,762	0.74
Chiang Rai	527,930	209,775	471,247	452,434	-5.01
Lamphun	94,434	63,724	72,787	73,976	-7.82
Phayao	206,181	85,329	209,418	208,991	0.45
Lop Buri	372,377	273,150	306,087	309,034	-6.03
Saraburi	191,441	131,844	125,693	147,857	-8.25
Chai Nat	389,053	374,067	337,705	473,762	6.79
Nakhon Pathom	236,642	230,745	198,412	231,354	-0.75
Nonthaburi	89,139	88,807	84,481	88,647	-0.18

Table 3.6.2(2) Position and Trend of Major Crops and Livestock in the Study Area

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Pathum Thani	201,803	174,783	193,888	200,363	-0.24
Ayutthaya	335,516	359,370	353,904	352,019	1.61
Sing Buri	188,867	188,904	204,558	182,595	-1.12
Suphan Buri	501,649	527,709	551,922	529,579	1.82
Ang Thong	172,768	150,377	136,439	153,433	-3.88
Bangkok Met.	60,685	52,194	57,484	81,868	10.50
Kanchanaburi	10,052	11,724	13,631	11,303	3.99
Chachoengsao	398,082	392,238	404,101	393,113	-0.42
Samut Prakan	33,931	28,601	40,350	35,267	1.30
Samut Sakhon	21,540	21,601	19,630	18,135	-5.57
TOTAL (A)	7,636,956	7,277,468	7,047,300	8,007,653	1.59
National Total (B)	17,517,892	17,302,465	16,482,663	18,160,715	1.21
A/Bx100	43.6	42.1	42.8	44.1	-

(Second+Major)

TOTAL (A)	9,891,192	9,399,848	8,709,401	10,562,699	2.21
National Total (B)	20,399,420	19,917,299	18,447,260	21,110,714	1.15
A/Bx100	48.5	47.2	47.2	50.0	-

3. Maize

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Nakhon Sawan	241,155	202,717	222,688	255,277	1.92
Petchabun	497,773	651,748	428,856	560,285	4.02
Uthai Thai	75,525	74,763	59,392	84,774	3.93
Kamphaeng Phet	183,518	136,068	113,628	137,086	-9.27
Tak	75,408	79,514	73,372	74,837	-0.25
Phichit	34,541	24,998	27,138	28,651	-6.04
Phitsanulok	107,997	98,148	81,953	103,712	-1.34
Nan	75,358	46,083	64,196	124,025	18.07
Phrae	54,869	27,006	25,021	33,405	-15.25
Lampang	12,887	11,916	9,984	9,705	9.02
Sukhothai	47,652	13,400	15,766	25,735	-18.56
Uttaradit	53,717	28,279	33,536	45,518	-5.34
Chiang Mai	17,352	3,754	10,611	7,839	-23.27
Chiang Rai	117,609	96,054	129,432	143,403	6.83
Lamphun	7,092	2,010	3,834	3,379	-21.90
Phayao	52,394	42,922	73,027	84,041	17.06
Lop Buri	337,682	312,466	273,963	382,271	4.22
Saraburi	126,256	84,691	134,657	155,525	7.20
Chai Nat	5,925	5,308	7,053	6,925	5.34
Suphan Buri	15,219	21,671	24,133	31,135	26.95
Kanchanaburi	5,921	5,087	5,068	5,328	-3.46
Chachoengsao	8,697	6,285	6,420	8,435	-0.82
TOTAL (A)	2,154,547	1,974,887	1,823,748	2,311,341	2.37
National Total (B)	3,792,652	3,672,022	3,328,228	3,965,339	1.50
A/Bx100	56.8	53.8	54.8	58.3	-

4. Sugar Cane

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Nakhon Sawan	2,316,554	2,013,728	1,855,960	3,098,919	10.18
Petchabun	119,039	152,707	85,652	241,109	26.52
Uthai Thai	834,151	317,754	403,553	619,305	-9.45
Kamphaeng Phet	4,747,567	4,452,936	3,172,190	4,076,979	-4.95
Tak	17,029	49,348	24,523	23,412	17.90
Phichit	197,070	143,588	140,637	194,198	-0.49
Phitsanulok	757,593	347,546	249,087	465,840	-14.96
Phrae	209,279	115,101	122,475	184,760	-4.07

Table 3.6.2(3) Position and Trend of Major Crops and Livestock in the Study Area

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Lampang	508,594	248,567	348,311	290,436	-17.04
Sukhotahai	1,289,040	838,160	988,844	1,439,645	3.75
Uttaradit	776,813	431,811	661,472	669,656	-4.83
Chiang Mai	84,547	25,253	37,960	29,121	-29.90
Chiang Rai	6,901	1,398	3,140	6,836	-2.80
Lamphun	7,588	1,196	3,236	-	-
Lop Buri	2,410,024	1,117,337	1,464,026	1,863,704	-8.21
Saraburi	427,765	339,117	326,055	286,691	-12.49
Chai Nat	284,436	192,391	259,881	326,410	4.70
Nakhon Pathom	1,246,026	1,228,903	925,961	1,115,659	-3.62
Sing Buri	221,089	213,923	383,248	474,191	28.96
Suphan Buri	5,128,176	3,654,201	4,166,460	5,383,354	1.63
Ang Thong	195,707	68,214	221,294	270,750	11.42
Kanchanaburi	826,480	605,152	577,658	668,254	-6.84
Chachoengsao	682,210	688,270	643,386	546,122	-7.15
TOTAL (A)	23,293,678	17,253,666	17,065,008	22,279,850	-1.47
National Total (B)	47,479,508	39,816,601	37,822,875	50,597,339	2.14
A/Bx100	49.1	43.3	45.1	44.0	-

5. Mungbean

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Nakhon Sawan	27,409	20,968	20,202	21,655	-7.56
Petchabun	85,456	91,977	70,723	70,801	-6.08
Uthai Thai	4,952	5,231	5,283	6,161	7.56
Kamphaeng Phet	25,420	21,205	18,558	22,126	-4.52
Tak	1,092	1,355	1,668	2,193	26.17
Phichit	13,204	6,731	7,568	8,805	-12.63
Phitsanulok	20,856	13,675	10,260	12,771	-15.08
Nan	12,643	7,595	8,012	9,080	-10.45
Phrae	3,020	1,635	943	926	-32.57
Lampang	1,068	499	157	280	-36.00
Sukhotahai	31,501	35,159	32,224	36,322	4.86
Uttaradit	6,382	2,522	3,056	4,463	-11.24
Chiang Mai	30	11	56	248	102.20
Chiang Rai	178	164	248	507	41.75
Lamphun	219	53	83	98	-23.51
Phayao	2,003	1,390	843	942	-22.23
Lop Buri	18,218	9,024	12,644	13,447	-9.63
Saraburi	6,159	3,261	1,847	3,916	-14.01
Chai Nat	2,528	5,450	3,452	3,842	14.97
Nakhon Pathom	-	84	-	-	-
Ayuthaya	2,234	831	923	1,322	-16.04
Sing Buri	1,469	1,048	1,614	1,584	2.54
Suphan Buri	273	249	982	429	16.26
Ang Thong	1,852	1,196	2,180	2,250	6.70
Kanchanaburi	-	17	144	290	-
TOTAL (A)	268,166	231,330	203,670	224,458	-5.76
National Total (B)	304,207	261,403	231,257	255,506	-5.65
A/Bx100	88.2	88.5	88.1	87.8	-

6. Soybean

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Nakhon Sawan	24,198	25,835	23,169	29,063	6.30
Petchabun	30,483	34,725	26,779	35,926	5.63
Uthai Thai	4,712	1,899	4,337	10,447	30.40
Kamphaeng Phet	32,467	36,304	46,905	45,491	11.90
Tak	12,002	12,993	21,291	12,144	0.39
Phichit	723	621	2,844	3,661	71.72

Table 3.6.2(4) Position and Trend of Major Crops and Livestock in the Study Area

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Phitsanulok	23,103	30,828	41,909	44,609	24.52
Nan	5,552	5,250	4,644	4,336	-7.91
Phrae	11,657	16,917	17,293	18,720	17.10
Lampang	4,552	4,956	6,543	7,417	17.67
Sukhotahai	83,435	72,437	74,096	75,324	-3.35
Uttaradit	27,982	34,176	34,523	34,535	7.27
Chiang Mai	46,368	43,737	39,505	35,880	-8.19
Chiang Rai	2,719	4,326	5,308	5,620	27.38
Lamphun	1,662	1,412	1,708	1,490	-3.58
Phayao	1,238	2,085	1,984	1,492	6.42
Lop Buri	14,342	18,525	23,266	23,594	18.05
Saraburi	1,787	2,642	1,964	3,272	22.35
Chai Nat	127	76	312	493	57.16
Sing Buri	11	-	-	144	135.68
Suphan Buri	334	170	20	95	-34.24
Ang Thong	-	-	17	142	-
Kanchanaburi	84	193	114	205	34.64
Chachoengsao	1,459	3,106	5,161	5,916	59.46
TOTAL (A)	330,996	353,212	383,692	400,016	6.52
National Total (B)	435,587	480,148	513,099	527,580	6.60
A/Bx100	76.0	73.6	74.8	75.8	-

7. Groundnut

Unit: tons

Province	1992	1993	1994	1995	Average Annual Growth Rate (%)
Nakhon Sawan	4,269	5,745	5,798	4,701	3.27
Petchabun	1,095	1,250	1,549	1,200	3.08
Uthai Thai	690	618	449	635	-2.74
Kamphaeng Phet	1,387	1,232	599	1,294	-2.29
Tak	1,286	1,035	1,873	1,951	14.91
Phichit	62	72	154	212	50.65
Phitsanulok	1,658	1,899	1,696	2,121	8.56
Nan	11,177	11,126	7,808	8,372	-9.18
Phrae	7,300	6,585	4,820	5,574	-15.06
Lampang	7,284	7,848	9,212	10,029	11.25
Sukhotahai	1,849	1,540	1,052	916	-20.87
Uttaradit	3,273	3,427	2,839	2,901	-3.94
Chiang Mai	11,109	10,113	7,337	7,452	-12.46
Chiang Rai	6,949	5,767	7,986	9,168	9.68
Lamphun	2,469	1,805	1,893	1,639	-12.77
Phayao	9,912	6,770	7,468	8,043	-6.73
Lop Buri	4,214	3,485	4,634	5,841	11.50
Saraburi	3,706	2,724	2,211	2,711	-9.90
Chai Nat	654	734	839	1,014	15.74
Sing Buri	1,250	649	1,380	1,140	-3.02
Suphan Buri	295	437	163	159	-18.59
Kanchanaburi	43	55	55	69	17.07
Chachoengsao	465	194	483	602	8.99
TOTAL (A)	82,396	75,108	72,384	77,744	-1.92
National Total (B)	156,913	136,863	136,363	150,329	-1.42
A/Bx100	52.5	54.9	53.1	51.7	-

8. Buffalo

Unit: heads

Province	1991	1992	1993	Average Annual Growth Rate (%)
Nakhon Sawan	47,444	45,789	45,534	-2.03
Petchabun	54,619	52,019	50,040	-4.28
Uthai Thai	31,013	30,402	29,235	-2.91
Kamphaeng Phet	24,177	23,373	22,716	-3.07
Tak	12,920	12,801	12,311	-2.39
Phichit	16,427	16,177	16,050	-1.15

Table 3.6.2(5) Position and Trend of Major Crops and Livestock in the Study Area

Unit: heads

Province	1991	1992	1993	Average Annual Growth Rate (%)
Phitsanulok	37,629	36,544	35,632	-2.69
Nan	54,829	53,603	51,969	-2.64
Phrae	39,762	38,720	37,675	-2.66
Lampang	78,233	74,874	73,974	-2.76
Sukhotahai	17,953	17,497	16,845	-3.13
Uttaradit	26,909	26,288	25,280	-3.07
Chiang Mai	92,162	88,512	84,200	-4.42
Chiang Rai	90,418	87,767	86,753	-2.05
Lamphun	17,057	16,783	16,040	-3.03
Phayao	45,723	44,668	43,949	-1.96
Lop Buri	20,376	19,675	19,174	-2.99
Saraburi	21,678	21,371	20,620	-2.47
Chai Nat	17,718	17,064	16,530	-3.41
Nakhon Pathom	3,536	3,307	2,957	-8.55
Nonthaburi	1,103	1,002	898	-9.77
Pathum Thani	4,463	4,266	4,020	-5.09
Ayutthaya	24,913	24,046	21,680	-6.71
Sing Buri	4,086	3,934	3,902	-2.28
Suphan Buri	27,010	26,864	25,976	-1.93
Ang Thong	6,443	6,294	5,962	-3.81
Bangkok Met.	1,605	1,457	1,415	-6.11
Kanchanaburi	2,445	2,422	2,347	-1.35
Chachoengsao	14,796	14,397	14,005	-2.71
Samut Prakan	92	84	75	-9.71
Samut Sakhon	121	118	84	-17.00
TOTAL (A)	837,660	812,118	787,848	-3.02
National Total (B)	4,916,907	4,804,171	4,753,697	-1.69
A/Bx100I	17.0	16.9	16.6	-

## 9. Cattle

Unit: heads

Province	1991	1992	1993	Average Annual Growth Rate (%)
Nakhon Sawan	180,077	185,972	198,451	4.98
Petchabun	161,473	171,680	182,993	6.46
Uthai Thai	24,778	30,208	34,599	18.17
Kamphaeng Phet	54,131	66,306	70,371	14.02
Tak	52,047	53,751	56,352	4.05
Phichit	40,169	47,795	55,817	17.88
Phitsanulok	93,873	100,111	106,350	6.44
Nan	55,921	57,752	59,855	3.46
Phrae	64,136	66,941	67,257	2.40
Lampang	128,404	132,607	149,169	7.78
Sukhotahai	72,470	90,104	106,862	21.43
Uttaradit	67,838	81,283	89,041	14.57
Chiang Mai	129,596	133,838	137,574	3.03
Chiang Rai	79,940	82,558	92,700	7.69
Lamphun	50,897	51,274	52,310	1.38
Phayao	88,931	91,820	95,175	3.45
Lop Buri	181,096	187,024	211,187	7.99
Saraburi	65,858	68,014	70,188	3.24
Chai Nat	65,872	69,128	80,022	10.22
Nakhon Pathom	43,646	45,075	45,987	2.65
Nonthaburi	3,778	3,902	3,237	-7.44
Pathum Thani	5,227	5,398	7,631	20.83
Ayutthaya	38,099	39,346	44,348	7.89
Sing Buri	23,876	25,848	24,697	1.70
Suphan Buri	137,341	141,837	145,975	3.10
Ang Thong	44,643	48,422	50,311	6.16
Bangkok Met.	5,282	5,455	6,750	13.05
Kanchanaburi	20,579	21,252	21,994	2.24
Chachoengsao	45,253	48,443	51,634	6.82
Samut Prakan	965	1,012	1,074	5.50



Table 3.6.2(6) Position and Trend of Major Crops and Livestock in the Study Area

Unit: heads

Province	1991	1992	1993	Average Annual Growth Rate (%)
Samut Sakhon	1,537	1,587	1,162	-13.05
TOTAL (A)	2,027,578	2,155,584	2,320,957	6.99
National Total (B)	5,771,052	6,023,227	6,360,455	4.98
A/Bx100	35.1	35.8	36.5	-

10. Swine

Unit: heads

Province	1991	1992	1993	Average Annual Growth Rate (%)
Nakhon Sawan	51,627	49,437	52,801	1.13
Petchabun	83,450	79,911	73,482	-6.16
Uthai Thai	36,644	35,090	35,276	-1.88
Kamphaeng Phet	66,215	63,407	64,215	-1.52
Tak	18,184	17,413	16,693	-4.19
Phichit	64,648	61,906	63,029	-1.26
Phitsanulok	86,805	83,124	70,766	-9.71
Nan	75,471	72,270	68,201	-4.94
Phrae	81,183	77,740	71,037	-6.46
Lampang	94,062	90,073	85,552	-4.63
Sukhotthai	58,573	56,089	61,235	2.25
Uttaradit	50,309	48,175	52,942	2.58
Chiang Mai	200,723	192,210	228,542	6.70
Chiang Rai	147,514	141,258	132,014	-5.40
Lamphun	43,886	42,024	46,993	5.92
Phayao	68,800	65,882	57,112	-8.89
Lop Buri	82,227	77,949	80,815	-0.86
Saraburi	52,967	50,211	52,957	-0.01
Chai Nat	37,311	35,370	40,395	4.05
Nakhon Pathom	377,128	357,510	365,716	-1.52
Nonthaburi	2,149	2,037	2,774	13.61
Pathum Thani	13,831	13,111	14,014	0.66
Ayutthaya	26,661	25,274	35,348	15.14
Sing Buri	35,020	33,198	38,031	4.21
Suphan Buri	141,898	134,516	150,456	6.03
Ang Thong	29,187	27,669	31,063	63.16
Bangkok Met.	9,191	8,713	6,901	-13.35
Kanchanaburi	3,235	3,066	3,247	0.19
Chachoengsao	180,708	171,308	185,879	1.42
Samut Prakan	13,260	12,570	10,803	-9.74
Samut Sakhon	5,514	5,227	4,466	-10.01
TOTAL (A)	2,238,381	2,133,738	2,202,754	-0.80
National Total (B)	4,857,036	4,655,479	4,984,962	1.29
A/Bx100	46.1	45.8	44.2	-

Source: "Agricultural Statistics of Thailand, Crop Year 1994/95", Ministry of Agriculture and Co-operatives

**Table 3.6.3(1) Important Position of Fisheries (Incl. Fresh Water Fisheries) in Thailand**

1. Trend and Position of Fisheries

(1) GDP (at 1988 Constant Prices)

(Unit: baht million)

Item		1984	1993	Average Annual Growth Rate (%)
GDP	(A)	1,138,353	2,472,298	9.0
GDP of Agricultural Sector	(B)	217,518	288,761	3.2
(B)/(A)x100		19.1	11.7	-
GDP of Crops Sub-Sector	(C)	139,171	174,817	2.6
GDP of Livestock Sub-Sector	(D)	20,008	32,124	5.4
GDP of Fisheries Sub-Sector	(E)	20,429	36,197	6.6
(C)/(B)x100		64.0	60.5	-
(D)/(B)x100		9.2	11.1	-
(E)/(B)x100		9.4	12.5	-

Source: Agricultural Statistics of Thailand Crop Year 1994/95

(2) Exports

(Unit: baht million)

Item		1990	1994	Average Annual Growth Rate (%)
Exports	(A)	588,157	1,135,513	17.9
Exports of Agricultural Goods	(B)	224,168	336,141	10.7
(B)/(A)x100		38.1	29.6	-
Exports of Rice	(C)	27,770	39,187	9.0
Exports of Fruits	(D)	11,198	16,032	9.6
Exports of Animal & Products	(E)	15,579	26,503	14.3
Exports of Fisheries Products	(F)	57,802	105,376	16.2
(C)/(B)x100		12.4	11.7	-
(D)/(B)x100		5.0	4.8	-
(E)/(B)x100		6.9	7.9	-
(F)/(B)x100		25.8	31.3	-

Source: Agricultural Statistics of Thailand Crop Year 1994/95

(3) Imports

(Unit: baht million)

Item		1990	1994	Average Annual Growth Rate (%)
Imports	(A)	852,982	1,369,034	12.6
Imports of Agricultural Goods	(B)	125,711	179,675	9.3
(B)/(A)x100		14.7	13.1	-
Imports of Food Crops	(C)	3,810	7,774	19.5
Imports of Animal & Products	(D)	18,485	32,980	15.6
Imports of Wood & Products	(E)	14,607	25,264	14.7
Imports of Fisheries Products	(F)	20,180	18,187	-2.6
(C)/(B)x100		3.0	4.3	-
(D)/(B)x100		14.6	11.9	-
(E)/(B)x100		11.6	14.1	-
(F)/(B)x100		16.1	10.1	-

Source: Agricultural Statistics of Thailand Crop Year 1994/95

**Table 3.6.3(2) Important Position of Fisheries (Incl. Fresh Water Fisheries) in Thailand**

2. Trend and Position of Fresh Water Fisheries

(1) Annual Catches of Fish

(Unit: 1,000 tons)

Item		1983	1992	Average Annual Growth Rate (%)
Total	(A)	2,255	3,240	4.1
Marine Water Fish	(B)	2,100	2,966	3.7
Fresh Water Fish	(C)	155	274	6.5
(B)/(A)x100		93.1	91.5	-
(C)/(A)x100		6.9	8.5	-

Source: Agricultural Statistics of Thailand Crop Year 1994/95

(2) Area of Fresh Water Fish Culture Farms

(Unit: rai)

Item		1983	1992	Average Annual Growth Rate (%)
Total	(A)	233,733	308,135	3.1
Paddy Fields	(B)	179,747	148,589	-2.1
Ditches	(C)	1,693	1,054	-5.1
Cages	(D)	46	24	-7.0
Ponds	(E)	52,247	158,468	13.1
(B)/(A)x100		76.8	48.2	-
(C)/(A)x100		0.7	0.3	-
(D)/(A)x100		0.2	0.1	-
(E)/(A)x100		22.4	51.4	-

Source: Agricultural Statistics of Thailand Crop Year 1994/95

(3) Production of Fresh Water Fish Culture Farms

(Unit: ton)

Item		1983	1992	Average Annual Growth Rate (%)
Total	(A)	46,966	142,104	13.1
Paddy Fields	(B)	19,697	29,160	4.5
Ditches	(C)	872	861	-0.1
Cages	(D)	326	1,138	14.9
Ponds	(E)	26,071	110,945	17.5
(B)/(A)x100		41.9	20.5	-
(C)/(A)x100		1.9	0.6	-
(D)/(A)x100		0.7	0.8	-
(E)/(A)x100		55.5	78.1	-

Source: Agricultural Statistics of Thailand Crop Year 1994/95

**Table 3.6.3(3) Important Position of Fisheries (Incl. Fresh Water Fisheries) in Thailand**

**(4) Popular Fresh Water Fish**

**a) Value**

(Unit: baht million)

Name of Fish	1990	1991	1992	Average Annual Growth Rate (%)
Pla Nil (Tilapia)	729	990	1,164	26.4
Pla Tapian (Local Carp)	776	777	956	11.0
Pla Chon (Snake Head)	678	804	810	9.3
Pla Duk (Catfish)	694	910	751	4.0
Sepat Siam	262	303	307	8.2
Pla Nai (Common Carp)	139	217	228	28.1
Pla Swai (Catfish)	147	177	211	19.8
Pla Mo (Climbing Perch)	230	189	178	-12.0

Source: Agricultural Statistics of Thailand Crop Year 1994/95

**b) Quantity**

(Unit: 1,000 tons)

Name of Fish	1990	1991	1992	Average Annual Growth Rate (%)
Pla Nil (Tilapia)	50.8	70.3	84.8	29.2
Pla Tapian (Local Carp)	40.6	39.4	46.2	6.7
Pla Chon (Snake Head)	16.8	20.0	18.7	5.5
Pla Duk (Catfish)	25.8	36.1	30.5	8.7
Sepat Siam	13.6	13.8	13.5	-0.4
Pla Nai (Common Carp)	5.8	9.3	9.0	24.6
Pla Swai (Catfish)	13.5	15.3	15.0	5.4
Pla Mo (Climbing Perch)	8.7	6.8	6.6	-12.9

Source: Agricultural Statistics of Thailand Crop Year 1994/95

**c) Price**

(Unit: baht/kg)

Name of Fish	1990	1991	1992
Pla Nil (Tilapia)	14	14	14
Pla Tapian (Local Carp)	19	20	21
Pla Chon (Snake Head)	40	45	43
Pla Duk (Catfish)	27	25	25
Sepat Siam	19	22	23
Pla Nai (Common Carp)	24	23	25
Pla Swai (Catfish)	11	12	14
Pla Mo (Climbing Perch)	26	25	27

Source: Agricultural Statistics of Thailand Crop Year 1994/95

**Table 3.6.3(4) Important Position of Fisheries (Incl. Fresh Water Fisheries) in Thailand**

**3. Productivity of Fresh Water Fish Culture**

**(1) Economic Net Benefit per ha of Crops and Fish**

(Unit: baht/ha)

Crops/Fish	Net Production Value per ha
1. Wet Paddy	7,000
2. Dry Paddy	8,000
3. Upland Crops	
Maize	3,700
Soybean	8,000
Peanut	6,400
Sugar Cane	6,700
4. Orchards	35,000
5. Vegetables	45,000
6. Fish	50,000

Source: JICA

**(2) Comparison of Net Income between Fresh Water Fish and Cattle**

(Unit: baht/ha)

Item	Net Income per ha
Cattle	21,550
Fresh Water Fish	49,431

Note: fresh water fish = pla nil, pla nai and pla tapian

Source: Mun River Basin Water Resources Development Master Plan

**4. Per Capita Indices of Fisheries in Recent Years (at 1996 Constant Prices)**

(Unit: baht/person)

Item	1989	1992	Average Annual Growth Rate (%)
Per Capita Catches of Fish	1,013	1,379	10.8

Source: JICA

(Unit: baht/person)

Item	1990	1994	Average Annual Growth Rate (%)
Per Capita Exports of Fisheries Products	1,377	2,004	9.8

Source: JICA

**Table 3.6.4(1) Budgetary Viability of Kok Ing Nan Water Diversion Project**

**I. Estimated Position of the Project Cost in RID Budget**

**1. Relationship between GDP and, RID Budget**

(Unit: baht million at 1996 constant prices)

Item	1989	1990	1991	1992	1993	1994	1995
GDP	2,799,801	2,934,287	3,181,295	3,439,440	3,724,289	4,049,666	4,400,484
RID Budget	15,571	19,558	20,179	21,404	25,325	27,124	31,249

Source: NESDB and JICA

Regression Equation:

$$y = -7625 + 0.00883393x \quad (r = 0.982796, T \text{ value} = 11.89858)$$

where y: GDP, x: RID budget

**2. Share of "Land Building Materials" in RID Budget and Share of "Construction" in "Land Building Materials"**

Share of "Land Building Materials" in RID Budget	Share of "Construction" in "Land Building Materials"
74.5%	43.1%

Source: NESDB and JICA

**3. Assumptions in Projection**

**(1) Economic Growth Rate**

Item	1996	1997 - 2001	2002 - 2006	2007
Annual GDP Growth Rate	7%	8%	7%	6%

**(2) Financial Resources of Project Cost**

Local Portions	Foreign Portions	Total
50%	50%	100%

**4. Estimated Position of Kok Ing Nan Water Diversion Project Cost in RID Budget**

(Unit: baht million at 1996 constant prices)

Projection	1996	1997	1998	1999	2000	2001
GDP	4,708,000	5,085,000	5,492,000	5,931,000	6,405,000	6,917,000
RID Budget	33,965	37,278	40,891	44,769	48,956	53,479
"Land Building Materials" (A)	25,297	27,772	30,464	33,353	36,472	39,842
"Construction" (B)	10,903	11,970	13,130	14,375	15,719	17,172
Project Cost (C)					1,250	2,500
C/Ax100					3.4	6.2
C/Bx100					8.0	14.6

**Table 3.6.4(2) Budgetary Viability of Kok Ing Nan Water Diversion Project**

(Unit: baht million at 1996 constant prices)

Projection	2002	2003	2004	2005	2006	2007
GDP	7,401,000	7,919,000	8,473,000	9,066,000	9,701,000	10,283,000
RID Budget	57,755	62,331	67,225	72,463	78,073	83,314
"Land Building Materials" (A)	43,027	46,437	50,083	53,985	58,164	62,069
"Construction" (B)	18,545	20,014	21,586	23,268	25,069	26,752
Project Cost (C)	3,750	3,750	3,750	3,750	3,750	2,500
C/Ax100	8.7	8.1	7.5	6.9	6.4	4.0
C/Bx100	20.2	18.7	17.4	16.1	15.0	9.3

**Cumulative Comparisons:**

(Unit: baht million at 1996 constant prices)

Projection	Cumulative 2000 to 2007
"Land Building Materials" (A)	390,079
"Construction" (B)	168,125
Project Cost (C)	25,000
C/Ax100	6.4
C/Bx100	14.9

**II. Estimated Position of the Project Cost in External Debt Services**

**1. External Debt Services and Debt Service Ratio in 1994**

(Unit: US\$ million)

Item	Amount
Debt Outstanding	
Public Sector	15,714
Private Sector	38,035
Total	53,747
Debt Service Payments	
Public	1,943
Private	4,486
Total	6,429
Debt Service Ratio	
Public	3.3%
Private	7.7%
Total	11.0%

Source: Quarterly Bulletin, December 1995

**2. Debt Service Payments for the Project**

(Unit: US\$ million)

External Loans	Annual Repayments
1,000	approx. 100

**Table 3.6.4(3) Budgetary Viability of Kok Ing Nan Water Diversion Project**

(Unit: US\$ million)

Item	Amount
External Public Debt Service Payments in 1994 (A)	1,943
Total External Debt Service Payments in 1994 (B)	6,429
Annual Repayments for the Project (C)	100
C/Ax100	5.1
C/Bx100	1.6



## **4.2 Water Demand and Supply in Kok, Ing and Upper Nan Basins**

The paragraph 4.2 of the Main Report is supported by the following tables;

- Proposed Water Resources Development Projects in Kok River Basin
- Proposed Water Resources Development Projects in Ing River Basin
- Proposed Water Resources Development Projects in Upper Nan River Basin

Table 4.2.1 Proposed Water Resources Development Projects in Kok River Basin

No.	Project Name	Drainage Area (sq.km)	Mean Annual Runoff (MCM)	Storage Capacity (MCM)	Irrigation Area (rai)	Year Studied	Agency	Phase of Study
1	Mae Kok Dam	5,870	-	570.0	116,500	1986	EGAT	Pre-feasibility
2	Upper Nam Mae Fang Dam	164	94.0	50.0	18,125	1973	-	Desk Study
3	Huai Krai Reservoir	71	47.0	48.5	28,000	1973	-	Desk Study
4	Mae Na Wang Dam	85	49.0	36.2	13,000	1973	-	Desk Study
5	Mae Chae Dee Reservoir	165	44.0	35.0	36,000	1973	-	Desk Study
6	Mae Pun Luang Reservoir	223	64.0	53.0	55,000	1973	-	Desk Study
7	Mae Yang Ka Min Reservoir	146	45.0	32.0	39,000	1973	-	Desk Study
8	Chai Sombat Weir	530	536.0	-	35,000	1983	RID	Existing Project
9	Nong Luang Reservoir	173	63.0	15.0	5,700	1973	RID	Existing Project

Table 4.2.2 Proposed Water Resources Development Projects in Ing River Basin

No.	Project Name	Drainage Area (sq.km)	Mean Annual Runoff (MCM)	Storage Capacity (MCM)	Irrigation Area (rai)	Year Studied	Agency	Phase of Study
1	Mae Chai Reservoir	-	-	-	-	-	RID	Under Construction
2	Nam Yuan Reservoir	-	-	24.0	20,000	-	RID	Detailed Design
3	Nong Leng Sai	120	26.5	6.5	10,000	-	RID	Existing Project
4	South of Amphoe Thoeng	4,380	1,464.0	13.0	37,000	-	-	None
5	North of Amphoe Thoeng	6,350	2,123.0	17.0	28,000	-	-	None
6	Pak Ing Regulator	7,300	2,440.0	13.5	48,000	1993	DEDP	Desk Study
7	People Irrigation Projects	-	-	-	30,600	-	RID	Existing Project

Table 4.2.3 Proposed Water Resources Development Projects in Upper Nan River Basin

No.	Project Name	Drainage Area (sq.km)	Mean Annual Runoff (MCM)	Storage Capacity (MCM)	Irrigation Area (rai)	Year Studied	Agency	Phase of Study
1	Nam Sa Dam	689	70.7	417.8	29,800	1990	EGAT	Desk Study
2	Nam Yao Dam	619	306.8	333.9	29,740	1990	EGAT	Desk Study
3	Nam Wa Dam	2,058	1,633.0	52.0	-	1995	DEDP	Detailed Design
4	Nam Muab Reservoir	56	17.1	6.0	5,800	1988	RID	Desk Study
5	Mae Kha Ning Reservoir	229	86.6	62.0	13,500	1991	RID	Desk Study
6	Huai Lod Reservoir	28	4.2	12.0	1,600	1991	RID	Desk Study
7	Ban Hi Reservoir	37	5.5	15.0	2,100	1991	RID	Desk Study
8	Ban Thang Noi Weir	5,385	2,984.8	9.6	22,800	1993	DEDP	Detailed Design
9	Ban Nong Nok Reservoir	8,834	5,203.2	6.9	23,900	1993	DEDP	Detailed Design
10	Nam Samun Reservoir	180	154.9	13.5	12,000	1991	RID	Desk Study
11	Nam Khwang Reservoir	89	80.5	7.1	5,500	1991	RID	Desk Study
12	Amphoe Tha Wang Pha	785	384.7	-	20,000	-	-	None

#### 4.4 Proposed Water Diversion Plan

The paragraph 4.4 of the Main Report is supported by the following tables and figures;

##### Table

- Case Study of Sirikit Reservoir Operation with Various Combination of Diversion Capacity
- Monthly Hydro-Power Energy Generated at Sirikit Dam
- Estimated Hydro-Power Energy Generated at Sirikit Dam (With Project Condition)
- Projected Total Water Diversion from Kok, Ing and Ing-Lao Rivers
- Projected Water Diversion from Kok River
- Projected Water Diversion from Ing and Ing-Lao River
- Residual Flow of Kok River after Projected Water Diversion
- Residual Flow of Ing and Ing-Lao River after Projected Water Diversion

##### Figure

- Sirikit Operation ( $K_{capt}=175$ ,  $K_{capk}=125$ )
- Rating Curve of Sirikit Hydro-Power Plant
- Projected Total Water Diversion from Kok, Ing and Ing-Lao River
- Projected Water Diversion from Kok River
- Projected Water Diversion from Ing and Ing-Lao River
- Flow Condition of Kok River with/without Project
- Flow Condition of Ing and Ing-Lao River with/without Project
- Flow Condition of Kok, Ing and Ing-Lao River with/without Project
- Residual Flow of Kok River after Projected Water Diversion
- Residual Flow of Ing River after Projected Water Diversion

**Table 4.4.1 Case Study of Sirikit Reservoir Operation with Various Combination of Diversion Capacity**

Ing-Nan Cap.	Kok-Ing Cap.	Carry-Over = 500MCM						Carry-Over = 1,000MCM						Carry-Over = 1,500MCM					
		Diversion		Usable Storage		Spill-age	Over URC	Diversion		Usable Storage		Spill-age	Over URC	Diversion		Usable Storage		Spill-age	Over URC
		Potent	Actual	Potent	Addit.			Potent	Actual	Potent	Addit.			Potent	Actual	Potent	Addit.		
150	75	1867	1803	5334	2238	0	0	1867	1741	5267	2171	26	1	1867	1631	5129	2033	459	2
	90	1956	1885	5414	2318	0	0	1956	1813	5336	2240	34	1	1956	1698	5193	2098	459	2
	105	2007	1930	5458	2362	0	0	2007	1852	5373	2278	37	1	2007	1735	5228	2132	459	2
	120	2030	1951	5477	2381	0	0	2030	1869	5389	2293	39	1	2030	1752	5243	2147	459	3
	87	2071	1989	5520	2424	0	0	2071	1896	5416	2320	123	1	2071	1763	5258	2163	459	2
175	105	2175	2077	5606	2510	0	0	2175	1970	5486	2391	133	1	2175	1838	5330	2235	459	3
	122	2230	2123	5649	2554	0	1	2230	2004	5517	2421	137	1	2230	1875	5365	2269	459	3
	140	2255	2142	5667	2572	0	1	2255	2018	5530	2434	140	1	2255	1889	5377	2281	459	3
	100	2258	2137	5668	2573	0	0	2258	2026	5540	2444	210	1	2258	1880	5373	2277	459	4
200	120	2367	2226	5753	2657	0	1	2367	2102	5610	2515	231	1	2367	1941	5430	2334	459	5
	140	2427	2271	5796	2700	0	1	2427	2148	5655	2559	237	2	2427	1974	5459	2364	459	5
	160	2450	2286	5810	2715	0	1	2450	2166	5671	2576	238	2	2450	2984	5468	2373	459	5

Note: (1) Carry-Over is the storage to be maintained at the end of dry season for unforeseen drought.

(2) Potential diversion is possible amount of diversion corresponding to capacity of diversion channel.

(3) Actual diversion is amount of water diverted after adjusted with the Sirikit storage.

(4) Potential usable storage is estimated at (November End Storage+Dry Season Inflow-Carryover).

(5) Additional usable storage is estimated at (Potential Usable Storage-Existing Water Use 3,095MCM).

(6) Spillage is the total amount of spillage during 20 years.

(7) Over URC means number of time when reservoir storage exceeds the upper rule curve.

Table 4.4.2 Monthly Hydro-Power Energy Generated at Sirikit Dam (Unit: MKWEH)

Year	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
1974	36.40	52.31	74.56	117.13	127.96	92.79	79.46	54.34	50.62	50.14	56.60	89.29	881.60
1975	106.07	77.12	61.89	111.75	143.12	150.34	137.51	104.92	96.77	69.03	111.68	139.91	1310.11
1976	161.76	152.81	142.64	104.48	108.36	85.86	86.96	86.73	103.61	102.18	101.82	126.16	1363.37
1977	120.31	121.81	112.82	106.85	111.45	41.53	47.81	83.50	40.73	27.46	35.31	61.75	911.33
1978	68.19	34.59	40.70	44.23	32.05	50.20	54.08	49.45	68.42	74.49	89.29	148.69	754.38
1979	130.57	114.53	69.48	83.40	101.93	64.81	73.80	78.85	44.49	29.85	24.09	38.99	854.79
1980	40.80	41.06	24.37	25.87	20.56	49.48	55.35	37.82	47.31	70.21	87.38	108.82	609.03
1981	119.64	103.06	114.14	75.45	202.96	103.85	82.01	103.87	62.27	79.97	115.67	144.66	1307.55
1982	143.03	95.14	42.25	75.43	105.65	32.72	39.21	62.61	47.91	84.07	98.27	115.35	941.64
1983	160.45	100.95	42.21	76.31	48.68	17.46	6.88	10.37	8.10	34.83	90.22	140.18	736.64
1984	128.49	80.49	43.14	58.48	111.65	138.57	44.05	102.84	32.18	89.66	127.95	176.45	1133.95
1985	165.28	92.31	46.82	42.50	33.14	41.95	12.03	21.96	24.65	37.41	104.15	157.20	779.40
1986	129.37	116.69	116.35	94.37	69.47	53.69	75.75	123.73	42.32	57.63	120.33	109.99	1109.69
1987	101.10	85.80	38.30	63.70	41.40	17.20	11.10	29.70	7.00	30.50	83.70	60.80	570.30
1988	34.40	20.00	9.10	22.00	19.20	31.60	24.40	30.50	13.40	36.50	59.20	60.70	361.00
1989	94.80	90.80	22.60	27.20	75.00	82.10	35.70	61.00	18.40	64.20	74.00	121.50	767.30
1990	101.30	72.30	55.40	61.60	64.20	69.40	52.80	54.10	27.60	33.50	80.90	99.40	772.50
1991	83.37	42.50	19.81	45.34	43.65	8.58	29.55	41.58	24.96	33.23	51.71	68.27	492.55
1992	64.96	43.13	15.18	15.14	3.44	8.14	5.92	31.5	32.47	22.78	45.34	62.33	350.33
1993	60.49	49.24	39.60	60.22	105.92	36.93	18.05	66.83	27.47	24.24	32.68	36.39	558.06
1994	17.77	13.15	3.99	1.98	17.13	58.91	32.58	93.56	69.75	74.06	127.55	161.90	672.33
MEAN	98.50	76.18	54.06	62.54	75.57	58.86	47.86	63.32	42.40	53.62	81.80	106.13	820.85
MAX	165.28	152.81	142.64	117.13	202.96	150.34	137.51	123.73	103.61	102.18	127.95	176.45	1363.37
MIN	17.77	13.15	3.99	1.98	3.44	8.14	5.92	10.37	7.00	22.78	24.09	36.39	350.33

Note: Unit=GWH

Table 4.4.3 Estimated Hydro-Power Energy Generated at Sirikit Dam (With Project Condition, Unit=MKWE)

Year	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual
1974	155.2	145.1	155.8	44.5	36.7	41.0	43.6	45.0	151.0	146.0	139.2	131.8	1214.9
1975	123.6	115.4	110.8	61.9	73.5	84.5	88.7	89.1	202.5	193.7	184.4	174.3	1502.3
1976	163.1	151.3	140.7	45.0	49.9	56.9	62.2	65.1	188.0	180.8	172.4	163.1	1438.4
1977	153.5	143.6	133.2	45.2	37.1	41.2	44.1	45.8	150.2	145.2	138.8	131.8	1209.7
1978	124.6	117.1	110.4	62.0	71.0	80.4	86.3	88.3	201.1	191.8	181.6	170.4	1484.8
1979	158.5	146.5	138.2	44.3	36.0	39.6	41.7	42.6	98.3	95.1	91.5	87.6	1019.8
1980	83.7	79.7	77.2	61.5	68.1	78.2	85.5	87.1	192.1	183.2	173.2	162.5	1332.0
1981	151.3	141.5	134.5	67.6	79.1	84.2	87.4	88.6	192.5	184.2	175.3	165.4	1551.6
1982	154.9	144.1	134.0	45.5	37.5	42.2	46.2	48.2	171.4	164.4	156.6	148.2	1293.1
1983	139.4	130.9	122.5	45.1	49.7	55.9	60.8	63.6	174.6	167.3	159.4	150.8	1320.0
1984	141.7	132.7	124.7	62.2	70.2	78.8	84.5	86.5	178.9	171.4	163.3	154.5	1449.6
1985	145.3	135.9	126.9	45.2	51.3	58.0	61.4	63.3	184.8	176.6	167.4	157.7	1373.8
1986	147.6	139.0	132.2	46.0	38.0	41.4	43.8	45.1	123.5	119.4	114.5	109.5	1100.1
1987	104.1	98.5	93.1	43.7	34.8	38.3	40.7	42.3	108.2	104.5	100.1	95.3	903.4
1988	90.3	86.4	84.5	46.1	52.1	57.1	59.6	61.1	140.3	135.2	129.1	122.6	1064.5
1989	115.6	109.3	104.2	45.7	37.5	41.1	44.0	45.4	141.7	136.4	130.2	123.4	1074.5
1990	116.1	109.3	104.7	45.8	37.6	41.2	43.7	45.2	136.2	131.2	125.3	118.8	1055.0
1991	111.9	105.7	101.1	44.5	35.9	39.4	42.1	43.5	101.9	99.1	95.6	91.8	912.6
1992	87.8	83.6	79.3	44.6	35.5	38.6	41.1	42.4	98.0	95.4	91.9	88.2	826.5
1993	84.4	80.6	77.4	45.9	37.4	40.2	42.4	43.5	-	-	-	-	-
MEAN	127.6	119.8	113.3	49.6	48.4	53.9	57.5	59.1	154.5	148.5	141.6	134.1	1217.2
MAX	163.1	151.3	140.7	67.6	79.1	84.5	88.7	89.1	202.5	193.7	184.4	174.3	1551.6
MIN	83.7	79.7	77.2	43.7	34.8	38.3	40.7	42.3	98.0	95.1	91.5	87.6	826.5



Table 4.4.4 Projected Total Water Diversion from Kok, Ing and Ing-Lao rivers (Unit: MCM)

	4	5	6	7	8	9	10	11	12	1	2	3	Wet	Dry	Annual
1974	0.0	0.0	109.3	181.4	455.2	453.6	407.9	431.7	260.2	0.0	0.0	0.0	2039.1	260.2	2299.3
1975	0.0	0.0	35.6	344.1	468.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	848.4	0.0	848.4
1976	0.0	0.0	26.9	164.7	453.2	403.5	467.0	405.5	0.0	0.0	0.0	0.0	1920.8	0.0	1920.8
1977	0.0	0.0	0.0	317.0	467.1	453.6	468.7	441.3	204.4	0.0	0.0	0.0	2147.7	204.4	2352.1
1978	0.0	0.0	0.0	465.9	468.7	453.6	465.4	270.6	0.0	0.0	0.0	0.0	2124.2	0.0	2124.2
1979	0.0	0.0	133.3	197.9	404.5	416.9	405.4	176.6	52.1	0.0	0.0	0.0	1734.6	52.1	1786.7
1980	0.0	0.0	55.7	258.2	460.5	453.6	468.7	327.8	0.0	0.0	0.0	0.0	2024.5	0.0	2024.5
1981	0.0	0.0	143.4	431.9	185.7	0.0	431.8	33.2	0.0	0.0	0.0	0.0	1226.0	0.0	1226.0
1982	0.0	0.0	160.6	256.6	395.3	443.1	452.6	311.8	48.8	0.0	0.0	0.0	2020.0	48.8	2068.8
1983	0.0	0.0	22.0	224.7	464.5	453.6	468.6	453.6	0.0	0.0	0.0	0.0	2087.1	0.0	2087.1
1984	0.0	0.0	0.0	287.1	427.6	444.0	462.8	344.4	0.0	0.0	0.0	0.0	1966.0	0.0	1966.0
1985	0.0	0.0	71.7	269.7	456.1	453.6	466.7	453.6	40.6	0.0	0.0	0.0	2171.4	40.6	2212.0
1986	0.0	0.0	56.0	257.4	453.6	451.4	448.7	314.6	62.8	0.0	0.0	0.0	1981.7	62.8	2044.5
1987	0.0	0.0	13.1	136.7	360.3	453.6	435.7	400.8	112.1	0.0	0.0	0.0	1800.3	112.1	1912.4
1988	0.0	0.0	192.2	399.9	467.0	453.0	463.5	349.1	127.0	0.0	0.0	0.0	2324.7	127.0	2451.6
1989	0.0	0.0	70.7	391.1	468.7	453.6	468.7	374.9	137.9	0.0	0.0	0.0	2227.8	137.9	2365.7
1990	0.0	0.0	129.3	350.5	404.2	453.6	442.1	430.8	116.4	0.0	0.0	0.0	2210.5	116.4	2326.9
1991	0.0	0.0	149.9	251.5	425.6	453.6	458.2	355.3	123.5	0.0	0.0	0.0	2094.0	123.5	2217.5
1992	0.0	0.0	0.0	208.6	331.7	429.3	404.7	325.6	133.7	0.0	0.0	0.0	1700.0	133.7	1833.7
1993	0.0	0.0	28.5	350.1	389.7	453.6	466.5	317.8	95.0	0.0	0.0	0.0	2006.2	95.0	2101.2
MEAN	0.0	0.0	69.9	287.3	420.4	401.5	427.7	325.9	75.7	0.0	0.0	0.0	1932.7	75.7	2008.5
MAX	0.0	0.0	192.2	465.9	468.7	453.6	468.7	453.6	260.2	0.0	0.0	0.0	2524.7	260.2	2451.6
MIN	0.0	0.0	0.0	136.7	185.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	848.4	0.0	848.4

Table 4.4.5 Projected Water Diversion from Kok River (Unit:MCM)

	4	5	6	7	8	9	10	11	12	1	2	3	Wet	Dry	Annual
1974	0.0	0.0	109.3	154.2	170.5	159.2	223.8	214.6	248.1	0.0	0.0	0.0	1031.5	248.1	1279.6
1975	0.0	0.0	8.1	218.2	46.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	272.3	0.0	272.3
1976	0.0	0.0	26.9	160.7	320.6	233.7	128.8	182.4	0.0	0.0	0.0	0.0	1053.1	0.0	1053.1
1977	0.0	0.0	0.0	240.8	236.9	0.0	15.9	164.5	185.1	0.0	0.0	0.0	658.2	185.1	843.3
1978	0.0	0.0	0.0	134.7	128.7	32.3	175.4	210.1	0.0	0.0	0.0	0.0	681.2	0.0	681.2
1979	0.0	0.0	81.4	135.1	296.2	306.6	267.0	157.9	52.1	0.0	0.0	0.0	1244.2	52.1	1296.3
1980	0.0	0.0	45.7	111.6	152.4	13.1	165.3	223.5	0.0	0.0	0.0	0.0	711.6	0.0	711.6
1981	0.0	0.0	143.4	282.3	0.0	0.0	294.6	0.0	0.0	0.0	0.0	0.0	720.3	0.0	720.3
1982	0.0	0.0	160.6	235.2	306.2	264.4	248.9	274.7	48.8	0.0	0.0	0.0	1490.0	48.8	1538.9
1983	0.0	0.0	22.0	196.3	265.9	145.2	225.5	181.6	0.0	0.0	0.0	0.0	1036.5	0.0	1036.5
1984	0.0	0.0	0.0	239.3	189.8	69.6	187.8	241.2	0.0	0.0	0.0	0.0	927.8	0.0	927.8
1985	0.0	0.0	71.7	211.7	297.2	251.6	262.0	82.3	0.0	0.0	0.0	0.0	1176.3	0.0	1176.3
1986	0.0	0.0	56.0	204.8	256.5	151.4	266.1	186.6	60.3	0.0	0.0	0.0	1121.5	60.3	1181.8
1987	0.0	0.0	13.1	133.3	203.6	97.3	173.1	218.4	112.1	0.0	0.0	0.0	838.8	112.1	951.0
1988	0.0	0.0	103.2	275.2	249.6	263.6	319.4	270.6	126.9	0.0	0.0	0.0	1481.4	126.9	1608.4
1989	0.0	0.0	31.6	291.3	249.9	154.6	57.1	295.3	137.9	0.0	0.0	0.0	1079.7	137.9	1217.7
1990	0.0	0.0	129.3	254.7	237.9	214.2	321.5	203.9	106.2	0.0	0.0	0.0	1361.4	106.2	1467.6
1991	0.0	0.0	134.5	232.7	306.0	36.6	288.2	271.3	123.5	0.0	0.0	0.0	1269.3	123.5	1392.8
1992	0.0	0.0	0.0	201.5	279.4	297.1	256.4	195.9	110.1	0.0	0.0	0.0	1230.3	110.1	1340.4
1993	0.0	0.0	28.5	290.3	317.5	218.6	274.9	230.2	94.1	0.0	0.0	0.0	1360.0	94.1	1454.1
MEAN	0.0	0.0	58.3	210.2	225.5	145.4	207.6	190.2	70.3	0.0	0.0	0.0	1037.5	70.3	1107.5
MAX	0.0	0.0	160.6	291.3	320.6	306.6	321.5	295.3	248.1	0.0	0.0	0.0	1490.0	248.1	1608.4
MIN	0.0	0.0	0.0	111.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	272.3	0.0	272.3

Table 4.4.6 Projected Water Diversion from Ing and Ing-Lao River (Unit:MCM)

	4	5	6	7	8	9	10	11	12	1	2	3	Wet	Dry	Annual
1974	0.0	0.0	0.0	27.2	284.7	294.4	184.0	217.1	12.1	0.0	0.0	0.0	1007.5	12.1	1019.6
1975	0.0	0.0	27.5	125.9	422.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	576.1	0.0	576.1
1976	0.0	0.0	0.0	4.0	132.7	169.8	338.3	223.1	0.0	0.0	0.0	0.0	867.8	0.0	867.8
1977	0.0	0.0	0.0	76.2	230.2	453.6	452.8	276.8	19.3	0.0	0.0	0.0	1489.5	19.3	1508.8
1978	0.0	0.0	0.0	331.2	340.0	421.3	290.0	60.5	0.0	0.0	0.0	0.0	1443.0	0.0	1443.0
1979	0.0	0.0	51.9	62.8	108.3	110.2	138.4	18.7	0.0	0.0	0.0	0.0	490.4	0.0	490.4
1980	0.0	0.0	10.0	146.5	308.1	440.5	303.4	104.4	0.0	0.0	0.0	0.0	1312.9	0.0	1312.9
1981	0.0	0.0	0.0	149.6	185.7	0.0	137.2	33.2	0.0	0.0	0.0	0.0	505.8	0.0	505.8
1982	0.0	0.0	0.0	21.4	89.0	178.7	203.7	37.1	0.0	0.0	0.0	0.0	530.0	0.0	530.0
1983	0.0	0.0	0.0	28.4	198.5	308.4	243.2	272.0	0.0	0.0	0.0	0.0	1050.6	0.0	1050.6
1984	0.0	0.0	0.0	47.7	237.8	374.4	275.0	103.2	0.0	0.0	0.0	0.0	1038.2	0.0	1038.2
1985	0.0	0.0	0.0	58.1	158.9	202.0	204.7	371.3	40.6	0.0	0.0	0.0	995.1	40.6	1035.7
1986	0.0	0.0	0.0	52.6	197.1	300.0	182.6	127.9	2.5	0.0	0.0	0.0	860.2	2.5	862.7
1987	0.0	0.0	0.0	3.4	156.7	356.3	262.5	182.4	0.0	0.0	0.0	0.0	961.4	0.0	961.4
1988	0.0	0.0	89.0	124.7	217.4	189.4	144.1	78.5	0.0	0.0	0.0	0.0	843.2	0.0	843.3
1989	0.0	0.0	39.0	99.8	218.8	299.0	411.6	79.7	0.0	0.0	0.0	0.0	1148.0	0.0	1148.0
1990	0.0	0.0	0.0	95.8	166.3	239.4	120.7	226.9	10.2	0.0	0.0	0.0	849.1	10.2	859.3
1991	0.0	0.0	15.5	18.8	119.6	417.0	170.0	84.0	0.0	0.0	0.0	0.0	824.8	0.0	824.8
1992	0.0	0.0	0.0	7.1	52.3	132.2	148.3	129.7	23.6	0.0	0.0	0.0	469.7	23.6	493.2
1993	0.0	0.0	0.0	59.8	72.3	235.0	191.6	87.5	0.8	0.0	0.0	0.0	646.2	0.8	647.0
MEAN	0.0	0.0	11.7	77.1	194.9	256.1	220.1	135.7	5.5	0.0	0.0	0.0	895.5	5.5	900.9
MAX	0.0	0.0	89.0	331.2	422.7	453.6	452.8	371.3	40.6	0.0	0.0	0.0	1489.5	40.6	1508.5
MIN	0.0	0.0	0.0	3.4	52.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	469.7	0.0	490.4

Table 4.4.7 Residual Flow of Kok River after Projected Water Diversion (Unit:MCM)

	4	5	6	7	8	9	10	11	12	1	2	3	Wet	Dry	Annual
1974	52.4	93.6	0.0	0.7	320.2	339.2	71.0	86.1	0.0	117.0	32.5	6.5	817.1	302.0	1119.1
1975	9.6	40.2	123.1	119.9	595.1	816.2	569.0	307.2	171.0	86.9	53.7	25.8	2530.7	387.2	2918.0
1976	21.7	85.1	0.0	3.8	164.0	210.3	302.6	92.5	111.3	80.9	34.4	15.3	773.2	348.7	1121.9
1977	52.4	110.0	0.0	77.8	106.3	688.8	509.4	167.5	0.0	149.0	55.4	32.5	1549.8	399.3	1949.1
1978	29.8	84.7	89.3	430.2	580.4	813.1	449.4	101.3	156.7	84.7	43.9	14.6	2463.7	414.4	2878.1
1979	10.0	53.8	0.0	0.0	137.6	139.3	100.6	0.0	0.0	15.3	0.2	0.0	377.5	79.2	456.7
1980	0.0	4.1	0.0	266.5	294.9	737.9	311.5	0.0	132.2	22.3	25.2	0.0	1610.7	183.8	1794.6
1981	5.1	151.3	0.0	229.4	853.0	671.5	287.4	419.4	230.0	117.3	58.7	32.8	2460.8	595.2	3056.0
1982	63.8	57.5	8.1	18.6	452.5	390.4	369.8	7.4	79.6	78.0	42.3	14.9	1246.9	336.1	1583.0
1983	11.3	28.3	0.0	34.5	405.9	582.6	326.0	337.1	345.9	127.4	72.5	36.3	1686.1	621.8	2307.9
1984	29.2	70.7	64.9	107.4	260.1	571.4	323.7	18.2	119.3	67.4	26.4	2.6	1345.8	315.6	1661.4
1985	18.2	84.3	0.0	99.6	306.3	476.3	179.9	428.4	237.5	102.5	54.4	30.2	1490.4	527.2	2017.7
1986	31.3	100.6	0.0	98.3	71.9	227.6	33.9	0.0	0.0	75.8	24.5	9.8	431.8	242.0	673.8
1987	5.8	15.0	0.0	3.5	282.0	296.4	143.7	38.6	0.0	37.8	12.4	0.0	764.1	70.9	835.0
1988	18.0	98.9	0.0	33.5	499.0	309.0	82.1	2.7	0.0	64.9	19.4	3.6	926.4	204.8	1131.1
1989	1.1	47.8	68.2	90.4	247.1	438.9	583.3	13.4	0.0	69.4	39.9	22.9	1441.4	181.2	1622.5
1990	11.5	89.8	0.0	122.8	98.9	231.1	53.6	53.6	0.0	45.7	19.1	0.0	559.9	166.1	726.1
1991	23.8	41.8	1.0	3.8	271.3	591.1	167.3	17.7	0.0	58.7	38.0	8.6	1052.2	170.9	1223.1
1992	2.5	6.1	0.0	44.9	40.9	47.0	12.7	1.4	0.0	55.7	12.0	0.0	146.8	76.3	223.1
1993	0.0	37.2	0.0	30.2	89.1	278.2	138.2	0.5	0.0	61.9	26.9	10.5	536.2	136.4	672.6
MEAN	19.9	65.0	17.7	90.8	303.3	442.8	250.7	104.6	79.2	75.9	34.6	13.3	1210.6	288.0	1498.5
MAX	63.8	151.3	123.1	430.2	853.0	816.2	583.3	428.4	345.9	149.0	72.5	36.3	2530.7	621.8	3056.0
MIN	0.0	4.1	0.0	0.0	40.9	47.0	12.7	0.0	0.0	15.3	0.2	0.0	146.8	70.9	223.1

Table 4.4.8 Residual Flow of Ing and Ing-Lao River after projected Water Diversion (Unit:MCM)

	4	5	6	7	8	9	10	11	12	1	2	3	Wet	Dry	Annual	
1974	8.0	17.9	0.0	0.0	0.7	0.0	0.0	0.0	0.0	76.9	0.0	0.0	0.0	0.7	102.8	103.5
1975	0.0	2.3	0.0	0.0	20.5	524.2	402.3	132.3	22.1	8.4	0.0	0.0	1079.3	32.9	1112.3	1112.3
1976	1.6	8.6	0.0	0.0	0.0	0.6	36.2	0.0	0.2	9.1	0.0	0.0	36.8	19.6	56.5	56.5
1977	6.4	44.5	0.0	0.0	0.0	200.1	34.1	1.8	0.0	52.4	0.0	0.0	235.9	103.2	339.2	339.2
1978	0.6	30.4	0.0	0.0	1.9	75.2	0.0	0.0	4.0	0.0	0.0	0.0	77.0	35.0	112.1	112.1
1979	0.8	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	9.6
1980	0.4	10.0	0.0	29.9	9.7	268.3	0.6	0.0	9.2	12.7	0.0	0.0	308.6	32.3	340.9	340.9
1981	1.8	25.8	0.0	4.4	51.0	155.3	0.0	179.9	18.0	0.0	0.0	0.0	390.6	45.6	436.2	436.2
1982	13.7	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.0	0.0	0.0	30.4	30.4	30.4
1983	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	14.5	0.0	0.0	0.0	0.0	16.2	16.2	16.2
1984	0.9	5.6	0.0	0.0	0.0	50.1	0.0	0.0	0.0	0.0	0.0	0.0	50.1	6.5	56.7	56.7
1985	0.0	8.5	0.0	0.0	0.0	0.0	0.0	43.5	35.1	0.0	0.0	0.0	43.5	43.6	87.1	87.1
1986	1.2	26.4	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.9	27.6	28.6	28.6
1987	0.5	20.9	0.0	0.0	9.7	22.8	10.4	0.0	0.0	0.0	0.0	0.0	43.0	21.3	64.3	64.3
1988	0.1	105.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	105.4	105.4	105.4
1989	1.4	9.2	0.0	0.0	0.0	19.7	21.1	0.0	0.0	0.0	0.0	0.0	40.7	10.6	51.3	51.3
1990	0.0	10.6	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	10.6	11.2	11.2
1991	1.3	3.4	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	3.9	4.7	8.6	8.6
1992	1.5	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.3	0.0	0.0	0.0	32.1	32.1	32.1
1993	0.8	20.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	21.2	21.2	21.2
MEAN	2.1	18.6	0.0	1.7	4.7	66.1	25.2	17.9	5.2	9.7	0.0	0.0	115.6	35.6	151.2	151.2
MAX	13.7	105.2	0.0	29.9	51.0	524.2	402.3	179.9	35.1	76.9	0.0	0.4	1079.3	105.4	1112.3	1112.3
MIN	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	8.6	8.6

Figure 4.4.1 Sirikit Operation (K<sub>capt</sub>=175, K<sub>capk</sub>=125)

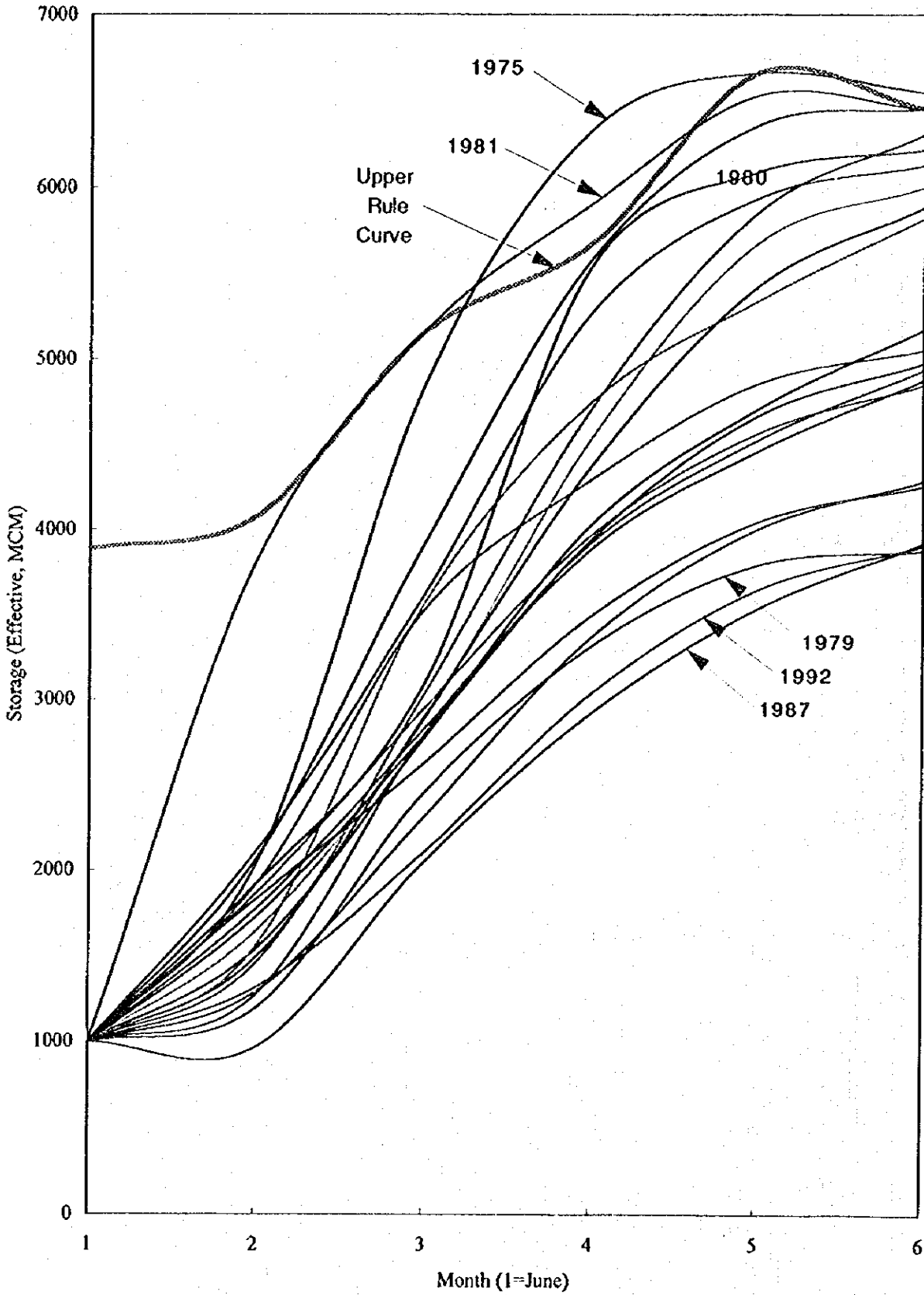


Figure 4.4.2 Rating Curve of Sirikit Hydro-Power Plant

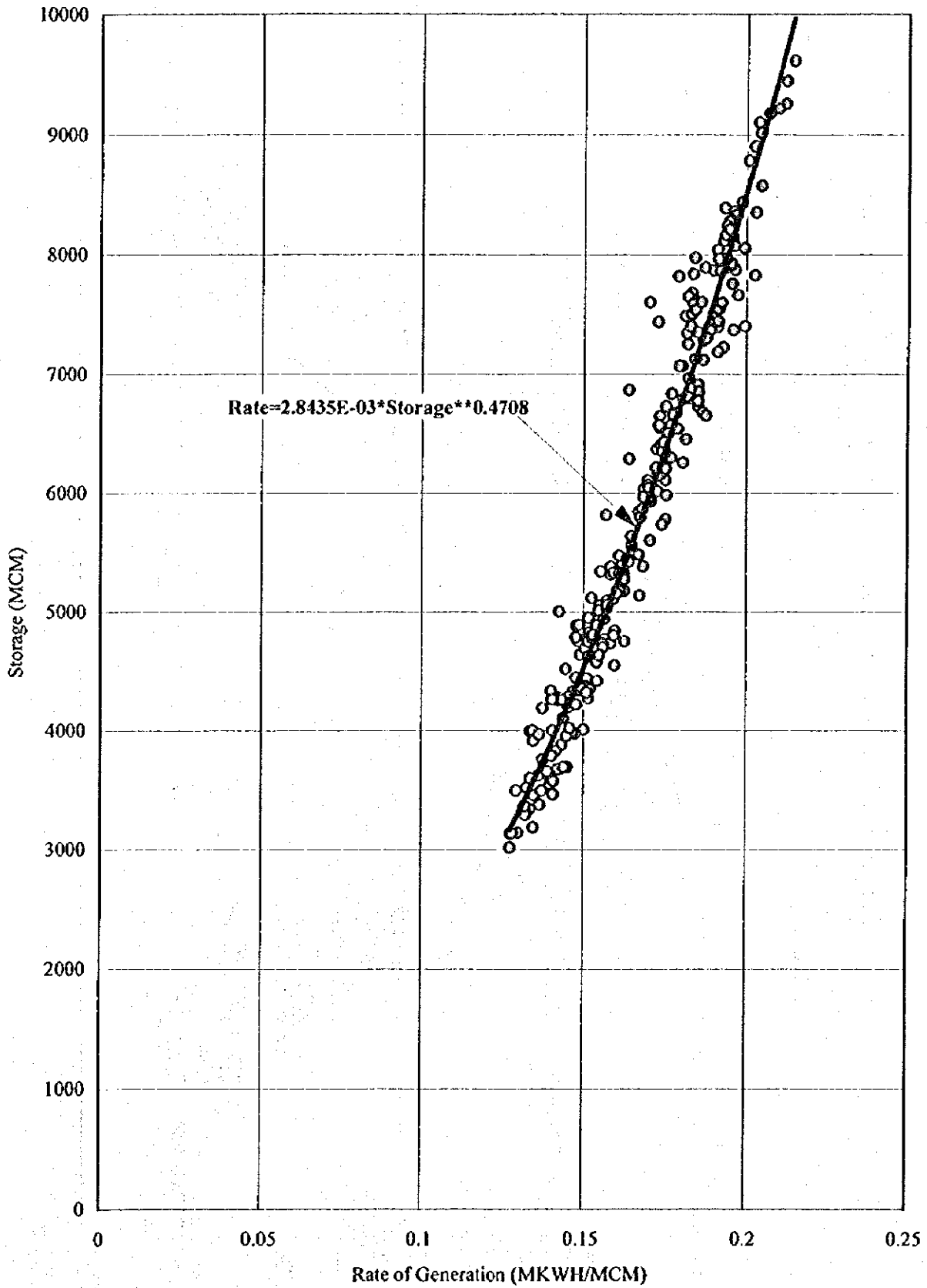
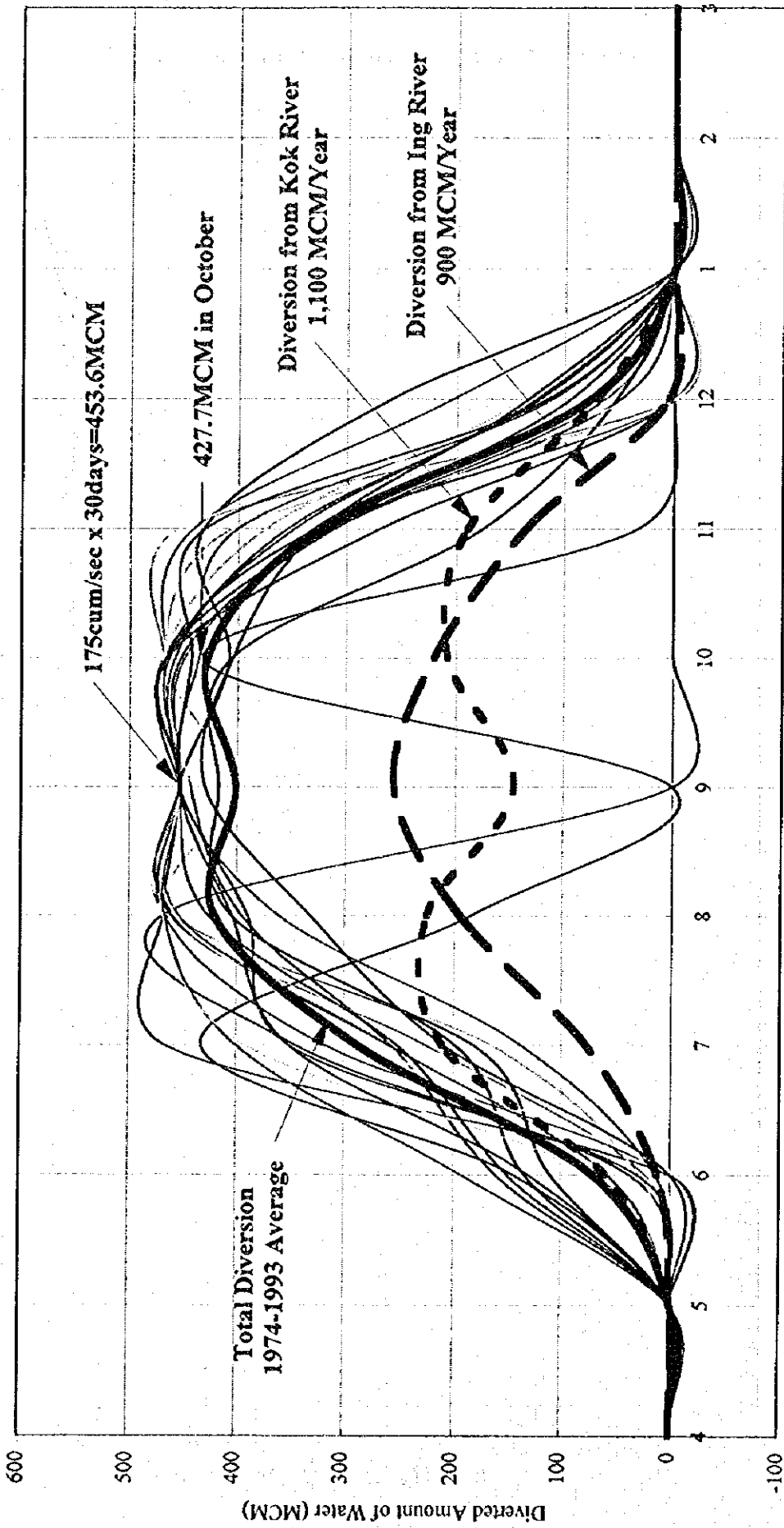


Figure 4.4.3 Projected Total Water Diversion from Kok, Ing and Ing-Lao River



Month



Figure 4.4.4 Projected Water Diversion from Kok River

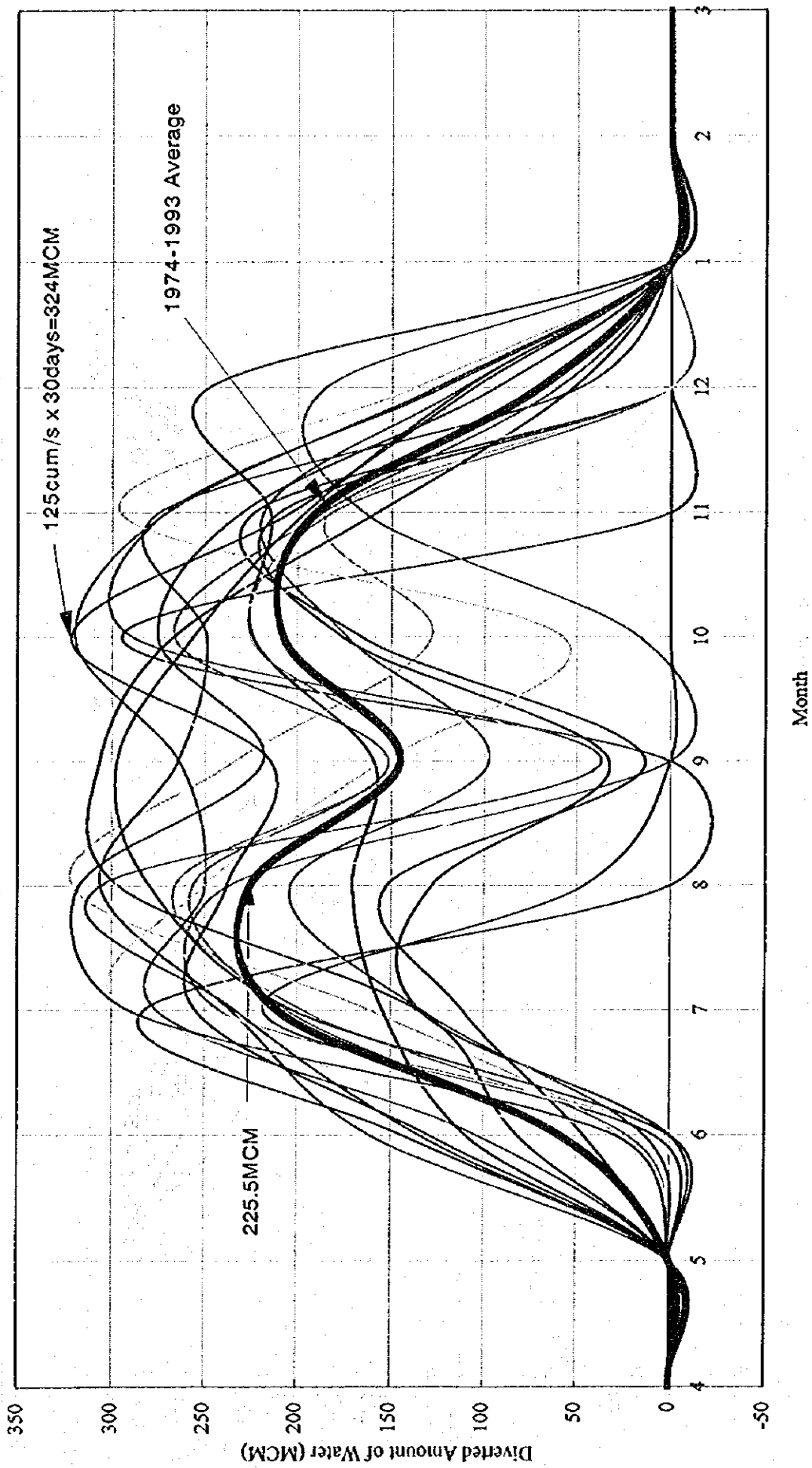


Figure 4.4.5 Projected Water Diversion from Ing and Ing-Lao River

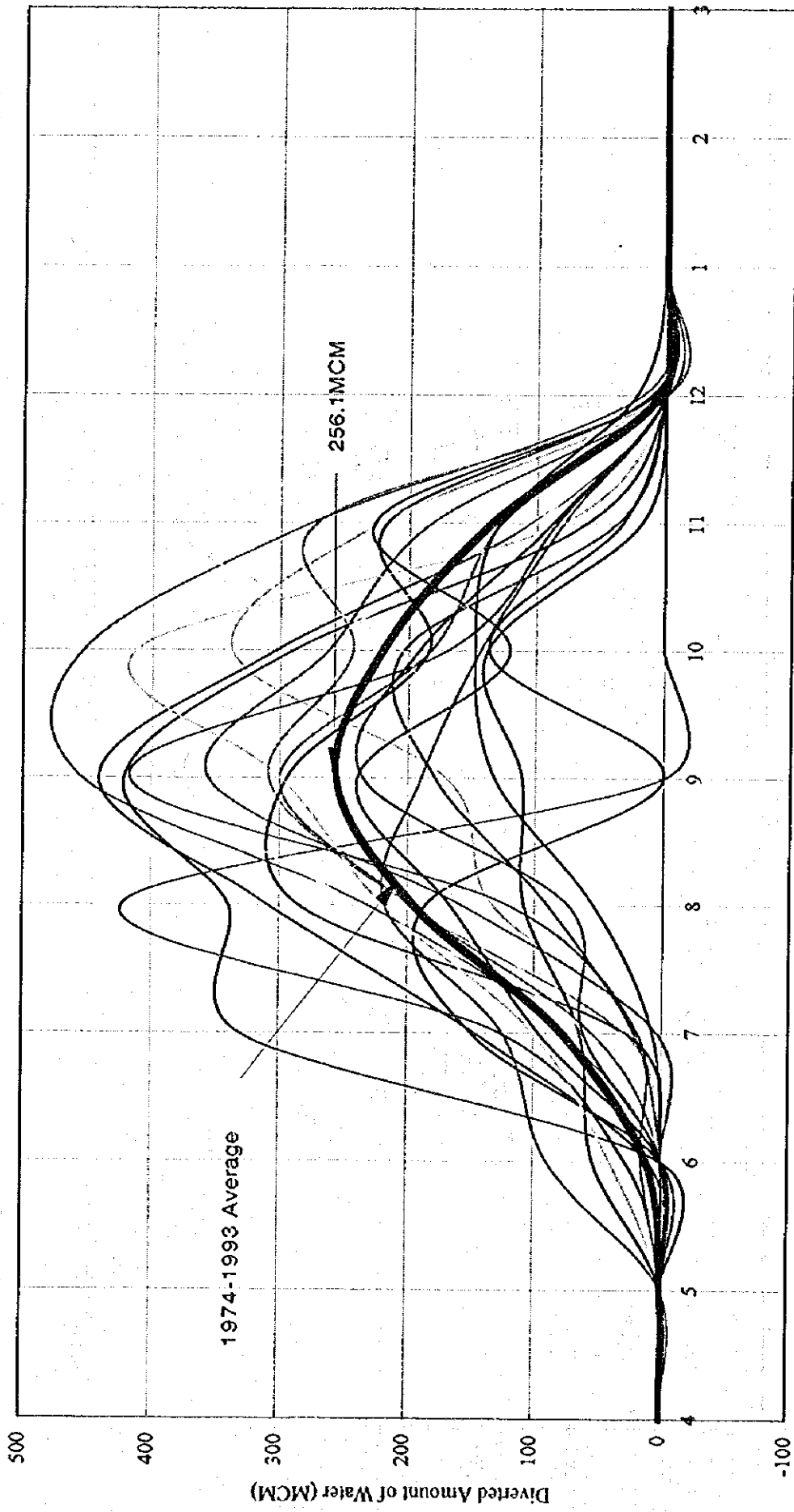


Figure 4.4.6 Flow Condition of Kok River with/without Project

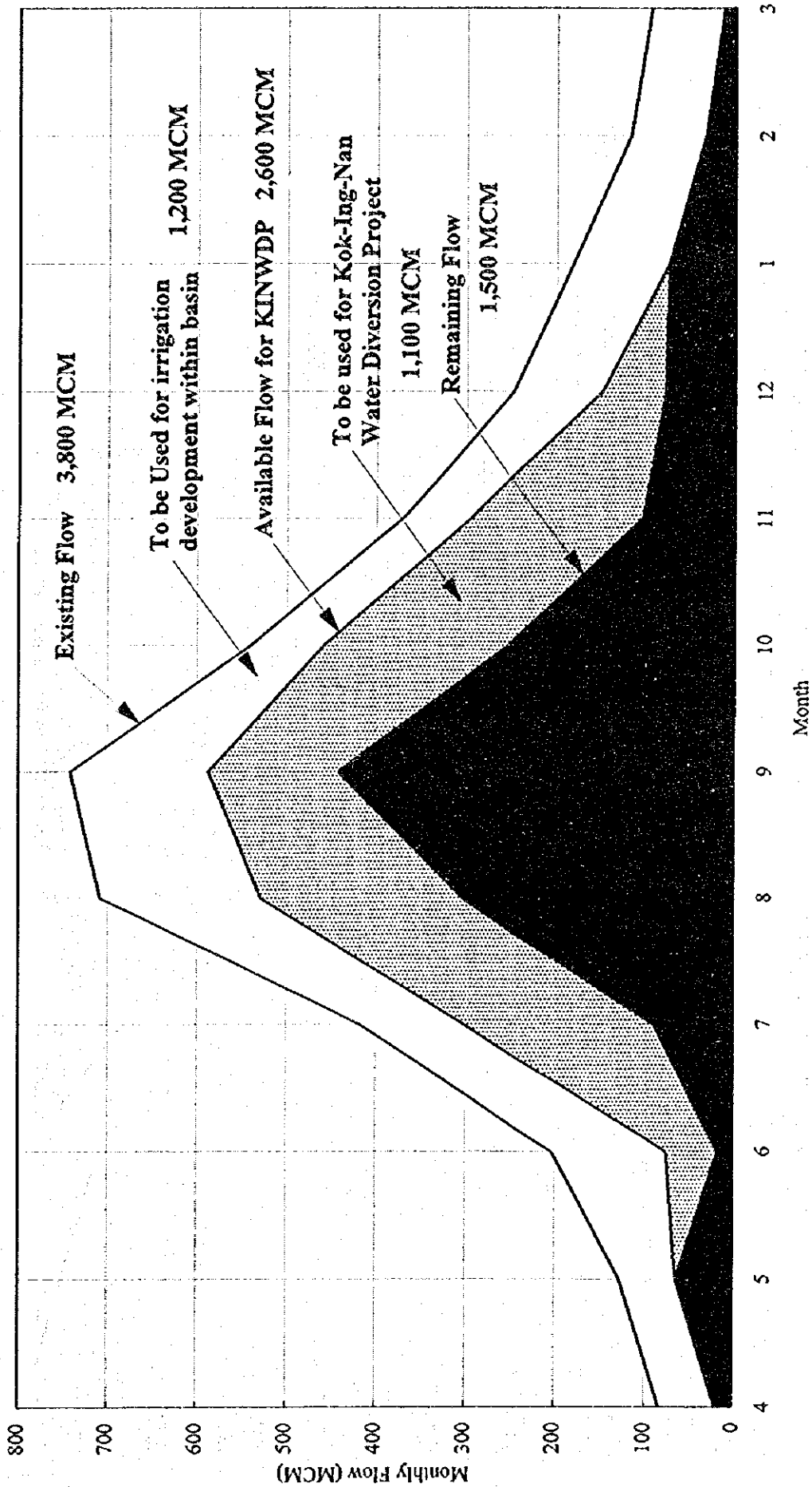


Figure 4.4.7 Flow Condition of Ing and Ing-Lao river with/without Project

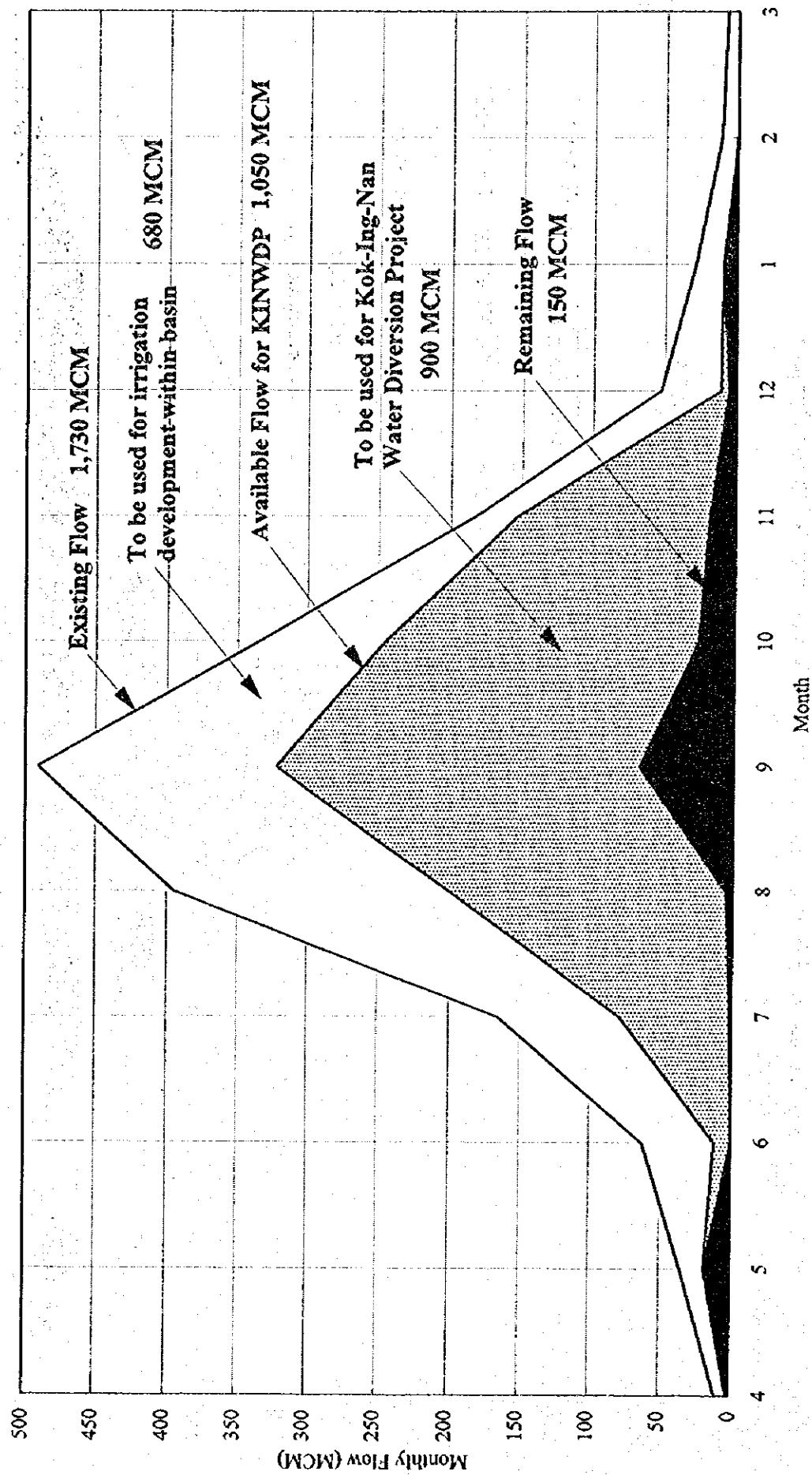


Figure 4.4.8 Flow Condition of Kok, Ing and Ing-Lao river with/without Project

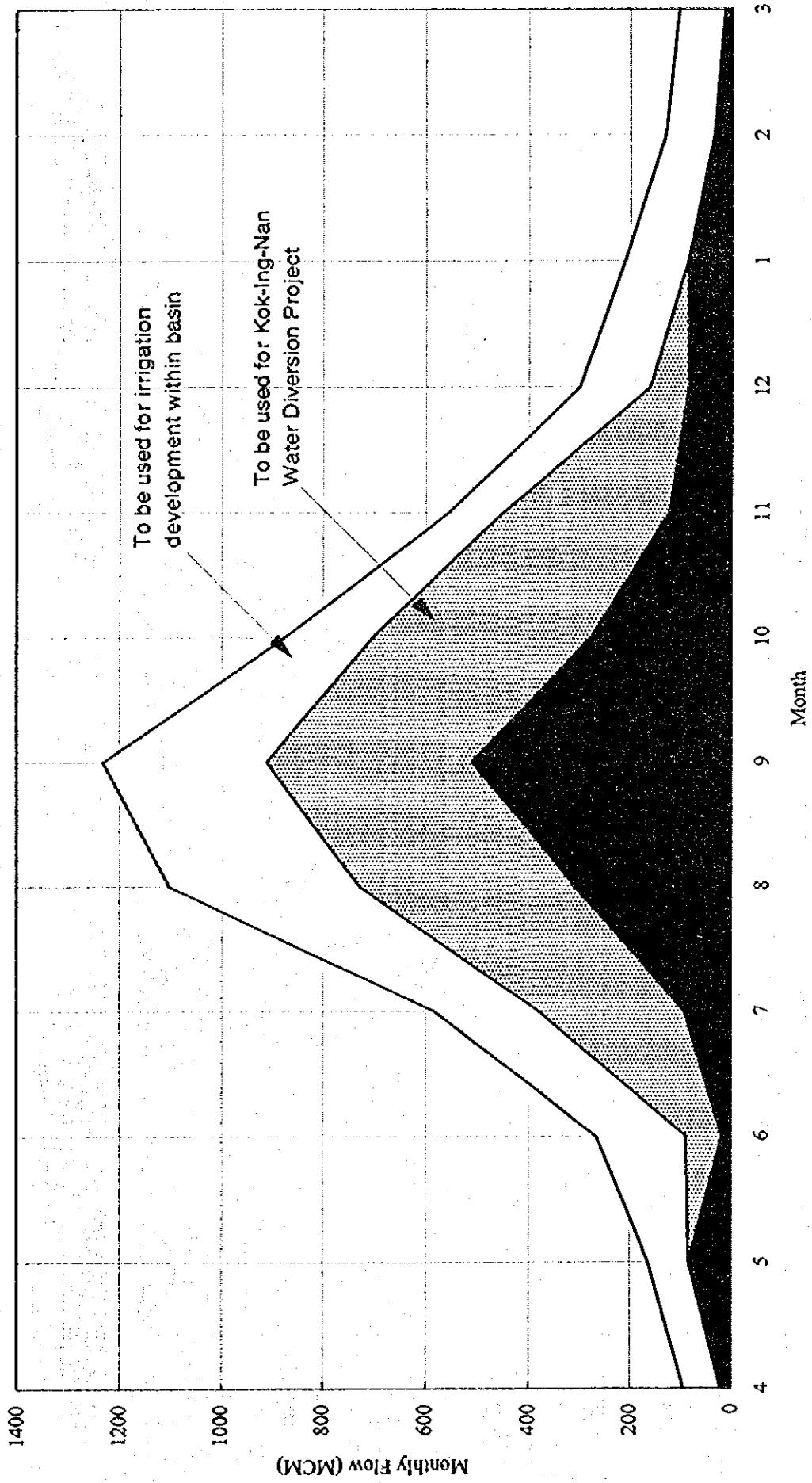


Figure 4.4.9 Residual Flow of Kok River after Projected Water Diversion

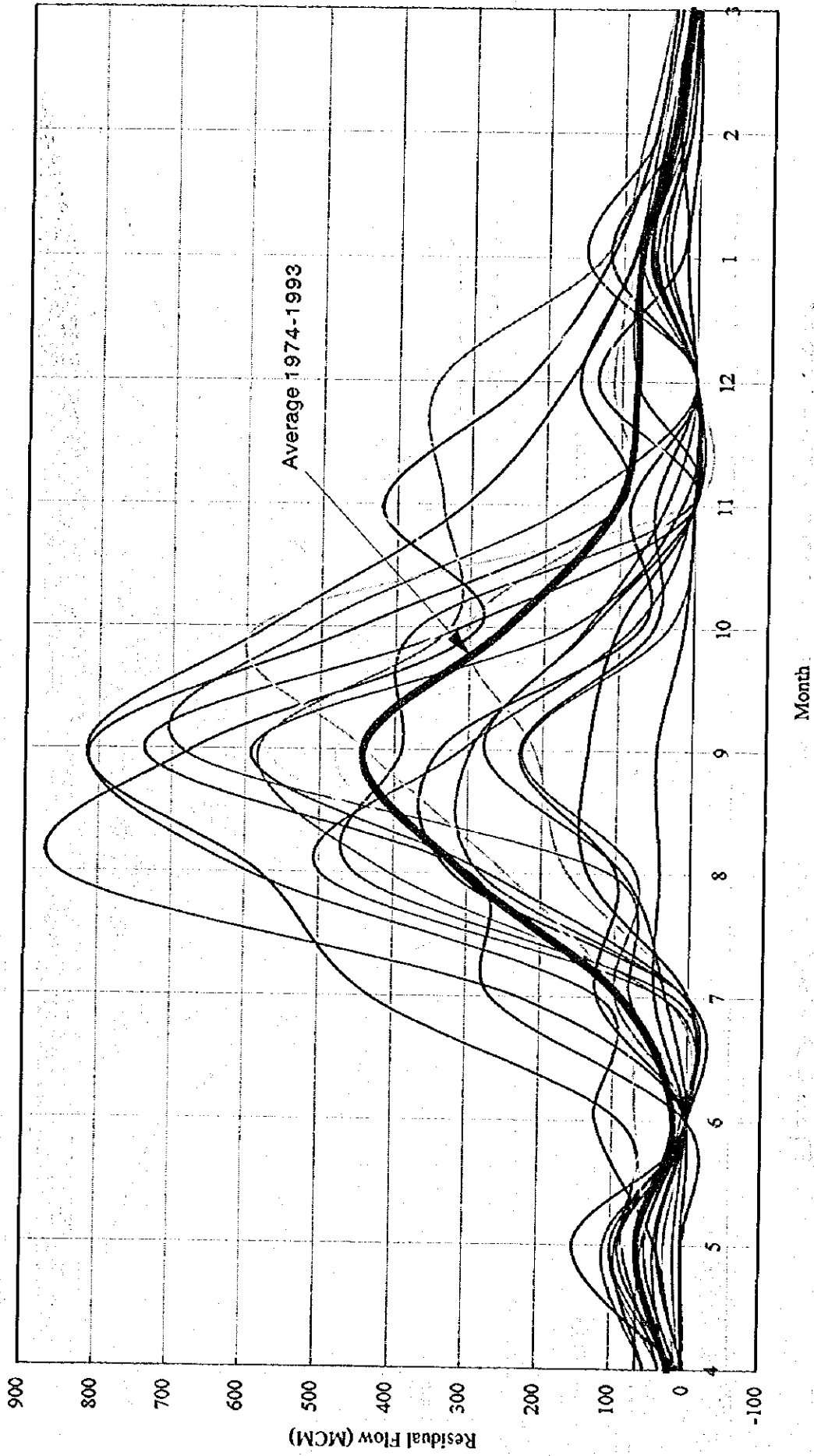


Figure 4.4.10 Residual Flow of Ing River after Projected Water Diversion

