US Army Corps of Engineers
Engineer Institute for Water Resources

DELFT HYDRAULICS LABORATORY
the netherlands

MARIN
Maritiem Research Instituut Nederland

Report of the Inland Waterway Transport (IWT) Mission

5 February-20 April 1985

June 1985

Appendices 85-88-Sh

ERRATA FOR

REPORT OF THE INLAND WATERWAY TRANSPORT (IWT) MISSION

5 February 20 April 1985

Appendices

1. Page 3, (a) line 2, change word reverine to riverine.

2. Page 4, last paragraph, line 3, change word rivirine to riverine.

3. Page 6, heading Study Output, first paragraph, line 2, change word reverine to riverine.

4. Page 9, first name change Holzhousen to Holzhausen and 11th name change Sonargoan Hotel to Sonargaon Hotel.

5. Page 10, fourth name from bottom change Anib to Anis.

6. Page 13, 3rd name change Marbour Department to Harbour Department.

7. Page 21, first name, change Casy Building to Casey Building.

8. Page 30, heading Main Ports, second paragraph, second line change Bhajabari to Baghabari.

9. Page 33, first line under Table 2 change word there to their and it to is. Under heading Traffic/Transport, second paragraph, first line change Table 2 to Table 2 and 3.

10. Page 34, (3) line 3 change word filed to field, and (10) should read.... Intelligence Unit, then standard designs were produced by Netherlands Naval etc.

11. Page 35, heading BIWTA Research, second line change word Jhasiakhali to Ghasiakhali.

12. Page 37, third line of chart, first block should be Bangladesh Inland Water Transport Authority. Last line of chart, first block should be Ship Surveyor Registration Office.

13. Page 38, second paragraph from bottom, second line should read of Ports, Shipping and IWT; it has 11 departments namely Traffic, Engineering, etc.

14. Page 43, first paragraph, fourth line change Mondalay to Mandalay.

15. Page 44, last paragraph, fourth line change Mondelay to Mandalay.

16. Page 46, second paragraph, second line delete last word be.

17. Page 48, third paragraph, second line change word formed to found.

18. Page 49, third paragraph (The operation is being....) should follow the last sentence in paragraph one (In discharging its functions,....).

19. Page 55, third paragraph, last line change word Hangzhan to Hangzhou, and fourth paragraph, fifth line change word Changjiang to Chongqing.

20. Page 57, first and second lines change the word Chonjqing to Chongqing.

21. Page 61, paragraph 7. Planning, 2. fifth line change word maintaain to maintain.

22. Page 62, part 5. third line change word Guizhan to Guizhou.

23. Page 66, fifth paragraph and first line of chart change word Kalimautau to Kalimautan.

24. Page 67 part (4) change word Kalimantau to Kalimantan.

25. Page 68 part d., last line change word Kalimautau to Kalimautan.

26. Page 81, second paragraph, last line change word Sutley to Sutlej.

27. Page 83, part c. (1), first line change date 1984 to 1985.

28. Page 90, footnote should have been placed on page 89 at the end of table above Source. Also the footnote should be changed to read "These figures do not include direct domestic cargo traffic". In Part 3 change word Oganization to Organization, delete star after (PPA)*, and change word Basig to Pasig.

29. Page 91, part (c) change word Minila to Manila.

30. Page 92, part 7 last line change words from to some and manila's to Manila's.

31. Page 103, part (1), second paragraph, second line from bottom should read "of the river in the Gulf of Thailand is of about 370 Km lying on its banks...".

32. Page 105, part (d), third line should read"at Pak Nam Poh, where their combined flows become...", and the sixth line should read " high-water season as, in the dry period, water level...". Eighth line should read " a result, Phrom Phiram in Uttaradit district was...".

33. Page 106, first paragraph, fifth line change word riges to ridges. In part f, first line delete the words The river,.

34. Page 107, part i., first line delete the words The river, and is separated. Line six should read "with the range Chao Phraya". Part 2, lines one and five charge word Mekong and Maelong to Maeklong. Last line of part 2 change 100 km to 130 km. Second paragraph, part 2 should read "source of its parent streams to its...". Third paragraph, last line should read "which has an navigation lock".

35. Page 109, part 8, second paragraph, second line change word Maekong to Mekong. Third paragraph, first line should read "The river flows also along the north of Thailand. The left...".

36. Page 110, first paragraph, first line should read "of the river are Chaing Rai, Loey, Nong Khaai, Nakornphanom, and...". Part a, last line change word shows to shoals.

37. Page 111, part 10, fifth line should read "is divided inot tow distributaries...". Line eight change word tributary to distributary. Line nine change word composes to composed.

38. Page 114, part 10, seventh line should read "northwestward and links the Suphanburi river with Bang...". The last line should read "The Salee Canal does not have locks".

39. Page 117, Table 1, Title should be Composition of Inland Fleet and Registered Capacity.

40. Page 136, first paragraph, third line change the word up to down.

41. Page 142, after part 2 add the following: Output: Report and Manual; Technology Tranfser Program and Training Program, and Scope: 12 Man-Months.

42. Page 173, fourth line change words with troubles to withdrawals. Line six change word formualte to formulae. Line seven change work school to scour. Last line change word banalling to bandalling.

43. Page 184, change Scale to Scope and add 3 Man-Years.

44. Page 188, Scope, first line should read "experts' salaries and travels".

45. Page 190, Scope, first line should read "experts' salaries and travels...".

46. Page 199, Description should read "irrigation canals...".

47. Page 221, line four change word terminal to terminals.

48. Page 222, Objective, line one change word ports to poles.

49. Page 247, delete.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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Inland waterway transport, water resources, navigation, Asia, Escap, U.N., ports and harbors, dredging, planning, operation, rivers.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Report identifies major problems and needs of inland waterways transport across nine Asian countries. It also recommended and prioritized 70 projects to meet these needs and problems.

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

REPORT OF THE INLAND WATERWAY TRANSPORT (IWT) MISSION

(5 February - 20 April 1985)

by

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John Moon, Ph.D.
Pieter von Groen
James Bradley
Clarence Fujii

Appendices
June 1985

Summary Report 85-SR-5b

CONTENTS

APPENDIX A

Terms of Reference

and

Nature of Services

APPENDIX A

Terms of Reference and Nature of Services

Except from Agreement signed by the members of the Expert Team, February, 1985.

Under the direction of Office of the Chief of Division for Shipping, Ports and Inland Waterways and in connection with project on Assistance for the Establishment of a Regional Centre for Development of Inland Water Transport, in Bangladesh (RAS/84/005), the subscriber shall assist the Secretariat in:

(a) obtaining a comprehensive list of problems and constraints which limit the ability of the present inland waterway systems in reverine countries of the ESCAP region to support important national objectives;

(b) evaluating potential solutions;

(c) assessing opportunities for inland waterway improvements which could be addressed during the next ten years; and

(d) drafting the relevant project document.

TERMS OF REFERENCE

January 1985

BACKGROUND

Inland water transport (IWT) is an important often predominant means of connecting markets and producers important to ESCAP countries. As much as 70 percent of all transport is by waterway in some ESCAP countries. Rivers and waterways, therefore, deserve careful scrutiny for opportunities to improve economic productivity, to increase access to markets, and to remove impediments which reduct the economic efficiency of the waterways. While inland waterways may have received less attention than other transport modes in public opinion and in governmental decision-making, they remain a fundamentally low cost and energy consuming mode, therefore highly suited for long-distance transportation of bulk commodities.

The ESCAP region is launching a Transport and Communications Decade for Asia and the Pacific (1985-1994) with emphasis among other things on inland water transport because of its importance to economic production and trade, now and in the future. Improvements in the productivity of these waterways could make significant contributions to economic efficiency and regional development. ESCAP countries, working together to solve their individual and common waterway problems, could significantly improve their standard of living with fewer resources than would other wise be required.

The concept of a Regional Research and Training Center has been introduced as a possible means of concentrating limited resources and expertise in the area of inland water transport. The approved work programme of ESCAP includes undertaking work on the establishment of a regional centre in Bangladesh. An objective of this study will be to evaluate the opportunities which such a Center could provide for the development of appropriate technology for IWT and in solving the problems identified in the forthcoming study.

METHODOLOGY

The short duration of the study, and the vastness of the geographic area to be addressed, limits the feasibility for an indepth evaluation. Extensive quantification and statistical analysis will probably not be possible during the 8-10 weeks of this study's duration. Where information is readily available, however, the methodology should allow the analysis to go beyond the physical waterway itself and include an assessment of commodity markets, alternative modes of transportation, and the socio-economic implications of proposed project recommendations.

The primary contribution of the study team is: (1) to obtain a comprehensive list of problems and constraints which limit the ability of the present inland waterway system in rivirine countries of the region to support important national objectives, and (2) to evaluate potential solutions. The study process should, therefore, be directed towards assessing the relative value of identified solutions.

The study should be explicit in regard to the applicability of a Regional Center in Bangladesh. It's potential role as a regional facility for fundamental research, information management, and training should be specifically addressed.

In order to assure an appropriate scope of study, and that all major problems and solutions are likely to be considered, the following methodolog, outline is suggested:

I. REVIEW OF AVAILABLE DATA WHICH CHARACTERIZES INLAND WATERWAYS

A. TRAFFIC CHARACTERISTICS

- Description of IWT and markets served
- Description of commodity flows, by type
  - Local
  - Inter-regional
  - Import/export
- Description of major overland transportation system that connects the inland waterways with applicable markets
- Comparative price/service characteristics of alternative modes described (qualified, but not necessarily quantified)

B. PHYSICAL DESCRIPTION OF PORTS AND INLAND WATERWAYS

- Principal ports and areas of cargo concentration
- Channel profiles (depth, width, stability, etc.)
- Aids to navigation
- Port facilities (loading/unloading, warehousing, transhipment facilities) at principal ports
- Availability and dissemination of data relevant to vessel operations (e.g. available draft, weather forecasting, etc.)

C. VESSEL CHARACTERISTICS

- Distribution of vessels by size and operating characteristics
- Description of vessel types, with commodities transported, by markets served
- Vessel propulsion
  - Engine
  - Sail
  - Other
- Vessel manning requirements

D. SOCIO-DEMOGRAPHICS OF VESSELS AND PORT OPERATIONS

- The socio-economic implications of a change in vessel or port operations

II. BASED ON THE ABOVE INFORMATION AND STUDY TEAM INTERVIEWS. THE TEAM WILL UNDERTAKE:

A. PROBLEM IDENTIFICATION

- Compatibility of IWT with markets served
- Compatibility of overland transportation
- Channel adequacy (e.g. erosion and sedimentation, hydrology and hydraulics, adequacy of dredging and training works)
  - Depths
  - Widths
  - Stability
  - Other
- Aids to navigation
- Ports and port infrastructure
- Vessel operations
- Changes in port and vessel technology
- Needs for training
- Need for traffic and waterway data

B. RECOMMENDATIONS FOR POSSIBLE ACTION OR FURTHER ANALYSIS

- Capital investment
  - Ports
  - Vessels
  - Waterways
  - Supporting infrastructure
- Operational changes
  - Vessel operations
  - Port operations
- Fundamental Research
- Information dissemination
- Training
- Safety

STUDY OUTPUT

The study report will include an assessment of opportunities for inland waterway improvements, in the reverine countries of the ESCAP region, which could be addressed during the next ten years. The study will determine which problems and solutions are common, and which are unique to a particular country. Opportunities for central coordination of waterways data, fundamental research, and training, will be specifically identified.

The applicability of a Regional Center for Inland Water Transport, and a listing of possible activities for such a Center, may also be expected as part of the study output.

Where possible, estimates of financial requirements will be made for each alternative solution. Other factors, such as possible disruption of lifestyle or employment impacts, will also be identified. The final output will be an evaluation of potential solutions and the development of an array of strategies which will provide a basis for subsequent action by ESCAP and/or the individual participating countries.

APPENDIX B

People Interviewed

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
Dhaka/Bangladesh	Mr. Walter Holzhousen	Resident Representative, UNDP
	Mr. Nigel Ringrose	Deputy Resident Representative, UNDP
	Dr. Ainun Nishat	Director, Institute of Flood Control and Drainage Research Bangladesh University of Engineering and Technology
	Dr. Walter A. Harvey	Team Leader, Bangladesh Water Sector Master Planning Office (Harza Engineering Company)
	Dr. G. Roy Elmore	Water Resources Planning Engineer, Bangladesh Water Sector Master Planning Office (Harza Engineering Company)
	Mr. Amjad Hossain Khan	Member, Indo-Bangladesh Joint Rivers Commission
	Mr. Paul B. McCabe	Economist, Country Department, Asian Development Bank (ADB)
	Dr. Shah Jahan Kabir Chowdhury	Associate Professor, Department of Water Resources, Engineering, Bangladesh University of Engineering and Technology
	Mr. Salehuddin	Chief, Engineering Department, Bangladesh Inland Water Transport Authority (BIWTA)
	Mr. M. Sanaullah	Director of Planning and Research, Inland Water Transport Authority (BIWTA)
	Mr. Guenter Ehrenhold	General Manager, Sonargoan Hotel
	Mr. Siddigur Rahman	Secretary, Ministry of Ports, Shipping and Inland Water Transport
	Mr. Omar Hadi	Chief of Planning, Ministry of Ports, Shipping and Inland Water Transport
	Mr. Alhas Shamiuzzaman	Acting Chairman, BIWTA and Financial Director, BIWTA
	Mr. Robert B. MacMillan	Consular for Economic Affairs, U.S. Embassy

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
	Mr. Serajul Islam	Director General, River Research Institute
	MD. Tozammel Hossain	Director, River Hydraulics, River Research Institute
	Mr. A. M. Zahural Islam	Director, Soil Mechanics and Materials River Research Institute
	MD. Serajuddin	Ex-Director-General, River Research Institute
	Dr. B.K.N. Bazlur Rahman	_____ River Research Institute
	Mr. Ziaul Ansar	Section Chief, Economics, Master Planning Office
	Mr. A. Rah Khan	_____ Master Planning Office
	Mr. Nahbub Ali	Planning Engineer, Engineering Section, Master Planning Office
	Mr. Chowdhury Mohd. A.K. Azad	_____
	Capt. Shamsul Alum Chowdhury	Charman, BIWTC
	Mr. Nooruddin Ahmed	Managing Director, Green & White Ltd.
	Mr. Hasan	Chief Engineer, Mechanical & Marine Engineering, BIWTA
	Mr. A. Hena	Chief, Hydrography Department, BIWTA
	Mr. Mohamed Hussain	Chief, Conservancy & Pilotage Department, BIWTA
	Mr. Anib Ahmed	Chief, Deck Personnel Training Centre, BIWTA
	Mr. Anwar Hussain	Chief, Ports & Traffic Department, BIWTA
	Mr. Nurollah	Chief, Audit Department, BIWTA
	Mr. Azao	Chief, Purchase & Stores Department, BIWTA

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
	Dr. Ainun Nishi	Director, Institute of Flood Control & Drainage Research Bangladesh University of Engineering & Technology
	Dr. Lung-Fa Ku	Tidal Expert, Department of Hydrography, BIWTA
	Mr. M. Igbal Hassin Khan	Asst. Chief Hydrographer, Department of Hydrography, BIWTA
	Mr. A. Mannan Talukder	Joint Chief, Planning Commission
	Mr. Nuhan Hock	Planning Commission
Chittagong/ Bangladesh	Mr. Nurul Momen Khan	Chirman, Chittagong Port Authority
	Mr. Neville C. Harney	Sr. Admin. Asst, UNDP
	Mr. Jahirul Hoque	Chief Engineer, Chittagong Port Authority
	Mr. A.M.M. Shahjahan	Chief Planning, Chittagong Port Authority
	Mr. S.M. Shahidullah	Senior Hydrographer, Chittagong Port Authority
	Mr. M. ImanBaksh	Asst. Traffic Manager, Chittagong Port Authority
Karachi/Pakistan	Commodore M. Naeem Beg	Joint Secretary/Director-General, Ports & Shipping, Ministry of Communications
	Mr. Mauk Muhammad Saeed Khan	Chief (T&C), Planning & Development Division
	Mr. Abdul Rasi.id Shaikh	Secretary, Irrigation & Power, Government of Sind
	Mr. Mashood A. Kuureishy	Chairman, Irrigation, Drainage & Flood Control, Research Council of Pakistan
	Mr. M. Badaruddin	General Manager, (Planning) Water & Power Development Authority
	Mr. Ahmad Masud Choudry	Director, General & Principal Investigator (ACOP)

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
	Mr. Mohsin Shaikh	Chief Engineer Development, Government of Sind
	Mr. Munir Ahmad Bhatti	Director, (Planning & Foreign Assistance), IDFCRC
	Capt. Ziauddin Khan	Director, (Admin, & Corporate Affairs) Pakistan National Shipping Corporation
	Capt. Iqbal A. Khan PN (Retired)	Director of Projects
	Capt. Riaz Ahmad PH (Retired)	Controller of Shipping
	Commander S.M. Hussain (Retired)	Chief Hydrographer, Port Qasim Authority
Sukkur/Pakistan	Mr. Shah	Chief Engineer, Sukkur Barrage
	Mr. D. M. Abro	Senior Engineer, WAPAA
	Mr. S. Saleem Ahmad	Junior Engineer, WAPAA
Colombo/Sri Lanka	Mr. S.B. Kurukulasuriya	Director, Canal Development Division, Ministry of Local Govt. Housing & Construction
		Director, Maligawatta Integrated Urban Development Project
7 March 1985		
Bangkok/Thailand	Mrs. Krishnee Varanusupakul	Director, Economic Division, Ministry of Communications
	Miss Sudanong Charuthus	Economic & Technical Research Economic Division, Ministry of Communications
	Mr. Vichet Rojanadhamkul	Acting Director, Technical Division, Harbour Department
	Mrs. Chuntana Shitgasorn	Infrastructure Project Division, National Economic & Social Development Board (NESDB)
	Mr. Narongsak Haetanurak	Technical Division, Harbour Department

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
	Ms. Jaree Rastapana	Ministry of Communications
	Mr. Phienchit Buakwan	River Training Branch, Medium Scale Construction Division, RID
	Ms. Valawan Tantichaut-Chavanvong	Technical Division, Marbour Department
	Cdr. Chalit Sukroongreung	Director, River Dredging and Maintenance Division
	Mr. Amphon Triyaborn	Director General, Harbour Department
	Mr. Virat Khao-Uppatum	Hydraulic Engineer, Water Operation Branch, O&M Division, RID
	Mr. Tongtowal Punsung	Economist, RID
13 March 1985		
Rangoon/Burma	U Saw Lwin	General Manager, Inland Water Transport Corporation (IWTC)
	U Aye Minn	Deputy General Manager (Admin. & Supply)
	U Tin Myint	Deputy General Manager (Engineering & Maintenance)
	U Thaung Sein	Marine Superintendent, Inland Water Transport Corporation (IWTC)
	U Ohn Tint	Chief Accountant, IWTC
	U Win Maung	Manager (Transport), IWTC
	U Maung Maung Lay	Director General, Waterways Department
	U Khin Maung Hla	Superintending Engineer, Waterways Department
	U Maung Maung Hla	Chief Civil Engineer Burma, Ports Corporation
	U Tin Soe	Deputy Traffic, Burma Ports Corporation

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
14 March 1985		
Rangoon/Burma	U Maung Maung Gyee	Division Manager, IWTC
	Dr. Khin Ng U	Naval Architect, IWTC
	U Aung Myint	Senior Branch Officer, HQ/Rgn/IWTC
	U Myint Kyan	Asst. Engineer, Waterway Department
19 March 1985		
Palembang/ Indonesia	Mr. Achadi	Chief of Sub-Directorate Shipbuilding, Jakarta
	Mr. Mock Sudana	Head of Branch, Office of South Sumatra
	Mr. Syukri	Staff of Directorate, Inland Waterways
	Mr. Nursalim	Project Officer of IWTC
	Mr. Martono W.	Chief of Inland Waterways Department
	Mr. Auiruddin	Chief of Highway Transport Department of Branch Office
21 March 1985		
Kuala Lumpur/ Malaysia (Maritime Division, Ministry of Communications)	Mr. Zakaria Yusoff	Asst. Director (Marine)
	Mr. Noor Ariff B. Yusoff	Marine Officer
	Mr. Teo Choo Cheng	Marine Dept. Sarawak
	Mr. Raja Malik B. Raja Kamarlizaman	Marine Dept. E. Malaysia
	Mr. Huzaimah Mohammed Yusoff	Principal Asst. Director (Marine)
	Mr. Zauiuddin Ramli	Asst. Director (Marine)
22 March 1985		
Kuching/Malaysia	Mr. Teo Kat	Naval Architect/Marine Department
	Mr. Goh Chin Guan	

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
	Capt. Pin Voon Sen	Sr. Marine Officer/Marine Dept.
	Mr. Bernard M. Geikie	Sr. Marine Officer (Engineering)
	Lt. Cdr. Hamdan Haji Othman	Sr. Hydrographic Surveyor, Marine Department
	Lt. Cheng Swee Hin	Hydrographic Surveyor, Marine Department
	Mr. John Wong	Mechanical Engineer, Public Works Department
	Mr. Lim Beng Liang	Mechanical Engineer, Drainage & Irrigation Department
	Mr. Siew Ching Ming	Agricultural DGM, Miri Port Authority
	Mr. Wee Kang Joo	Asst. Secretary, MCW
	Mr. Huang Cheng Hua	General Manager, Rajang Port Authority
	Mr. Abdul Karim	Bintulu Port Authority
	Mr. Lee Hein Soon	K.P.A. A.M.S.M.
	Mr. Rapheal Nissom	K.P.A. - General Manager
	Capt. Teo Choo Cheng	Agricultural Director of Marine, Marine Department
Philippines	Mr. Paciencio M. Balbon, Jr.	Planning & Programming Staff Director
	Mr. Rose Padre	Planning Specialist
	Ms. Arhileen Romero	Sr. Planning Specialist
	Mr. Edvardo G. Ente	EE Marine Construction Corp.
	Mr. Vic M. Cordero, Jr.	Deck Loaders, Inc.
	Mr. Resty C. Abalos	Navotas Industrial Corp.
	Mr. Reynaldo C. Tamayo	Chemoil Lighterage Corp.
	Mr. L. A. Contreras	Chemoil Lighterage Corp.
	Mr. F. V. Gonzhez	ISLOFF

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
	Mr. L. Benjamin	Commodity Transport Corp.
	Mr. C. L. Reyes	DRES - LAP Lighterage Asst. of the Philippines
	Mr. Bomfacio Q. Nery	Rizal Lighererage Corp., Manager
30 March 1985		
Beijing/China	Mr. Shen Zhaoqi	Deputy Director, Bureau of Foreign Affairs, Ministry of Communications
	Mr. Zhang Yan Yang	Deputy Chief Engineer, Bureau of Inland WAterways Transportation, Ministry of Communications
	Mr. Ke Mo Shan	Deputy Director, International Organizations Department, Bureau of Foreign Affairs, Ministry of Communications
	Mr. Rong Xian Run	Deputy Director, Harbour Department, Bureau of IWT, Ministry of Communications
	Mr. Zhou Mingjing	Senior Engineer, Bureau of IWT, Ministry of Communications
	Mr. Zeng Qinmin	Coordinator, International Organizations Dept. Bureau of Foreign Affairs, Ministry of Communications
	Mr. Zhao Hengping	Official, Bureau of Foreign Affairs, Ministry of Communications
2 April 1985		
Wuhan/China	Mr. Yu Xianhuan	Chief Engineer, Changjiang River Administration of Navigational Affairs
	Mr. Yang Wencheng	Planning Division, Changjiang River Administration of Navigational Affairs
	Mr. Chen Da	Chief, Division for Science and Technology, Changjiang River Administration of Navigational Affairs

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
	Mr. Li Guangwu	Division for Science and Technology, Changjiang River Administration of Navigational Affairs (CRANA)
	Mr. Lin Fangxi	" " " " "
	Mr. Lu Zhenguo	" " " " "
	Mr. Xiao Wanyuan	" " " " "
	Mr. Wang Guoying	" " " " "
	Mr. Yang Liangqing	Deputy Chief, Ship Dispatch Office, Changjiang River Administration of Navigational Affairs (CRANA)
	Mr. Fu Junli	Ship Despatch Office, Changjiang River Administration of Navigational Affairs (CRANA)
	Mr. Guo Tingshui	Harbour Division, Changjiang River Administration of Navigational Affairs (CRANA)
	Mr. Li Zhitao	Director, Changjiang Waterway Bureau
	Mr. Rong Tianfu	Chief Engineer, Changjiang Waterway Bureau
	Mr. Du Guang Qi	Technical Division, Changjiang Shipping Company
	Mr. Xia Tong Yin	Port Authority of Wuhan
2 April 1985		
Hubei Provencial Shipping Admin/ China	Mr. Zhang Zhe	Director
	Mr. Liu Yu	Deputy Director
	Mr. Xu Cheng	Deputy Director
	Mr. Xu Youlin	Engineer & Deputy Director
	Mr. Lei Peicheng	Chief, Port Section
	Mr. Zai Zhanfei	Engineer & Chief Waterways Section

INDIVIDUALS INTERVIEWED

Place/Country	Individual	Position Titles
	Mr. Shi Jiechi	Deputy Chief, Office of Administration
	Mr. Chen Shixiong	Deputy Chief, Office of Administration
4 April 1985		
Shanghai Shipping Corp./China	Mr. Xia Guo Fen	Manager
	Mr. Tan Yon Fa	Deputy Manager
	Mr. Chen Li Min	Chief Engineer
	Mr. Chen Zhao Zhong	Head of Technology Department
	Mr. Chang Qian Yun	Director of Transport Department
	Mr. Su Jian Qian	Director of Planning Department
	Mr. Chen Yan Hua	Deputy Director of Technology Department
	Mr. Chen Tai Ting	Deputy Manager of Development Company (Sub.)
	Mr. Jin Yun Ke	Director of the Manager's Office
	Mr. Yang Ming	Head of the Commercial Section

APPENDIX C

Non-ESCAP Team Members

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APPENDIX D

Background Reports of Countries Visited

APPENDIX D

NOTE: These background descriptions are compiled on the basis of:

- Information made available by ESCAP
- Literature found in the region
- Observations of the mission

BANGLADESH

BANGLADESH

General

Bangladesh is a flat, low-lying plain with a total area of about 144,000 sq km, approximately one-third of which is flooded and remains under water for extended periods of time each year. The country is criss-crossed by numerous rivers, canals, and creeks, constituting slightly more than 6 percent of the total area of the country.

Rivers

There are three major rivers, namely, the Brahmaputra-Jamuna, the Meghna and the Ganges-Padma, which wash Bangladesh before flowing into the Bay of Bangal and provided the arterial water routes of the country. These three rivers together have a peak flood flow of 5 million cusecs and an annual sediment load of 2.4 billion tons. The main characteristics of the river network is:

- strongly meandering (no major river training);
- strong seasonal discharge variation;
- flooding;
- heavy transport of fine sediments during monsoon; and
- tidal penetration far inland.

It is reported that in the last decade the sedimentation in rivers and estuaries has been increased and hence, the capacity of the rivers are gradually deteriorating. This holds both for the capacity to transporting water (increased flooding) and for the capacity of waterborne transport (decrease of navigable depth).

Rivers and Transport

Obviously there is a strong interrelation between rivers and transport. The dense river network, the flooding, and the meandering hamper the dry transport. The dense river network promotes the waterborne transport. However, most of the above-mentioned river characteristics cause constraint for navigation, e.g., small water depth due to siltation and small run-offs in the lean season.

a. IWT Routes

Bangladesh has about 15,000 miles of inland waterways. The navigable length during the monsoon is more than 5,000 miles and during the lean season about 3,500 miles. About 2,000 miles of the navigation routes are

classified. The class indicates the degree of control of the waterway (depth, navigational aids).

The IWT routes and depth are indicated on the map. (Figure 1) for the classification and the depth see Table 1.

TABLE 1: Length of Classified Waterways, in Miles

CLASS DEPTH (ft)	12	9	6	4-1/2	3	TOTAL
CLASS I	390	55	145	30	-	620
CLASS II	-	160	125	200	-	485
CLASS III	-	55	550	265	180	1,050
TOTAL	390	270	820	495	180	2,155

Source: BIWTA map of classified waterways.

Class I routes are those which are important enough to guarantee within reasonable limits the indicated depth, if necessary by means of dredging. The routes are moreover provided with navigational aids.

Class II routes are also important, but not to the extent that any depth is to be guaranteed. The routes are provided with navigational aids.

Class III routes are traffic lines of regional importance. Channel inspections are done regularly. Channel markings are provided in some cases.

The specified depth is expressed with regard to Standard Low Water (SLW), a low water level, determined on the basis of a statistical analysis of water levels, and defined at such a value that actual water levels will seldom be lower. In meaning and actual value in coastal waters, SLW is identical to Chart Datum used in hydrographic charts at sea.

Main Ports

The seaports of Bangladesh are Mongla and Chittagong. In these ports the cargo is transferred between the ocean-going vessels and the IWT fleet.

There are eight major inland ports: Dhaka and its annexes, Narayanganj, Chandpur, Barisal, Khulna and its annexes, Bhajabari, Mongla, and Sirajganj.

For the locations, see the previous map.

N.B.

In the past, Calcutta was the main inland and ocean port of the entire region. This changed in 1947. The entire transport pattern had to be reoriented. Chittagong became the main seaport (import). A second port came

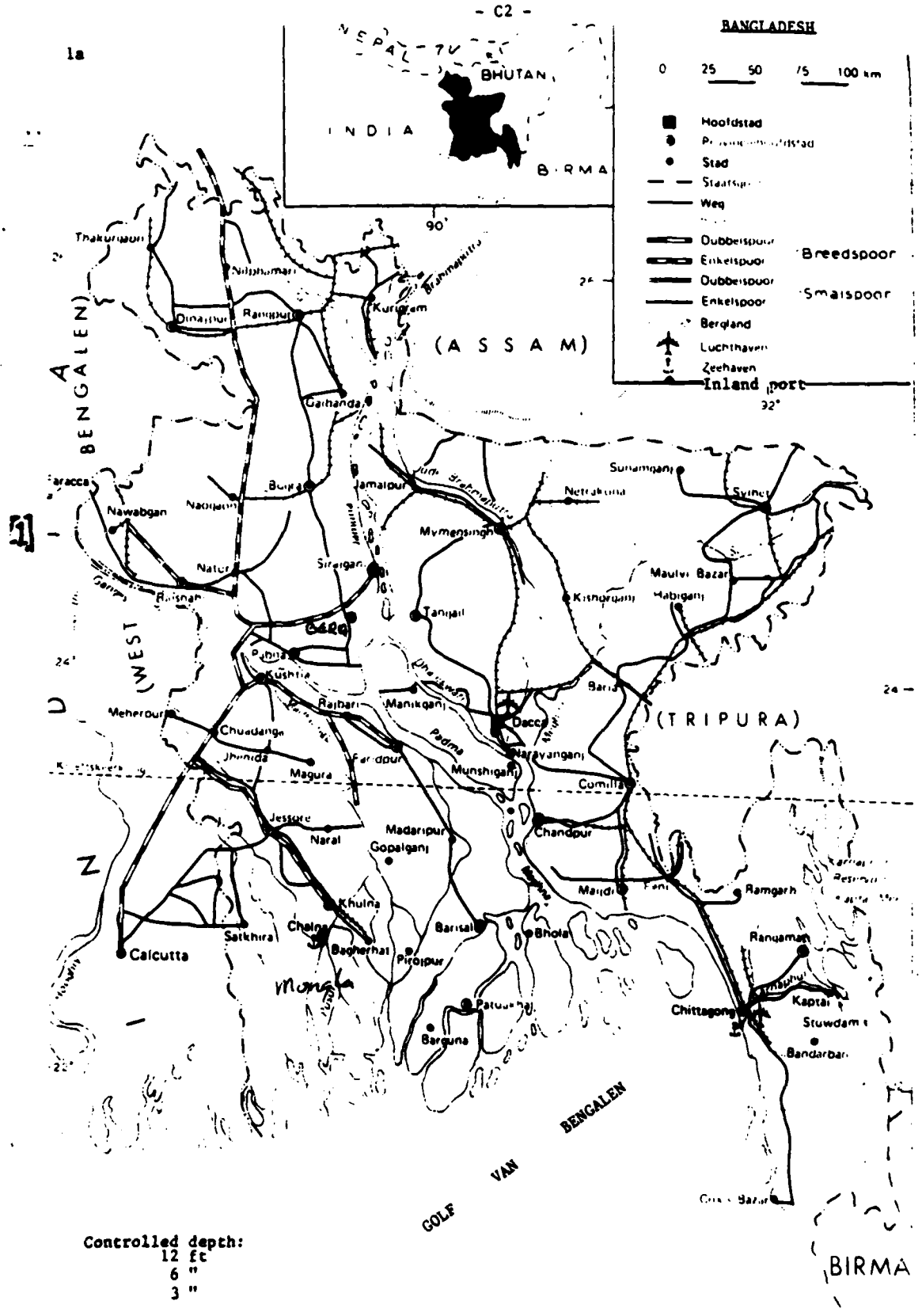


Figure 1 - Map of Bangladesh

into operation in Chalna near Khulna. Due to the siltation of the Pusur River the location of the seaport shifted from Chalna to Mongla. By tradition this port is still known as Chalna port authority.

b. Sense of Importance of IWT to the Country (Fleet and Traffic)

In a riverine country such as Bangladesh, inland navigation has always been an integral part of human existence. In rural areas without roads, or where roads are unusable during a great deal of the year through inundations, movement of men and goods depend largely on waterborne transport. Various indigenous types of craft have been developed in the country, moved by human force or by wind, and they still play an important role in the transport economy.

In addition to these, mechanized water transport made its entry into the inland waterways in the last century.

At the time of independence, part of the original fleet remained in the country, but with the completely changed traffic pattern they had to operate partly in waterways for which they were not fully suited. Nevertheless the inland water transport sector reacted and survived as it did at the time Bangladesh came into existence as an independent State.

Inland water transport continues to be the most important mode of transport in the country - the mechanized fleet alone carries more than half of the total annual traffic volume, the rest being carried by road and rail together. Moreover, it is estimated that the non-mechanized country boats carry an even larger annual volume than the mechanized fleet. It may be expected that the importance of inland navigation will continue in future because the rivers constitute a fine network of waterways. Moreover, improvements in the extent, quality and operation of the fleet and of the inland port will strengthen the dominating role of water transport over road and rail transport.

Fleet

The importance of IWT to the country is reflected by the composition of the existing inland fleet. Distinction is made in:

- public sector, about 444 registered vessels;
- private sector, about 2,717 registered vessels; and
- country boats, about 722,300 not registered.

TABLE 2: IWT Traffic 1982 - 1983

	Public	Private	
Passengers Carried	2.8	46.0	million passengers
Cargo Carried	1.243	2.816	million tons

As regard country boats, there traffic it a rather wild guess.

Table 2 given in a report of the early sixties is a rather wild guess. Though various attempts are made to produce more accurate data on amounts of vessels, sizes, and cargo volumes, statistics remain scarce and weak. The 1964 Country Boat Study (See c.(4)) following) concluded, reviewing the methods used at that time, that 300,000 was an underestimation of the reality.

Traffic/Transport

About 65 percent of the freight traffic and 38 percent of the passenger traffic is carried by inland water transport, the rest being carried by roads and railways together.[1]

Table 3 gives a picture of the overall inland water transport traffic carried by mechanized vessels in the past few years.

TABLE 3

	1975		1976-1977		1977-1978	
	Public sector	Private sector	Public sector	Private sector	Public sector	Private sector
Passengers carried (in millions)	1.55	36.68	1.88	40.01	2.00	41.21
Cargo carried (in thousand metric tons)	1,311	1,555	1,065	1,686	1,585	2,108

Country boats, however, operate all over the waterway system, playing a complementary role to mechanized vessels by carrying commodities between village markets and trade centres connected with more important business centres by road, railway or arterial river network. It is estimated that about 300,000 country boats can carry two or three times the quantity carried by mechanized vessels.

1 For more data on multimodal transport. (See c.(5) following.)

c. Major IWT Reports in Country

(1) Mr. J.M. Deplaix's notes;

Waterways

(2) The feasibility of establishing an Inland Water Transport Centre in Bangladesh by the Secretariat. (E/ESCAP/STC. 4/16, 13 November 1980);

(3) A comprehensive study of the hydrologic, hydraulic and hydrographic aspects of the waterways, as well as an assessment of the needs in the filed of maintenance and development of inland waterways and ports of this country, was made by the Netherlands Engineering Consultants (NEDECO) from 1963 through 1967.

(4) BIWTA map;

Traffic

(5) Multimodal Transport in Bangladesh.

(6) Traffic studies in the field of IWT have been carried out so far by the Transportation Consultants, Inc. (United States) and the Economic Intelligence Unit (United Kingdom).

(7) BIWTA statistics, reports, yearbooks, etc. BIWTA annual traffic reports.

(8) The country boats of Bangladesh, February 1984, Institute of Social Studies, the Netherlands (Co-author);

(9) Report of the working group on third five-year plan of the ports, shipping and inland water transport sub-sector.

Design and Construction of Vessels

(10) Studies have been carried out by Economic Intelligence Unit and Netherlands Naval architects under the Netherlands technical assistance to BIWTA.

Mechanization of Country Boats

(11) Studies have been carried out by BIWTA with the assistance of ESCAP as well as Netherlands experts.

Use of Ferro-cement

(12) In 1970 two ferro-cement boats were received from the Government of China. A Canadian private team (Canadian Hunger Foundation) and a Danish private firm were working on such prototype boats at Chittagong.

Fiberglass

(13) BIWTA has a yard at Narayanganj to make fiberglass hulls for speed boats. It has a future plan for building launches and other craft of bigger size.

Design of Inland Ports/Jetties/Landing Places

(14) Designs were initiated by NEDECO in the mid-1960s. All such river front structures are now designed by Bangladesh consultants with the active collaboration of BIWTA engineers and constructed by local contractors.

Traffic Handling

(15) A study was carried out in 1979 by the Shipping Research Services (Norway) with the financial help of the World Bank.

Costs of Operation

(16) Studies have been undertaken by the Economic Intelligence Unit.

BIWTA Research

Basic research on the hydraulics of waterways has been done by BIWTA on the behavior of the 3-1/2 mile-long Mongla-Jhasiakhali link canal east of Chalna Port as well as, loop cuttings under BIWTS's pilot scheme on "resuscitation of dead and dying waterways".

d. Major Proposed IWT Projects in the Country

The main projects during the Second Five-year (1980-1985) Plan include excavation of waterways, construction of jetties and improvement of cargo handling facilities at the existing inland river ports, development of additional inland river ports and launch landing stations, replacement of old pontoons, vessels and aid to navigation, establishment of a teleommunication network and several feasibility studies.

For the major projects proposed for the Third Five-year Plan (TFYP), 1985-1990, reference is made to two sources:

(1) This report, see Chapter 4a, from which a number of project proposals have been derived.

(2) The IWT projects proposed by Bangladesh, December 1984. (See 9.)

e. Major Future IWT Program

There is a lot to be done to improve the inland waterways and the operation of the inland ports of Bangladesh. Unstable river banks, a sharp decline in channel depth during the low water season, the high cost of materials and low paying capacity of the people, a shortage of technically and professionally qualified personnel, inadequate technological advancement and above all the lack of surplus resources for investment in infrastructure are the main hurdles impeding the development of this sub-sector.

The main future IWT program is to be based on the priorities given to the proposed projects (previous section).

(1) Fairway Improvement:

(a) political issue

(b) master planning

(2) Reduction of Maintenance Dredging:

(a) siltation studies

(b) low cost technologies

(c) operation efficiency

(3) Port Terminal Improvement

(4) Fleet Improvement:

(a) country boat design

(b) fuel saving

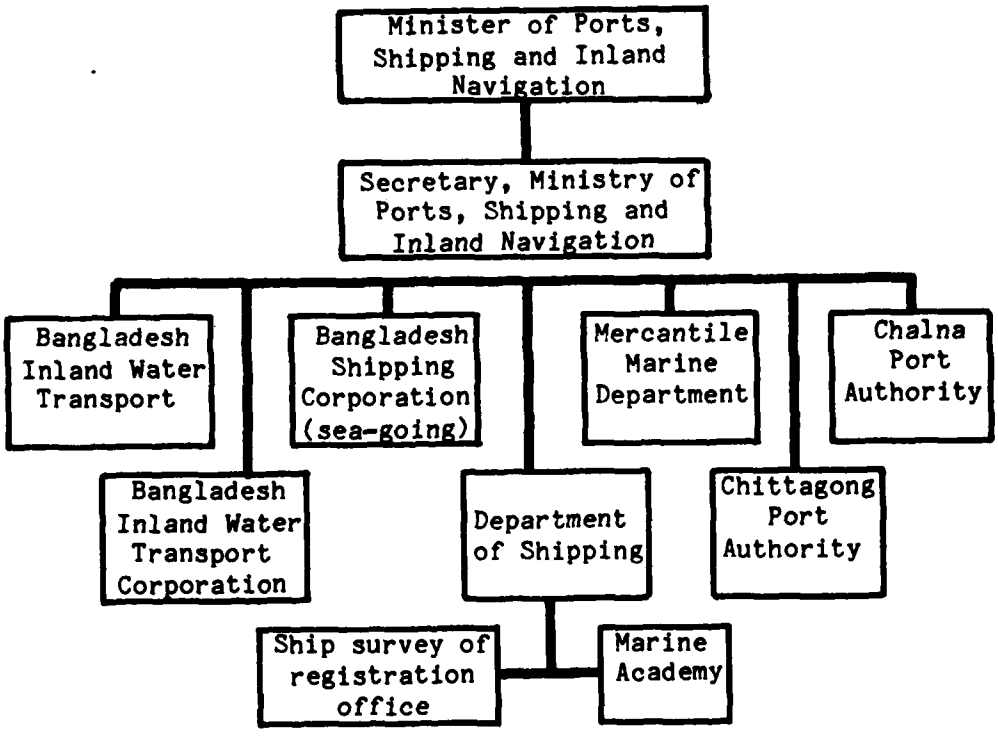
(c) containerization

(5) Transfer of Knowledge During These Projects to be emphasized.

f. Position of IWT in Country's Administration/Organization/ Regulations

There are in Bangladesh several institutions and agencies in the public sector, which are occupied in some way to another with the interests of inland navigation. An organizational chart is showing the relations between the various government agencies.

ORGANIZATIONAL CHART OF THE PUBLIC SECTOR FOR INLAND WATER TRANSPORT IN BANGLADESH



The major organizations involved in the inland waterways systems are the Bangladesh Inland Water Transport Authority (BIWTA), the Bangladesh Inland Water Transport Corporation (BIWTC) and private enterprises. The latter consists of some 184 separate companies.

The BIWTA is responsible for the complete infrastructure and management operations of the inland waterways system and is specially charged with the following functions:

(a) Carrying out river conservancy works including river training works for navigational purposes and for provision of aids to navigation including marks, buoys, lights and semaphore signals;

(b) Disseminating navigational and meteorological information including publication of river charts;

(c) Provision of pilotage and hydrographic survey services;

(d) Drawing up programs of dredging requirements and priorities for efficient maintenance of existing navigable waterways and for the resuscitation of dead or dying rivers, channels or canals, including development of new channels and canals for navigation;

(e) Construction and operation of inland river port facilities.

(f) Removal of wrecks and obstructions in channels;

(g) Conducting traffic surveys to establish passenger and cargo requirements on the main rivers, feeders and creek routes;

(h) Fixing maximum and minimum fares and freight rates and approving time-tables for passenger services;

(i) Developing rural water transport by progressing schemes for modernizing and mechanizing country craft;

(j) Arranging training for inland water transport personnel;

(k) Conducting research in matters relating to craft design, techniques of towage, landing and terminal facilities and port installation;

(l) Ensuring coordination of inland water transport with other forms of transport.

BIWTA is a governmental body directly under the control of the Ministry of Ports, Shipping and Traffic, engineering, Conservancy and Pilotage, Hydrography, Mechanical and Marine Engineering, Secretariat, Planning, Deck personnel, Accounts, Finance and Purchase and Stores.

BIWTA runs a Deck personnel Training Centre in Narayanganj for providing training to freshers and in-service crew working on inland vessels in both the public and the private sectors. There is a Marine Diesel Training Centre located also in Narayanganj for training of engine crew of inland vessels.

For removal of wrecks from the waterways, BIWTA operates a salvage unit with a 60 ton capacity.

Bangladesh Inland Water Transport Corporation (BIWTC) is another autonomous organization under the Ministry of Ports, Shipping and Inland Water Transport. It is responsible for furthering the development of coastal and inland shipping by discharging the following functions:

(a) Operating coastal vessels;

(b) Operating cargo services including lighterage;

(c) Undertaking passenger and cargo services in inland waterways;

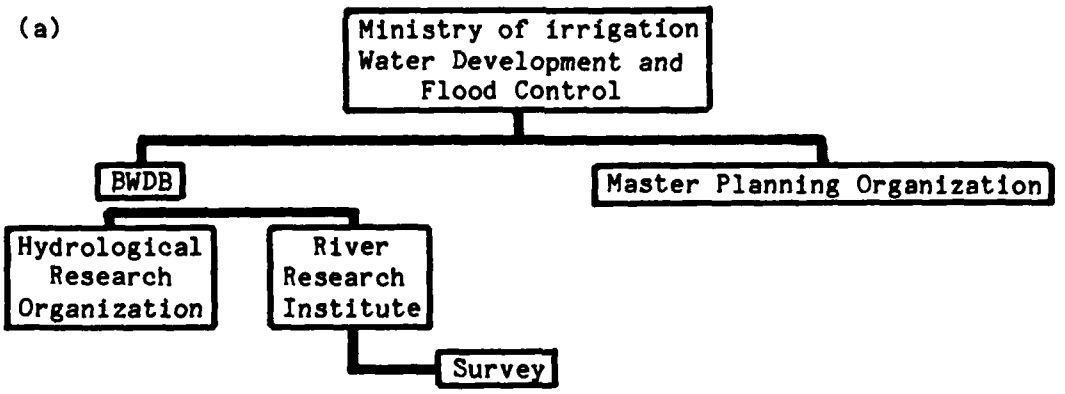
(d) Operating ferry services; and,

(e) Establishing and maintaining dockyard and repair workshop.

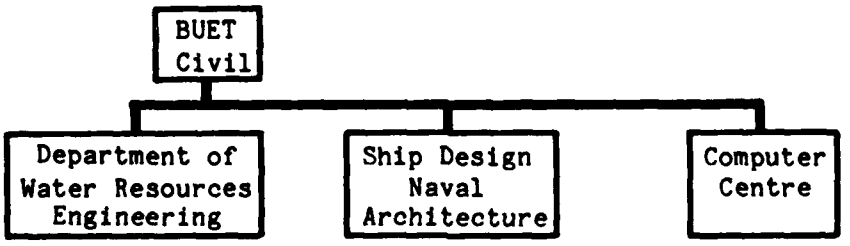
Bangladesh Inland Water Transport Corporation (BIWTC) now operates 591 mechanized vessels of different types providing cargo and passenger service over the entire system of navigable waterways and ferry service for transporting trucks, cars, buses and passengers across rivers that serve as vital links between roads and highways. It carries about 50 percent of the total IWT freight traffic and 10 percent of passenger traffic.

Other organizations related to IWT

(a)



(b)



(c) Institute of flood Control and drainage research;

(d) Interministerial: National Water Council;

(e) Planning Commission.

Under the Ministry of Industries, the Government is involved in shipbuilding and ship-repair facilities through the Bangladesh Engineering and Shipbuilding Corporation, comprising four different companies in this field in Narayanganj, Khulna and Chittagong.

Next to the public sector, the private sector too is actively engaged in inland water transport, with over 200 operators running passenger services, while more than 100 operators are engaged in cargo traffic. Moreover, there are over 30 private shipbuilding facilities in the country.

Regulations/Acts/Rules

The following statutes (acts and rules) are applicable:

(a) The Port Act of 1908;

(b) The Inland Shipping Ordinance, 1976;

(c) The Conservator of Ports, Lands and Buildings (Recovery of Possession) Act, 1967;

(d) The Canal Act;

(e) The Inland Water Transport (Allocation of Routes and Grant of Routes Permits) Rules, 1967;

(f) The Time and Fare Table Approval Rules, 1970;

(g) The Port Rules, 1966.

For further information, see reference (3), page 33.

Available data (type of data, tonnage, etc.)

Rivers (geometry, Hydraulics):

Basic Data: (6)

Basic hydrologic and hydrographic data for development and maintenance of inland waterways are available with the BIWTA and BWDB.

BIWTA and BWDB maintain an extensive network of water level gauges along the inland waterways from which data are collected, compiled, analyzed, processed and published on a regular basis. BWDB survey operates more upstream (more directed towards hydrology), while BIWTA concentrates on navigation (more downstream).

Traffic: BIWTA Annual Traffic Report
Fleet: registered - BIWTA
not registered - (4)

BURMA

BURMA

1. General

Burma has an area of 261,789 square miles with a population of over 35 million of whom over 3 million live in the capital, Rangoon. The Irrawaddy River, 3,500 miles long, is the country's economic lifeline and major transportation system, connecting Rangoon with Mondalay in the central area. Burma relies on its river traversing almost the entire length of the country from north to south for inland transportation. The total demand for transport is about 60-70 million tons out of which 50 percent is carried by the waterways. Table 1 below shows the breakdown and comparison between the years 1971-72 and 1980-81 for volume of freight.

2. Commerce

These rivers, with their numerous tributaries and coastal waterways, offer some 6,436 km of commercially navigable waterways. Larger areas along the Irrawaddy and Chindwin Valleys and coastal areas of Arakan and Tenasserim are accessible only by rivers. On all the navigable waterways, many manually operated country crafts are also being used as they provide the only means of travel and transport for rural areas. Most of the population lives along the river valleys and the cultivation of rice is their main livelihood. Hence, the people of the river valleys have a natural dependence on waterway transportation of their produce, such as rice, vegetables, fresh fish, fowl, eggs and other agricultural products, of which rice is recorded as the highest amount national export commodities.

TABLE 1. Volume of Freight for Transportation

Number		Items	In Thousand Tons	
1		2	1971-72	1980-81
1		Domestic Output	1/	62949
2		Imports	1/	885
3		Total Tonnage Required for Transportation (1+2)	1/	63834
	1	Short Haul	1/	37458
	2	Medium Haul	1/	12436
	3	Long Haul	1/	13946
4		Transportation by State-owned Transport Organizations	6378 2/	4859
5		Transportation by Other State-owned Organizations		4824
6		Transportation by Cooperatives	715	2742
7		Transportation by Private Sector		51409
	1	Transportation by Powered Vessels	20513	30865
	2	Transportation by Slow Crafts	16324	20544
8		Total Tonnage for Transportation (4+5+6+7)	43930	63834

1/ Data not available.

2/ No breakdown between State-owned and other State-owned Organization available.

Inland Water Transport Corporation (IWTC) reported that 2.1 million tons and 18.6 million passengers traverse the Chindwin River. In 1983-84, 400,000 tons of rice, 207,000 tons of cement and 176,000 tons of literage were carried by craft in the river. In Mondelay, IWTC reported that in 1983-84, it carried 144,810 tons of cargo on 1,290 trips and 1,486,500 passengers. A large amount of the cargo consisted of cement and gypsum.

3. Irrawaddy River System

This system includes the Irrawaddy, the Chindwin and their tributaries and the connecting canals, draining nearly 372,960 square km covering 55 percent of the country, thus constituting the main artery of waterborne commerce in Burma. The Salween and Gyaing rivers and their tributaries add many miles of navigable waterways in the southeastern part of the country. The Kaledan, Lemro, Mayu and other rivers with their tributaries constitute the river system of the Arakan Division, separated from the Irrawaddy by the Arakan Yoma. The Rangoon River and its principal tributaries, the Pazundaung Creek, the Pegu River and others, while relatively smaller in drainage area and shorter in navigable length, carry probably the heaviest load of waterborne commerce in the country, as this river system comprises the approaches to the port of Rangoon.

4. Irrawaddy River

This river is 2,011 km long with navigable length of about 1,600 kilometers. The average water discharge is 13,000 m^3/sec; maximum water discharge of 64,000 m^3/sec; and minimum water discharge of 1,300 m^3/sec. The average sediment discharge is about 300 x 10^6 ton/year.

5. Delta Area

The Delta area is entirely different from the main river as regards to river transportation. In the Delta, intricate waterways with sharp bends have to be traversed and great care has to be exercised to avoid collisions with other vessels. In many cases speed has to be reduced to avoid capsizing of small loaded native craft and paddy gigs.

The numerous creeks which intersect the delta regions are navigable all the year round.

6. Chindwin River

The Chindwin is navigable from its river mouth at Pakokku to Khamti, a distance of 843 km. However, owing to the presence of sand banks and shoals formed by silt in various places along the route and the swift current, navigation is difficult during the low-water season.

The draught limitations in the Chindwin for the low-water season commencing from 15 November to 15 May are given below:

Chindwin mouth to Monywa	-	0.90 m
Monywa to Kalewa	-	1.00 m
Kalewa to Homalin	-	0.90 m
Homalin to Khamti	-	0.75 m

It is probable, however, that one or two shoal channels with soundings 0.15 meters or so, less than the minimum stated above, will be encountered in all the above stretches for short periods of about two weeks when the river is at its lowest level in or around the months of February and March.

There are about 23 rock channels and 11 snag channels and 27 shoal channels located near the fairway channels throughout the Chindwin River be between Pakokku and Khamti with depths of less than 1.20 meters.

7. Moulmein Area

The Salween River from Moulmein to Shwegun, a distance of 88 km, is navigable by launches measuring up to 30.48 meters in length on a draught of 1.50 meters. The Attaran River from Moulmein to Kyondo is navigable by launches up to about 30,48 meters in length on a draught of 1.50 meters. Passenger and cargo services are being operated on these rivers with a fleet numbering some 20 double-decked launches.

8. Arakan Area

The principal towns are along or near the sea coast, where many islands are formed with navigable waterways along either side of these islands. On the southern route from Akyab, river transport voyages are mixed with coastal and creek routes. Rivers in Arakan, the Kaledan, Lemro, Saingtin and Naaf are all navigable. At Cheduba, the vessels can only go alongside the port according to the tide. In the neap tide period the vessel has to stop at the mouth of Cheduba creek in open sea where passenger embarkation and disembarkation has to be made with native canoes.

Navigation in the northern part of Arakan is entirely along rivers and in a few stretches through narrow creeks where vessels have to maneuvre with great care.

9. Waterways

The rivers in Burma with their numerous tributaries and coastal waterways offer some 6,435 km of navigable waterways. The following section describes factors limiting the navigation on the rivers.

a. Rise and Fall of the River

The rivers rise and fall during the seasons' monsoons, which commence in about May and end in October.

In Table 2 below one can see the maximum difference between high- and low-water levels as indicated by gauges at Bhamo, Mandalay and Prome.

TABLE 2

	Bhamo	Mandalay	Prome
Maximum high-water reading (m)	11.60 to 12.20	69.90	29.55
Maximum low-water reading (m)	2.00	60.20	18.20
Difference in level	10.20	9.70	11.35

The gauge reading at Bhamo is taken on the actual depth of the water, whereas at Mandalay and Prome it is taken on the actual depth of the water plus elevation of the bank.

The variation in river level during the course of the year may differ each year but, in general, the following holds true:

(1) From December to March, four months inclusive, the river is 0 to 1.50 meters above the lowest level;

(2) From mid-June to mid-October, four months, the river is 6.10 to 9.10 meters above the lowest level.

Owing to the above situation, it is usually necessary to have separate high and low landing points at river ports, and great care has to be exercised for vessels navigating on a falling river, particularly at the end of high-water season.

b. Current Velocity

The current velocity varies not only with the season but also with the locality. At Mandalay, for example, the speed of current in the main channel varies as follows:

Low-water	-	2.4 to 3.2 km per hour
High-water season	-	3.2 to 6.4 km per hour

During the low-water season, a current velocity of 6.4 to 9.6 km per hour may be encountered in various short reaches between Rangoon and Bhamo velocity a current velocity of 12.8 km per hour may be encountered but only the exceptional circumstances.

The speed of the current between Rangoon and Bhamo is:

	Average	Maximum
Low-water season	3.2 km/hr	6.4 km/hr
High-water season	6.4 km/hr	9.6 km/hr

As such, the vessels should have sufficient power to stem the maximum current towing a full load of flats or barges. Undue delays have occurred to many under powered vessels while negotiating a river stretch with strong current.

c. Draught Limitations

The draught of vessel operating during the low-water season (15 November to 15 May) is usually limited as follows:

Irrawaddy River	Restricted Draught
Henzada to Prome	1.70 meters
Prome to Mandalay	1.50 meters
Mandalay to Katha	1.20 meters
Katha to Bhamo	1.15 meters
Sinbo to Kyitkyina	0.75 meters

Great care has to be exercised when navigating on the Irrawaddy, where rocks are formed in or near the channels in many stretches between Henzada and Mandalay with the depth of less than 1.80 meters in the low-water season. Between Mandalay and Bhamo there are about 7 rocky channels and 31 shoal channels with a depth less than 1.50 meters in the low-water season. In addition, there are about 360 World War II wrecks which are being removed at an average rate of 20 wrecks per year by commercial firms. Also shifting of the river bottom creates additional navigational problems. Irrawaddy River has also a major problem with the erosion of its banks.

10. Organization

The Inland Water Transport Corporation (IWTC) is authorized to operate inland water transport services throughout the country and to undertake activities necessary or expedient for the proper carrying out of its functions.

The functions in general are to:

a. Purchase, construct, hire, sell or dispose of any form of water transport craft, jetty, godown, landing stages and stores;

b. Operate inland water transport services in the navigable waterways;

c. Maintain any other different form of feeder or subsidiary transport services;

d. Organize tourist transport, trade and travel;

e. Undertake the management of dockyards, workships, foundries, mills, artesan wells or tubes and such other operations as may be necessary for operating inland water transport; and

f. Determine, raise or reduce freights, fares and charges.

In discharging its functions, IWTC is to act according to business principles with due regard to the interests of the agricultural industry, commerce and the general public, and on policy questions as instructed.

The Waterways Division's, formed in 1972, main objective is to improve and maintain rivers for safe navigation. Although authorized 4,500 staffs, only 25 percent is presently filled. Its main function is:

a. Survey of rivers;

b. Make maps;

c. Design and improvement of channels;

d. Dredging; and

e. Navigational aids.

The operation is being carried out by five divisions through the Transportation Department:

a. The Arakan Division (headquarters - Akyab);

b. The Irrawaddy Division (Headquarters - Mandalay);

c. The Cargo Division (Headquarters - Rangoon);

d. The Delta Division (Headquarters - Rangoon); and

e. The Salween Division (Headquarters - Moulmein);

11. Inland Fleet

Most of the private-owned and state-owned craft operate on the Irrawaddy and Chindwin Rivers. The breakdown showing the number of craft operating in these rivers are shown below in Table 3. IWTC also operates passenger and cargo services in the Arakan Sector, consisting primarily of moving paddy from neighboring stations into the port of Akyab.

TABLE 3

LIST OF STATE-OWNED CRAFTS (1982)

Length = 50 feet to 150 feet
Width = 6 feet to 30 feet
Draught = 1 foot to 5-1/2 feet
Tonnage = 50 to 850

Location	Approx. No. of Craft	Remarks
1. Irrawaddy Delta	560	of which
2. Irrawaddy River	350	20% (approx.)
3. Chindwin River	58	are the
4. Other Rivers	55	barges.
TOTAL	1,023	

LIST OF PRIVATE-OWNED CRAFTS (1982)

Length = 35 feet to 100 feet
Width = 1 foot to 19 feet
Draught = 1 foot to 5-1/2 feet
Tonnage = 30 to 600

Location	Approx. No. of Craft	Remarks
1. Irrawaddy Delta	935	All of the
2. Irrawaddy River	755	them are
3. Chindwin River	120	self-propelled
4. Other Rivers	130	crafts.
TOTAL	1,940	

Source: Mr. Maung Maung Lay

In addition, IWTC owns 11 dredgers and does an annual maintenance dredging of 1.1 million cubic meters.

IWTC operates dockyards in Rangoon, Mandalay, Moulmein and Aykab for regular maintenance of its craft deployed in their respective areas and also for emergency repairs such as propeller casualties or rudder defects which commonly happen while on maneuvres.

Apart from repairs and maintenance of its fleet, the dockyards also undertake the construction of new vessels with length sizes ranging from 18.29 to 54.87 meters. However, owing to frequent price hikes for ship construction materials and engines for installation on new ships, the working program of the dockyards has to be changed, and all possible construction of entire ships or renovation of hulls and re-engining of outdated engines on ships presently in hand have to be done locally with materials imported.

12. IWTC Traffic

The following Table 4 gives a picture of the overall inland water transport traffic in the past years.

TABLE 4

	Before 1942	1980-1981
Passengers carried	8 million annually	424.77 million passenger-km
Cargo carried	362 million ton/km	308.93 million ton/km

13. Planning

IWTC's fourth Four Year Plan will include 1982/83 to 1985/86. Revenue expected to be realized at the end of the fourth Four Year Plan would be about 13.6 percent growth against the income estimate of base year 1981/82. The freight and passenger movement during the plan years will be considerably increased with a target of 360.42 million ton/km and 514.88 million passenger/km, respectively at the end of the plan years.

The new projects in plan years are:

a. New construction of vessels;

b. Power increasing of 'Kyant' tugs;

c. Major renovation of obsolete vessels;

d. Re-engining of vessels;

e. Replacement of dockyard machiner;

f. Civil engineering works; and

g. A comprehensive study of Irrawaddy River by consultants from the Netherlands.

CHINA

China

1. Introduction

China has a long history in both using its natural waterways and constructing canals for inland waterway transport. The earliest navigation canal being dug in 600 BC connecting the Sha and Ru Rivers (Henan Province).

In total, China has more than 5600 navigable rivers with a total length of 108,000 km, 80 per cent of which are navigable all year round.

The most important river system is the Changjiang (Yangtze) and its 3,600 tributaries. The Changjiang itself is the third largest river in the world (6,300 km) and the whole system amounts to more than 70,000 km of rivers. The second largest river system is the Zhujiang (Pearl River) and its 988 tributaries - 823 of which are navigable. The whole system amounts to 12,830 km, of which 5,347 km are navigable. In the north, the Heilungjing River system amounts to 4,782 km. Each year, there are about 200 navigation days only due to icing of the river. Another famous river in China is the Huanghe (Yellow River) however the high level of siltation has limited its navigation. The Grand Canal is 1747 km in length and runs from Beijing to Hangzhan.

2. Organization

The Bureau of Inland Waterway Transport under the Ministry of Communications is responsible for all the administration and some shipping operations on China's inland waterways. At a local level, navigational affairs are administered by Provincial Bureaus. Two exceptions to this are the Changjiang and Heilunjiang which have their own rivers administrations directly responsible to the Bureau of Inland Waterway Transport. Recently, the Changjiang Shipping Administration has been split into the Changjiang Navigation Affairs Administration and the Changjiang Shipping Company. The Administration is responsible for all aspects of navigation including: research and development--Science and Technology Institute; dredging, lighting and buoying the channels, rivers, patroling, hydrographic surveying, etc.--Waterway Bureau; registration of vessels, certification of seamen, surveying of vessels, etc--Superintendency Bureau; administration of ports--Port Authorities; Telecommunications and Navigation Centre and Education and Training Colleges. The Shipping Company is one of the companies operating on the Changjiang and it has five quasi-autonomous branch offices located at Changjing, Wuhan (the largest fleet), Nanjing (mainly involved in oil transport) Wuhu (the smallest fleet) and Shanghai.

3. Waterways

The total length of inland waterways is 430,000 km. According to a survey made in 1980, the over-all length of navigable waterways amounted to 107,829 km, nearly doubling the length of the early years after liberation in 1949. The navigable length with different water depths is as follows:

TABLE 1

	more than 1.0 m		less than 1.0 m	
	1975	1980	1975	1980
Rivers (km)	49,298.5	56,531.5	—	50,329.0
Canals (km)	968.5	968.5	—	—

The navigable waterways are classified into six classes with specifications as given in the following table:

Fairway Class	Water depth (m)	Bottom width (m)	Curvature radius (m)	Barge DWT (t)	Effective size of ship lock l x w x d (m)
I	3.2	75-100	900-1,200	3,000	254 x 18 x 5.0
II	2.5-3.0	75-100	850-1,100	2,000	230 x 18 x 4.0
III	1.8-2.3	60-80	700-900	1,000	190 x 16 x 3.0
IV	1.5-1.8	45-60	600-750	500	160 x 12 x 2.5
V	1.2-1.5	35-50	200-500	300	130 x 12 x 2.0
VI	1.0-1.2	20-30	150-400	50-400	100 x 7 x 1.5

The above specifications, formulated in 1963, are undergoing total revision.

After the founding of People's Republic of China, many dredging, regulation and canalization projects have been carried out for improvement and development of IWT on numerous rivers. As a result, navigation channels have been deepened and broadened; many shoals and rapids removed and navigational conditions remarkably improved. The navigable waterways are all marked with aids to navigation which may fall into three classes:

(a) First-class marks are installed in those sections of the river where traffic is heaviest and all the marks are lit throughout the night;

(b) Second-class marks are set up at places where navigation is relatively developed and the marks are lit according to the sections;

(c) Third-class marks are put in places where navigation is less developed and the marks are scattered and not illuminated.

Every lit mark is electrified with various kinds of batteries as power source. Solar energy navigation lights are being studied and developed.

The Changjiang is the most important artery for IWT in China and is divided into three reaches:

Port Range	Draft in LW Season	Approx. Length	Reach
Yibin - Chonjqing	1.8m	1000 km	Upper
Chonjqing - Yichang	2.9m		
Yichang - Wuhan	2.9m	600 km	Middle
Wuhan - Shanghai	4.0m	1000 km	Lower

At present, 1,000 ton barge-tows can negotiate all year round in the upper reaches. Passenger-cum-cargo steamers of 3,000 tons and tankers and iron-ore barges of 5,000 tons can sail up to Wuhan. The channel below Nanjing in the lower reaches can accommodate sea-going vessels of 15,000 tons and tankers of 24,000 tons.

The construction of a two-step multi-purpose hydro project in the upper reaches of the Yangtze River has been completed. The Gezhouba Project which was put into operation in July 1981 is a pilot project for the future Three Gorges Scheme. It is commissioned to power generation and navigation.

The Pearl River (Zhujiang) System has a total length of 12,830 km and has 988 navigable waterways. It is formed by the confluence of three rivers, namely, the West River (Xijiang), North River (Beijiang) and East River (Dongjiang). It is next in importance only to the Yangtze River system, and is the main artery of water transport in South China. The length of the main trunk of the Pearl River is 2,167 km with ample inflow, low sediment and stable navigation channel. But the navigational potentials of the Pearl River are not fully exploited. For example, at present the West River in the upper reaches of the Pearl River can only accommodate small passenger boats with 200-300 berths and barge tows made up of 80-120 ton barges. In 1979, the traffic volume was only about 16 million tons.

The lower reaches of the Pearl River, downstream of Wuzhou, with a length of 333 km, can accommodate barges of 500 tons all year round and barges of 1,000 tons in medium- and high-water seasons.

The mouth of the Pearl River is an estuarine delta crisscrossed with about 823 branches and tributaries with a total navigable length of about 5,332 km. The Pearl River has 8 outlets pouring into the South China Sea. Four of these outlets can accommodate ships of 500-1,000 tons, and two of them have an annual traffic volume of more than 5 million tons each.

The Grand Canal originating from Beijing in the north runs a total length of 1,747 km and passes through the city of Tianjin and the provinces of Hebei, Shandong, Jiangsu and Zhejiang and finally terminates at Hangzhou in the south. At present, the northern section, with the exception of the Beijing-Tianjin stretch (180 km) and the Lingqing-Yellow River stretch (90 km), can accommodate boats of 100-200 tons. The canal section between Xuzhou and the Yangtze River, because of its meandering and narrowness, could only allow wooden boats of 30 tons about 20 years ago. During 1958-1961, a programme of improvement and canalization was put into execution, including 10 boat-locks and some other hydraulic works. Thus, multiple effects of

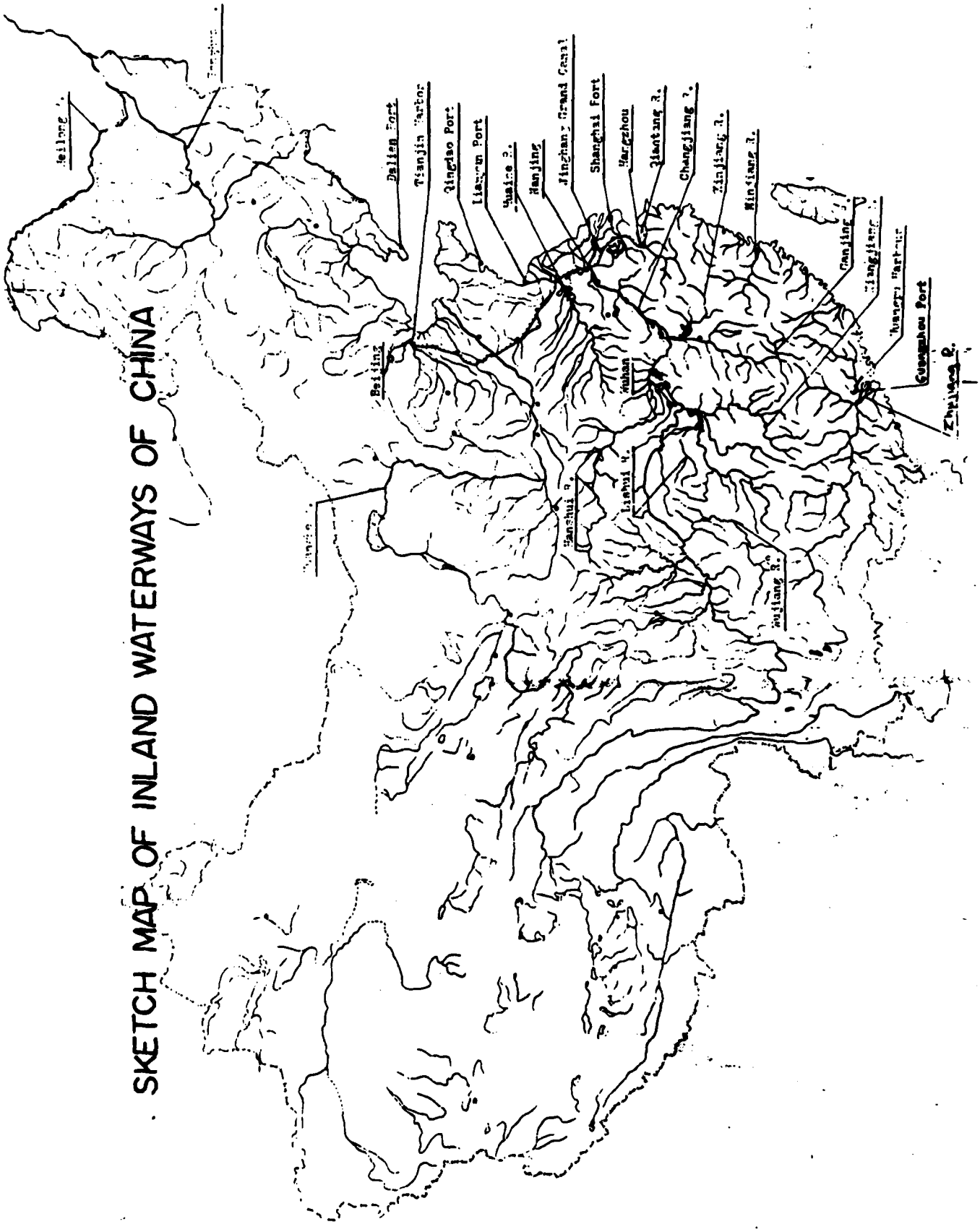


Figure 1 - Sketch Map of Inland Waterways of China

navigation, flood control, drainage of water-logged areas and irrigation were realized. Now, barges of 500 tons can navigate all year round. In 1980, traffic volume of this section has increased to more than 1,700,000 tons. At the southern part of the Grand Canal, from Zhenjiang to Hangzhou, the traffic is so busy that every one or two minutes a barge train would pass through, and at some sections of the Canal, signal lights have to be established to give control over traffic movement. In 1979, the traffic volume reached 36 million tons.

4. Inland ports

There are 300 river ports, each with an annual cargo handling capacity exceeding 100,000 tons. Among those, more than 8 have a capacity of over 1 million tons per year. From the 17 dilapidated ports of the early days of liberation in 1949, 25 major ports (exclusive of Shanghai port) have been established along the Yangtze River. These 25 ports possess more than 200 berths, 400 pieces of various types of cargo handling equipment and 173 mechanized or semi-mechanized operation lines. The throughput capacity has increased more than 19 times that of 1949. Nanjing port is the largest and the next is the port of Wuhan, with annual capacities of over 12 million and 10 million tons respectively. The configurations of the majority of wharves and quays of the river ports are of the pontoon type and simple sloping landing stages. These technologies have been specially developed to cope with the large seasonal rise and fall in water level. In the mid-1960s, a unitized transportation system was introduced in the Yangtze River. The pallet, net-sling, container etc. have been adapted to fit various types of cargo. There are 33 unitized transport lines in the Yangtze River occupying more than 50 per cent of the total volume of unitized cargo. Most of the major ports of the other rivers have realized mechanization or semi-mechanization for cargo handling, whereas in other ports in general the degree of mechanization is not very high. Manual handling is still quite common.

5. Inland fleet

Since the founding of PRC, the development of IWT is characterized by the rapid increase in mechanization of the inland fleet. Ninety per cent of the total freight volume is mainly carried by tug-barge trains and push-tows. The remaining 10 per cent is by wooden sailing vessels, which are more and more replaced by steel vessels.

In 1978, river tugs and barges amounted to a dead weight tonnage of 3,800,000 and junks to a dead weight tonnage of 730,000. The vessels consisted of tugs or pushers of 20 to 4,000 hp and barges from 50 to 5,000 tons. in recent years, the pushboat with integrated barge fleet is being introduced and developed in the river systems such as the Yangtze River, the Songhua River, the Huai and the Pearl Rivers, as well as the Dongting Lake and the Poyang Lake areas. The Changjiang Shipping Company alone possesses 200 tugs and pushers, some 1,500 barges, 130 passenger/cargo ships and over 40 freighters totalling about 1.5 million tons. Its pushers and tugs are mainly of four types, i.e., 2,640, 2,400, 2,000 and 500 hp and barges of 800 to 5,000 ton dwt. Four 6,000 hp pushers have also been imported from the United States. Boats of a number of local shipping companies are run by certain

provinces, municipalities and counties. In the lower stretch of the Yangtze River, the integrated barge and pushboat fleets are of 10,000 dwt range with barges of the 1,000 and 5,000 dwt. In other waterways, barges of 300 and 500 dwt are mainly being used.

Ferro-cement vessels have been very popular after many years of satisfactory performance, both technically and economically. At present, there are more than 100 types of ferro-cement vessels such as wharf pontoons, pumping pontoons, floating cranes, floating pile drivers, dredgers, floating dry docks, etc. There are also numerous ferro-cement country boats for rural transport. The aggregate tonnage of the various types of ferro-cement vessels is 870,000 which is nearly 20 per cent of the total tonnage of the inland fleet. In the future however China will concentrate on the construction of steel vessels.

Glass fibre-reinforced plastic, being very expensive, is rarely used in shipbuilding. A 100 dwt oil barge made of a combination of glass fibre-reinforced plastic and mesh-cement was built in 1979.

6. Traffic

In 1980, the cargo moved by inland waterways was 330 million tons, which was 14 times the corresponding figure for 1950. The number of passengers moved was 260 million. These figures cover only the traffic volume of vessels operated by river transport enterprises, not including the traffic volume of vessels operated by other industrial enterprises or side-line boats of rural areas. The Yangtze River shipping Administration alone moved 48 million tons of cargo and more than 23 million passengers. Total ton/kilometers have increased from 57.1 billion in 1980 and 30.3 billion in 1970 to 78 billion in 1984.

The following Table 2 gives a picture of the over-all IWT traffic in the past few years:

Table 2 - IWT Traffic 1975 - 1984

	1975	1977	1980	1983	1984
Passengers carried (in million)	207.16	221.29	250.00	250.00	234.00
Cargo carried (in million tons)	288.42	317.22	330.00	320.00	330.00

In some provinces, such as Jiangsu and Guandgdong, IWT is the main transport mode and traffic by this mode is more than 60 per cent of the total traffic volume of all modes of transport.

The major commodities of freight movement are coal, petroleum, ores, iron and steel, sand, stone and other construction materials, lumber, grains, cotton, fertilizers, insecticides and general cargoes.

According to statistics, the unit output, i.e., the volume of cargo transported per unit hp, is 3 to 8 tons/hp for river transport, whereas it is only about 1 ton/hp for railways and still less for road. The fuel consumption for road transport is 68 g/ton-km and that of river transport is only 12 g/ton-km. Thus, the cost of river transport is also much lower, in many cases only about one fifth to one half that of railway and one tenth to one fifth of road transport.

7. Planning

In the course of developing China's four modernization, energy and communications (including transport) are two strategic keys. The government has submitted a policy of making full use of water transportation. At present, China is working on the master planning of navigation and waterway works for major river systems. For example, planning of the Huaihe river basin, Zhijiang basin, the Grand Canal and Haihe river basin have commenced and that of the Changjiang basin, Heilongjiang and Minjiang will begin very soon. Prototype ship model tests and offers scientific research are also being undertaken.

There are five rivers which were specifically mentioned during the discussions, for which the authorities would like to call for foreign investment on a barter deal basis or to receive low interest loans from World Bank, ADB, etc.

1. Han Shui (Hubei Province) - This river would be mainly used for transportation. A letter of intent has been signed with the Federal Republic of Germany to undertake aerial and hydrographic surveys.

2. Qingjiang (South West of Hubei Province) - Development of this river is mainly for hydro-electric power purposes and consequently falls under the Ministry of Water Conservancy and Hydro-Power. It is proposed to build five dams on the river and Hubei Province Shipping Administration has requested that the navigation of the river is maintaain - possibly with 300 ton ship lifts.

3. Qijiang (South of Changjing, Sechuan Province) - This river is mainly for navigation (270 km) and it is anticipated that cargo volumes could increase from 300,000 tons to 4 million if the river was improved. The investment would be Y60-100 million.

4. Qujiang (North of Chengjing, Sechuan Province) - has a total length of 358 km. Canalization of this river involves the construction of nine steps along the river. Between 1958 and 1962, three of these steps were constructed. The remaining steps need to be constructed. The river has abundant resources including coal reserves of 900 m tons, 800 m cubic metres of black marble, 8.4 billion cubic metres of mineral water, iron-ore, limestone, natural gas, etc. It is estimated that if developed the cargo volume could increase from 500,000 tons to 5 million tons per annum. The investment cost is estimated at around Y170 million with a barter deal being suggested.

5. Chishui (Guizhou Province) - This river has a total length of 520 km. It is envisaged that it is used both for hydro-power and transport. The main cargo from Guizhan Province would be coal, urea and moutai. It is proposed to build 6 dams along the river. Cargo volume could increase from 600,000 tons to 3.0 millions tons per annum. The investment would be around Y200 million.

8. Studies/Reports

1. Ministry of Communications, "The Present Status of China's Inland Waterways", May 1983.

INDONESIA

Indonesia

Country Background Description

General

Indonesia consists of more than 13,000 islands of which 1000 inhabited wth a total land area of 1.9 km^2. East-West distance about 5000 km.

Population consists of about 160 x 10^6 of which nearly 100 X 10^6 live on Java (estimate 1985).

Transmigration

In order to decrease population pressure on Java and in view of required development large amount of people are transmigrated towards islands outside Java. Quantitative target of the third five year plan (Repeleta III; '79-'84) is 100,000 families ($\simeq$ 500,000 persons) per year.

The majority of the transmigrants have been or will be settled in newly opened transmigrant areas located along rivers in the tidal swamps of the main islands Sumatra, Kalimautau, Sulawesi and Irian Jaya; see map.

Common characteristics of these areas are:

- partly cleared tropical forest/swamp vegetation
- no infrastructure
- area's crisscrossed by a network of irrigation/drainage canals under tidal influence
- during high water the primary and secondary canals are used for local water transport

Rivers

In contrary to other countries is the region, the rivers of Indonesia are not of the alluvial type: flat, wide, shallow, sandy, meandering rivers. Most of the rivers, especially those running through the swamps have different characteristics:

- up-river stretch: rocky, steep
- middle stretch: clay, narrow, deep, strong seasonal changes
- downstream: estuary, governed by the tide, wide, deep except at the mouth; mostly a bar, weak seasonal changes
- natural system (only a few rivers are partly trained; in a few cases multi-purpose dams were constructed (hydropower, irrigation) e.g. in Citarum River
- stable

Bore

In a number of rivers a tidal bore is occurring, for instance:

Sumatra: Rokan River
Irian Jaya: Bian and Digul Rivers

a. IWT routes, main ports; ferries

From transport point of view the main rivers on Java and Irian Jaya, are not (yet) important.

On Java, it is because of either the existence of Dams (Citrarum, Brantas) or the lack of industrial development along the river. Some local transport exist on Cimanuk and Citanduy Rivers for instance.

On Irian Jaya, it is because of lack of development, though plans for huge scale transmigration are starting to materialize there.

Important rivers in view of IWT are to be joined on Sumatra and Kalimautau. They are (from [1]):

	Sumatra		Kalimautau
1.	Siak	7.	Sebuku
2.	Indragioi	8.	Sembakung
3.	Batanghari	9.	Sesayap
4.	Musi	10.	Kayan
5.	Lalang	11.	Mahakans
6.	Rawas	12.	Barito
		13.	Dayak Kecil
		14.	Kahayan
		15.	Kapuas

The location of the rivers are indicated on the map. In view of IWT also a number of lakes are mentioned in [1].

Main ports

The location of the inland ports is reflected by the location of the regional offices of the Directorate General Land Transport and Inland Waterways (see [1]). It should be noted that in some of the rivers or estuaries, sea ports are located. Generally in those rivers IWT is further developed due to cargo transfer between ocean going transport and IWT.

Ferries

For the many ferry links, mostly in between the islands reference is made to [1].

b. Sense of importance of IWT to country; fleet & traffic

The importance of IWT to the country is indicated by the magnitude of the inland fleet. Only part of it is registered:

In 1904: nearly 90,000 vessels with a net tonnage of more than one million tons (see [6]). Also in Indonesia it holds that the importance of the country craft is not visible and the country boats are not counted.

A quantitative estimate of cargo and passenger transport is not possible.

The main reason is the governments open policy to leave smooth going IWT (uncounted) to the private sector. And as many rivers are stable and navigable no comprehensive picture exists on traffic intensity (cargo and passenger). Moreover the Directorate General of Land Transport and Inland Waterways put the emphasis (besides ferries) on the difficult parts of the waterway section: there, IWT is hampered to such a degree that the private sector is not interested.

At the moment the difficult parts of the waterway system are mainly located in the newly opened transmigration areas.

The importance of IWT there is evident. No infrastructure, only irrigation/drainage canals to be used for navigation (cash crops, passengers) and vast numbers of transmigrant: e.g. North of Palembang recently 400,000 transmigrants were settled.

The main problem is that the canals are not suitable for IWT (often dry, during low water).

IWT in Indonesia is still in its developing state. The sense of importance of IWT to the country is probably best reflected by the country's efforts to establish an IWT training center: the first of its kind in the ESCAP region (see also under C end).

c. Major previous reports on IWT in country

[1] Directorate General Land Transport and Inland Waterways
"ESCAP/UN preparatory assistance mission March 1985.

[2] L'universite de Liege
"Inland Waterways and Ferries Training Centre"

[3] ESCAP qustionnaire
March 1985

[4] Terms of Reference for Study of Inland Waterways Transport in Central and West Kalimantau.

[5] Reucana Pembangunan
Dilingkungan KANWIL V DITJENDAT (proposal for the improvement of the facilities of the Directorate General Land Transport and Inland Waterways near Palembang: a.o. harbors for workboats) March 1985.

[6] Note on dredging, registered IWT crafts and marine casualties Directorate Island Waterways and Ferry Services April 1985.

d. Major proposed IWT projects

The major proposed IWT projects recently started are:

- The IWT center north of Palembang (see [2])
- The IWT study for Center and West Kalimautau (see [4]).

The IWT and Ferry Training Center

The mission visited the site where the Center (classrooms; campus) is under construction. The Center is located along the Musi River north of Palembang. In the River a small dredge is moored for training purposes. The courses will start in September 1985 at a small scale. Besides Indonesian staff, Belgium is scheduled to provide two expert staff members. The center is set up so far with bilateral assistance from Belgium. The Centre will run, after a 4-month preparatory session, three types of courses:

A. Administration, exploitation management
B. Naval engineering and navigation
C Civil Engineering

These courses are chopped up in three sections of 3.5, 6 and 6 months with in between periods with practical work. The total training lasts 3 to 4 years. Some topics out of the Center's curriculum:

- importance of IWT's social-economic role
- administration
- economics
- operation, handling, transport systems
- technology: a.o.: IWT terminals
- navigation
- mechanics, maintenance
- hydraulics
- mathematics

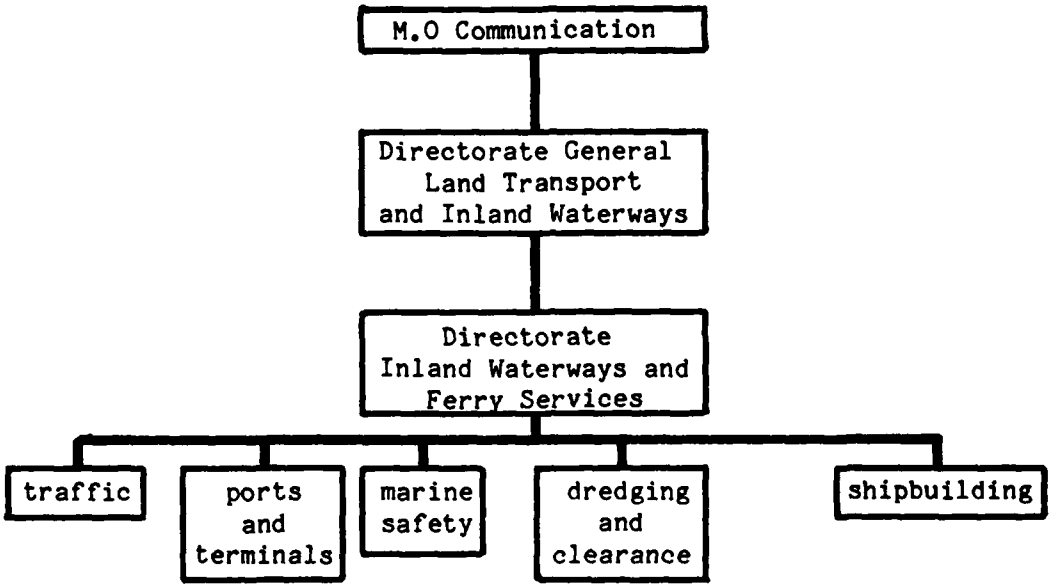
The Center is scheduled to start in 1986 for about 40 students. In 1989 the Centre will reach its full size: 60 to 80 students per year.

e. Major future IWT program

The major future IWT program is to be focused on the problems identified in Indonesia. It is believed that Indonesia is fully capable of solving the most problems themselves (e.g. improve transport for transmigrant). Some of

the problems, however, to be solved with the aid of the projects described in their report viz. IWT terminal design, tackling situation problems, navigation aids and additional support for the IWT Training Center.

f. Position of IWT in Country's Administration



MALAYSIA

Malaysia

1. Introduction

Owing to large scale siltation of the waterways and because of the good network of land transport and air services, the role of inland water transport as a means of transport on Peninsular Malaysia is almost non-existent except for some minor traffic plying up and down short stretches of some rivers.

East Malaysia, especially Sarawak, presents a different picture, there being more than 30 rivers which are navigated by various sizes of vessels. The most important river is the Rajang with a total length of 306 miles.

2. Organization

The Marine Department of the Ministry of Transport has responsibility for licensing and surveying IWT vessels over the whole of Malaysia.

In Sarawak these these are various bodies with different and sometimes overlapping functions. These include the Federal and State Marine Departments, Public Works Department, Drainage and irrigation Department. Local authorities (for example Sivar Local Authority has constructed bank protection walls in the city area) and Port Authorities (Kuching, Rajang, Bintulu and Miri).

3. Waterways

The two main rivers in peninsular Malaysia are the Perak River and the Pahang River. They are used limitedly as a means of transport, especially by fisherman and rural people living near the rivers. The present emphasis is mainly on the development of waterways in the estuaries or their vicinity to serve the needs of the fishing population as well as to provide better drainage for the agricultural land in the coastal areas.

In Sabah and Sarawak, owing to several geographical factors such as hilly areas, land transport is not extensive and only available in major towns. (Most of the population living along the banks of the Rivers.) Transport between areas in these two states is either by coastal shipping or by air services.

Table 1 lists the main navigable rivers in Sarawak, the most important of which is the 306 mile long Rajang. The stretch from the Kuala Rajang and Kuala Palsh entrances in Sibar have been surveyed and it is understood that surveys have been undertaken to Kanswit. From Kanswit to Kapite the river is navigable but with local knowledge. At Kapit the Rajang turns northwards to Belaga whilst the Baleh continues to the east. Between Kapit and Belaga (92 nautical miles) there are three rapids -- pelagus rapids, Kakok rapids and Bungar rapids. These rapids are navigated by small country craft. There are however plans to build a hydro-electric power system on this stretch of the river.

Table 1

MAIN NAVIGABLE RIVERS IN SARAWAK

NAME	LENGTH	PURPOSE	LEAST DEPTHS (NAVIGABLE CHANNEL)
1. Sematan River	8 miles	For small cargo vessel	0.6 m at the river bar
2. Kayan River (Lundu)	32 miles	For small cargo vessel	0.6 m at the river bar
3. Sempadi River	6 miles	For small cargo vessel	0.2 m at the river bar
4. Rambungan River	5 miles	For small cargo vessel	0.3 m at the river bar
5. Sibu Laut River	6 miles	For small cargo vessel	0.3 m at the river bar
6. Salak River	6 miles	For small cargo vessel	1.8 m at the river bar
7. Santubong River	13 miles	For small cargo vessel	1.8 m at the river bar
8. Sarawak River	21 miles	For foreign ship up to 168 m length with 7.6 m draught up to Sajingkat anchorage and 131 m length with 5.2 m draught to Tanah Puteh Wharf (Kuching)	5.2 m at the river bar
9. Samarahan River	18 miles	For small cargo vessel	2.4 m at the river bar
10. Sadong River	40 miles	For small cargo vessel	0.6 m at the river bar
11. Lupar River	73 miles	For small cargo vessel	1.2 m at the river bar
12. Saribas River	52 miles	For small cargo vessel	1.5 m at the river bar
13. Kabong River	26 miles	For small cargo vessel	1.8 m at the river bar
14. Rajang River	306 miles	For foreign ships up to to 9 m draught anchorage at Tg. Mani and 4 m draught up to Sibu	5.8 m at the river bar
15. Baleh River	51 miles upstream from Kapit	For boats	Not surveyed
16. Belawai River	25 miles	For small cargo vessel	3 m at the river bar
17. Paloh River	38 miles	For foreign vessel up to 5.5 m draught during dry season and 4.5 m draught during monsoon period	2.7 m at the river bar
18. Igan River	59 miles	For small cargo vessel	0.9 m at the river bar
19. Oya River	17 miles	For small cargo vessel	0.1 m at the river bar
20. Lassa River	22 miles	For small cargo vessel	4.2 m at the river bar
21. Mukah River	62 miles	For small cargo vessel	0.1 m at the river bar
22. Balingian River	13 miles	For small cargo vessel	0.3 m at the river bar
23. Tatau River	13 miles	For small cargo vessel	1.0 m at the river bar
24. Kemena River	25 miles	For small cargo vessel	0.6 m at the river bar
25. Niah River	11 miles	For small cargo vessel	0.4 m at the river bar
26. Suai River	13 miles	For small cargo vessel	0.4 m at the river bar
27. Sibuti River	12 miles	For small cargo vessel	0.3 m at the river bar
28. Miri River	3 miles	For small cargo vessel	0.1-0.6 m at the river bar
29. Baram River	180 miles	For small cargo vessel	1.1 m at the river bar
30. Limbang River	49 miles	For small cargo vessel	0.7 m at the river bar
31. Lawas River	27 miles	For small cargo vessel	0.5 m at the river bar
32. Simujau River	8 miles	For small cargo vessel	0.3 m at the river bar

One important canal in the state is the Kut Canal which links the Batang Igan (running to the north of Sibu) with the Batang Oya (to the east of the Batang Igan). This canal has a length of 93 km, clear width between 15 and 25 m. Depths in the dry season (March-September) varying with tides between 2 ft to 10 ft and in the rainy season (October-February) the minimum depth is 4 feet. There are however problems in maintaining the depth of the canal and in bank erosion.

4. Inland Ports

There are a number of "major" ports for coastal traffic including Kuchang and Sibu. International traffic mainly handles logs at anchor - Tanjang Mani (16 nautical miles from the entrance of Kuala Rajang) being an important anchorage. The banks of the river are used for storage of export logs.

IWT terminal facilities consist of landing stages for passenger services, various bamboo and timber constructions and quays (Sibu). At Sibu, there is considerable congestion at the passenger terminal with some vessels waiting alongside before making its next trip. One of the proposed solutions is to require vessels to proceed to mid-stream stations however this does not receive favorable response from the crews. The Sibu Local Authority has constructed a retaining wall along the main quay wall line in the port, an area which undoubtedly will be used by IWT craft although the wall has not been designed for this purpose.

5. Inland Fleet

The Marine Department is a Federal body under the Ministry of Transport and one of the major functions of the Department is the registration of local vessels within the Sibu area (i.e., 3rd, 6th, and 7th Divisions)

There are 3 categories of vessels under Sibu's registration:

(i) Sarawak Licensed Ship
- Under Sarawak Licensed Ships, the vessels, are divided into various classes accordingly to the type of vessels and their plying limits.

(ii) Small Ship License
- Small Shiop License are for those vessels of under 15 tons net used as cargo/passengers (maximum 12) only.

(iii) Fishing Boat License
- Fishing Boat License are for fishing vessels.

Classification of Sarawak Licensed Ships

Class III - Passenger steamers engaged on voyage within Coastal Trade limits.

Class IV - Passengers steamers which do not proceed to sea.

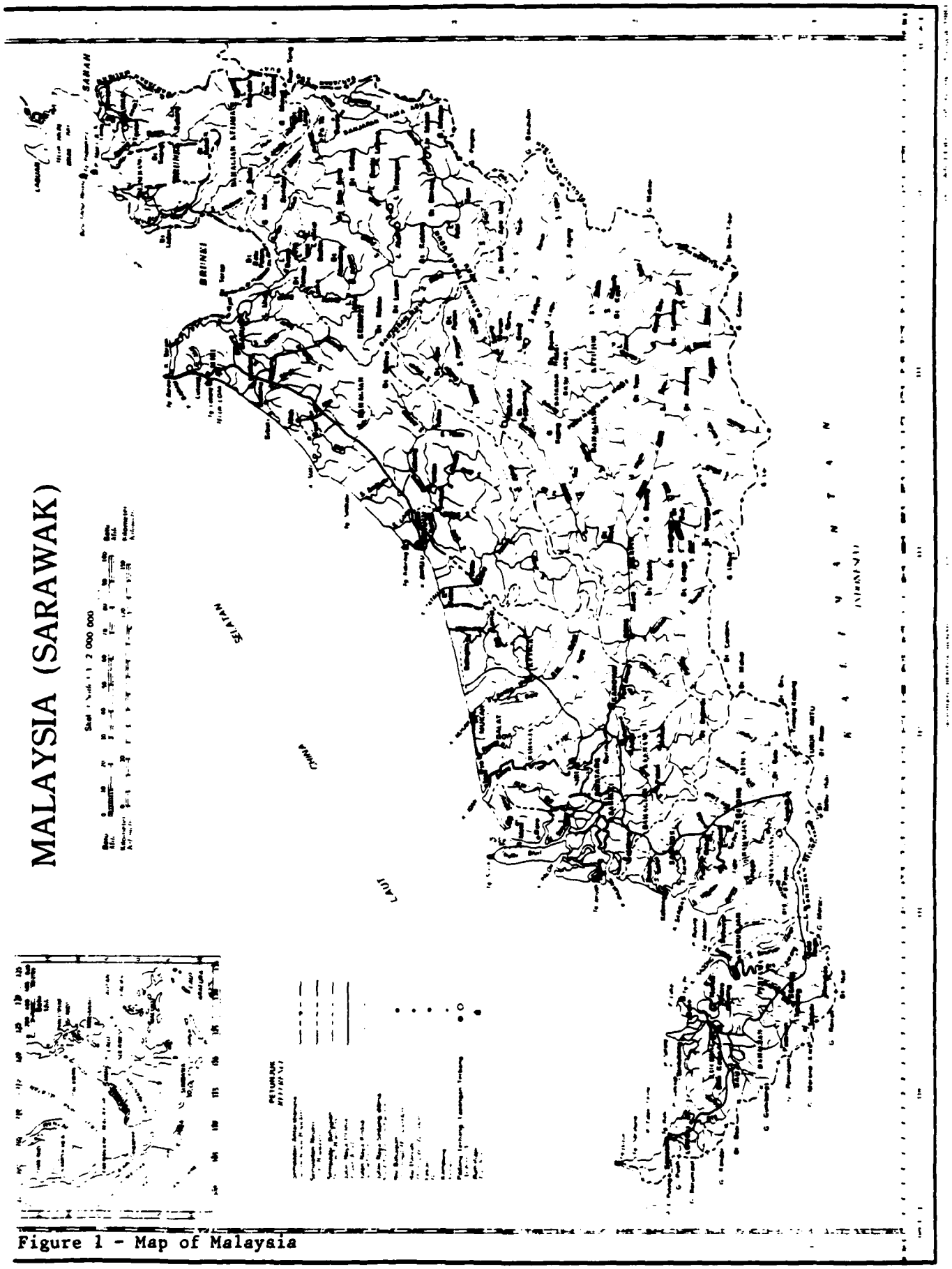


Figure 1 - Map of Malaysia

Class VII - Steamers.

Class VIII - Steamers, tugs, tenders, launches, lighters, dredgers, barges and hoppers engaged on voyages within coastal trade limits which is further sub-divided into C.C., C.B., and C.A.

C.C. - Ships are cargo ships which are allowed to operate within a certain coastal area only.

C.B. - Cargo ship classified for area One to Five inclusive.

C.A. - Cargo ship classified for coastal trade limits

Class X - Steamers, tugs, tenders, launches, lighters, dredgers, barges, and hoppers which do not proceed to sea.

Class XII - Pleasure yachts (other than ships of Classes I to IV inclusive) exceeding fifteen tons.

Table 2 records a breakdown of the vessels registered and surveyed in Sibu as of December 1983.

Table 2 Vessels Registered and Surveyed in Sibu as of December 1983

i)	Total number of Sarawak Licensed Ships	-	1,493
	Total gross tonnage:	-	954,022.34
ii)	Express Launches (P.D.)*	-	579
	Total gross tonnage:	-	12,627.08
iii)	Total number of Licensed Small Ships:	-	711
	Total gross tonnage:	-	8,106.97
iv)	Total number of Fishing Trawlers	-	127
	Total gross tonnage:	-	848.23
v)	Total number of Fishing Kotak:	-	71
	Total gross tonnage:	-	186.41
vi)	Total number of Dumb-barges	-	59
	Total gross tonnage:	-	18,378.13

(* included in (i))

6. Traffic

The main cargo carried on the major rivers of Sarawak is logs. In recent years, 2 million tons of logs and 500,000 tons of sawn timber are recorded to have been exported by Rajang Port Authority. Logs are either floated in rafts to the loading points or are carried in barges.

Other cargoes include construction materials, pepper, rubber, rattan and seasonal fruits. Upstream movements consist of general cargo including supplies for logging camps.

Some of the rivers (e.g., Rajang) are the main means of transport in the area.

7. Planning

Currently there is no comprehensive plan for the development of IWT. The State of Sarawak is however investigating the term of reference for a State Revenue Transport Authority.

In 1977, a study tour on "Navigational Improvement" was undertaken for the Batang Rajang.

8. Studies/Reports

1. Southeast Asian Agency for Regional Transport and Communications (SEATEC), "Navigation Improvement, Report on the Batang Rajang in Sarawak-Malaysia", Project RS12, Kuala Lumpur, June 1977.

PAKISTAN

PAKISTAN

2 a IWT routes, main ports

General

From geological point of view Pakistan can be divided into two parts. The mountain region with high plains in the North and West and the Indus basin. A flat alluvial basin with a length of 1,300 km from coast to Pakistan North-eastern frontier, where river levels are about 200 m above sea level.

River

The Indus River is one of the major rivers in the world with a total length of over 3,000 km. It originates from the Himalayas and after passing the plains of Punjab and Sind, the river falls in the Arabian Sea. In the North-eastern part of the basin there are 5 tributaries (Jhelum, Chenab, Ravi, Beas and Sutley; Punjab means "land of 5 rivers").

In 1960 the Indus Water Treaty was made up to regulate the use of water in the basin between Pakistan and India: Pakistan got 70 percent. This meant that Pakistan uses the water from the Indus, Jhelum and Chenab Rivers, whereas the water of the Ravi, Beas and Shutlej Rivers is kept and used in India.

To realize this a number of dams were built. Moreover canals were constructed to divert water from the Indus, Jehlum and Chenab Rivers towards the dry river beds of the Ravi, Beas and Shutlej Rivers.

In both Punjab and Sind and extensive network of irrigation canals has been developed.

Near the sea the Indus forms a small delta. The main branch tends to shift eastwards (formerly Karachi was located at the river mouth).

Dams, barrages

There are presently two dams and five barrages in the Indus Rivers (see map).

1. Kotri barrage (1955).
2. Sukkur barrage (1952).
3. Guddu barrage (1963).
4. Taunsa barrage.
5. Chashma barrage.
6. Kalabagh dam (under construction).
7. Tarbela dam.

Main purpose of the barrages is improvement of irrigation. Some withdrawal figures:

Kotri	1,150 m^3/s
Sukkur	1,640 m^3/s
Guddu	1,020 m^3/s

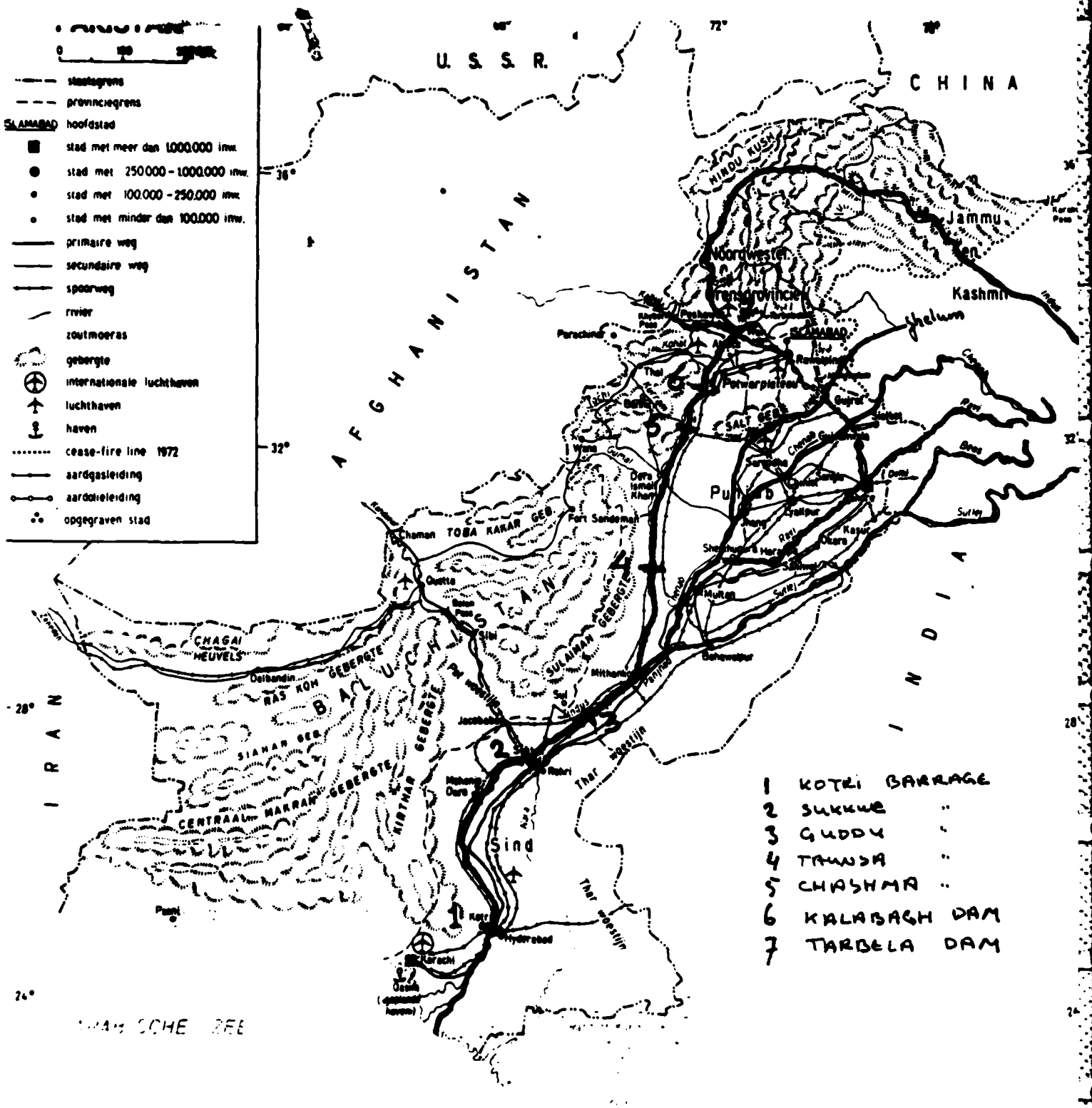


Figure 1 - Map of Pakistan

IWT routes

Indus River had been used for navigation from time immemorial. Some of the oldest civilizations of the world i.e. Mohenjodaro and Harappa were located on the banks of this river. Since the advent of railways in the 19th century in the Indus was almost abandoned. All barrages have been provided with a navigation lock except at Sukkur.

Main ports

Main seaports are Karachi and Qasim (under construction). Both ports are not linked with potential IWT routes. No inland ports exist.

b. Sense of importance of IWT to country
(Fleet and traffic)

At the moment no navigation is possible between the sea and Sukkur in dry season. Upstream of Sukkur there is some navigation. Country boats are reported to sail from Sukkur up to Kalabagh. However, it can be stated that the present IWT system is not developed at all and waterborne transport (both freight and passengers) is negligible in relation with the total transport in the country.

If feasible the government wants to promote/to develop the IWT sector in the years to come. It is believed that with relative small investments (canals & rivers exist already) IWT can obtain an important share in the total country's transport, which is considered important in view of energy consumption and foreign exchange.

c. Major previous reports on IWT in the country

[1] "Inland water transport mission", February 1984, reflecting the view of the Government of Pakistan on the prospects to develop IWT in the country.

[2] Inland water route from Port Qasim to Sukkur 1975 by NESPAK.

[3] Navigation from Sukkur and Kalabagh, 1976 by WAPDA's Dams Monitoring Organization.

[4] Feasibility Study of Inland Navigation in Pakistan by ACOP 1983.

[5] Inland Navigation in Pakistan 1984 by Irrigation, Drainage and Flood Control Research Council of Pakistan.

[6] Background notes
ESCAP/Mr. J.M. Deplaix

[7] National Transportation Plan study, December 1984, Ministry of Planning.

[8] Jica Study (mentioned, not seen).

[9] List of structures (IWT obstructions).

d. Major proposed IWT projects

The government requests in fact one major study:

A technical-economical full-fledged feasibility study on the development of IWT between Port Qasim and the Kalabagh Dam.

(1,335 km waterway; phase 1; later to be followed by phase 2 the development of Indus tributaries and link/irrigation canals).

For the proposed waterway between Qasim and Sukkur see the next map. Between Sukkur and Kalabagh the main river Indus will be used as a fairway.

The mission discussed the proposed study and visited downstream part of the proposed routes. The mission detected a number of problems and issues with respect to the development of IWT in Pakistan as listed in Chapter 2.

A first indication of the required study is given in project document No.3 see Appendix E.

e. Major future IWT programme

Will mainly focus on the proposed feasibility study.

If the set-up of an IWT system appears feasible an enormous amount of work has to be done, such as:

- organizational set-up;
- studies/design/execution of projects on:
  - waterway improvements;
  - adaptation of structures;
  - construction of inland ports and terminals;
  - fleet construction;
- transfer of knowledge/training.

f. Position of IWT in countries administration (organizations/regulations)

- national transport centre (road, rail, not yet IWT);
- institute for management training;
- WAPDA, Pakistan Water Power Development Authority, Lahore (Barrage Operations = local WAPDA)
- ACOP;
- Irrigation, Drainage and Flood Control Research Council.

g. Available data

- river geometry
  water levels, etc. ____ WAPDA
- transport ____ Ministry of Planning: [f]
- seaport charts
  tides etc. ____ Port Authority
- structures between Qasim and Kalabagh: see [g].

PHILIPPINES

Philippines

1. General

The Philippines Archipelego extends about 1770 kilometers and consists of some 7100 islands: The Capital of Philippines, Manila, is on Luzon, the largest island. The country's social and commercial interaction has mainly been conducted through waterborne transportation.

2. Major Inland Waterway

There is only one major inland waterway in the country, the Pasig River, and the more common means of transport from one point to the other is by road. The commerce in Pasig River is somewhat limited by the 12 bridges spanning the river. In 1984 there were 2014 shipcalls in Pasig River carrying 854,807 tons of cargo. The major commodity types were steel and aluminum product, grain and cereals, refined sugar, fertilizers, ores and minerals, petroleum products. This river also conveys floodwaters to the ocean.

PASIG RIVER PORT STATISTICS

VESSEL TRAFFIC

	1982	1983	1984
Shipcalls	4,147	2,758	2,014
GRT (Total)	1,296,463	865,143	624,340
Average/Vessel	313	314	310

CARGO TRAFFIC

In	1,074,977	1,179,011	770,904
Out	97,313	89,551	83,903
Total	1,172,290	1,268,562	854,807

COMMODITY TYPE

Steel and Aluminum Products	28.00%
Grain and Cereals	23.00%
Refined Sugar	24.00%
Fertilizers	10.00%
Ores, Minerals	9.00%
Hemp and Fibers	3.00%
Copra and Copra Cake	1.00%
Various	0.70%
Molasses	0.50%
Lumber and Lumber Products	0.50%
Alcohol	0.30%

Source: PPA

3. Oganization

The Ministry of Transportation and Communication (MOTC) is responsible for inland and water transport and waterways. The agency caring for port construction, operation and maintenance is the Philippines Ports Authority (PPA)*, created in 1974 and is a government corporation attached to MOTC. Stederian services are privately owned and operated upon authorization of PPA. Maintenance dredging of about 6 million cubic meter annually in performed by PPA. Private contractors must be hired to dredge the Basig River.

4. Harbors in Manila

The Port of Manila account for over half of the total freight traffic handled as public ports in the Philippines. The port of Manila consists of 7 harbors, 5 of which are located along Manila's shorelines:

South Harbor - for international shipping and trade

North Harbor - for domestic operations

Manila International Port - for containers. Limay and Mariveles are located in Bataan. The two other ports are Romblon and Sutic in Zambales.

Cargo handling at Manila Port is largely mechanized. conventional general cargo is handled by ship's gear, and horizontal transport between quay and shed is mainly carried by forklift. Transport between shed and warehouse is done by flat trailer and tractors or trucks.

Handling speeds are generally adequate for conventional operations, but slow for container operations. The South Harbor handles about 540 tons per shipday for conventional cargo, the North Harbor averages about 410 tons per shipday and the Pasig River handles only about 70 tons per shipday.

The Manila International Container Terminal is being developed in three phases. The first two being completed and the last phase scheduled to be completed in 1986. The three phases are as follows:

a. Interim Phase - This was already completed. It involved the dredging of the harbor basin and channel to a depth of 25 feet, the asphalt paving of about 3.50 hectares of Container Yard area, the improvement of the temporary Container Freight Station (CFS).

b. Phase I - This involved the paving of an additional 20 hectares of Container Yard, dredging of the harbor basin and channel to 45 feet depth, construction of the breakwater extension, one CFS and ancillary facilities including 60 temporary reefer outlets. All of these were completed by the end of 1980.

c. Phase II, which is expected to be completed by 1985, will complement the existing facilities (Phase I) of the MICT to enable it to handle the projected container traffic of 450,000 TEUs by 1986.

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*Does not include direct domestic cargo traffic

The project will include the quay extension for a third container berth, the construction of a Ro-Ro facility, two Container Freight Stations, an Administration Building, Access Road, the asphalt paving of the Container Yard, and the installation of ancillary facilities.

5. Commerce

The following commerce data for years 1983 and 1984 are shown below:

a. Statistical Report on Operations

(1) Container Traffic, TEUs

		1984	1983	Variance, %
(a)	Foreign			
	South Harbor	125,240	159,974	-21.71
	M I C T	111,084	133,310	-16.67
	Mariveles	781	1,048	-25.48
	Total Foreign	237,105	294,332	-19.44
(b)	Domestic			
	North Harbor	234,558	262,722	-10.22
	Total Domestic	234,558	262,722	-10.22
(c)	Total PMU-Manila	471,668	557,054	-15.33

(2) Shipcalls

(a)	Foreign			
	South Harbor	1,544	2,096	-26.34
	M I C T	343	374	- 8.29
	Subports	294	343	-14.29
	Total Foreign	2,181	2,813	-22.47
(b)	Domestic			
	South Harbor	12	-	-
	North Harbor	4,889	5,252	- 6.91
	Pasig	2,014	2,758	-26.98
	Subports	4,794	4,644	+ 3.23
	Total Domestic	11,709	12,654	- 7.47
(c)	Total PMU-Minila	13,890	15,467	-10.20

(3) Cargo Traffic, in Million Metric Tons

(a)	Foreign			
	South Harbor	3.462	5.051	-31.46
	M I C T	0.912	0.995	- 8.34
	Subports	4.210	5.785	-27.23
	Total Foreign	8.584	11.828	-27.43
(b)	Domestic			
	South Harbor	0.033	-	-
	North Harbor	6.731	7.207	- 6.06
	Pasig	0.855	1.268	-32.57
	Subports	3.181	3.233	- 1.61
	Total Domestic	10.800	11.708	- 7.76
(c)	Total PMU-Manila	19.384	23.536	-17.64

6. Inland Fleet and Facilities

The ships calling at the Manila port for the South Harbor are conventional, multi-purpose and small feeder ships; for the North Harbor, the majority are coargo-passenger ships with a number of container ships; and on the Pasig River, most of the vessels are barges. Capacity of these barges range from 250-2,000 tons and average about 750 tons. About 84% of the Pasig River traffic is inbound.

There are 59 PPA-controlled cargo berths along the river: 37 for small vessels and barges along the north bank and 22 along the south bank. However, nearly half are assigned to private companies which own storage or other facilities along the river. Most of the berthing facilities along the banks are in very poor condition. The major private facilities, in general, are in good condition.

7. Planning

Studies have been going on to provide passenger river boat service along the Pasig River which is expected to cater to 32,000 passengers daily and to alleviate from parts of manila's urban transport network.

SRI LANKA

SRI LANKA

1. Introduction

Sri Lanka has a network of canals and waterways which in the past have been used for transporting export items from places of origin for shipment abroad and import items to the Western Sector of Ceylon. With the introduction of lorries with cheap fuel, transport by canals came to an end, and during the early 1950s all wooden barges disappeared. With the increase of fuel price around 1970, ways and means of economical transport were studied. On the recommendations of the Inter-Ministerial Sub-Committee appointed by the Cabinet, the government decided to redevelop the canal and waterways for economic transport.

2. Organization

The Canal Development Division under the Ministry of Housing and Construction is integrating water transport with the rest of the transport complex of the country.

There were proposals to set up a Canal Development and transport Authority which will have the following functions:

a. To promote and undertake the development of the canal;

b. To undertake, regulate and control navigation and transportation;

c. To take such steps as necessary to provide or to procure, or to facilitate the provisions or procuring of such facilities and services as may be necessary for the development of the canal.

However, these proposals have not been implemented.

3. Waterways

a. Colombo-Puttalam Canal

The total distance is 82 miles and it is generally known as the "Dutch Canal". This canal started from Hekitta off Kelani Ganga and reached Pamunugama, one end of the Negombo lagoon, and ran through Muthurajawela swamps. Subsequently, a deviation was dug and this section is now known as the "Hamilton Canal". The work on the section between Negombo and Maha Oya was in progress in 1706 and the stretch to Puttalam was completed soon after. A scheme of inland river transport south of Kelani Ganga started from the Colombo Harbor and went through Beira Lake, St. Sebastian Canal and Kelani Ganga.

Redevelopment of the canal was proposed to be undertaken in three stages:

Stage I
- Phase A - Hekitta to Kochchikade
- Phase B - Kelani Ganga to Beira Lake (Harbor)
- Phase C - Kelani Ganga to Welisara Food Stores

Stage II - Kochchikade to Bangadeniya (Chilaw)

Stage III - Chilaw to Puttalam

The work on Stage I, Phase A, a distance of 22 miles, was commenced in 1975. It consists of the following sections:

Hekitta to Pamunugama	(9 miles)
Negombo to Lagoon	(8 miles)
Negombo to Kochchikade	(5 miles)

During the past nine years, the entire length from Hekitta to Pamunugama (9 miles) and Negombo to Kochchikade (5 miles) has been dredged to a depth of 4-1/2 feet. Bank protection was completed from Hekitta to Pamunugama except for a length of four miles on the left bank. Some bank protection from Negombo to Kochchikade has been completed however, more work is required.

This work has not only provided employment to a large labor force and increased several fold the number of boats using the canal, but also brought about:

(1) Better drainage facilities;

(2) Easier movement of fishing craft;

(3) Secure protection to the adjoining public road as a result of canal bank protection, which in turn prevents the erosion of the road;

(4) Increase in tourist promotional activities;

(5) General development of the hinterland.

b. Kalutara-Colombo Canal

The canal starts from Kalu Ganga, connects Bolgoda Lake by a canal, passes through Nedimala, Dehiwela and Kirulapone, Kotte Lake, Kolannawa River and falls to Kelani Ganga. The total distance from Kalutara to Kelani Ganga along this canal is 32 miles. Access by waterborne vessels can be obtained from Kuala Ganga, however, after this point there is a considerable amount of water weed, fishing nets and in some parts, the canal is dry.

4. Inland Ports

No major inland terminals were seen by the team.

5. Inland Fleet

The construction of 25-ton barges of the "wire-con" type (cement concrete) was done. They are flat-bottomed barges and are propelled by polling, but provision exists for fixing outboard motors. Research is being done on the benefit derived by giving a rubber protective coat. Low draught double canoe-type crafts of 3-ton and 6-ton capacity are also being

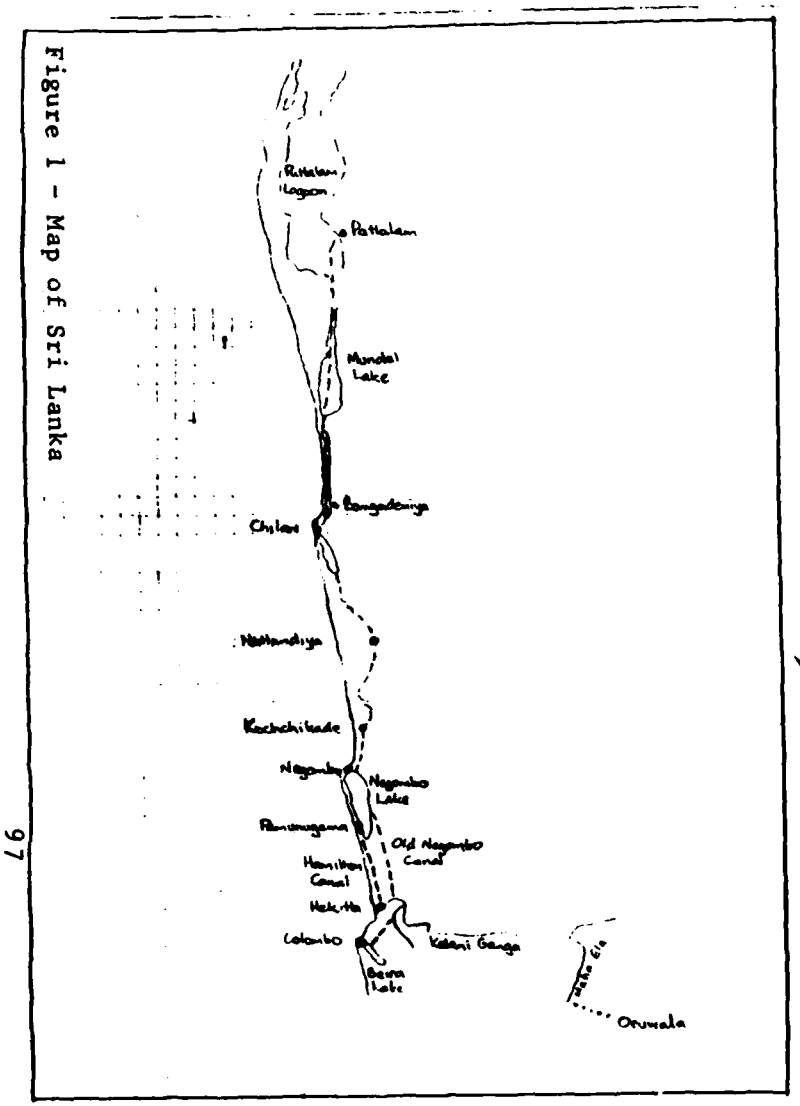
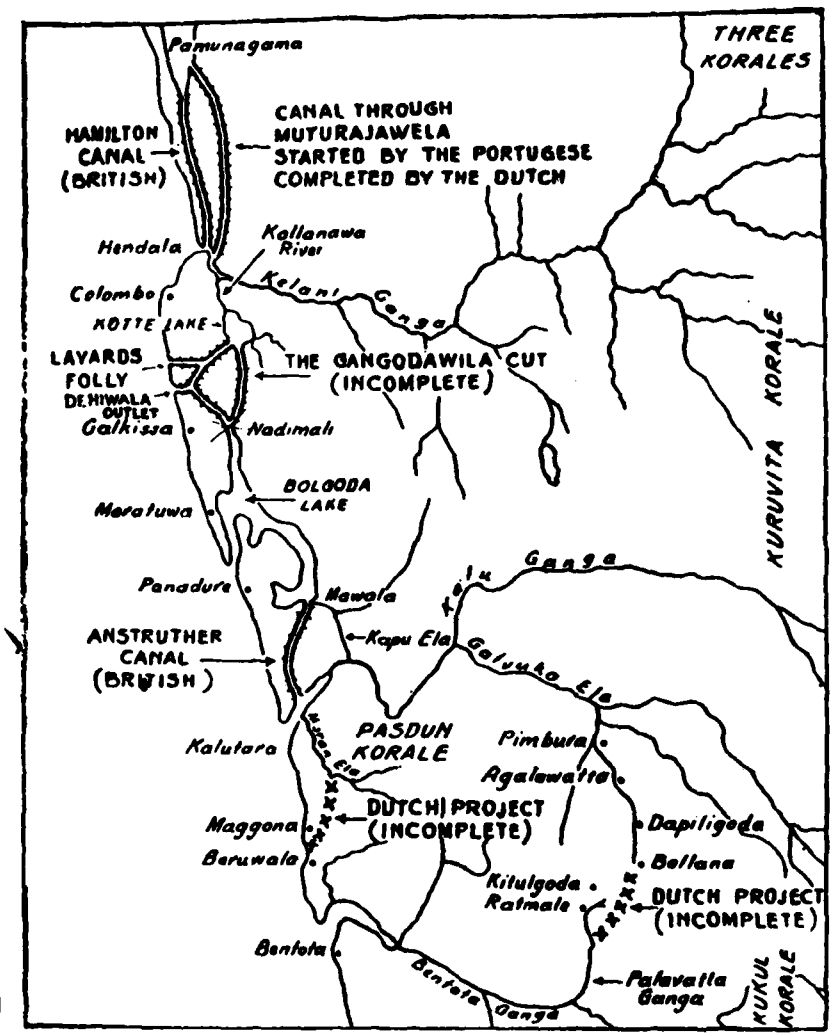


Figure 1 - Map of Sri Lanka



Man-made waterways in the west-coast areas of Colombo-Kalutara.

constructed for use not only in the main canal, but also, in shallower connecting canals. For transport of passengers fiberglass boats are being manufactured on a large scale within the country.

An improved project barge was proposed with the following dimension: length 16 meters; width 4.68 meters; depth at the side 1.60 meters; draft 0.915 meters, to be later increased to 1.22 meters. Its capacity would vary between 20 and 45 tons at 0.915 meters draft and 48 to 63 tons at 1.22 meters, according to the type of construction. The biggest carrying capacity would be for a composite wood-GRP structure.

6. Traffic

Currently, the canals are performing a very minor transport function.

7. Planning

The cost of the entire project from Colombo to Puttalam has accelerated so that it now exceeds Rs 200 million. The project is currently more or less at a standstill.

A number of studies have been undertaken, the NEI report (1981) being particularly unfavorable towards developing the canals for transport purposes. This report has however, been criticised both locally and in an ESCAP report (12).

8. Studies/Reports

a. Brohier, R.L., "Legacies of the Colonial Dutch Engineer", Transactions of the engineering Association of Ceylon.

b. Brohier, R.L., "A Book of dutch Ceylon", Chapter 5, "Canals and Irrigation", pp. 120-128.

c. Ministry of Housing and Construction "Feasibility Report on the Development of Canals in Ceylon for Transport Purposes: Preliminary Stage I - Colombo - Puttalam Canal", State Engineering Corporation, Research and Development Section, September 1970.

d. Seminar on Water Transport and Canal Development, 17 February 1970:

(1) Fernando, A.D.N., "Integrated Development of Canals, Muthurajawela Fields and Negombo Lagoon".

(2) de Fonseka, K.S.C., "Methods and Techniques for Canal Development in Sri Lanka".

(3) Diandas, J., "Economics of Water Transport".

(4) Amarkone, N., "Canal Projects".

e. Witteveen and Bos, "Rehabilitation of the Colombo Puttalam Canal: Report Phase II, Stage I, of Technical Cooperation", September 1977.

f. Report of the committee Appointed by the Secretary to the Ministry of Local government Housing and Construction, "Re-Development of the Colombo-Puttalam Canal", June 1978.

g. Netherlands Economic Institute, "Transport Economic Feasibility Assessment of Rehabilitation of the Colombo-Puttalam Canal", June 1981.

h. Economic Review, "Special Report, Inland Waterways - The Colombo-Puttalam and other Canals", Vol. 7, No. 5, August 1981, People's Bank, Colombo.

i. Kurukulasuriya, S.B., "Canal Development", paper presented to Canal Pollution Research Seminar, Slaas, 5 November 1981.

j. ESCAP, "Review of the Developments and Problems in the ESCAP Region with Regard to (a) Inland Waterway Transport and (b) Inland Waterways", SPIW/IWTIWA (1)/3, 12 May 1982.

k. ESCAP, "Developments in Inland Waterways", E/ESCAP/STC.6/3, 13 October 1982.

l. Deplaix, J.M., "Report on a Mission to Sri Lanka", November 1982, (UN-ESCAP IWT Expert).

m. ESCAP, "Review of Developments in Shipping, Ports and Inland Waterways", E.ESCAP/STC.8/1, 13 December 1984.

THAILAND

1. General

Thailand can be classed into four general regions: a densely populated central plain, watered by the Chao Phraya River system; an eastern plateau bordered on the east by the Mekong River; a mountain range spanning the country in the west and separating the plain and plateau in east-central Thailand; and, the southerly isthmus joining the land mass with Malaysia. its climate is tropical monsoon.

2. Rivers and Canals

a. Rivers

(1) Chao Phraya River

The Chao Phraya River is the principal river of Thailand primarily because of its mouth which lies in the vicinity of Bangkok, the capital. The river allows year round navigation to great number of ocean-going vessels calling at, and departing from, the Port of Bangkok. Another cause attributed to this importance is the fertility of the river banks.

Originating from the confluence of various tributaries at Nakorn Sawan, the river flows southwards through the central plain to empty into the gulf of Thailand at Samut Prakarn. The river overflows its banks in the high-water season, fertilizing the soil in the process. These areas are as a result highly cultivatable. The Chao Phraya Dam, which was constructed in 1957 at Sapaya District in Chainat for the purpose of regulating the outflow of water from Chainat to the Gulf of Thailand, had wrought tremendous benefits to the country. The dam has not only benefitted irrigation, but also transport and cultivation. Its existence not only provides protection against the flooding of the Chao Phraya River, but also ensures a steady flow of water. The navigation lock of the Chao Phraya dam allows access to large-sized vessels and rafts. The length of the Chao Phraya River extending from Paknam Poh to the mouth of the river banks are Samutprakarn, Bangkok, Thonburi, Nonthaburi, Pathumthani, Ayuttaya, Angthong, Singburi, Chainat and Nakornsawan.

The four tributaries which form the Chao Phraya River are:

(a) Ping River. Originating from a mountain in the north of Chiang Dao District of Chiang Mai, the river composes of different streams. It flows southwards through Tak and Kampaeng Phet, forming a confluence with the Nan River at Pak Nampoh in Nakorn Sawan. A large number of islets dot its course, making navigation difficult. the currents in this area are fast-moving. A number of other tributaries empty into the Ping River, but these are often referred to as "Huay" or brook. Notable among the brooks is the Huay Wang Chao in Kampaeng Phet, which eastern branch is the Wang River. The Ping River measures approximately 600 km. Provinces found on its banks are Chiang Mai, Lamphun, Tak and Kampaeng Phet. Its watercourse is accessible to cargo ships sailing between Nakorn Sawan, Tak, and betwen Chiang Mai and Lamphun.

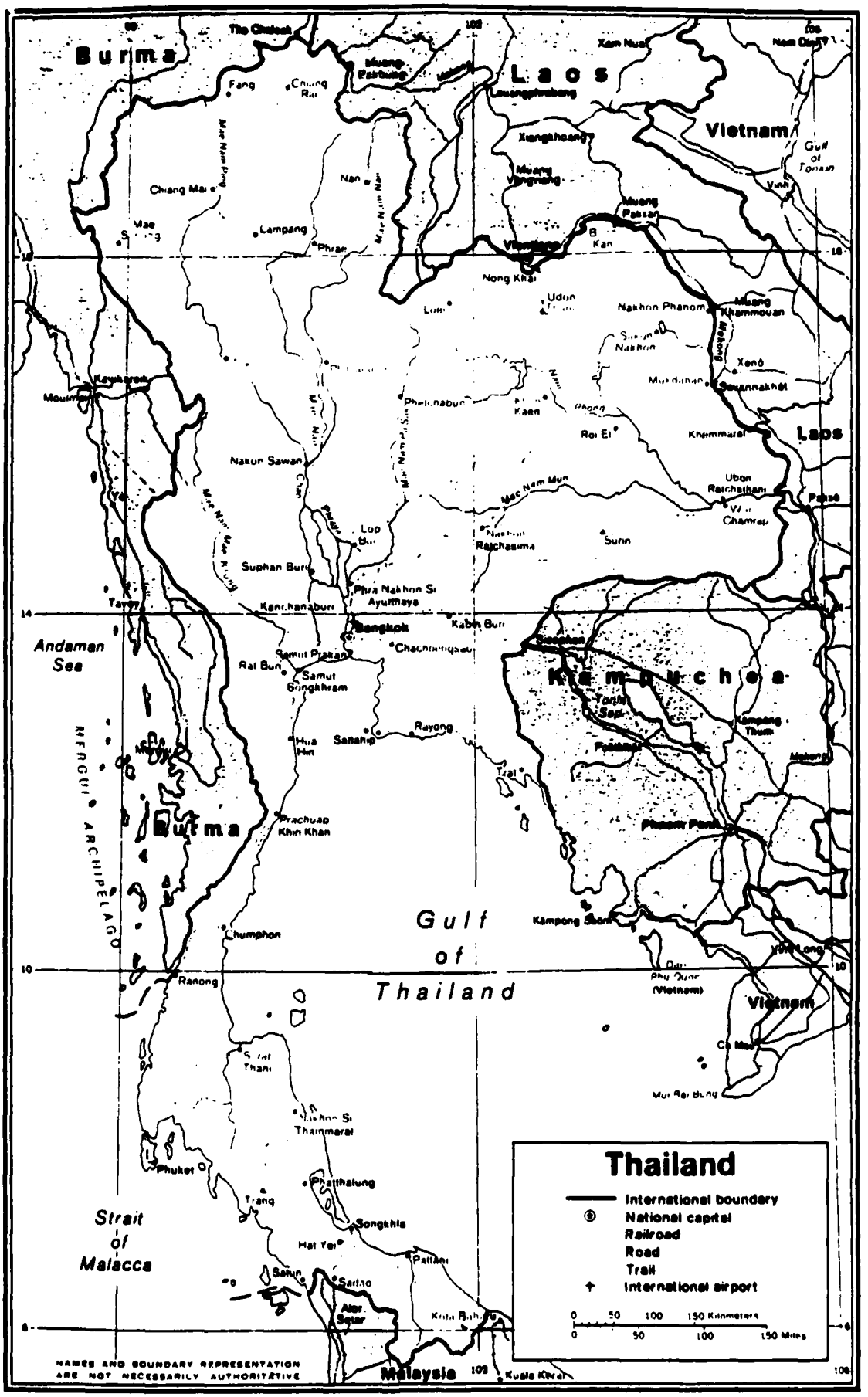


Figure 1 - Map of Thailand

(b) Wang River. The river, with a total length of about 300 km, rises in a mountain range north of Lampang. It flows southward to form a confluence with the Ping River at Ban Tak District of Tak. There are a number of islets midstream at the section of the river which flows through Lampang.

(c) Yom River. The source of the river is at Koon Yuam Mountain in Pong District of Chiang Rai, it has a total length of approximately 550 km. The river flows southeastward through Nan and Prae, forming a confluence with the Nan river at Keorn Chai Sub-district of Nakorn Sawan. The upper reach of the river is dry in the dry season and the water depth thus becomes shallow in the lower reach. This situation complicates navigation. A number of islets in the midstream further compound the problem. Lying on its banks are Prae, Sawan, Khalok and Sukhothai.

(d) Nan River. The river, with a total length of about 740 km, rises at the Bua District in Nan; then, flows southward through Phitsanulok and Pichit to form a confluence with the Ping River at Pak Nam Poh, and empties into the Chao Phraya River. Lying on its banks are Nan, Uttaradit, Phitsanulok and Pichit. Navigation between the Bua district and Pak Nam Poh is only possible during the high-water season as water level drops below safe limits. A large number of islets in the midstream hinder navigation. A survey of the Nan River was recently undertaken and, as a result, Ta Phraya sub-district of Uttaradit was identified as a dam construction site. This dam would be similar to the Chao Phraya Dam, its main functions would be:

(i) To regulate the water flow downstream to the central plain;

(ii) to facilitate irrigation;

(iii) To provide protection against floods and draught speeds; and

(iv) To develop suitable conditions for water transport.

THE BAR

The entrance of the Chao Phraya River at the gulf of Thailand is marked by sand shoals or "bar". The bar which stretches over a distance of about 100 km, obstructs navigation. At low tide the bar comes up 1.20-1.50 meters below Mean Sea Level; thus, rendering this section of the river inaccessible to large vessels. The water level on the bar varies from 3.30-4.20 meters below Mean Sea level at high tide. The maximum draft of vessels allowed to cross the bar is 4.20 meters. Since navigable channel at the bar is restricted, a bar beacon serves to better visibility range. Additionally, a pilot is compulsory except if the navigator himself is familiar with the bar channel. In order to facilitate navigation for ocean-going vessels entering and leaving the Port of Bangkok the bar channel is dredged annually; this practice allows year round navigation for 10,000-ton vessels. The most critical condition is however, the congestion at the Port of Bangkok. For this reason, the government has accorded high priority to alleviating this very important problem.

The maximum water depth recorded on the bar from April to September varies from 1.15-4.35 meters while the minimum is between 1.50-1.80 meters. The maximum water depth from October to March is within the range of 4.15-4.80 meters while the minimum varies form 1.80-2.10 meters. The bar is attributed to a formation of riges of alluvial matter carried downstream and extending across the river. These large quantities of alluvial matter, which are eroded from the highland and deposited at the mouth of the river, could well project above the surface of the water and subsequently turn into an island.

The bars which are found midstream of the rivers that empty into the Gulf of Thailand, namely the Bang Pakong River, the Chao Phraya River, the Tachin River, and the Mae Klong River, obstruct effective port operations in the provinces which are situated at the mouth of the river such as Samutprakarn, Samutsakorn and Samutsongkram.

The Chao Phraya River in the central plain, is divided into various distributaries. In the central plain, namely in the vicinity of Chainat and Ayuttaya, the river is divided into various tributaries, some of which subsequently reunite with the Chao Phraya River. Important rivers which prove themselves beneficial to navigation and cultivation in the central plain are:

e. Pasak River. This river is one of the tributaries of the Chao Phraya River. It rises in the Phetchabun mountain range in Loei; then, flows southward through Lumsak District in Phetchabun emptying into the Chao Phraya River at Krung Kao District of Ayuttaya. The length and width of the river are 500 km and 120 meters, respectively. The narrowest point stretches over a distance of 15 m. The water depth rises to about 8 m in the high-water season and becomes as shallow as 50 cm in the dry season. From Sao District to the source of the river, there are great numbers of islets and sand shoals in the midstream. The provinces found on the river banks are Phetchabun, Saraburi and Ayuttaya.

f. Lopburi River. The river, this distributaries, with a total length is separated of approximately 85 km, is separated from the Upper Chao Phraya River (left side) at Muang Moo District in Singburi. It flows downstream through Lopburi, forming a confluence with the Pasak River at Koh Loy sub-district of Ayuttaya. The river is not navigable in the dry season due to the shallow waters. It is however, accessible to passenger boats in the high-water season between Singburi and Lopburi, and between Lopburi and Ayuttaya. Lying on its banks are Singburi and Lopburi.

g. Noi River. The river, this distributaries, with a total length is separated of about 145 km, is separated from the right side of the Chao Phraya River at Chainat Sub-district of Chainat. It flows across Ang Thong and Ayuttaya; then links with the Pong Pang Channel at Hua Vieng Sub-district (Sena District) and empties into the Chao Phraya River (right side)at Bang Sai District of Ayutaya.

h. Sa Kae Krung River. This is one of the tributaries of the Chao Phraya River (right side), which lies in Uthaithani. The river, with a total length of about 180 km, rises in the Mae Wong mountain range in Kampaeng Phet; then, flows southward through Uthaithani, emptying into the Chao Phraya River

at Kung Samphao Sub-district (Manorom District of Chainat). It is not navigable in the dry season due to shallow waters which render it inaccessible to rice barges.

i. The Tachin River. The river, this distributaries, with a total length is separated of approximately 300 km, is separated from the Chao Phraya River at Wat Sing District of Chainat; then, flows southward through Suphanburi and Nakorn Pratom, and empties into the Gulf of Thailand at Samut Songkram - the mouth of the river. It has one tributary called Huay Krathong; this stream which joins the river at the northern junction with the range Kork Kwai, rises in the mountain range in Kork Kwai District in Uthaithani. Navigation is impossible in the dry season due to the shallowness of the water depth. The water level however, rises in the high-water season overflowing the river banks, fertilizing the soil in the process. It is accessible to 100-passenger boats. Lying on the river banks are Samutsongkram, Nakorn Pathom and Suphanburi.

This river carries different names, namely, the river mouth is called the Tachin River; the section that flows through Nakorn Pathom is called the Nakorn Chaisri River; while, the section flowing in Suphanburi is called the Suphanburi river. In addition, the section which flows upstream from Suphanburi to Chainat is called the Makam Tao Channel.

2. Mekong River. The river lies in the western region of the central plain. It flows southeastward through Kanchanaburi and Rachaburi; then, empties into the Gulf of Thailand. The source of the river originates from the confluence of two tributaries (the Kwai Yai River, which is sometimes referred to as the Sri Sawat or Maelong River, and the Kwai Noi or Saiyok River) flowing from the northern part of the country; the confluence itself is at Pak Praek Sub-district of Kanchanaburi. Provinces which are found along the river banks are Samutsongkram, Rachaburi and Kanchanaburi. The total length of the river extending from the mouth of the river to the Municipal Office of Kanchanaburi is approximately 100 km.

The water depth is shallow in the dry season with large quantities of sand and gravel in the midstream. The section which flows through Rachaburi is sometimes referred to as the Rachaburi River. The total length from the source of the river to its mouth measures about 520 km.

There is an irrigation dam across this river near Kanchanaburi, the Vajiralongkorn dam, which as an navigation lock.

a. Sri Sawat River (Kwai Yai). The river, with a total length of about 200 km, rises in the Tanao Sri mountain chain located on the borders of Kanchanaburi, Tak and Uttaithani. It is made up of many different streams, the most notable is Lump Ta Ploen which joins the right side of the Sri Sawat River north of Old Kanchanaburi. The water depth is shallow in the dry season, but the current pick up their speed in the high-water season. The fact that the river sometimes overflows its banks in the high-water season makes it particularly beneficial to the paddy-fields in the area.

b. Saiyok River (Kwai Noi). The river which lies to the right of the Sri Sawat River rises in the mountain area of Sangklaburi District of Kanchanaburi. It composes of various streams, the major one being the Lump pachi which flows downstream from the Tanao Sri mountain chain located in Jom Bueng District of Rachaburi; then, empties into the Sai Yok River. The total length of this particular river is approximately 230 km, its water depth is shallow in the dry season with water level rising intermittently.

3. Bang Pakong River. The source of the river is at the Bantad mountain range located in Kabinburi, its total length is about 230 km. The mountain range referred to is connected to the Dong Prayayen mountain chain. Lying on the east of the Chao Phraya River, it flows upstream through Kabin district and downstream through Prachinburi through Chachoengsao; then, empties into the Gulf of Thailand at the junction of two districts, namely the Bang Pakong and Muang Cholburi. Lying on its banks are Chachoengsao and Prachinburi. Its winding channel extends from the source of the river to the Muang Kabinburi District. The currents are strong in the high-water season but, the water level subsides in the dry season with shoals projecting above the water level. This river has two tributaries namely Kwai Hanuman and Kwai Praprong. It is navigable from Prachinburi to the Gulf of Thailand.

a. Kwai Hanuman. Stretching over a distance of approximately 25 km, the width of this tributary is only a little narrower than that of the Bang Pakong River. It originates from various streams flowing from the southern part of the San Kampaeng mountain range converging at the Sampata Sub-district. The tributary empties into the Bang Pakong river (right side) at the Kabinburi Sub-district, this particular section is called the Kabin River Mouth and constitutes one of the branches of the Bang-Pakong River. It is navigable in the high-water season but, the water depth becomes too shallow in the dry season with islets and sand shoals constituting a danger to navigation.

b. Kwai Praprong. This tributary joins the Bang Pakong river on the left side, its total length is about 160 kilometers. Rising in the Nangching or Chakarn mountain area in the Sankampaeng mountain chain, it is small-sized and joins the Bang-Pakong River the Yarnree Sub-district of Muang Karabin District. Its water level is high in the high-water season but, subsides in the dry season. It is navigable for some distance.

A bar at the mouth of the river obstructs the entrance by vessels with a minimum draft of 2 meters. It is accessible to vessels only at high tide.

c. Nakorn Nayok River (Yotaka). The source of the river is at the mountain area of Intanee in the Muang district of Nakorn Nayok, its total length measures approximately 100 km. The river flows southward and empties into the Bang Pakong River at the Bang Tan Sub-district of Prachinburi, this particular section is called the Yotaka River Mouth. This constitutes one of the tributaries of the Bang Prakong River. Lying on its banks is Nakorn Nayok. The currents are strong in the high-water season rendering it inaccessible to cargo vessels up to the Nong Poh sub-district (Wang Krachom District). Narrow and extremely winding water channel extends from that point to the source of the river with large numbers of islets dotting its course.

The water depth is shallow in the dry season upstream from Nakorn Nayok while the channel's width is about 16 meters downstream. Although the water depth is shallow, it is sufficient for safe navigation by small cargo vessels all year round.

4. Chantaburi River. The river, with a total length of approximately 100 km, flows across Chanthaburi which lies on its banks. It originates from Soidaonua Mountain and Chan Kab Mountain north of Cahnthaburi; then, traverses Muang District of Chanthaburi, and empties into the sea at the edge of Lamsing Mountain in Lamsing District called "Lamsing River Mouth". On the right side of the river mouth, there is a cape projecting into the sea which a plain occupies the left side with another cape in the water channel. Navigation is thus difficult. The strait is 400 meters long and 1,600 meters wide. Approximately 6,800 meters from the mouth of the river there is a canal called Hua Laman. The water depth between Chanthaburi Market and the source of the river is very shallow. It is accessible to small-sized ocean-going vessels.

5. Wen River. The river, with a total length of approximately 50 km, rises in the northeastern part of Sarabab Mountain; then, flows to the east of the mountain, joining a number of small streams which originate from Troknong Waterfall in Sarabab Mountain, and empties into the Gulf of Thailand via Klung District in Chanthaburi. The mouth of the river is very wide with a water channel (called Sanyoa Channel) extending as far as Klung District. This channel is wider than the Chanthaburi River and is accessible to ocean-going vessels as far as Klung District.

6. Irad River. The length of the river is short. It originates from the confluence of two tributaries (called Klong Yai and Kong Huay Rang) at Huay Rang Sub-district in Bangpra District of Trad. The tributaries lead form a mountain in the north of Trad. The river flows down south and empties into the sea. The water depth is shallow in the dry season with a large number of islets in the midstream. Small-sized motor boats have access to the port in Trad during the high-water season. The water overflows the banks in the high-water season, benefitting the paddy-fields. Lying on its bank is Trad.

7. Rayong River. The length of the river is short. Originating from a number of streams flowing from the mountain areas in the north of Rayong, it empties into the sea at Ta Pradoo District of Rayong. The river is accessible to sail boats in the high-water season, but navigation is difficult in the dry season.

8. Mekong River. This is the longest and widest river in Indochina, and is found in the east of Thailand. Large numbers of islets dotting its watercourse obstruct navigation.

The river originates from Tibet; then, flows downstream and empties into the sea at Saigon in Vietnam. Maekong River serves as a boundary line between Thailand and Laos extending from Chiang Kan District of Nong Khai to the east as far as Ubolrachathani.

The river flows also along the north Thailand, namely along the north of Chiang Rai province. The left side of the river lies in the Loatian territory.

The Thai provinces which are found on the right bank of the river are Nong Khai, Nakornphanom and Ubonrachathani.

a. Mool River. In the northeastern region, in the vicinity of Nakorn Rachasima, Roi-et, Ubolrachathani and Udornthai, there are a number of small rivers of minor significance, most of which are tributaries of the Mekong River. Most notable among them is the Mool River which flows across the plateau in the northeastern region. The river originates from a mountain in the San Kampaeng mountain range at Puk Thongchai District of Nakornrachasima. It flows to the east through Roi-et and Ubolrachathani and empties into Mekong River at Suwankhiri in Laos. The length of the river is approximately 640 km. on its banks lie Ubolrachathani and Nakornrachasima. The waters are shallow in the dry season, but overflow the banks in the rainy season. This has often caused heavy flooding of paddy fields resulting to their destruction. Navigation is possible for passenger boats in the high-water season. The section which extends from Ubonrachathani to the Mekong River consists of great numbers of shows, rendering it inaccessible to vessels.

b. Chi River. This river, with a total length of approximately 756 km, constitutes one of the branches of the Mool River. It originates from Praya-fore Mountain in the northwestern part of Chaiyapoom; then, flows downstream through Khonkaen, Mahasarakham and Roi-et and empties into the Mool River at Ubonrachathani. The waters are shallow in the dry season, but overflow the banks in the high-water season. This situation is beneficial to cultivation as long as the overflowing stays within safe limits. Provinces of Chaiyapoom, Khonkaen, Mahasarakham and Roi-et are situated along the river. Tributaries that merge into Chi River are Pong River, Lampao and Young on the left; and Lam-kan-choo on the right. The Government was in the process of constructing dams at Pong Channel in Khonkaen and Lampao in Kalasin with a view to alleviating problems associated with draught spells as well as for economic development, etc.

c. Kok River. This river, with a total length of approximately 290 km, is found in the north of Thailand and constitutes one of the tributaries of the Mekong River. It originates from a mountain located in the Dan-lao mountain chain north of Fang District of Chiang Rai; then, flows upstream across Muang Chiang Rai District and downstream across Chiang Saen, and empties into the Mekong River. The currents are very strong in the high-water season. The section which lies between Chiang Rai/Chiang Saen is accessible to motor boats.

d. Songkram River. This river, with a total length of 420 km, is a small tributary of the Mekong River. It originates from a small mountain of Parn Mountain in Ban-han District of Sakolnakorn; then, flows through Nong-harn district of Udornthani, straddling the Udornthani-Sakolnakorn boundary. It flows to the east and empties into the Mekong River at Chaiburi Sub-district, Tha-udane District of Nakornphanom. The water level is high in the high-water season, but subsides in the dry season.

9. Pattani River. The river, with a total length of approximately 190 km, is an important river of Pattani. It originates from a mountain located in the south of Baetong district of Yala, and composes of a number of streams

flowing from Bannung-sata District. It flows through Yala to the east of Malay Peninsula; then, traverses Pattani and empties into the sea. Provinces of Pattani and Yala are found along the river, with the river mouth located at Pattani called Pattani River Mouth. In the dry season, sea-water can flow from the mouth of the river as far inland as Talmoh Sub-district of Pattani District. Bannung-sata of Yala is shallow with sand shoals surfacing above the water level. It is navigable in respect of barges only. The section which extends from Bannang-sata to Baetong district on the border is composed of a large number of islets. The channel meanders to an alarming extent making it inaccessible to vessels. Also, the currents gain high velocity in the high-water season.

The water depth at the Pattani River Mouth is shallow in the dry season. The whirlpool at the Pattani River Mouth is a result of the joining together of a channel of the Pattani River and that of another river in Yaring district. Another cause attributed to the shallowness is the sand deposits at the mouth of the river. The Government has proposed a budget for the dredging of the Pattani River Mouth with a view to facilitating navigation.

10. Saiburi River (Talubun). The river, with a total length of approximately 170 km, empties into the sea on the east of the Malay Peninsula. The banks are high; the water depth alternates between shallow and high. Originating from a mountain in Warng District of Narathiwat, the river has two tributaries divided into two tributaries. It traverses Saiburi District of Pattani and is accessible to vessels, in the dry season, up to a sub-district of Rue-song District. The channel which extends between Rue-song and Tok-moh District is extremely winding with very shallow water depth. This tributary flowing parallel to the coastline is composes of sea-water; navigation is possible on its watercourse.

11. Tapee River. The river, with a total length of approximately 232 km, is found in Suratthani. The biggest river in the southern region, it originates from the ridge of Luang Mountain and another mountain located in Nakorn Ratchasima, as well as, other mountains in Ban-na District and Pra-saeng District of Suratthani. It composes of many streams and flows eastward through Suratthani; then, empties into Ban Don Gulf which is a small gulf in the Gulf of Thailand. The water depth at the mouth of the Tapee River is shallow because of too many outlets to the sea. This situation makes navigation for vessels with a maximum draft of 2 meters impossible at low tide. The width of the river varies from 60 to 80 meters. The area along the river are very fertile and densely populated. The only province found on its bank is Suratthani.

This river was formerly called Luang River. The name was changed to Tapee when Suratthani was proclaimed a province in 1815. The section which extends between the source of the river and Kirirat River is 210 km in length and is called Laung River while the section lying between that point and the sea is called Ban Don River and is 22 km long.

12. Trang River. The river, with a total length of approximately 175 km, originates from Nakorn Srithammarat mountain range located in Toong-song District of Nakorn Srithammarat. The river flows southwestwards, collects

water from Phuket mountain range, and empties into the sea on the west of the Malay Peninsula at Kantan District of Trang. A port located at the mouth of the river serves the west coast. The port referred to is situated in the vicinity of a southern railway terminal in Kantang District. Passengers embark for other provinces and abroad from this port. Lying on its bank is Trang.

13. Lang Suan River. The river, with a total length and width of approximately 100 km and 50 meters respectively, originates from Yai Moon Mountain located on the Ranong-Chumporn border. It flows to the east and empties into the sea at Lang Suan District of Chumporn. In the dry season, the water depth measures about 40 cm. The river is divided into two branches starting from Yai Moon Mountain - one branch joins the channel at Chumporn while the other joins various streams in Ranong and flows eastward to the sea. The river is rich in tin and a great number of orchards scattered along its banks. Chumporn is the only province along this river.

14. Chumporn River. The river, with a total length of approximately 60 km, originates from Tanaosri mountain chain and is found in Chumporn. It flows eastward, traversing Chumporn which is the only province on its bank.

15. Pakchan River. Originating from Tanaosri mountain chain, the river is approximately 135 km in length and lies in Rayong. The river, which is sometimes called Draburi River, forms a boundary between Thailand and Burma.

16. Bang Nara River. The river originates from a mountain located in Su-ngaipadee District of Narathiwat. One branch flows in the direction of Tak District and joins one branch of the Kolok River; the other runs towards Bang Nara District and empties into the sea at Narathiwat river mouth. This river is of minor significance to transportation.

17. Kolok River. The river forms a boundary between Thailand at Tak-bai District of Narathiwat and Malaysia at Kalatan. It rises in the mountain area in Saiburi to empty into the sea east of the Malay Peninsula. A number of islets dot the section from Munoh Sub-district upward making it difficult for navigation.

18. Salawin River. The river forms a boundary between west Thailand and Burma. Originating from the northern areas of Burma, the river flows southward to form the aforesaid boundary at Mae Hongsorn; then, empties into the sea at Mohtama Gulf in Burma.

CANALS

The canals in Thailand are mainly located in the central plain because of the numerous rivers in the areas. The Government has undertaken maintenance dredging work on these canals specifically for irrigation and cultivation of crops; as well as, to make them navigable for vessels and transportation of products. These canals also provide connecting links between various rivers. Notable among them are:

(Canals located east of the Chao Phraya River)

1. Samrong Canal. The mouth of the section of the canal which follows the direction of the Chao Phraya River, is located in Prapradang District (Samrong Sub-district). The navigation lock situated at the mouth is called Samrong navigation lock. The canal traverses the plain and empties into the Bang Pakong River at Bang Pakong District of Chachoengsao. It measures approximately 48 km. The section which forms a boundary between Prapradang and Samutprakarn is called Samrong Canal while the section lying within Chachoengsao itself, is called Pak Ta-klong Canal. The navigation lock of the Pak Ta-klong Canal is located at the point where it merges with the Bang Pakong River called Pak Klong navigation lock. This canal is divided into different sections; most notable among them is the section which is located at Bor Sub-district of Samutprakarn. This section flows southward and empties into the Gulf of Thailand at Bang-hia Sub-district of Samutprakarn. It is called Bang-hia Canal and has a total length of 8 km. A navigation lock called Bang-hia navigation lock is located at the mouth of the canal where it merges with the sea.

2. Prawet Burirom Canal. The mouth of the canal which runs in the direction of the Chao Phraya River is located at Prakanong Sub-district of Bangkok. The navigation lock is called Prakanong. The section which stretches over the distance between the mouth of the canal and Prapradang District of Samutprakarn is called Prakanong Canal, while the section extending from Prapradang District, passing through Minburi District to Chachoengsao, is called Prawet Burirom Canal. Another section which extends between Minburi District and Bang Pakong River at Bang Krood Sub-district is called Ta Tua Canal; the navigation lock of which is also called Ta Tua. This section measures approximately 50 km. In addition, the canal forms connecting links with other canals.

3. Saen Sab Canal. The section which runs in the direction of the Chao Phraya River forms connecting links with other canals in Bangkok, namely Mahanak Canal, Padung Krungkasem Canal. The section running across paddy-fields in Minburi is called Saen Sab Canal. This section is subsequently divided into two canals at Chachoengsao: one canal flows southeastward and empties into the Bang Pakong River called Tah Kai Canal, the navigation lock of which also carries the same name; the other runs northeastward and empties into the Bang Pakong River at Bang Kanark Sub-district, called Bang Kanark Canal, its navigation lock having the same name. The total length of Saen Sab Canal extending from Mahanark to the intersection is approximately 40 km, from the intersection to Bang Pakong River measures about 25 km.

4. Rangsit Canal. The mouth of the canal which follows the direction of the Chao Phraya River is located at Pathumthani. This canal traverses Tanyaburi District and empties into the Nakorn Nayok River; it measures approximately 50 km. The navigation lock located in the direction of the Chao Phraya River is called Chulalongkorn while another connecting to Nakorn Nayok River is called Saowapa.

Two other canals running parallel with the Rangsit Canal were dredged during the same period - one lies north of Rangsit Canal called Hok-wa-sai-bon Canal and forms a boundary between Tanyaburi District and Ayutthaya; the other flows to the south of Rangsit Canal parallel to the latter's watercourse called Hok-wa-sai-lang Canal. These two canals have connecting links composing of 33 canals. Although these canals were dredged by a private company entitled "Kood Klong and Koon Siam Company" by Royal permission, they fell under the ownership of the Government at the expiration of the contract.

(Canals located west of the Chao Phraya River)

5. Mahachai Canal. The mouth of the canal which joins the Chao Phraya River is located at the junction of the Dhakhanong Canal and Darn Canal, cutting across Bangkok Yai Canal in Thonburi. The other section empties into Tachin River at Samutsakorn. This canal measures approximately 30 km. It has no locks.

6. Maeklong or Mahorn Canal. The canal extending between the mouth of the canal to the west of the Tachin River and Maeklong River in Samutsongkram measures approximately 25 km. It has no locks.

7. Pasicharoen Canal. The section which stretches from the inner Pasicharen navigation lock in Thonburi to Tachin River at Kratoom-ban District in Samutsakorn, measures approximately 25 km. The navigation lock at Tachin River is called Pasicharoen Ton Nok (Oute Pasicharoen); the mouth of the canal at Pasicharoen navigation lock is connected to the Bangkok Yai Canal. This section empties into the Chao Phraya River.

8. Damnoen Saduak Canal. A navigation lock called Bang Yao has been installed at the mouth of the canal on the right of the Tachin River, at Bangyao Sub-district which is situated on the opposite side of the mouth of the Pasicharoen Canal. This canal, with a total length of approximately 35 km, flows eastward, crossing the Maeklong river at Bangnok Kwak Sub-district of Samutsongkram. A navigation lock carries the same name as the sub-district.

9. Mahasawat Canal. The canal runs westward from Wat Chaiyapruck Sub-district of Bangyai District (Nonthaburi) and empties into Nakornchaisri River at Nakornchaisri District of Nakorn Phatom. This canal measures approximately 25 km with its mouth lying in the vicinity of Chaiyapruck Temple, forming a connection with Bangkok Noi Canal which flows into the sea. The canal empties into the Chao Phraya River at Thonburi. It has one lock at each end.

10. Bang Yeehon Canal. This canal extends from Seesook River (a tributary of the Suphan River) down to the An River at Chao Ched Du-District. The main branch is the usual connection between the Suphan River and the Chao Phraya River and is known as Chao Ched Canal. It has two sub-branches: one canal entitled Salee Canal, with a total length of about 12 km, flows southwestward and empties into the Supanburi River. The other, approximately 25 km in length, runs northwestward and empties into the Supanburi River at Bang Yeehon Sub-district, its name being Bang Yeehon Canal. This particular canal is connected to the Chao Jet Canal. The other two do not have locks.

11. Bang Phlama Canal. The east section of the mouth of the canal lying in the direction of the Seesook River (an harm of the Nakornchaisri River) is found at Puck Hai Sub-district (Puck Hai District of Ayuttaya); it empties into the Supanburi River at Bang Phlama Sub-district and measures 20 km in length. The section lying within Supanburi is called Bang Phlama Canal; the name of the other section which is found in Ayuttaya is Chado Canal.

12. Prapa Canal. This canal was excavated by the Government in 1908 to supply water to Bangkok. The excavation was commanded by His Majesty King Rama V who was intent on ameliorating the welfare of His people. The dredging work extended from the Chao Phraya River to a sub-district north of Samrae Temple in Pathumthani to Bang Luang Chiang Rark Canal, to be fed by fresh-water from the Chao Phaya River. Fresh water is possible all the year round because sea-water cannot flow this far inland. Bang Laung Chiang Rak Canal was thus utilized as a reservoir. The dredging work extended as far as Samsen Canal in Bangkok for the purpose of pumping water to its appropriate station. The canal is 25 km in length.

The water from the pumping station is distilled before being distributed to water pipes all over Bangkok. In addition to being waste-free, boats are prohibited from utilizing its watercourse.

Inland Ports

There are few public terminal facilities on the waterways network. Besides Bangkok, the major port in Thailand, and the private berths spreading along the rivers (mainly rice mills), other inland ports which deserve mentioning are: Tha Rua on the Pasak River; Phayuha Khiri in the Upper Chao Phraya River; Nakhon Sawan on the Upper Chao Phraya River at the junction of the Ping and Nan Rivers; Chumsaeng, Bang Mun Nak and Taphan Hin on the lower Nan River; Ayutthaya, Pamoke and Bang Pa In on the lower Chao Phraya River, Supanburi on the Suphan River; Ratchburi on the Maeklong River; and, Chachoengsa on the Bang Pakong.

Inland Fleet

There are two main types: barges and tow-boats. Self-propelled freighters of a reasonable capacity are very few on inland waterways.

a. Barges

Traditional wooden barges are the most popular. Their capacity ranges from a few tons to about 100 tonnes. Most of them are from 12 to 17 Meters long and 3 to 6 meters wide, with a maximum draft ranging from 1.1 meters to 2.3 meters.

Most of the newly built barges are steel made. They usually have a capacity of other 100 tons, a length of 22 meters and a width of 6.5 to 7 meters with maximum draft ranging from 2.6 to 2.9 meters. They are mostly operated between Tha Rua (Pasak River) and Bangkok for cement, maize and gravel transport, or on the lower Chao Phraya for sand transport.

b. Tug-boats

Wooden barges and steel barges are always towed on convoys by tug-boats. Their capacity ranges form 5 to 10 tonnes. Length usually ranges from 8 to 15 meters and width from 2 to 3 meters, with draft never exceeding 0.9 meters. Horse-power ranges from 50 hp to 200 hp with the exception of a few over 200 hp.

A picture of the composition of the inland fleet and carrying capacity is given in Table 1 below.

Traffic

From surveys carried out in 1984, duplicated annual traffic through lock was calculated to be:

Rice, paddy, maize	2.5 million tons
Livestock	50,000 heads
Sand gravel and stones	6.04 million tons
Sugar, coconut, tins	4.9 million pieces
Fuel (charcoal and firewood)	1.01 million bags
Bricks	51.3 million pieces

TABLE 1. Composition of Inland Fleet and Registered

Type of Vessel	1975		1980	
	No. of vessels	Cargo (reg. tons)	No. of vessels	Cargo (reg. tons)
1. Mechanically propelled launch for passengers	4,734	-	1,169	-
2. Mechanically propelled vessel for cargo				
(a) Tanker	4	820	10	2,400
(b) Dry and general cargo vessel				
- 3-50 dwt	773	-	1,806	8,855
- over 50 dwt	27	-	73	9,000
3. Dumb/non-self propelled vessel: Dry and general cargo vessel				
- 3-50 dwt	3,543	-	9,436	110,344
- over 50 dwt	1,193	-	2,097	113,687
4. Tug	1,154	-	2,356	-
5. Country boat:				
(a) Mechanized	2,504	-	5,847	4,500
(b) Non-mechanized	540	-	1,452	4,580

Planning

Comprehensive studies have been undertaken since 1975.

As a result of the studies, a project aimed at improving the Chao Phraya River and lower Nan River between Nakhon Sawn and Taphan Hin has been undertaken. This major project includes:

a. Improvement of navigation by means of dredging, river training works (groins, bottom panels, bank protection) and aids to navigation on these rivers;

b. Construction of new terminal facilities at Nakhon Sawan. Studies will soon be undertaken for the construction of similar facilities at Taphan Hin, if their profitability is demonstrated;

c. Implementation of a new organization in charge of management and maintenance of the waterways; and

d. Initiating new river craft to be operated on the improved waterways.

The improvement works on the Chao Phraya River will allow year round navigation with a minimum water depth of 1.70 meters. The Chao Phraya traffic tonnage expected is about 2.1 million tons in 1985 and 5 million tons in 2,000, whereas the figure would be only 600,000 tons approximately without the project on that part of the river.

The push-tow system will be introduced for better efficiency.

The typical convoy, which consists of one pusher and four barges, will have a maximum capacity of about 2,800 tons (700 tons per barge) when fully loaded (2.80 meters draft), while the minimum capacity in dry season will be about 1,300 tons for the whole convoy with a 1.50 meters draft. Furthermore, this push-tow being designed for navigation in sheltered waters in the Gulf of Thailand will make it possible to reach deep sea ports on the east coast.

A new system of navigational aids is also included in the project. It will be specifically adapted to the training works (groins, bottom panels) to be built within the river bed and will consist mainly of buoys marking obstacles and channels and signs on land signaling difficult reaches. These aids to navigation conform to the Geneva Regulations (1936) and the principles enacted by the Inland Transport committee of Economic Commission for Europe. They will be equipped with reflecting tape for night time navigation.

This Chao Phraya River Project was implemented between 1981 and 1984.

Furthermore, the Harbor Department is now in the process of initiating new developments on inland waterways with a view to minimizing transport costs, saving energy and encouraging the agricultural development by providing an alternative means of transport.

The prospective feasibility studies to be undertaken are as follows:

a. Improvement of the Pasak River to facilitate the transport of agricultural and other products from its transport centre at Saraburi (on the Rama VI Dam's pool) to the deep sea ports on the eastern coast of the Gulf of Thailand, through the Pasak and the Chao Phraya Rivers. Navigation on the Pasak River is at present difficult in the dry season between Ayutthaya and Tha Rua due to a shallow, narrow and winding channel, and almost impossible between Tha Rua and Saraburi due to the small size of the lock that equips the Rama VI Dam at Tha Rua.

b. Improvement of the Sapansamit Canal to facilitate the transport of agricultural products, gravel and minerals from the Tachin River and the western region up to Bangkok. This canal which links the Tachin and Chao Phraya Rivers has limiting characteristics (depth, width) and does not allow navigation for modern vessels, but has no locks.

c. Improvement of the Tachin Canal to facilitate the transport of agricultural products and mineral resources from Kanchanaburi and Ratchaburi to the sea port of Samut Sakhon and to Bangkok through the Maeklong River.

This canal which links the Maeklong and Tachin Rivers has limiting characteristics and does not allow year round navigation.

d. Improvement of the Maeklong River to facilitate the transport of agricultural products and minerals from Kanchanaburi and other western provinces to Bangkok and the deep sea ports along the coast of the Gulf of Thailand. Navigation is at present impossible in the dry season between Ratchaburi and Vajiralongkorn Dam due to shallow waters.

e. Improvement of the Ping River for the transport of agricultural products and minerals from Tak, Kamphaeng Phet and other northern provinces. Transport on this river is at present almost zero.

The improvement works on the Chao Phraya will reach their full efficiency only if maintenance works are properly carried out. In order to ensure suitable maintenance on that future waterway, an annual volume of maintenance dredging of about 400,000 meters^3 has to be excavated just before the dry season in order to allow year round navigation. River structures and aids to navigation will also require maintenance works, while bank protections should be progressively extended.

A new organization will be in charge of the waterway and will include the head office in Bangkok and regional units along the river, the most important of which will be at Nakhon Sawn where a port is to be built. The regional units, in addition to the maintenance works, will be in charge of hydrologic and hydrographic surveys, the results of which will be centralized in Bangkok and constitute a data bank for a new hydro-information system. This hydro-information system will be aimed at giving all necessary hydrological data and information to the boatmen, for instance, water levels, rate of flow, water depth available and forecasts on a permanent basis so as to increase transport efficiency.

A hydrographic survey on the river is an important step towards proper management of the waterway. Surveys will have to be carried out during the short time available after the floods and before the lowest low-water when the channel is reduced to its minimum cross-section and access by boat difficult in shallow portions. At the same time, permanent monuments and benchmarks will have to be installed all along the river banks to facilitate surveying operations.

Organization

The Harbor Department of the Ministry of Communications is vested with authority to administer inland navigation and is in charge of river works and maintenance for navigation on the whole river network in Thailand, as well as port operation.

Its responsibility is related to the following functions:

a. Regulation and control of inland waterways navigation and traffic in accordance with the Thai Waters Act;

b. Planning of the development of inland waterway and inland water transport;

c. Planning and implementation of improvement and maintenance works on the navigation channels, including aids to navigation and river bank protection works;

d. Control and inspection of construction works along the river banks, up to the highest water level;

e. Issuance of licenses to private companies for dredging in the river beds and control of these dredging works;

f. Vessel registration and inspection, including issuance and renewal of licenses, in accordance with the Thai Vessel Act;

g. Examination of crew competency and issuance of certificates; and

h. Registration of waterway transport companies and coordination of the private section activities.

The Harbor Department is directed by a Director General who is assisted by two Deputy Director Generals for administration and technical matters. The above functions are being discharged through the office of the Secretary and several divisions such as finance, technical, survey and charts production, dredging and maintenance, harbor master, ship registration, pilot, ship survey, etc.

Importance Attributed to IWT

IWT ranks well down the list of priorities in Thailand's National Budget and Planning Process. Leading the list and consuming approximately 75 percent of the outlays is the national highway system. However, progress is being made on improving river systems through deepening projects, locks and dams, and bank stabilization. Funding of IWT projects is possibly hampered by the lack of interest of the major trucking establishments in the country to make the shift from road to water transport, even though the positive economic benefits of such a move is well recognized. This is due primarily to the initial capital outlay required and the lack of storage space at terminal sites for additional barge cargo.

APPENDIX E

Project Documentations

APPENDIX E

TABLE OF CONTENTS

CONTENTS (Con't)

CONTENTS (Con't)

Water Management

WATER MANAGEMENT: SUBJECT AREA DESCRIPTION

Almost all participating countries have several agencies within their governmental agencies dealing with single phases of water uses. They are effective in their own area of planning such as flood control, irrigation or hydro power. Under the concept of total water management planning for the region, all users must be considered to effectively evaluate and balance the impacts on all users. The primary interest user groups are in transport, navigation, hydropower, irrigation, flood control, domestic and industrial water. The water management plan should also address any environmental impacts that may result from the implementation of the proposed project.

In the context of this report, this subject area has an even a broader scope as river basin planning and master planning included. This means that the problems and projects classified under this subject area contain besides water management also elements of IWT planning such as modal split and river basin infrastructure. The main characteristics of this subject area are: "multi-disciplinary", "comprehensive" and "total picture".

The various elements of the "total picture" are treated independently in the second subject area description: 'PLANNING'.

Project 1: Comprehensive Water Management Plan

1. Background:

Almost all participating countries have various water management plans developed by different agencies within their government organizations dealing only with their area of interest. Often one agency is planning a major water project unknown to the other agencies. The project must be coordinated and planned with other water users to maximize the use of this natural resource.

2. Objective:

Develop a comprehensive water management plan for the region.

3. Description:

The study will address the present and future water needs of the region by different uses of the waterways. It will further present scenarios for the impact when water is allocated in different proportions at different population centres of the country.

4. Output:

A comprehensive water management plan for the region for use in allocating water to various users.

5. Scale:

15 man-years over 3 years

Project 2: Administration of Water Resources

1. Background:

The multi-use nature of water resources including:

- irrigation;
- drainage;
- flood control;
- hydro-electric power;
- domestic - water supply and sewerage;
- industrial - water use and waste disposal;
- inland waterway transport (IWT); and
- fishing;

suggest that a high degree of cooperation and coordination between the interested parties is desirable. In most countries, however, different uses fall under different ministries or departments and consequently the views of all interested parties are not always adequately represented.

2. Objective:

To investigate means by which cooperation and coordination in water resource management can be achieved.

3. Description:

(a) To review the existing administrative structures for water resource management in ESCAP countries.

(b) To review the existing administrative structures for water resource management in other countries.

(c) To consider the desirable and undesirable features of the existing systems.

(d) To outline alternative means by which cooperation and coordination can be achieved in water resource management.

4. Output:

Report containing model administrative structures for water resources.

5. Scope:

One man-year.

Project 3: Indus River Navigation Feasibility Study

1. Background:

Feasibility studies of the region's major rivers were accorded a high priority by the team. The Indus River is one of the major rivers of the world with a total length of over 3,000 KM travelling in a north to south direction. There are presently two dams (of which one under construction) and five barrages over River Indus which support a well developed network of irrigation canals. Currently the major portion of the commerce within Pakistan is carried by rail and trucks. The projected commerce in the future years indicates a need to supplement the rail and road system to transport commerce. It is the desire of the Pakistan officials to use the Indus River as a vehicle to transport commerce and at the same time, keeping irrigation as top priority in the allocation of water from River Indus.

2. Objective:

A detailed economic and technical study of the Indus River to determine the most efficient and economical development of inland waterway transport an adverse impact on the irrigation system. The study will include a detailed inventory of all structures which may obstruct navigation in the future and will also provide possible solutions to the problems of obstructions. The feasibility of developing IWT in the Indus will be judged on the basis of a comparison of transport costs (in terms of ton kilometer) of the various modes of transport.

3. Description:

The study will encompass an economic evaluation of the commerce allocation (long term planning) of water to different users, planning studies to develop alternative routes between barrages, and engineering studies to determine the features of the required adaptions of waterway and structures and finally the benefit-cost of each plan developed. It will also involve field data collection, preparation of design guides for future bridges over the waterways. In addition, the study will include the following features:

a) A minimum navigable depth study (for general description see project no. 30);

b) The infrastructure costs of adapting the current system to IWT and the annual operations and maintenance cost;

c) In conjunction with the infrastructure cost analysis, the optimum IWT vessel size, fleet requirements (see also next item) and transport capacity of the system;

d) The volume of traffic likely to use the IWT system (see also Project No. 15 on Modal Split Analysis) including analyses of traffic generation and commodities, traffic distribution, and route assignment.

4. Output:

The study would consist of 3 phases shown below. The final plan will be to accommodate the irrigation and navigation interests which will meet the needs of the country.

Phase I: initial investigation of feasibility by reviewing existing reports and site visits and by executing limited surveys and global masterplanning.

Phase II: investigation of major constraints.

Phase III: full-fledged techno-economic study, including a bridge design guide and an overall guide to methodology.

After each phase there would be a breakpoint.

5. Scale:

Phase I: 4 man-years
Phase II: 2 man-years
Phase III: 10 man years subject to local government providing survey data and aerial photography.

Project 4: Irrawady River Feasibility Study

1. Background:

The Irrawady River is the largest river in Burma travelling over 1250 miles and is the major inland waterway of the country. Most of the population is concentrated along this river and its tributaries. Future development of the river for greater uses to transport commerce will greatly enhance the economy of the region.

2. Objective:

Develop a comprehensive feasibility study to examine all the possible uses of the river to enhance the economy of the region.

3. Description:

The study will include the present and future uses of the river for alternative purposes, needs, and proposed improvements and its estimated costs.

4. Output:

A comprehensive water resources plan for the future development of the Irrawady River.

5. Scale:

15 man-years over 3 years

Project 5: Pasig River Multipurpose Study

1. Background:

The Pasig River is the only major inland waterway in the Philippines which was visited by the team. It serves about 49 commercial and industrial complexes which are located along its banks. The river is also a floodway and there are plans for developing passenger traffic. With the competing users, a study is needed to properly develop the waterway. Such a study was undertaken prior to the construction of a sluice and a lock; however the old study needs upgrading. IWT should be emphasized and possibilities to develop passenger traffic should be examined.

2. Objective:

A detailed multi-purpose study to develop the most efficient and economical system for the Pasig River for inland water transport and other competing transport modes and water users.

3. Description:

The study will encompass an economic evaluation of present and future commerce and passenger traffic, flood control measures, and environmental consideration to improve the quality of the water of the river.

4. Output:

A report describing the study findings and a plan which will accommodate the needs of the users.

5. Scale:

12 man-years over 3 years

Project 6: Canalization of Atrai-Jamuna and Karatoya Rivers

1. Background:

Improvements are needed to the communication and transportation systems in the northern regions of Bangladesh. Canalization of the Atrai-Jamuna and Karatoya River up to Baghabari Port is essential especially for carrying the limestone and cement traffic from Joypur Hat Factory and Jamalgong Coal Mine. Improvements of the inland water systems are needed to carry the commerce in these regions as the rail and road systems are now taxed to their capacity.

2. Objective:

Improvements of the inland waterways for boats in Atrai-Jamuna and Karatoya Rivers.

3. Description:

A technical and economic study for the canalization of the Atrai-Jamuna and Karatoya Rivers down to Baghabari Port. The work will consist of river structure and associated costs together with cost-benefit analysis of the proposed improvement.

4. Output:

A proposed plan of improvement for the Atrai-Jamuna and Karatoya Rivers with cost-benefit analysis to demonstrate the economic feasibility of the project.

5. Scale:

3 man-year ------- 1 year.

Planning

THE PLANNING OF IWT: SUBJECT AREA DESCRIPTION

The overall planning process requires data from all of the other project areas. This subject area broadly assumes that this information is available in the degree of detail required to undertake a study and is primarily concerned with marketing, forecasting (including modal split), project appraisal and pricing. Figure 3-1 outlines these areas and demonstrates their inter-relationships.

One of the basic inputs for any forecasting model is historical data concerning traffic volumes by mode of transport. In the absence of such data or in order to supplement it market studies are a valuable input to the forecasting model. Marketing is also a valuable tool whereby future traffic levels can be influenced by informative and persuasive means.

The two main outputs of the forecasting model are estimates of traffic volumes and an indication of what users would be willing to pay for IWT services. The means by which the IWT authorities intend to meet the forecast demand is shown as the project proposal. Using physical data, cost data and output from various other physical models (e.g. water transport capacity models) the project can be costed. These costs are then input into an appraisal model one of its outputs being the cost of supplying the output of the proposed project.

At this stage, the demand price can be compared with the supply price and the project accepted or rejected on financial grounds. Alternatively the socio-economic aspect (external effects) of the proposed project can be evaluated (see Project Area 3 - Socio-Economic) and incorporated in the decision criteria.

If the proposed project is rejected, it could be refined or if there are other alternative project proposals then an iterative procedure is followed either to the forecasting model or to the proposed project.

Each of the project areas considered below can be shown to fit within the framework of Figure 3-1 and consequently the linkages between the projects is established.

The transport planning process is conventionally divided into four stages: traffic generation; traffic distribution; modal split and route assignment.

A single project proposal "Transport Planning and IWT" could be quite large in terms of man-years and consequently, four sub-projects convering the modelling aspects of each of the few stages has been proposed, namely;

Sub-Project Numbers	Project Title
13	Traffic Generation and Commodity Analysis
14	Traffic Distribution
15	Modal Split Analysis with Special Reference to IWT
16	Route Assignment Analysis and IWT

The final output of these four sub-projects is an IWT Transport Planning Manual.

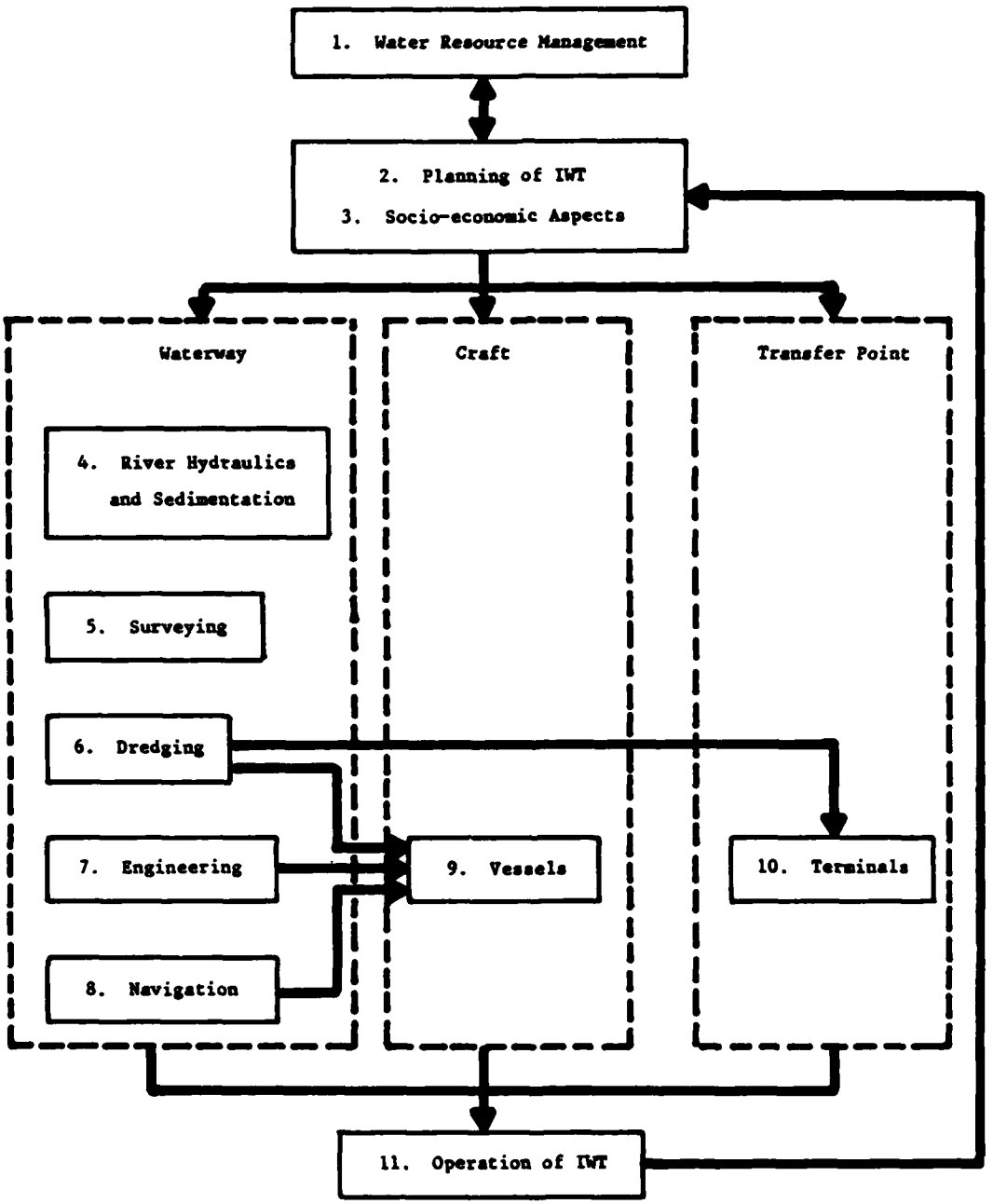


Fig. 3.1 Relationships Among the Eleven Subject Areas

Project 7: Data Collection and Definitions for IWT in the ESCAP Region

1. Background:

An expert group meeting has provided guidelines for development of a uniform system for compilation of information on inland waterways and of IWT statistics. Due to lack of proper training and the absence of designated national counterparts, few follow-up actions have been undertaken at national level, and thus no feed-back has reached the secretariat enabling it to start publishing the proposed regional statistics.

2. Objective:

a) Provide appropriate spreading of the results of the expert group meeting on IWT statistics (project RAS/82/009/C/01/53) in seven countries of the ESCAP region.

b) Train key personnels in the use of the "uniform terms and definitions for IWT" and of the questionnaires and formats adopted by the expert group meeting for use at the national level.

c) Train key personnels on the reporting of national IWT statistics to ESCAP for establishing IWT statistics for Asia and the Pacific.

d) Promote a uniform approach in the establishing of national IWT statistics.

Project 8: Manual on Statistical Sampling Techniques for IWT Traffic

1. Background:

In many countries there are a large number of IWT vessels which fall outside of the usual scheme of data collection. Consequently the impact and efficiency of this fleet is not adequately understood. This usually arises because of the high cost of collection of such data. In these cases, the only viable alternative is to undertake sample surveys of IWT craft and cargoes.

2. Objective:

In order to obtain meaningful results from sample surveys it is necessary that they are carefully planned and executed and that the resulting data is correctly analyzed. The objective of this project is to set guidelines for undertaking such sample surveys and to outline the statistical techniques for analyzing the resulting data.

3. Description:

Manual on statistical sampling techniques for IWT traffic.

4. Output:

Manual.

5. Scope:

9 man-months.

Project 9: Develop a Learning Resource Center (LRC) in Conjunction with Palembang IWT Training Center

1. Background:

When the Palembang training center is completed it is likely to be the best and only such IWT center in the Region outside of China. One of its main needs will be to attract competent outside experts. One of the best ways to do this is to set up a database to collect useful IWT information which can be used for IWT analysis and management. Such an information base should be added to the planning of the new Palembang Center.

2. Objective:

To improve the Palembang training center and the available IWT data base in the region.

3. Description:

Space at the proposed site should be allocated within the plans to an LRC.

4. Output:

An LRC properly staffed and equipped at Palembang.

5. Method:

Hire an LRC expert to review both the current Master Plan for the center and LRC's at other analagous centers. Then design an LRC and build it during the initial phase of the Palembang construction.

6. Scope:

Review design = 1/2 man-year
Construction about 5% of construction budget.

Project 10: National Inventory of Rivers Serving IWT in the Philippines

1. Background:

The lack of basic information on rivers serving IWT hamper the development of IWT in the country. Moreover, without the information, policy makers cannot determine the importance of IWT in the national goals of the country.

2. Objective:

The project will fill a major deficiency in the data and analysis of how IWT can support the economy of the region. It should also assist policy makers to better evaluate the alternatives when developing different modes of transportation within the country.

3. Description:

The project will review previous studies, conclude field visits, interviews and prepare an inventory of rivers serving IWT.

4. Output:

An inventory of rivers serving IWT and categorizing the river by controlling depth.

5. Scale:

2 man-years over 1 year.

Project 11: The Marketing of IWT Services - Supply Aspects

1. Background:

The major benefits of IWT have been well documented in a qualitative sense. Inter alia, the list of advantages includes generally lower terminal-to-terminal transport costs, energy (and consequently foreign exchange) savings, low maintenance cost of the "way" and indirect benefits such as irrigation, flood control, water supply and the development of social infrastructure.

For some of these items, quantitative estimates have been obtained, usually by employing the estimates from the developed country experience. Experience in ESCAP countries suggests that some of these cost levels may not be relevant (e.g. lock construction costs in India may be only one-third of those in Western Europe). Consequently, the developed country case may not be relevant to the ESCAP region.

In addition, the IWT sector is probably the least "visible" of all transport modes and as such requires a greater marketing effort in order to increase public awareness of its existence and advantages.

2. Objective:

To increase general awareness of IWT.

3. Description:

In order to increase public awareness, a major marketing document which draws upon cost levels and experience in the ESCAP region will be produced. This document will require the following input:

1. Collection of the following data from ESCAP countries:

(i) transport costs by mode (road, rail, IWT and coastal shipping);
(ii) terminal cost;
(iii) infrastructure construction costs (waterways, locks, etc.);
(iv) commodity flows by transport mode.

2. Regional case studies of:

(i) the incremental cost of IWT when it is linked to other water use projects;
(ii) the social impact of developing IWT.

3. Publication of marketing documents for IWT.

4. Output:

Marketing document for IWT

5. Scale:

2 man-years

Project 12: Study to Define and Market the IWT Services - Demand Aspects

1. Background:

IWT in the ESCAP region has developed without adequate market analysis of the public it serves or of the origin and destination of commodities.

2. Objective:

To provide official and planners in the ESCAP region with data to assist them in identifying future projects for IWT development.

3. Description:

Conduct a study of the market IWT serves, including identifying the origin and destination of commerce transported e.g. agricultural, minerals, manufactured goods, construction materials, etc. The study will also project future movement of commerce and to which areas.

4. Output:

The study will produce the present and future market IWT serves and the origin and destination of commerce.

5. Scale:

6 man-years over 2 years.

Sub-Project 13: Traffic Generation and Commodity Analysis

1. Background:

In general, the commodities most suited to be transported by IWT are those with large volumes and low unit value. Thus, the main commodities of interest are bulk commodities. Relatively recently however increases in the numbers of import and export containers carried by IWT have been experienced in Western Europe and elsewhere with specialized container barge vessels being designed and built. Consequently the possibilities of carrying higher valued cargoes cannot be ignored. Similarly, there may be domestic movements of higher valued cargo (especially fruit and vegetables which are damaged when transported by land).

Placed in the general context of transport planning, one of the steps is traffic generation, it asks how much cargo (including the commodity structure) is flowing into and out of an area.

2. Objective:

To model the traffic generation step of transport planning with special emphasis on IWT.

3. Description:

1. Review of traffic generation models.
2. Review of existing studies and documents relating to the country's domestic and international trade.
3. Review of data available.
4. Collection of data.
5. Modelling of traffic generation.
6. Validation of models.

4. Output:

Part of IWT planning manual. Applied studies.

5. Scale: one man-year.

Sub-Project 14: Traffic Distribution

1. Background: (see Transport Planning and IWT)

Placed in the general context of transport planning, one of the steps is traffic distribution, it asks between which areas do the main passenger and goods movements occur.

2. Objective: To model the traffic distribution step of transport planning with special emphasis on IWT.

3. Description:

1. Review of traffic distribution models.

2. Review of existing studies and documents relating to the country's domestic and international trade.

3. Review of data available.

4. Collection of data.

5. Modelling of traffic distribution.

6. Validation of models.

4. Output:

Part of IWT planning manual.
Applied studies.

5. Scale:

One man-year.

Sub-Project 15: Modal Split Analysis with Special Reference to IWT

1. Background: (see Transport Planning and IWT)

Placed in the general context of transport planning, one of the steps is modal split analysis, it asks what means of transport or combination of means of transport is used between the areas under study.

2. Objective: To undertake a modal split analysis with special emphasis on IWT.

3. Description:

1. Review of modal split models.

2. Review of existing studies and documents relating to passenger and freight within the country and internationally by mode.

3. Review of data available.

4. Collection of data including line haul and terminal costs and waiting times.

5. Modelling of modal split.

6. Validation of models.

4. Output:

Part of IWT planning manual.
Applied studies.

5. Scale:

One man-year.

Sub-Project 16: Route Assignment Analysis and IWT

1. Background: (see Transport Planning and IWT)

Placed in the general context of transport planning, one of the steps is route assignment, it asks which route do the craft follow during the transport.

2. Objective: To investigate the factors influencing the routes chosen by IWT.

3. Description:

As the main project is primarily concerned with IWT, the routes may be well defined. In the event that alternate IWT routes are available, then the scope of work would include:

1. Review of traffic distribution models.
2. Review of existing studies and documents relating to route assignment.
3. Review of data available.
4. Collection of data.
5. Modelling of route assignment.
6. Validation of models.

4. Output:

Part of IWT planning manual.
Applied studies.

5. Scale:

1/2 to 1 man-year.

Project 17: Manual on Techno-Economic Analysis of IWT

1. Background:

In general, it is desirable that the methodology for establishing the techno-economic feasibility of IWT is developed and the results documented in a manual.

2. Objective:

To write a manual on the techno-economic analysis of IWT.

3. Description:

By its very nature, this project is multi-disciplinary and consequently involves aspects of all the project areas.

4. Output:

Manual or techno-economic analysis of IWT.

5. Scale: 1 1/2 to 2 man-years.

Project 18: IWT as a Long-Term Domestic Transport Mode

1. Background:

A priori, IWT would appear to be an appropriate technology in a number of countries in the ESCAP region. The arguments for this observation include the energy and foreign exchange savings of IWT, the high cost of building and maintaining roadways and rail track (especially in low lying countries and swampy regions) and the social impact in terms of "opening up" areas which previously had poor transport connections and of providing employment. For some countries and routes however the question arises as to whether IWT is a long-term solution to domestic transport problems or whether it is an appropriate interim solution (say for the next 20 years). The answer to this question may have considerable influence on an investment programme in IWT infrastructure. If the current status of IWT in developed countries can be taken as a broad indicator of IWT in the future in developing countries then one of the major differences occurs in the size of barges and the capacity of push-tow systems (up to 50,000 tons in U.S.A.). Thus, inter alia, the following questions require further consideration:

1. What is the optimum size of an IWT vessel (taking into consideration the trade-off between the economies of vessel size and the cost of infrastructure)?

2. What is the optimum timing of IWT investments? Is it worthwhile incorporating the possibility of future widening, deepening, etc. into the current investment plans?

3. To what extent does a budget constraint influence transport sector investment plans? What decisions would be made in the absence of a budget constraint?

2. Objective:

To investigate the extent to which IWT represents a long-term solution for domestic transport.

3. Description:

A study of "IWT as a long-term domestic transport mode" tends to have a number of country specific elements. The scope of work would therefore be divided into two phases:

Phase I: Development and documentation of the appropriate methodology for ascertaining the long-term future of IWT.

Phase II: Implementation of the methodology in interested countries in the ESCAP region.

4. Output:

Report outlining the methodology for ascertaining the long-term viability of IWT.

Implementation of methodology in interested ESCAP countries.

5. Scale:

One man-year for development of methodology.

Implementation on a project basis.

Project 19: The Pricing of IWT and Associated Facilities

1. Background:

One of the main functions of any pricing system is to provide information to the user of services and facilities so that he can make rational decisions concerning his level of consumption and to provide a signal to the producer concerning the level of services and facilities which he should make available.

In virtually all countries with major IWT systems the user does not directly pay for the infrastructure costs. This situation is however changing and there have recently been moves towards the introduction of user charges. In countries where user charges are levied they were sometimes established over 60 years ago and either the original basis was not wholly rational or operable or in the intervening years, circumstances have changed so that the system is no longer rational.

2. Objective:

To develop model charging structures for IWT and associated facilities.

3. Description:

1. Theoretical considerations for the pricing of IWT infrastructure.
2. Review of international pricing structures and proposals.
3. Review of IWT charges in the ESCAP region.
4. Development of model IWT tariff structures.
5. Seminar on IWT tariffs.
6. Implementation manual for tariff structures.

4. Output:

- Model IWT tariff structure
- Implementation manual
- Seminars on IWT tariffs

5. Scale:

- 1/2 man-year review and development
- 1/2 man-year for manual and seminars
- implementation as required

Project 20: The Level and Structure of IWT Freight Rates

1. Background:

Whilst little attempt is made in most countries to recover the infrastructure costs of IWT, freight rates are charged by the operators of mechanized craft and country boats. In some cases these charges are left to the "free market" whilst in other cases minimum and/or maximum rates are set (especially for essential commodities such as food grains, fertilizers, etc.).

Country boats generally fall into the "free market" sector. Evidence would suggest that in some cases owners have to make "unplanned" expenditures during a voyage and that no demurrage (payment to owner for delay of the boat) or despatch money (payment by owner for time saved) is paid.

2. Objective:

To develop model IWT freight rate charging structures.

3. Description:

1. Theoretical considerations for freight rate determination.
2. Review of international and regional freight rate structures.
3. Development of model IWT freight rate structures.
4. Implementation manual for tariff structures.

4. Output:

- Model IWT freight rate structure
- Implementation manual

5. Scale:

- 1/2 man-year review and development
- 1/2 man-year for manual
- implementation as required

Project 21: Water Transport Capacity Models

1. Background:

In some countries of the region questions were asked how to determine the capacity of the water transport system, especially in smaller tributaries and canals where the capacity may become critical. This capacity can be determined with so called Water Transport Capacity Models. These models are also used:

- in feasibility studies related with IWT development
- to detect limiting factors of the IWT capacity (investment strategies)
- to define required amount of berths and waiting places near terminals (and locks)
- to define (un)loading facilities and storage capacity of terminals

A water transport capacity model describes inter alia:

- the waterway (dimensions, navigable depth, etc.)
- the fleet (type of vessels, draft)
- navigational aspects (speed, passing, waiting, etc.)
- structures affecting navigation (bridges, locks, terminals) and berth capacity
- cargo flow (aboard and via terminals)
- transport process as a function of time

2. Objective:

To introduce knowledge into the region concerning the use of water transport capacity models.

3. Description:

- description of models
- case studies
  - o feasibility study to develop IWT
  - o terminal capacity
- preparing guidebook with these items
- organizing a 1 week course

4. Output:

Guidebook with model description and some case studies to be used as lecture notes for a one week course.

5. Scale:

1/3 man-year over six months

Socio-Economics

SOCIO-ECONOMICS SUBJECT AREA DESCRIPTION

IWT exists within a social fabric and coexists with other modes of transportation. The effects of IWT projects on this social fabric and other transport modes should be examined. Likewise, the impact of other transport mode projects on the social fabric and existing IWT operations should also be examined. Therefore, the benefits and costs, and the distribution of those benefits and costs within the society which it is to serve should be evaluated. Benefits and costs are qualitative as well as quantitative. In fact, major social benefits to IWT in the ESCAP region have rarely been measured and little quantitative data is collected. IWT actions must also be assessed against the national social and development objective. Does IWT help or hinder reaching national objective? Why? Also, the social capacity to adapt and to use changes in IWT technology should be examined before investment in new or modified technology is initiated. In fact, proposed new technology should be designed with basic social norms and values as a guide. Finally, potential mitigative actions for adverse social effects or social/community trauma generated by IWT actions must be evaluated. The following subjects are a few examples of those usually examined in connection with infrastructure investment; employment generation and impacts; community development and disruption, communication patterns; life styles, values and social norms; social capacity for change; and probability of social conflict and trauma.

Project 22: The Socio/Economic Importance of Country Boats

1. Background:

Country boats are critical to the socio-economic fabric of some countries in the ESCAP region, especially Bangladesh. Yet, little data exists or is collected on their operations. Only minimal analysis has been done to explicitly describe how and why the country boats are important.

2. Objective:

This project should begin to fill the major gap in data and analysis of how country boats support the economy in the region. It should help officials and planners improve their development planning and execution.

3. Description:

This project will review previous studies and develop new method to collect data and assess the importance of country boats. Using such methods it will assess the country boat importance. The assessment will be published and disseminated throughout the region.

4. Output:

The project will produce two major outputs: (1) techniques for evaluating country boat operations, and (2) an assessment of the importance of country boats to the region.

5. Method:

(a) A review of previous studies.

(b) Development of new techniques to evaluate country boat cooperation and pretest of approach.

(c) Development of a research approach.

(d) Execution of a research approach.

(e) Write-up of findings.

(f) Dissemination of findings.

6. Scope:

Completion should take 2 years and 3-1/2 man-years.

Project 23: Calculating Locational and Other Socio-Economic Benefits to IWT Development

1. Background:

To maximize IWT benefits, officials and planners need to assess the best locations for IWT facilities. Also, they must employ techniques to encourage development at the most advantageous locations.

2. Objective:

To provide officials and planners in the ESCAP region with tools which will help them to identify best locations for IWT development and to encourage such development.

3. Description:

To examine available post-audit studies of development around waterways and extract appropriate lesson learned. It will review established techniques for calculating locational benefits to see which are applicable to the IWT situation in the ESCAP region. Where necessary, the project will develop new techniques, appropriate to the ESCAP region, for calculating such benefits. Finally, the project will publish and disseminate a guide for officials on methods for such calculation.

4. Output:

To produce one major product: a guide to methods for officials.

5. Methods:

The project involves the following steps:

(a) A literature search of post-audit studies.

(b) An analysis of these studies to extract lesson learned.

(c) A review and assessment of existing techniques.

(d) Development of appropriate new technique.

(e) Development, publication and dissemination of a guide.

6. Scope:

3 man-years over 2 years.

Project 24: The Use of IWT to Achieve Other Social Development Goals

1. Background:

IWT should not be viewed discretely. It is part of the social fabric of communication patterns, transport movement and culture. In the case of some ESCAP countries, like Bangladesh, IWT is a major part of that social fabric. IWT is often a primary link between rural and urban areas.

2. Objective:

Several ESCAP countries are attempting to reduce urban population concentration by encouraging small, medium and, in some cases, large industrial development in rural areas. Such decentralization requires efficient and inexpensive transport routes among such new centres of development and older established centres. Officials often assume that IWT can play a major role in such policy goals. This assumption should be examined. Also, the most appropriate means for IWT to assist such objectives should be identified and disseminated among relevant countries.

3. Description:

This project will examine how and whether IWT can help governments achieve policies of decentralized industries and of reducing urban population congestion.

4. Output:

This project will produce four outputs: (1) a comprehensive review and analysis of this assumption; (2) a practical guide for planners and policy officials on how to use or not use IWT to achieve social goals of decentralization; (3) a plan for dissemination of these outputs among mid- to senior level IWT and other government managers; and, (4) an applied training course in social analysis techniques for IWT planners and other officials.

5. Method:

The project involves the following steps:

(a) Identifying those areas within selected countries where IWT is assumed to help decentralization.

(b) Review of existing literature on the theory and empirical studies on this topic.

(c) A professionally facilitated workshop with selected specialists in this area to examine assumptions and suggest an approach.

(d) Analyze results of (b) and (c) and apply to these areas identified in (a).

(e) Write up first 3 project outputs.

(f) Development of training course using experiential learning techniques.

(g) Publish a course workbook and run one pilot training session in the ESCAP region.

(h) Schedule and run a series of training courses.

6. Scope:

Completion of items (a) through (e) should take 2 years and require 3 man-years of effort. Completion of items (f) and (g) should take 1 year and require 1 man-year of effort. Items (f) and (g) can be done in parallel with items (a) through (e). The total requirement for items (a) through (g) should be 4 man-years. Item (h) should require 1 man-month per training session.

Project 25: Employment Generation and Impact of IWT in ESCAP Region

1. Background:

Many government officials and a few studies assert that IWT has very important current and potential direct and indirect employment effects in the ESCAP region. However, little has been done to document such effects.

2. Objective:

Any changes in IWT, either IWT sponsored or generated by other development projects, will have important employment effects. Neither ESCAP or ESCAP members currently possess the capacity to calculate such effects.

3. Description:

This project will develop new techniques where needed and use established technique where appropriate to document IWT employment generation and effects.

4. Output:

This project will have three outputs: (1) an assessment of IWT employment effects within the ESCAP region and countries; (2) a practical guide to methods for assessing IWT employee effects, and; (3) initiation of an IWT employment database which could be used by all ESCAP members to calculate such effects.

5. Method:

The project involves the following steps:

(a) A review of the methodological needs to do such calculation in the ESCAP region.

(b) An assessment of established methods.

(c) Development of appropriate new methods.

(d) Testing new and appropriate old methods on a limited sample basis.

(e) Designing an approach to data gathering and regional assessment and plans for periodic update.

(f) Execute assessment.

(g) Begin a "user-friendly", "easy-access" employment effects database.

(h) Produce a practical guide to calculate employment effects and using the database.

(i) Issue summary and final project reports.

6. Scope:

Completion of the project should take 5 years. After completion of the database, update and maintenance will be required on a continued basis. Roughly 5 man-years of effort.

Project 26: The Diffusion, Social Adoption and Impacts of Changes in IWT Technology

1. Background:

New, modified or changed technology is not worth the investment, if that change is neither adopted or diffused throughout a region. Likewise, the introduction of new, modified or changed technology without consideration of its likely effects can result in the demand for rapid action to either mitigate undesirable effects or to capitalize on positive benefits.

2. Objective:

Policy officials should attempt to anticipate such positive and negative effects before changes are begun. Also, proposed changes in IWT technology should incorporate social value consideration into their design. In these ways officials can increase the probability that investment in IWT technology changes will realize the desired multiplier effects throughout ESCAP regions.

3. Description:

To relate the lessons of two major fields of inquiry to the specific circumstances of IWT in the ESCAP region. These fields are: Technology Forecasting and Assessment, and Diffusion of Innovations. It will use the lessons to prescribe how to properly design and plan for incremental technical change in IWT operations and vessel design.

4. Output:

This project will produce three outputs: (1) a review of how the theory and concepts of innovation, diffusion and adoption relate to IWT; (2) a technology assessment of the most likely changes in IWT operation and vessel design; and (3) a practical guide for policy officials in how to maximize diffusion and adoption of technology.

5. Method:

The project involves the following steps:

(a) Review of the literature of innovation to extract principles applicable to IWT.

(b) Technology forecast of the most likely technical and operational changes in the ESCAP region IWT for the next 10 years. This forecast should use state-of-the-art technology forecasting methods.

(c) a technology assessment (TA), using accepted TA methods of those likely technical and operational changes.

(d) application of the results of (a) and (c); TA results.

(e) write-up of outputs: review, TA and practical guide.

6. Scope:

Completion should take 3 years and a total of 4 man-years (review: 1/2 man-year; TA: 2-1/2 man-years; and guide: 1 man-year).

River Hydraulics and Sediments

RIVER HYDRAULICS/SEDIMENTS

1. Subject Area Description:

This subject area includes the following aspects:

Hydrology at upstream boundary; rain, runoff and water level statistics; far field river basin analysis; water levels (navigable depths and flood control); velocities (erosion, propulsion); discharge (including barrage operations and with troubles; tidal hydraulics especially at the downstream boundary; water and salt motion; near field analysis around structures, flow pattern (maneuverability); sediment transport mechanism and formulate; far field morphology; river meandering, local school and shoals, and effects of river training and maintenance dredging.

This subject area also includes the following techniques such as mathematical modelling (far field base analysis for WM model); scale modelling, sometimes with moveable bed (mainly near field analysis), field tests, test dredging and banalling.

Project 27: Training on Alluvial River Model Building

1. Background:

In the last decade, various research centres in the world have made progress in understanding the physics of the alluvial rivers. A lot of problems can nowadays be tackled with the aid of mathematical models. However, for some problems scale models are desired or even required. In the ESCAP region the alluvial rivers form the major IWT routes.

2. Objective:

Preparing, organizing and executing a training course and workshop on the state-of-the-art of alluvial river modelling in view of the navigability.

3. Description:

- preparing, organizing and executing a course (lecturing) on IWT and rivers, among others, in close cooperation with the Alluvial Channels Observation Project (ACOP), Pakistan, inclusive local case studies.

- a workshop using desk computers for river/IWT modelling.

- a physical demonstration in a scale model in a research institute.

4. Output:

Lecture notes, workshop notes, and course execution.

5. Organization:

The course can be given anywhere. For the workshop a fixed location is preferable. For the physical demonstration a fixed location is required. If the full training is given in the centre it can become either a short course, say one month or a part of the programme of a long course.

6. Scale:

1 man-year for the set-up (inclusive case studies).

3 month/year for the execution.

Project 28: Advanced Methods to Solve Shoaling Problems

1. Background:

In many rivers in the region navigation is hampered by shoals. In the alluvial rivers shoaling occurs in the middle and downstream stretches. Nearly all rivers have shoaling problems in the river mouth. (Low cost techniques to be treated separately.)

2. Objective:

Develop a review of modern methods to solve shoaling problems giving a comprehensive picture of the physics (fundamentals of water and sediment motion) and the engineering side.

3. Description:

- o alluvial and other shoals
- o physics of water and sediment motion
- o methods to solve shoaling

4. Output:

Guidebook on advanced methods to solve shoaling problems.

5. Scale:

four man-years over six months

Surveying

SURVEYING SUBJECT AREA DESCRIPTION

For surveying the following items can be distinguished:

a) equipment (vessels, instruments)

b) calibration of instruments

c) execution of the survey

d) field checks on proper operation of instruments and measuring results

e) office data processing and reporting

Vessel

Relevant aspects are: operation and logistics, maintenance, regulations, safety, specifications, anchoring system.

Instruments

Relevant aspects are: administration, storage, type selection, purchase, laboratory testing, preparation for survey, field checks and trouble shooting, repair and maintenance.

Execution

Relevant aspects are: planning and organization, accuracy considerations, measuring methods, field team briefing, field checks on results.

Project 29: Navigation Chart Development

1. Background:

In a number of countries, for example Bangladesh, Indonesia and Malaysia the need was expressed to develop the applied methods for making navigation charts.

2. Objective:

Setting up of a set of guideline describing methods of charting and required equipment from minimum cost systems up to most advanced automatized systems.

3. Description:

- data collection on applied methods equipment (type, price indications)
- lines for step-wise development
- guidelines
- country visits to advide on navigation chart development taking into account the current applied methods and available equipment

4. Output:

- guidelines
- applied advice per country

5. Scale:

1/3 man-year; 1/3 year.

Project 30: Minimum Navigable Depth Study

1. Background:

The available navigable depth in the region is often a problem in the low water season. However, in most cases there is no systematic approach to determine the navigable depth. In addition to lack of methodology, lack of data is a major constraint.

These problems become strongly visible in feasibility studies on developing IWT systems. A minimum depth study is mostly part of the master planning required to judge the feasibility. A method to determine the minimum navigable depth is to use a far field mathematical model of the river basin to compute water levels at critical locations for IWT. Also (statistical) relations between water levels discharge (run-off, operation of barrages, withdrawals, etc.) and rain may be considered. The basic programme for such a model is available. Absence of far field data is the major constraint.

2. Objective:

Promote the knowledge in the region on the systematical approach of determining the minimum navigable depth.

3. Description:

The items covered in the guidebook are e.g.:

- methods to determine minimum navigable depth e.g.
  - o a practical low cost method
  - o advanced method based on a mathematical model of the river basin hydrology (including barrage operations, etc.)
- required far field survey data (in low water season) on river geometry, water levels and discharges (operation of barrages and withdrawals);
- rain-run-off- water level statistics/definition of critical points (such as locations just downstream of barrages);
- water depth exceeding curves.

4. Output:

The production of a guidebook including description of an existing case study.

- Guidebook on methodology inclusive a case study

5. Spin-off:

The described mathematical model can be used for WM purposes.

6. Scale:

The required amount of manpower can be very limited, provided a case study is available.

A global set-up can be realized within half a year:

- hydrologist .25 man-year
- surveyor .2 man-year
- mathematician .5 man-year

Project 31: Study of Big Shoal (South of Chandpur) Bangladesh

1. Background:

During the monsoon at a certain location in the Meghna River, South of Chandpur considerable siltation occurs. Only at the cost of extensive maintenance dredging can the river be kept navigable. The river section forms the main IWT route in between the sea ports of Mongla and Chittagong and the capital Dhaka.

2. Objective:

Develop a method to maintain a minimum navigable depth of 12 ft. throughout the year at minimum cost.

3. Description:

First stage: Study on present conditions/operations.

- collection of existing data
- planning/execution of additional surveys
- desk study with the aid of a mathematical model
- development of promising measures
- defining second stage or stop

Second stage: Testing of promising measures.

- model testing with mathematical and/or scale models
- field testing e.g., test dredging, bandalling, etc.
- additional surveys
- feasibility of proposed measures

4. Output:

First stage: Are there measures to realize a substantial decrease of maintenance dredging?

Second stage: Estimate of reduction of volumes of maintenance dredging; economical justification.

5. Scale:

First stage: Expat.: 1 eng. + 1 surveyor 1 1/2 year long-term) expat. 1 instr. eng./1 math/1 sedim/1 econ/3 month each)	4 man-year
local 2 counterparts + office + survey personnel	10 man-year
duration 1.5 year	

Projec 32: Pile-Screen Survey, Burma

1. Background:

In the Irrawaddy River a number of projects dealing with low cost river training are being executed. With open pile screens up to a length of 3 km the flow is directed and siltation is generated at certain locations in order to maintain navigable depth in the main channel. Some results are very promising, although sometimes there is a failure. Basic research is hampered due to lack of survey (experience and equipment).

2. Objective:

Promote the research on the effectiveness of the pile screens.

3. Description:

- assistance for setting up of research program
- setting up of survey planning
- supply of instruments
- field training

4. Output:

- start of research
- a trained and equipped survey team
- field data report
- input for further research

5. Scale

Dredging Technology

DREDGING TECHNOLOGY: SUBJECT AREA DESCRIPTION

This subject area incorporates two pertinent functions; proper equipment selection and project management. The selection and use of a dredger includes proper operation and maintenance of the dredgers and support equipment. For large-scale fleets of dredgers sophisticated maintenance and repair yards are required as well as a good training programme for the personnel who maintain and operate the equipment. Project management includes proper timing of dredging work and the incorporation of other features such as training works to reduce dredging requirements. Disposal of material is a key factor in the selection of an economic dredging solution.

Project 33: Regional Cooperation in Dredging Technology

1. Background:

There appears throughout the region some knowledge of dredging and the equipment which performs this function. Sufficient data is not available to determine if proper equipment is being utilized in all dredging cases, or if proper disposal practices are being employed at all dredging sites.

2. Objective:

To disseminate proper dredging and disposal methods and technology throughout the region.

3. Description:

A cooperative effort through seminars, technical experts technology transfer to upgrade expertise in dredge operations and enhance dredge performance.

4. Output:

Improved dredger performance. Better equipment maintenance, better trained personnel, and proper disposal techniques.

5. Scope:

Semi-annual seminars, one week in duration. Five experts', salary and travel. Salary and travel of participants paid by home country. Technical experts available on loan basis to UN from selected countries to troubleshoot problems upon request. These experts could first make an overall assessment suggesting corrective action when necessary of each country's dredge fleet and of the dredging operations, to be used later for problem resolution. Two experts, two weeks per call-out, salary and travel, technology transfer can be accomplished during the seminars and while services of technical experts are being utilized.

Project 34: Study to Determine Best Investment Strategy for Operation and Maintenance

1. Background:

Dredging practices and procedures in this region have evolved without the benefit of field tests of alternative equipment and alternative disposal schemes, nor the combination of proper equipment and sediment control structures.

2. Objective:

To disseminate to all agencies involved all the alternatives that are available (dredges, control structures, disposal methods, techniques etc.) which can be used individually or concurrently for the most efficient operation and maintenance program.

3. Description:

a. Preparation of a descriptive manual of all techniques and describing when they are most effective.

b. A large scale seminar, two week duration taught by experts from several countries repeated annually. In addition demonstration projects in actual field operations during seminars.

4. Output:

Student Manuals, Field Project Descriptions
Technical Document
Improved skills
Improved overall operation and maintenance of projects at reduced cost.

5. Scope:

a. Team of 3 experts visiting all countries and documenting accepted techniques over a 6 month period.

b. Ten experts for two-week seminar, salary and travel cost. Volunteer demonstration projects by member countries interested in a particular facet of dredging operations and disposal.

Project 35: Study to Develop a Comprehensive Dredging Plan

1. Background:

Throughout the Region maintenance dredging is approached on the "put out the fire approach" often creating more serious problems in another location while solving the immediate problem.

2. Objective:

To provide a more systematic approach to channel dredging.

3. Description:

To provide a document that outlines the scope of a survey investigation to define dredging requirements. This document would provide guidance as to when advanced maintenance (over depth, over width and extension of dredging limits) should be considered and list pitfalls in disposal practices for various types of dredging which should be avoided.

4. Output:

Improved maintenance conditions of rivers. Lower cost per cubic yard of dredged material.

5. Scope:

Three experts', salary and travel to review current dredging practices over a one month period followed by preparation of the required document (one additional month). Six man months in total.

Project 36: Introduction of Dustpan Dredge

1. Background:

The dustpan dredge has not been tried on the river systems in Asia. Its principles appear promising for improved productivity during the dredging process for fine compact sand.

2. Objective:

To establish the effectiveness of dustpan dredges in Asia's major navigation projects.

3. Description:

Obtaining the loan of a dustpan dredge with crew and testing dredge production on various river options in Asia during peak dredging season.

4. Output:

Definition of productive merits of dustpan dredges for various river systems in Asia.

5. Scope: Dredge with crew for up to two years. 60 man years of effort. Maintenance on equipment and supplies.

Engineering

ENGINEERING
SUBJECT AREA DESCRIPTION

This subject area includes topics such as, types of structures, design aspects, tendering, construction, operation and maintenance, river training and engineering tools and techniques.

Structures consider the following: canals, locks, sluices, barrages, dams, river training works, bank protection, bridges, hydraulic equipment such as pumps.

Design aspects include subjects such as appropriate technology and local materials, hydraulic interaction of sediments and structures in both far field and near field, hydraulic and navigation interaction and structures in lock filling/emptying systems, generated currents, jets, generated forces on vessels and hawsers, duration of lock cycle and lock capacity, and operation and maintenance design.

Tools and techniques include physical and mathematical modelling to solve problems associated with interactions described above.

Project 37: Research on Bandalling Techniques

1. Background:

Bandalling is an appropriate low cost technology to maintain a certain navigable depth in the low water season. Though the physics behind bandalling are fully understood, assessments of the effectiveness vary widely. In a number of countries in the ESCAP region knowledge of bandalling techniques has increased.

2. Objective:

To provide/promote bandalling techniques.

3. Description:

Phase I: Collection of data, reports, etc.; an inventory
Site visits to current bandalling projects
Definition of main constraints
Formulation of research program to tackle the constraints

Phase II: Scale model investigations
Field investigations including survey
Model-field comparison study

Phase III: Publication(s) on applicability/effectiveness
Guide-line how to apply bandalling

4. Output:

Phase I: description of constraints + research program
Phase II: study reports
Phase III: publication(s) and guideline

5. Scale:

Phase I: 1 man-years over 1 year
Phase II: 3 man-years over 1/2 year
Phase III: 1 man-year over 1/2 year

Project 38: Guide to Remodelling Old Bridges

1. Background:

The need for remodelling can be initiated by the surface traffic and/or by the navigation (more width and/or more head clearance). Methods of improvements should be based on appropriate techniques and focus on the final result (bridge type/design) and the way in which construction can be realized without obstructing navigation.

2. Objective:

A guideline for appropriate techniques for remodelling old bridges considering design and reconstruction methods.

3. Description:

- inventory of type of old bridges which (may) obstruct navigation;
- inventory of ways of reconstruction;
- catalogue of promising design alternatives from concrete highway bridges to bamboo passenger bridges considering;
  appropriate techniques;
  catalogue of promising methods of reconstruction.

4. Output:

The guideline.

5. Scale:

1/2 man-year - 1/2 year.

Project 39: Design of Still Water Canals

1. Background:

During irrigation season the intakes of an irrigation canal are often closed and the sloping canal dries. Special measures such as water level control and structures are required to keep the canal navigable throughout the year. Similar problems are encountered when designing a still water canal.

2. Objective:

To prepare a set of guidelines for the design of still water canals.

3. Description:

- inventory of problems, solutions and failures in the region in relation with still water canals;
- subjects that will be covered are:
    - water balance, water level control
    - type of structures required
    - operational aspect
    - water quality and diseases (malaria)
- per subject, a description of problems and solutions must be given, methods of study must be indicated, inclusive of a bibliography;

4. Output:

A guideline for the design of still water canals.

5. Scale:

1 man-year over 1/2 year.

Project 40: Guide to Adapt Irrigation Canals to IWT

1. Background:

As agriculture is in general dominant with respect to navigation, in many cases in the region, canals have been constructed for irrigation and/or drainage purposes. Afterwards one considers the possibilities to use these canals for IWT. The question arises how to adapt these canals to IWT.

2. Objective:

To compose a guideline for the adaption of irrigation canals to IWT.

3. Description:

- inventory of the problems, solutions and failures throughout the region in relation to the adaptation of canals to IWT;
- subjects can be:
  - canal dimensions versus vessel size
  - vessel speed and bank protection
  - how to cope with obstructions (existing low bridges)
  - by-passing regulators
  - navigational aids
- per subject a problem description, possible solutions, methods for study and a bibliography should be given.

4. Output:

A guideline for identification of problems and solutions.

5. Scale:

1 man-year over 1/2 year.

Project 41: Model Testing of River Training Structures

1. Background:

Many rivers in the region either not trained or only partly trained. Training structures deteriorate in many cases. Proper design of the structures can and in some cases must be done with the aid of model testing.

2. Objective:

To promote better design of training structures

3. Description:

- to compose guidelines for type of structures;
- to indicate design method: when to use desk design, when to use mathematical modelling and when to use scale modelling;
- requirements for scale modelling;
  - determination of scale
  - only hydraulics or also with sediments
- case studies of a number of projects in the country;
- research on appropriate techniques;
- training/courses.

4. Output:

- type of structures
- design methods
- scale modelling problems/solutions
- case studies
- research results
- lecture notes

5. Scale:

3 man-years over 3 years.

Project 42: Standard Design of Bank Protection Structures

1. Background:

Many of the countries in the ESCAP region have constructed bank protection structures along the rivers without proper design. As a result, many failures have occurred within a relatively short time exposing the banks again to erosion. The maintenance of these poorly designed structures are expensive and in many instance, it may be less costly to reconstruct the structure.

2. Objective:

Bank protection design guidelines.

3. Description:

The study will include collecting data on bank erosion problems in the various countries, site visit and develop standard designs considering the initial cost and annual cost of operation and maintenance.

4. Output:

A guideline on design of Bank Protection Structures.

5. Scale:

2 man-years over 1 year.

Navigation

NAVIGATION: SUBJECT AREA DESCRIPTION

This area covers the collection, development, analysis, and storage of navigation data, training of personnel and use of data processing systems to provide current data to users of the inland waterway system. The type of information includes aids to navigation, tides, water depths, navigable channels, pilotage, ship handling and maneuvering interactions in narrow channels.

Project 43: Aids to Navigation

1. Background:

Many of the navigable waters are either unmarked or marked with locally manufactured products. With the anticipated opening of new waterways and increased boat traffic along the existing and future waterways, a more efficient/modernized system of aids to navigation is needed.

2. Objective:

Develop and standardize efficient aids to navigation for use in all participating countries with a view towards increased safety and ease of traffic.

3. Description:

The work will consist of research, application of latest technical knowledge in developing a standard guide for aids to navigation together with estimated initial cost and annual operation and maintenance costs.

4. Output:

A report that illustrates a number of standard designs of aids to navigation that can be installed in inland waterways.

5. Scale:

2 man-years over 1 year

Project 44: Navigational Information

1. Background:

Inland waterways are often a lifeline for the countries. IWT can assure the mobility of people and goods in the region. Technical information on the state and extent of inland waterways is either scarce or non-existent or scattered among the many agencies of the country. Operational data needed by the users are the aids to navigation, tides, water depths, navigable channels, pilotage, ship handling and manoeuvring interaction in narrow channels. There is also a need to standardize the classification of waterways.

2. Objective:

Primary objectives are to collect additional data, centralize and disseminate these data to the users and to ultimately standardize the classification of waterways.

3. Description:

This project will initially train personnel on procedures of data collection followed by training in storing, dissemination and distribution. It will also define the criteria to be used in standardizing the classification of waterways in such areas as standard low water level, yearly average water level, optimum safe dimension, dimensions for one or two way traffic.

4. Output:

Direct assistance to participating countries on methods of collection, computation, use of statistics, defining and standardizing the waterways and developing the organizational link between the generators and the users.

5. Scale:

5 man-years annually.

Project 45: Guide to Debris Control

1. Background:

In a number of countries, a major hazard to navigation is floating and submerged debris in the form of trees, logs, etc.

2. Objective:

To develop means of controlling debris.

3. Description:

(a) Review of the means of debris control in countries both within and outside of the ESCAP region.

(b) The development of guidelines for debris control which would be appropriate for application in ESCAP countries.

4. Output:

A guideline on controlling debris.

5. Scale:

1 man-year - 1 year including site visits.

Vessels

VESSELS: SUBJECT AREA DESCRIPTION

This subject area involves the selection of vessel type, redesign and modification of existing vessels, powering and optimizing for carrying capacity and fuel savings vessel repair and the manipulation of cargoes and fleeting operations to enhance cargo movement savings.

Project 46: Inventory of Existing Types of Country Boats and Analysis of Their Traffic Flow

1. Background:

In most countries of the region country boats have not been inventoried. There needs to be a total inventory of all boats, their design, carrying capacity, method of powering and a systems analysis of their traffic flow.

2. Objective:

To categorize all existing country boats in the region, including development of traffic flow patterns.

3. Description:

A special effort by the countries involved at completing forms.

4. Output:

Total inventory of all country boats in the region and plotting of their traffic flow patterns.

5. Scale:

Approximately 6-month effort by all countries in the region supported by several ESCAP personnel followed up by special team of two consultants analyzing and documenting traffic flow patterns (6 man years).

Project 47: Low Cost Repair Yards for Country Boats

1. Background:

Many of the country boats are in bad need of repair, are taking on water and generally hazardous to sail. The basic reason given for these vessels not being in a well maintained state is the expense and time involved for using repair yards.

2. Objective:

A safe and well maintained country boat fleet at low cost.

3. Description:

Methods for each government to set up repair yards at all major IWT ports. Vessels will be inspected annually and repaired as necessary to insure safe operation for the coming year. Inspection times will be scheduled so as to hold to a minimum the down time of the country boats. Vessels needing repair will immediately be repaired at the repair yard.

4. Output:

Immediate improvement of country boat operations. Improved safety. Overall lower cost per volume of country boat commodity movement.

5. Scale:

Massive undertaking. Up to one hundred inspection and repair and facilities in the participating countries. Joint funding by countries and donors such as UN, AID, etc. Approximately 3 years for all boats to pass through initial screening.

Project 48: Optimization of Design of Country Boats Including Modernization of Existing Fleet

1. Background:

Country boats are of every size, shape and form, and constructed of different materials with various sail arrangements. There is a need to improve the standard of present day country boats by upgrading the vessels with some modern-day technology.

2. Objective:

Development of standard design and construction procedure for country boats to achieve optimal vessel sizing which provides more capacity at shallower draft. Standardize width (beam) of vessels for inland waterways in region. Improved performance of country boats.

3. Description:

Design experts preparing standard designs for dissemination throughout the region. Designs to include limited mechanized vessels, capable of push towing, motorized and sail combination vessels, barge for pushing and towing.

4. Output:

Standard designs to fit various situations.

5. Scale:

Team of 6 vessel design experts visiting all navigable waterways and structures, then preparing designs. Approximately 6 months duration. Salaries donated by loaning countries, travel cost borne by ESCAP member countries.

Project 49: Development of Vessel Designs for People Transport on Waterways

1. Background:

Throughout the ESCAP region people are one of the more dominant items being transported on the river systems. In most countries this is a necessity due to lack of rail and road transportation links.

2. Objective:

To develop various designs of transport vessels for passengers.

3. Description:

Preparation of design manuals with design of passenger transport vessels of all descriptions - short haul vessels, long haul with overnight accommodations, shallow draft, deep draft, moderate or fast speed, etc.

4. Output:

Standard designs for all requirements.

5. Scale:

Team of 6 design engineers visiting all countries over a 3 month period followed by one year of intensive design effort.

Project 50: Conversion of Barges for Push Towing

1. Background:

Most countries are starting to accept the fact that push towing is more efficient and economical than pull towing. Two hurdles must be overcome. Push tugs need to replace the older pull tow tugs. This is being accomplished through replacement and modernization. In addition there exist numerous serviceable barges which can be adapted through conversion to push tow barges.

2. Objective:

Provide multiple designs for conversion of barges to push towing.

3. Description:

Preparation of design drawings for the conversion of various types of barges.

4. Output:

Design manual for barge conversion.

5. Scale:

Three design engineers visiting all countries and observing existing barge fleets over a 6 week period followed by the preparation of drawings over the next three month period.

Project 51: Benefits Analysis of the Introduction of Radar to IWT Vessels

1. Background:

Numerous accidents are beginning to occur on some of the congested rivers. Methods need to be developed to reduce the frequency of occurrence of these accidents and to increase night travel.

2. Objective:

To study the feasibility and benefits obtained from use of radar by all vessels operating on congested river system.

3. Description:

All accidents over a given period would be reviewed to determine which ones could possibly have been prevented had the vessels had radar aboard. In addition an estimate will be developed of the amount of additional sailing time that could have been taken advantage of if radar would have been available (inclement weather and night travel).

4. Output:

An estimate of the benefits to be derived by adopting mandatory radar requirements -- measured in terms of a) property damage prevented, b) lives saved, c) reduced insurance premiums and 4) increased sailing time.

5. Scale:

2 man-years over 1 year.

Project 52: Introduction of Long-Tail Boats Throughout the Region

1. Background:

Throughout Asia, particularly in Bangladesh and Indonesia there appeared to be considerable need for a fast, yet shallow draft vessel.

2. Objective:

To demonstrate to proper officials in all countries the beneficial uses of long-tail boats.

3. Description:

Studies to improve the existing fittings of the long-tail boats in order to be able to install them in all types of country boats at minimum costs. It will include construction and testing of new or modified devices and theoretical studies to determine the propeller efficiency of their engines and other types of mechanizations.

4. Output:

Development of a new fittings for long-tail boats.

Demonstration in various countries.

5. Scale:

2 man-years over 6 months.

Terminals, Ports and Harbors

TERMINALS, PORTS AND HARBOURS: SUBJECT AREA DESCRIPTION

The existing physical facilities and technology to handle containers and bulk commodities at deep sea ports are oriented towards distributing their commerce overland by rail and roads. IWT terminal include also all the jetties, docks, wharves, etc. which support the activities of country boats. The existing rail and road systems are in need of modernization, costly to maintain and would be unable to handle in the future the additional cargoes that would be traversing the sea port terminals. The inland waterways offer the best potential to not only accommodate the future increased cargo loads economically but also to carry the bulk of the cargo presently handled by the rail and road systems. Future design of terminal layout and operations must consider the services to the inland waterway system.

Project 53: Commercial Traffic Between Ports

1. Background:

At present there are no records kept of movement of commercial traffic in terms of tonnages, types, and destination by country boats. With the anticipated growth in the use of IWT to move commerce and passengers, and opening of new routes, additional port facilities may be needed to accommodate the increased traffic.

2. Objective:

To identify the commercial traffic ports and develop a system of ports (existing of new linking) each of these, as well as to define the minimum additional facilities needed to accommodate future growth of commerce.

3. Description:

An origin-destination (OD) study will be conducted to identify the movement of cargo by types, and passengers between specific ports. It will further identify the existing physical facilities at each port and the necessary changes that may be required if increased commerce occurs.

4. Output:

Identification of the system of ports, the commodity and passenger movement, and the necessary physical facilities needed at these ports.

5. Scale:

6 man-year over 2 years.

Project 54: Modification of Deep Sea Ports, to Include Accommodating Commodity Transfer to Country Boats

1. Background:

Overland cargoes delivered to or generated from deep sea ports are primarily transported by rail or trucks. The present rail and road systems are costly to maintain and the construction of new systems will require huge capital investments. The inland waterway system is an alternative means of transportation but the deep sea ports need either to modify their facilities or install new equipment to service this system.

2. Objective:

To identify the necessary additions/renovations to the deep sea port facilities to service the inland waterway system.

3. Description:

To assess the impact of new shipping technologies such as containerization, loading and unloading equipment and types of boats to carry these cargoes to and from its destination on the IWT system.

4. Output:

An economic means to modify the deep sea ports to accommodate the inland waterways transport vessels as another means of cargo movement inland.

5. Scale:

2 man-years over 1 year.

Project 55: Standard Design and Operation of Inland Waterway Facilities

1. Background:

Most of the facilities serving the inland waterways are crowded, inefficient in operations and in many ways lacks equipment/back-up areas to service the users. As a result there is a long period of delay associated with terminal movement. Moreover, the mixing of commercial and passenger traffic leads to inefficiency in cargo and passenger movements and consequently creates a hazard to life.

2. Objective:

To develop standard design of inland facilities taking into account the natural conditions (e.g. large water level fluctuations and type of commodities and vessels). Also a manual for proper operation of the facilities is to be developed.

3. Description:

The study will determine what facilities can be standardized both for cargo and passenger transport. Considering the annual cost of operation and maintenance, this will lead to the most effective use of the facilities.

4. Output:

Two manuals: A standard design of inland facilities that can be used at many ports and a manual for facility operations.

5. Scale:

3 man-years over 2 years.

Project 56: Design and Layout of IWT Ports, Including Separate Docks for Country Boats

1. Background:

Throughout the region major terminals, jetties and wharves were congested with commerce and vessels, ocean-going and country boats laying in anchor either to unload or load cargo. At one port for example the wait for non-perishable goods exceeded one month.

2. Objective:

To reduce congestion at terminals jetties, wharves, etc. by providing adequate docking space with sufficient and improved loading and unloading facilities.

3. Description:

Phase I: A port operational management team of 2 to 3 to visit each major ocean and inland port to observe operations and recommend changes at the ports. Scope of study should include recognized berthing spaces for country boats where feasible.

Phase II: New designs to be developed for ports which have exceeded their manageable load even with incorporation of changes from Phase One.

4. Output:

From Phase One - immediate improvement in turnaround time, more profit for vessel operators. From Phase Two - even more profit for port operators and vessel owners by improved turnaround time.

5. Scope:

One time visit to all ports by expert team. Experts' salary and travel cost for 6 to 8 weeks. Follow-up changes in present operation, major design and construction of new port facilities.

Project 57: Develop Proper Means to Introduce Containers, Including Proper Sizing for Container

1. Background:

The use of containers, properly sized will expedite the transfer of cargo from vessels to dock, vessels to vessels, and dock to vessels. It will, however, cause some disruption in employment, possibly introduce more mechanization than is desired. However, containerization is at hand and must be faced up to.

2. Objective:

To manage the smooth transition to containerization at a level appropriate with the desires of the supporting countries.

3. Description:

A detailed study of port facilities and country boats to determine proper sizing of containers and required mechanization.

4. Output:

Port design changes required, vessel design changes required, mechanization required, impact on employment, required training.

5. Scope:

Major study, six months of intensive effort by team of 4 to 6 professionals. Detailed report on changes required and cost approximation with recommendations of phasing and funding sources.

Project 58: Design of Terminals for Special Conditions

1. Background:

Throughout the region two specific types of terminals were in overwhelming demand with very few in existence. Those in being were not performing up to expectation.

2. Objective:

a) Provide for general design of terminals which can be adapted for multiple level operation.

b) Provide for general design of portable (movable) terminals for inland river operations which can withstand frequent movement and can be set up and dismantled at reasonable cost and effort.

3. Description:

Preparation of two separate detailed design manuals for multiple material construction of terminal facilities.

4. Output:

2 Design manuals.

5. Scope:

A 3 man team will visit each country and review operational characteristics of required designs over a two month period. The team will then prepare 2 design manuals over the next 4 month period. 18 man months total requirement.

Project 59: Planned Maintenance of IWT Terminals

1. Background:

In a number of countries of the ESCAP region terminal facilities have very high utilization rates. Consequently it is difficult for repairs and maintenance of the terminal to be undertaken. For these cases specifically and all terminals in general greater efficiency can be obtained if a planned maintenance system is available to the terminal operator.

2. Objective:

To develop planned maintenance systems appropriate to the varying circumstances at IWT terminals.

3. Description:

A team of experts visiting selected ports over a month period. Selection of the type of maintenance to be performed annually, proper performance procedures, time constraints involved, labour and materials required; and then preparing a step by step manual for expedient accomplishment.

4. Output:

Manual on planned maintenance applied to IWT terminals. Seminars in ESCAP countries.

5. Scope:

6-9 man-months for manual.
Seminars.

Operations

OPERATIONS: SUBJECT AREA DESCRIPTION

In order to obtain efficient inland waterways, it is important for the waterway, vessels and terminals to have a well organized administrative structure, strong management, effective marketing and a sound financial basis.

This project area is consequently concerned with administration of IWT and its associated activities, the management of the sector (including the management of vessels, dredging, terminals and the provision of navigational aids and data) and the financial aspects.

The team considered the means of achieving efficient operations of IWT and its associated activities and concluded that the best method is through staff receiving exposure to systems which are operated elsewhere, education and training. This conclusion is reflected in the following project areas.

Project 60: Management of IWT Activities

1. Background:

In addition to the primary function of transporting goods and passengers there are a number of support activities required for the efficient operation of IWT. These activities include:

- navigational data
- navigational aids
- dredging operations
- terminal operations
- vessel operations

Within the ESCAP region, there are countries which have extensive IWT networks, others where road and rail transport have largely displaced IWT and still others where the possibility of IWT has only recently been considered. In the two latter cases, the associated management expertise has been lost or is very limited.

There are four main areas where suitably qualified management personnel, who do not have specific IWT knowledge, can be assisted in building up their knowledge:

- exchange visits
- short courses
- seminars
- publication of manuals

2. Objective:

To identify the main areas where management training in IWT is required and to assist by publishing manuals and organizing seminars.

3. Description:

1. To identify the main areas of need in IWT management.
2. To assist in the transfer of knowledge.

4. Output:

- arranging seminars in the management of IWT and associated areas;
- publishing manuals on the management of IWT and associated areas.

5. Scale:

Manual: one man-year
Seminars: time required for development of course content and general administration.

Project 61: Port Management Training Program

1. Background:

Every country in the ESCAP region needs, in some degree to improve port management. While better networking and technology transfer will produce better information sharing, a more formal approach of education for Port Managers is needed.

2. Objective:

To increase both the quantity and quality of port managers in the ESCAP region.

3. Description:

This training programme should consist of the following:

a. A formal 2 weeks training course given at different locations in the region 1 to 2 times each year.

b. A short 2 days executive/refresh course keyed into the same themes as in the 1 week course.

c. A series of audio-visual tapes in selected topics of port management which is periodically updated.

d. An IWT-port management newsletter printed and edited 4 times each year.

4. Output:

a. 1 or 2 1 week courses per year.

b. 1 or 2 executive courses per year.

c. A series of Audio/Visual training tapes.

d. A newsletter.

5. Method:

a. Hire an adult education expert to design both training course in conjuction with ESCAP and other IWT experts.

b. Run 2 pilot courses and evaluate changes.

c. After the courses are instituted begin development of training tapes on from 4-5 main themes.

d. Hire a training tape specialist to produce tapes.

e. Begin a newsletter immediately using consolidated mailing list from ESCAP.

6. Scope:

a. Training course development and 2 pilots courses 1 man-year over 6 months.

b. Audio Visual tape program 1 man year over 1 year.

c. Newsletter. 1/2 man year effort per year.

Project 62: Series of IWT Audio Visuals

1. Background:

To promote exchange of IWT knowledge within the region and to supply information on IWT developments outside the region a series of audio visuals should be developed (e.g. video-tape).

2. Objective:

Set up of a series of IWT and audio visuals.

3. Description:

- o selection of subjects and case studies (both regional and from outside the region)
- o collection of existing audio visuals (e.g. on fundamentals of river behavior etc.)
- o creation of audio visuals of relevant case studies on subjects such as:
  - low cost dredging and alternatives
  - type of vessels; pushtowing
  - inland ports, type of terminals and (un)loading equipment
  - containerization
  - river training
  - aids to navigation

4. Output:

Set of audio visuals on various aspects of IWT.

5. Scale:

1 IWT expert, 1/4 man-year - year
1 audio-visual technician, 1/4 man-year - year
during 3 years = 1-1/2 man-year.

Project 63: Training for Trainers for IWT in the Region

1. Background:

The number of people dealing with IWT is large which makes it impossible to train them all directly. A system of training the trainers seems more appropriate.

2. Objective:

Develop a training for trainers program.

3. Description:

- o Develop a method to identify IWT officials throughout the region who will be trained then return to their countries to train other officials in their countries.
- o Outline a profile of training subject matter.
- o Design a training program for training in those subject matter.
- o Begin such a program in a phased approach.

4. Output:

An ongoing training program.

5. Scale:

Preliminary work, 1/2 man-year
Develop overall program, 3 man-year
Implementing Program, 1 to 2 man-years

Project 64: "In Service" Training

1. Background:

The often heavy work load and the limited number of well trained personnel ask for on the job assistance and training including discussions on current problems related with IWT operations.

2. Objective:

Direct support of IWT operations.

3. Description:

- o Short visits of IWT experts on request
- o On the job training
- o Exchange of knowledge (if possible with some audio visuals)

4. Output:

Support of IWT in general; solving ad hoc problems; keep in touch.

5. Scale:

0.1 man-year every year.

Project 65: Regional Study Tour Program

1. Background:

The development stage of IWT in the countries of the region varies considerably. The most developed IWT system of the region is to be found in China. Exchange of knowledge during study tours within the region is recommended. (For Chinese officials a different study tour program is proposed.)

2. Objective:

Exchange of knowledge during study tours in the region, focused on IWT.

3. Description:

- Setting up a program
- Getting funds
- Tour organization and guidance

4. Output:

Study tours. .

5. Scope:

10 days tour: 2 or 3 countries
each 2 years
2 man-year effort each year.

Project 66: Customs Procedures and IWT

1. Background:

In order to realize the benefits of modern cargo handling facilities it is desirable that the necessary steps are taken to facilitate the rapid transit of cargo through deep-sea ports.

One area where bottlenecks often occur is in the requirement that goods clear customs before leaving the deep-sea port. In the transport of containers this problem is becoming gradually overcome with road and rail Inland Clearance Depots (ICD's). For container traffic specifically and other goods in general it is desirable that customs facilities are established at major inland ports.

2. Objective:

To outline model customs procedures which assist in the rapid transfer of goods from international transport to IWT and vice versa.

3. Description:

1. Review of current customs clearance facilities including ICD's.
2. Identification of the general problems associated with ICD's and the specific problems which may occur with customs facilities at IWT ports.
3. Recommendations for the establishment of customs facilities at IWT ports.

4. Output:

- Recommendations for the facilitation of customs procedures.

5. Scale: One man-year

Project 67: IWT Information Network

1. Background:

At various occasions in China the need was expressed to have direct information links either with ESCAP or bilateral with counterpart organizations in U.S. and/or Europe.

2. Objective:

Set up of an IWT information system to promote exchange of knowledge.

3. Description:

- o selection of Chinese organization and relevant counterparts organization
- o arranging contacts (to be combined with study tours)
- o Establish more direct links between counterparts organizations.

4. Output:

IWT information system between China and organizations in the U.S. and Europe.

5. Scale:

1/4 man-year - 1 year.

Project 68: Technology Transfer of Selected Indigenous IWT Appropriate Technologies and Innovations Among Countries in ESCAP Region

1. Background:

Important appropriate technologies and IWT innovation have emerged throughout the region. These technologies need to be better shared and disseminated. In particular, a technology transfer program is needed for bandalling techniques, retro-fit with steerable propellers as found in Burma, low cost dredging and as seen in China and long-tail boats as developed in Thailand.

2. Objective:

To increase the use of appropriate IWT technologies throughout the ESCAP region.

3. Description:

This program will use technology transfer experts to design procedures to transfer and to disseminate appropriate technologies identified by IWT experts throughout ESCAP.

4. Output:

An ongoing technology transfer program.

5. Method:

IWT experts will first select appropriate technologies. Then, technology transfer experts with practical experience will familiarize themselves with those technologies and the condition of their users. Using this background the technology transfer experts will design a transfer program to be administered by IWT experts. This program will begin with a pilot project on one of the selected technologies. After this pilot project is evaluated, a full fledged, program will begin. Its length of time will depend on the success in dissemination of each technology.

6. Scope:

1 man-year to design a program and begin a pilot test. After this 1 man-year should be devoted to such a program.

Project 69: Develop a Quarterly IWT Journal

1. Background:

While there are many officials either responsible for or interested in IWT throughout the ESCAP region, they lack formal networking and need to better dialogue about IWT problems and successes. A quarterly journal, which encourages exchange of opinions among such professionals is a good way to begin such networking.

2. Objective:

To improve the dialogue and information exchange among officials concerned with IWT in the region.

3. Description:

A quarterly journal should feature case studies, current events and policies, solutions and problems. Also, it should contain articles on experiences from outside ESCAP which could be applied to IWT within the ESCAP region.

4. Output:

A journal published 4 times per year.

5. Method:

An expert in publishing, editing, and magazine layout should be hired to develop in consultation with ESCAP officials, the initial formatting and to guide the first year's operation. After the first year IWT staff should be able to take over operation. This expert should also help devise a strategy to build a mailing list and attract subscribers.

6. Scope:

1 man-year for design and first volume
3/4 man-year to maintain and publish the journal.

Project 70: Yearly Meeting of Key IWT Officials in the ESCAP Region

1. Background:

Most officials acknowledge that IWT is important and that transfer of IWT technology must be improved. Many officials feel that better networking is needed among IWT officials. If key officials set aside time to routinely meet with foreign IWT officials, knowledge of success and failures will be shared and an extra impetus given to the adoption of new technologies.

2. Objective:

To initiate a routine IWT policy dialogue and to improve networking among the countries of the region. Each meeting will discuss IWT problems and solutions as well as generate recommendations for ESCAP on general action programmes.

3. Description:

This project will consist of a series of professionally designed and facilitated 2 to 3 day meetings, one such meeting should be held each year at different locations.

4. Output:

A series of meetings complete with formal documentation of both the meeting proceeding as well as its conclusion.

5. Method:

a. Hire an outside meeting/group process expert to design and run appropriate 2 to 3 day programs.

b. Run the first program using the results of the 1985 IWT expert mission.

c. Using the outside process expert write up and disseminate results.

d. Review and continue the process each year.

6. Scope:

a. design and initial meeting with writing 1 man month

b. 3/4 man-month each subsequent year.

Project 71: An Immediate 2-day Seminar for ADB, World Bank and other Selected Potential Donors to Describe the Study and Build an Action Program.

1. Background

While IWT is important in the development process in much of the ESCAP Region. Very few IWT projects are funded by traditional donors. In part, this is due to a lack of awareness of the role of IWT and the potential pay-offs to ESCAP region for IWT projects.

2. Objectives

To hold a seminar for representation of donor organizations to: describe and discuss the results of this mission: inform organization of IWT potential in the development process and; clarify needed IWT projects for the ESCAP region.

3. Description

The seminar should lasttwo days and be professionally designed and facilitated.

4. Output

A post seminar document describing discussions and agreements for immediate and potential project funding.

5. Method

a. Identify and invite appropriate representative of donor organization.
b. Design service process
c. Send preliminary information and mission report to donor organization
d. Run service
e. Within 2 weeks of Seminar, document the seminar and mail back documentation to attendees.

6. Scope

a. Design, facilitation, documentation - 2 manweeks
b. Seminar: Travels and per diems for 7-12 offical for three days.

APPENDIX F

BASIS OF PERSONNEL/RESOURCE CALCULATIONS FOR IWT STUDY CENTRE ALTERNATIVES

RIVER HYDRAULICS/SEDIMENT SUBJECT AREA

The IWT subject are includes the following aspects: hydrologic at the upstream boundary and transport mechanisms and formulae; rain and run-off water level statistics and for field morphology. Far field river basins analysis, river meandering and near field analysis, water levels, navigable depths, flood control and local shoals, velocities, erosion propulsion and effects of river training, discharge, barrage operations, maintenance dredging and withdrawals. Tidal hydraulics especially the downstream boundary; water and salt motion; near field analysis around structures, and, flow pattern and maneuverability.

Also, the subject are includes the following techniques, mathematical modeling, far field base analysis for WM models, scale modelling sometimes with moveable bed, mainly near field analysis, field tests, test dredging and bandalling.

Appendix F: Basis of Personnel/Resource Calculations for IWT Study Centre Alternatives*

1) Rates

1 Professional	= US$ 100,000/year including overhead
1 Resident expert + fellow	= US$ 50,000/year
1 Administrative support person	= US$ 50,000/year
1 Typing person	= US$ 30,000/year
1 Driver	= US$ 20,000/year

2) Estimates

18-20 Professionals	= US$ 1.8-2.0 million/year
7 Experts + fellow	= US$ 350,000/year
7-10 Administrative people	= US$ 350,000 - US$ 500,000/year
5 Typing people	= US$ 150,000/year
8-10 Drivers	= US$ 160,000 - US$ 200,000/year
Travel and communications (including expenses for the technical advisory and governing board)	= US$ 300,000/year

3) Rough total estimates for personnel costs for full-scale Centre

From US$ 3.1 million/year to US$ 3.5 million/year.

4) Rough total estimate for personnel costs for a small-scale Centre

3 Professionals	= US$ 300,000
2 Administrative staff	= US$ 100,000
Funds for contracting (based on the assumption that 1 Professional can manage 2.5 Professional man-years work plus his own)	= US$ 750,000
Travel and communications	= US$ 300,000
Total	= US$ 1.5 million/year

* Estimates for physical plant, equipment procurement and operation were not included since the mission has been advised that they are likely to be provided by the Centre's host country.