BANGLADESH

DALTON · DALTON · LITTLE · NEWPORT
ARCHITECTS ENGINEERS PLANNERS

Bryan

That's a lot of work for 3 weeks. I have skim read it & am impressed

WJH

How was this job obtained by Planning Research? Is there follow-on work?

WALTER J. HOOD

AGENCY FOR INTERNATIONAL DEVELOPMENT

DEPARTMENT OF STATE

WASHINGTON, D.C.

DRAFT

SITE RECOMMENDATION REPORT

FOR

SITE SELECTION AND FEASIBILITY STUDY

BANGLADESH BULK FERTILIZER HANDLING AND BAGGING

APRIL - MAY, 1977

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Section 1

Introduction and Summary of Activities

1.1 Introduction

In accordance with the provisions of Contract No. AID/otr-c-1293, between the Agency for International Development, Washington, D.C. and Planning Research Corporation, Los Angeles, California, Contractor, the services of two specialists were provided to AID in Bangladesh for the preparation of a study and recommendations in connection with planning for the construction of facilities for unloading, temporary storage, bagging and shipping of imported fertilizers. This report is the draft site recommendation report to be submitted to USAID prior to consultants departure from Bangladesh upon completion of the requested three weeks of study.

1.1.1 Objective

The objective of the study was to determine the feasibility of establishing fertilizer bulk handling and bagging capacity in Bangladesh for imported Triple Super Phosphate (TSP) and Muriate of Potash (MP). In addition, the contractor was to recommend the location or locations for any proposed facilities which would, at least cost, provide a system of fertilizer import best serving the needs of Bangladesh for the next ten years (1978-1987).

1.3 Summary of Activities

The team consisted of a Senior Port Operations Specialist, Mr. Ernest Ball, from Frederic R. Harris, Inc. New York, and a Transportation Economist, Mr. L. Brian Browne, from the Los Angeles office of Economics Research Associates, both FRC companies. Upon arrival of Mr. Browne from California on 10 April, 1977 the team departed New York on 11 April, arriving in Bangladesh on the morning of 13 April. Working a seven day week, the team met with AID, UN and Bangladesh Government officials and reviewed and collected available data during the period of 13-18 April. In addition a site visit to the river port of Narayanganj was undertaken. On 19 April, accompanied by Mr. Robert Gonsalves, of the AID staff in Dacca, the team went to the principal port of Chittagong for the evaluation of potential sites there. While there a survey of the condition of the unloader at the cement clinker plant was carried out. The survey report is contained in Appendix Section 3. The cement plant, the TSP plant and other properties in the area were examined as potential sites for the subject facility. Evaluations of these locations are contained in Section 3, alternatives and completed site questionnaires will be found in Appendix Section 2. On 21 April, the team proceeded to Khulna in southwest Bangladesh, where they visited the Port Director and inspected Khulna Port facilities. On the 22nd they travelled by water to the site of the new deepwater port of Mongla, now under construction on the Pasur River, some 30 miles

south of Khulna. Returning to Dacca, the team commenced preparation of the site recommendation draft report, and met with additional AID officials for further data. A list of persons contacted during the study is contained in Table 1.1. The report was reviewed with AID on 2 May, and discussed with Bangladesh Government officials on 3 May. The draft report was submitted to the AID Mission in Dacca on 3 May and the team departed Bangladesh on 4 May, 1977.

TABLE 1.1

Bangladesh Government Officials and other foreign Experts contacted during Team visit:

Bangladesh Officials Interviewed:

Md. Mujibur Rahman	General Manager Bangladesh Chemical Industries Corp.
Mr. A.N.M. Yusuf	Member-Director Bangladesh Agricultural Development Corp.
Mr. M.K. Kobad Hussain	Manager of Sales Bangladesh Agricultural Development Corp.
Dr. Alam Shamsul Huq	Director of Production Bangladesh Chemical Industries Corp.
Mr. Sadrul Alam	General Manager Chittagong ESP Plant
Mr. Golam Kibria	Chairman Chittagong Port Trust Authority
Mr. K. R. Zaman	Chief Financial Officer Chittagong Port Trust Authority
Capt. S. Y. Kamal	Manager of Operations Chittagong Port
Mr. Moazzem Hossain	Deputy Manager (Shipping) Bangladesh Agricultural Development Corp. Chittagong
Mr. Badrul Islam Siddiky	Regional Manager Bangladesh Agricultural Development Corp. Chittagong
Mr. Altaf Uddin Miah	Maintenance Manager Chittagong ESP Plant
Capt. S. M. A. Kalam	Port Director Khulna/Chalna Port
Mr. M. Kibria	Port Executive Engineer Mongla Port Development
Mr. James L. Mendes	Commercial Manager Bangladesh Shipping Corp.

Mr. Lutfar Rahman	Director, Traffic, Deputy Secretary, Ministry of Communications (Ports, Railway and Inland Navigation)
Mr. M. Chisti	Section Officer, Ministry of Communication (Ports and Shipping)
Mr. A. M. Talukdar	Deputy Chief, Bangladesh Transport Survey Planning Commission
Mr. A. Shajahan	Deputy Secretary Ministry of Communication (Railways)
Mr. Zahurul Huq	Commercial Manager Bangladesh Inland Waterways Transport Corp.

Foreign Experts providing information:

Mr. H. Miermans	Port Operations, Management & Shipping Expert, Netherlands Economic Institute Chittagong Port Entrance Study
Mr. Boris Rafajlovic	Project Manager and Chief Engineer Chalna Port Project - Mongla Ivan Welutinovic - PIM Yugoslav Construction Company
Mr. H. A. Dare	Project Manager Chittagong Port Construction Frederic R. Harris, Inc. US Engineering Firm
Mr. Milton Gertsch	United Nations Development Program Agricultural Expert
Mr. John R. Cuthbertson	Consulting Economist Transport Study Group
Mr. Hector Davidson	First Secretary British High Commission (AID Agr.)

AID Personnel assisting in the study:

Mr. D. J. Alter, Capital Development Officer

Mr. Robert Gonsalves, Transportation Section

Mr. James E. Gardner, Engineering Division

Mr. Emory M. Howard, Chief, Agriculture Division

Section 2

Conclusions and Observations

2.1 Conclusions

Following observation and study of the Bangladesh fertilizer transport system and examination of alternative sites for location of bulk storage and bagging facilities, the consultants concluded that in order to provide a system of fertilizer import best serving the country's needs over the period 1978 through 1987 there is only one feasible solution. That solution is the importation of TSP and MP in bulk and the establishment of a bulk storage and bagging facility on the grounds of the TSP plant in Chittagong. The reasons for reaching this conclusion follow.

2.1.1 Bulk Imports Versus Bagged Imports

A comparison of cost of purchasing and receiving fertilizer from shipping port in bulk or bagged to on board Bangladesh inland transport is shown on Table 2.1. As can be seen on the table, there is a potential saving of $20.00 per ton, by switching to the purchase of imported fertilizer materials in bulk, and storage and bagging at Bangladesh port of entry. It should be noted that the figures shown on Table 2.1 represent independent estimates of the consultants, and are not taken from USAID or the estimates of others. These figures will be verified by the team upon their return to USA, where current figures can be obtained. It is interesting to observe that the $20.00 saving is the same number calculated by AID using their own source data.

Table 2.1

Comparison of Costs 1/

Bulk Fertilizer Imports versus Bagged Imports

(Costs are in US $/ton)

Cost Category	In Bulk	In Bags	Difference
Material Cost 2/	Same	Same	-0-
Cost of Bags 2/	-	8.00	+8.00
Cost of Bagging 2/	-	2.50	+2.50
Export Stevedoring 2/	1.50	7.00	+5.50
Ocean Freight 3/	16.00	20.00	+4.00
Import Stevedoring	1.00	5.00	+4.00
Port Charge	.50	1.00	+ .50
Handling to Storage	.50	1.00	+ .50
Storage at Port (2 months) 4/	.80	1.60	+ .80
Cost of Bags	5.00	-	-5.00
Cost of Bagging	1.50	-	-1.50
Loading out cost 5/	1.00	1.00	-
Shrinkage 6/	1.50	.85	- .65
Demurrage on Vessel 3/		2.00	+2.00
Total	$29.30/ton	$ 49.95/ton	$ 20.65/ton

1/ Costs are estimated subject to verification upon return to US.

2/ Costs are basis FSP originating US Gulf or East Coast Port 1976.

3/ Chartered Vessel non-US Flag, ± 10,000 tons full parcel.
L/D rates: Bulk 2,000T/day; Bag 1,000T/day; Demurrage $4,000/day.

4/ Assumes Bulk Storage cost of own facility. Bag storage at Port Transit.

5/ Example in cost of loading to truck or rail.

6/ Bulk Shrinkage 1.5% Bagged Shrinkage .75%

2.1.1.1 Potential Cost Saving

Table 2.2 lists the projected demand for imported TSP and MP over the study period. Further details of projected domestic production and consumption of fertilizers by the Bangladesh agricultural economy are contained in Appendix 1.

Table 2.2

Projected Demand for Imported TSP and MP
Bangladesh, 1978 thru 1987 1/

	Tons
1977-78	121,000
1978-79	146,000
1979-80	176,000
1980-81	210,000
1981-82	250,000
1982-83	295,000
1983-84	347,000
1984-85	407,000
1985-86	477,000
1986-87	556,000
10 year Total	2,985,000
10 year average	298,500

1/ Computed from the following sources:

1) Economics Intelligence Unit, Ltd. Interim Report, Jan.1977 Bangladesh Fertilizer Marketing and Distribution Study.

2) AID Projections.

See Appendix Section 1

According to the projected increases in demand shown above, imports of TSP and MP are forecast to rise from an estimated 121,000 tons/year in 1978 to 556,000 tons/year in 1987, and to average about 300,000 tons/year during the study period. Importing and storing this volume in bulk and bagging it in Bangladesh should generate a significant saving. Raw saving before capital cost on an average of 399,000 tons/year at $20/ton would be $6.0 million per year. A cost/benefit analysis for the recommended solution is found in Section 4.

2.1.1.2 Internal Distribution in Bags or Bulk

The team observed and studied the present transport and storage system of Bangladesh and investigated future planning for the project period. They observed a lack of internal transport equipment for and experience in the handling and control of bulk materials. Based on these observations it was concluded that fertilizers should be bagged at the port prior to shipment, and that internal transport should be in bags. Transport in bulk to interior storage and bagging facilities should not be considered at this time for the reasons contained in the description of the internal transport system in the following section.

2.2 Observations

2.2.1 Summary of Field Observations

2.2.1.1 Site Visits

The team inspected six potential sites for the proposed facility.

The sites visited were the following:

- Narayangaaj Port
- Chittagong ESP Plant
- Chittagong Cement Plant
- Chittagong Main Port
- Khulna/Chalna Port
- Mongla New Port Site

Site questionnaires describing conditions and observations for each site are contained in Appendix Section 2.

2.2.1.2 Fertilizer Distribution

During the field trips the team was able to observe the condition of the existing fertilizer (godown) storage system, which has been discussed in detail in the EIU report, and can confirm that the physical condition and capacity of these facilities leaves much to be deserved. Further it was observed that delivery of fertilizer to the ultimate users in certain remote areas must be by country boat. However, it could not be confirmed that water delivery would be the major mode, as discussed below and in Section 2.2.2 Transport.

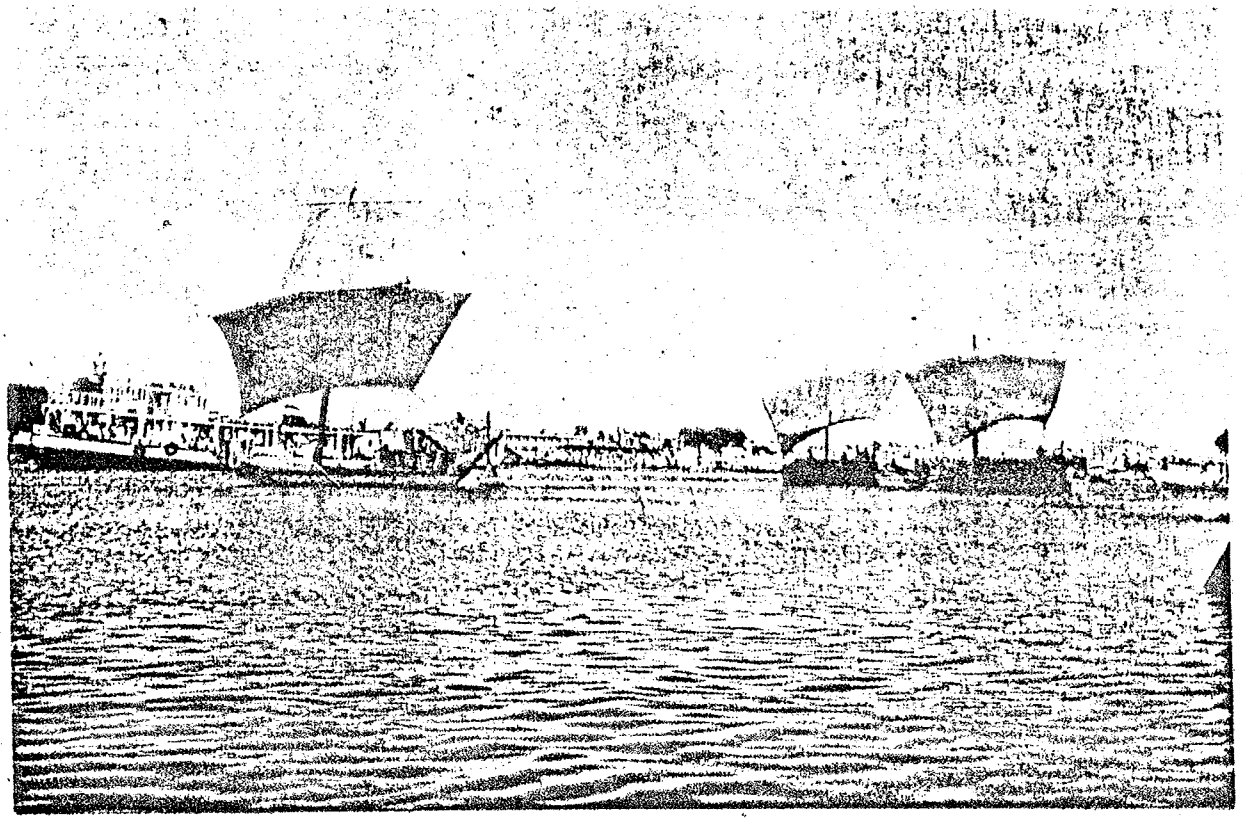
2.2.1.3 Transport Observations

During the field trip to Khulna, observation was made of the highway and rail system between Jessore and Khulna. Two way traffic was easily maintained by trucks and buses on the highway, and side roads leading to other towns and villages appeared to be in good condition, many of them paved. Much

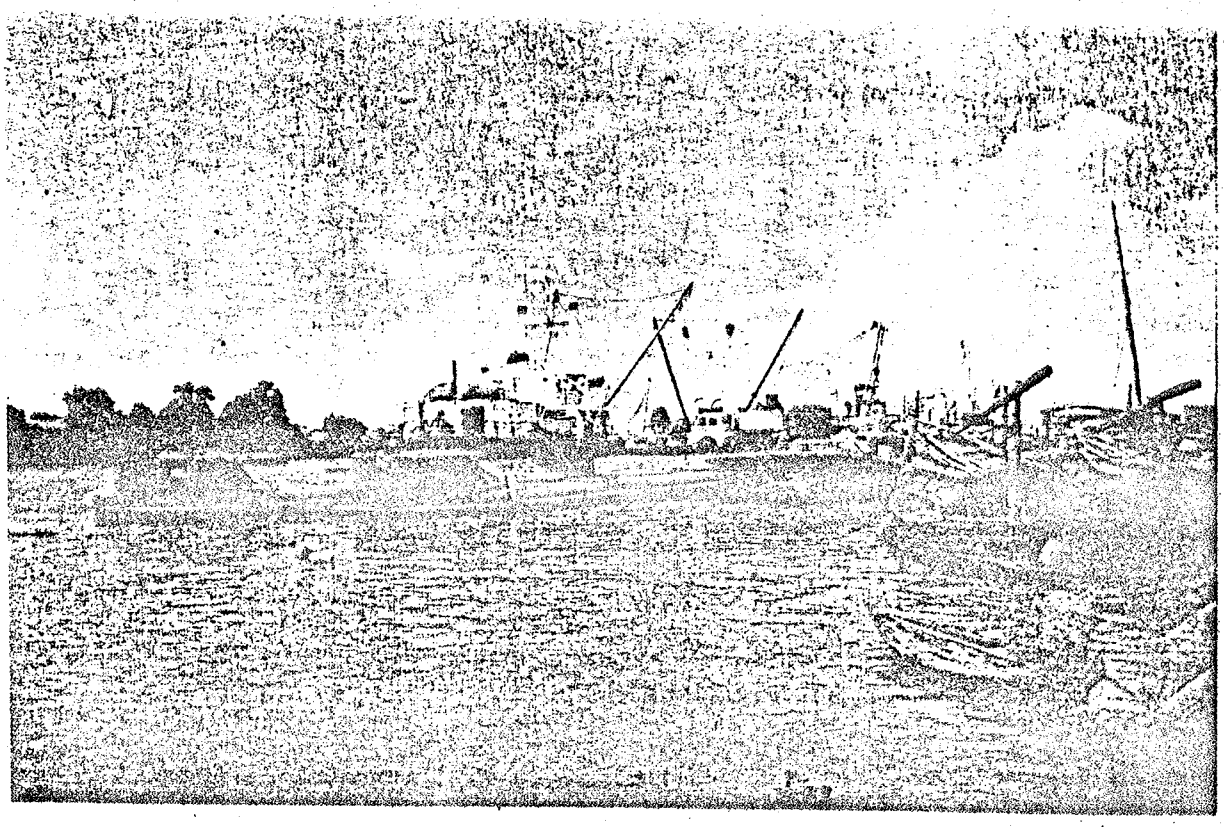
truck traffic was observed, generally heavily laden, and consisting principally of 7½-8 ton stake body trucks. The rail track appeared to be in good condition but little traffic was observed, and few rail cars were seen in Khulna. With regard to waterway traffic, which the team was able to observe in action on the Pusur River, it was seen to consist of extremely slow wooden craft, also heavily laden to perhaps 40 tons (the largest observed) and powered by pars, by current or by sail. In the opinion of the team, regardless of the number of such units, this mode of transport should not be considered as a significant carrier for any distance. Final delivery perhaps, to inaccessible locations where no alternative exists. Figure 2.1 shows photos of water crafts seen in the river. Barge traffic on the Pusur river was very light, despite the fact that there were 6 ships unloading at the Mongla anchorage. Not more than 8 barges were observed, one being about 100 DWT, travelling light down river. The remaining barges were alongside vessels and were of a variety of types, from 100 to 200 DWT. Khulna had 4 barges being unloaded during the visit to that port. It is the team's belief that a much more extensive watercrafts fleet would be required if an increase in effective water transport movement is to be attained.

FIGURE 2.1

RIVER CRAFT OF BANGLADESH



A BANGLADESH RIVER PORT



2.2.2 The Internal Transport System

Movement of goods by surface transportation modes in Bangladesh is performed by an integration of the road, rail, and water systems. Table No. 2.3 delineates the extent of the inland route mileage for each system during the period 1970-71 to 1974-75.

A review of table No. 2.3 indicates that in 1974-75 rail route mileage comprised 12.8% of the total route mileage; road mileage accounted for 50.9%; and river systems provided 36.3%. During the period studied, growth of rail mileage was negligible, while aggregate road mileage grew at an annualized rate of 2.2%. During the same period river routeage showed an analogous pattern to that of rail in that its annualized percentage change was only .2% (.1% for rail).

Table No. 2.4 presents the consultants estimate of aggregate commodity flow by surface modes during the period 1970-71 to 1974-75. In 1974-75 it was estimated that percentage tonnage carried by rail, road, and water was respectively 20.7%, 54.1%, and 25.2%. The historical evolution of the various modal tonnage performed during the period studied (1970/71 - 1974-75), indicates that rail's share of the tonnage production declined from 3.4 million tons in 1970-71 to 2.4 million tons in 1974-75. This represented an annualized percentage decline of -8%. However, during the 5 year period, road transportation increased its share of tonnage carried from 43.5% (4.6 million tons) to 54.1% (6.3 million tons). This significant increase

in road uplift represented an annualized growth rate of 7.8%. In the same period, waterway traffic increased from 2.6 million tons in 1970-71 to 2.9 million tons in 1974-75. However, while annual tonnage performance increased by 2.5%, market share remained relatively stagnant, 24.9% to 25.2%.

In order to quantify the impact upon the total system of route mileage and tonnage production regarding route changes and work performed per system, the consultants computed the ratios of the relative changes. It was found that the rail system ratio was .80; the road system ratio 5.6; and the river system 2.5. The efficacy of applying this statistic to the railway system must be tempered by the deterioration that has been inflicted upon the railways by external events beginning during world war II. For a discussion of the specific causes of this deterioration see the Ministry of Communications, Government of the People's Republic of Bangladesh, "Requirements of External Assistance for the Rehabilitation and Development of Surface Transport and Communication" (August 1976, pp 1 - 8). While acknowledging the obvious defects in this approach, it was the consultants opinion based on statistical information and site observation that unit modal systems such as truck had significant "production" flexibility in terms of the developing Bangladesh environment. This point is discussed further in Section 2.2.2.1. This proven flexibility, coupled with the

10.1% annual growth rate in the national truck fleet for the period 1964-65 to 1973-74 was considered indicative of the particular effectiveness and reliability of the truck as a major primary transport system for Bangladesh.

Table No. 2.5 presents a summary statement of the comparative historical analysis performed with respect to the inland transportation distribution system. This table draws together much of the data discussed in text and found in various tables.

MILAGE FOR BANGLADESH SURFACE TRANSPORTATION SYSTEM[1]

Year	Railways					Road			
	Broad Gauge	Meter Gauge	Narrow Gauge	Total Rail	% Total	High type 2 (a)	Low type 2 (b)	Total Road	% Total
1970-71	595	1,181	(19.75)	1,776	13.6	4,481	1,874	6,335	48.3
1971-72	595	1,176	(19.75)	1,776	13.4	4,526	1,907	6,433	48.5
1972-73	610	1,176	(19.75)	1,736	13.3	4,596	2,052	6,021	49.2
1973-74	610	1,176	(19.75)	1,786	13.1	4,657	2,102	6,759	49.7
1974-75[3]	610	1,176	(19.75)	1,786	13.0	4,718	2,184	6,902	50.2
1975-76	610	1,176	(19.75)	1,786	12.8	4,808	2,269	7,077	50.9
Annual % Rate of Change	.5%	-.08		.1%		1.4%	3.9%	2.2%	

1 Bangladesh Statistical Abstract 1973-74, PP 245 250 256
2 (a) High type refers to roads having cement, concrete or bituminous, cements surfaces or bituminous surface.
(b) Low type refers to roads generally of stones, bricks, gravel or ordinary earth roads properly aligned with drainage structure provided.
3 Figures 1974-75 - 1975-76 consultants estimate.

Year	Navigable Waterways				Total Mileage All systems
	Perennial	Seasonal	Total Water Ways	% Total	
1970-71	3,352	1,643	4,995	38.1	13,106
1971-72	3,352	1,695	5,047	38.1	13,256
1972-73	3,352	1,695	5,047	37.5	13,456
1973-74	3,352	1,695	5,047	37.1	13,592
1974-75	3,352	2,695	5,047	36.7	13,736
1975-76	3,352	1,695	5,047	36.3	13,910
Annual % Rate of Change	0%	.6%		1.2%	1.2%

Table 2.4

Estimated Annual Tonnage Carried by all Modes of Surface Transportation

	RAIL		ROAD		WATERWAYS		TOTAL
Year	Tonnage	% Total	Tonnage	% Total	Tonnage	% Total	
1970-71	3,347,000	31.5%	4,636,695	43.5%	2,640,000	24.9%	10,623,695
1971-72	1,073,000	12.4%	4,943,648	57.1%	2,645,280	30.5%	8,661,928
1972-73	2,830,000	25.4%	5,491,020	49.4%	2,803,997	25.2%	11,125,017
1973-74	2,603,600	23.1%	5,805,188	51.5%	2,860,076	25.4%	11,268,864
1974-75	2,395,312	20.7%	6,269,603	54.1%	2,917,278	25.2%	11,582,193
Annual Percentage Change	-8%		7.8%		2.5%		2.2%
% Change Ratios	(-80)		5.6		2.0		

Source: Consultants

Table 2.5

Annualized Percentage Changes by Mode and Route for
Inland Distribution of Fertilizer
and Aggregate Commodity Movements

(Production/Route Ratio)

	Rail	Road	Water	Total
Fertilizer Chittagong	-20.5%	17.3%	2.0%	4.7%
All Commodities Chittagong	- 4.6%	5.0%	7.2%	3.1%
Aggregate Mileage Bangladesh Transportation System	.1%	2.2%	1.2%	1.2%
Aggregate Tonnage Bangladesh Transportation System	- 8.0%	7.8%	2.5%	2.2%
RATIO = $\frac{\%\text{change tonnage}}{\%\text{change route mileage}}$	(-80)	5.6	2.0	1.8

Source:
Consultants

2.3.2.1 The Bangladesh Road System

The main road system of Bangladesh is made up of approximately 4,808 miles of high type roads and 2,269 low type roads. High type refers to roads having cement, concrete or bituminous surfaces. Low type refers to roads generally of stone, bricks gravel or ordinary earth roads properly aligned and with drainage structure provided. A review of the literature indicates that of the 4,788 high type road miles noted in the statistical abstract only 2,394 miles are fully bituminous and of that the Ministry of Communications considers only 1200 miles as falling into the category of a primary truck system.

The primary and secondary road systems are interdicted by numerous waterways. It has been estimated that the main road system is divided into 30 Ferry River Crossings. Additionally, it is calculated that the secondary feeder systems at the district and Thana level have roadage equal to 20,000 and 30,000-40,000 miles. While acknowledging the constraints of terrain, climate and structural deficiencies, it would appear that a usable road infrastructure is emerging in Bangladesh. A review of Table No. 2.6 "Number of trucks registered 1964-65 to 1973-74", indicates that the number of trucks increased from 7,077 trucks to 16,778 in 1974. This represented an annual increase of 10.1% for the nine year period. However, while acknowledging that internal problems during

1970 caused a sudden spurt in truck registration in 1970-71. It is of interest that recorded annual rates for the following three year period remained consistently high, e.g., 1971 to 1972 = 6.73, 1972 to 1973 = 6.28; 1973 to 1974 = 5.72. A review of aggregate traffic statistics as presented in Table No.2.4 indicates that in the years immediately following the war of liberation most of the tonnage lost by the rail system appears to have been taken up by road transportation.

A large proportion of the trucks in Bangladesh are operated in the private sector. However, the Bangladesh Road Transport Corporation, a publicly owned entity, does operate some vehicles. Most of the trucks are assembled locally and have a capacity of approximately 7 tons. However, manufacturers stated capacity is usually exceed by up to 50%.

Table No.2.7 outlines the geographical distribution of truck registration in Bangladesh. Reference to this table indicates the concentration of trucks at Chittagong relative to other areas. There were approximately 3690 registered trucks in the Chittagong area versus an estimated 1914 of the larger Dacca region. This largely is attributed to the requirement for quick unloading/loading of imports/exports at the Chittagong port site. Observations at Chittagong Port indicate that trucks proved the most responsive to sudden surges in freight haulage demands.

A review of the Statistics presented in Tables No.2.4 and No.2.5 and summarized in a comparative basis in Table No.2.5 indicates

that road traffic is proving an effective mode for freight haulage in Bangladesh.

The consultants believe that the following reasons outline some of the advantage of truck transport over other modes on parallel "competitive" traffic hauls. This has been found to be the case with primary fertilizer distribution. These reasons are:

- Trucks require relatively small initial capital outlays. Additionally these outlays are in most cases generated from the private sector and returns on investment are internalized by this sector.
- Trucks are versatile in their mode of operation, and provide a point to point (where geographically possible) pick up and delivery system.
- Trucks because of their speed range and variable load factor can readily adapt their mode of operation to changes in demand for their use.
- In Bangladesh, truck maintenance costs which are often largely labor costs are minimized.
- Continuing development of a road infrastructure in Bangladesh appears to be achieving the highest marginal return per mile of development. See Tables No. 2.4 and 2.5, where percentage of road tonnage freight productivity is found to be the highest per percentage change in route infrastructure (% change in tonnage productivity ÷ % change in route infrastructure).

It is not suggested in the above that the total freight transportation system be turned over to trucks. What has been indicated by this exercise of comparative analysis is that the trucking industry has shown great flexibility and adaptability in providing (especially short term) solutions to changes in demand for haulage capacity. The consultants see trucks as integral to their selection of a site for the proposed facility. However, the availability of a complimentary and integrated (rail, road and water) network has been a requirement in determining the site selection. These considerations have all been evaluated in terms of the time constraints related to the proposed facility.

Table No. 2.6

Number of motor Trucks registered in 1964-65 to 1973-74

Year	Number of Trucks Registered
1964-65	7,077
1965-66	7,067
1966-67	7,241
1967-68	8,507
1968-69	8,844
1969-70	9,608
1970-71	13,397
1971-72	14,283
1972-73	15,870
1973-74	16,778

Source: Ministry of Communication.

TABLE NUMBER 2.7

Number of trucks registered/disposed clasified by districts and by weight and by kind of fuel used as on 31st. December, 1973

District	Trucks										Truck/Tractor Units		Truck Trailor or Semi Tractor	Total	
	Up to 2 tons		Over 2 tons to 5 tons		Over 5 tons to 8 tons		Over 8 tons		Total						
	P	D	P	D	P	D	P	D	P	D	P	D	P	P	D
1. Dacca ...	271	...	204	795	...	644	...	...	475	1,439	25	186	72	572	1,625
2. Mymensingh ...	5	2	11	104	...	27	...	...	16	133	...	...	...	16	133
3. Faridpur ...	5	...	22	2	...	13	...	...	27	15	...	...	...	27	15
4. Bakergani ...	12	...	46	...	8	...	...	...	66	...	...	...	...	66	...
5. Chittagong ...	243	509	537	1,618	63	168	6	37	849	2,332	10	24	...	859	2,356
6. Chittagong H.T....	147	23	183	1	144	...	8	3	482	27	88	...	...	570	27
7. Sylhet ...	...	4	12	2	405	3	1	...	418	9	6	287	321	745	296
8. Noakhali ...	12	3	100	76	...	93	...	...	112	172	...	2	...	112	174
9. Comilla ...	...	...	131	16	23	18	36	14	190	48	19	26	5	214	74
10. Khulna ...	17	1	32	16	40	20	3	44	92	81	9	...	9	110	81
11. Jessore ...	15	...	162	130	1	89	...	18	178	245	...	28	...	178	273
12. Kushtia ...	6	...	43	14	7	60	...	2	56	76	...	22	...	56	98
13. Rajshahi ...	1	6	45	44	8	4	...	...	54	54	54	...	11	119	54
14. Dinajpur ...	3	...	40	81	...	42	...	8	43	131	12	55	...	55	186
15. Rangpur ...	17	...	82	48	...	5	...	...	99	53	30	15	8	137	68
16. Bogra ...	54	1	91	45	24	9	12	38	181	93	26	29	4	211	122
17. Pabna ...	...	...	42	2	8	142	...	...	50	144	7	1	2	59	145
Total	803	549	1783	3002	731	1337	66	164	3383	5052	286	675	432	4106	5,727

Notes : P—Petrol, D—Diesel.

Source : Ministry of Communication.

2.2.2.2 The Rail System

The rail system of Bangladesh has a nominal route mileage of 1,786 miles. The Bangladesh statistical abstract reports that of this guage, and 1,176 miles are meter guage. This statistical source shows that there are 115 steam and 34 diesel locomotives on the bread guage segment, and 223 steam, and 144 diesels on the meter guage. The meter guage is spread throughout the country in both east/west and north/south orientations. The bread guage is located in west Bangladesh and connects the Khulna area with north Bengal crossing the narrow guage system at 3 points.

Tables No. 2.8 "Route mileage and stations by guage of Bangladesh Railways - 1964-65 to 1973-74," No. 2.9 "Rolling stock of Bangladesh Railways by gauge and type category - 1964-65 and 1973-74," and No. 2.10 "Freight carried by Bangladesh Railways classified by commodity - 1969-70 to 1972-73" presents a review historical of the freight/handling capacity of the Bangladesh Railways. These tables indicates that the Bangladesh Railways are showing a decline in all major production indicators. This is particularly the case in the basic criterion of performance; namely freight carried. In the years 1969-70 to 1972-73 for which statistics were available, commodity haulage fell from 4.8 million tons to 2.8 million, an annual decline of 16.2%.

The Bangladesh Government in their document "Requirements for External Assistance for the Rehabilitation and Development of Surface Transport and Communications - Railway Rehabilitation Programme, (August, 1976), notes; "...the condition of the Bangladesh Government Railways has deteriorated to an extent that frequent derailments and engine failures while on the run have become almost a routine affair. Unless immediate remedial measures are taken the entire railway system may collapse in a couple of years."

The reasons outlined in the above document for this condition are summarized as follows:

- The damages sustained by the railway during World War II had not been repaired before partition of the country.
- During the period of liberation "300 bridges and almost all the important railway stations near the border were completely damaged, 71 miles of railway track were destroyed, 722 units of passenger coaches, 1484 units of freight wagons, 140 units of locomotives and 20 marine craft were seriously damaged. Besides 12 diesel locomotives and 24 steam locomotives were damaged beyond repair."
- This period also had a serious impact upon the skill base of the system in that the above mentioned Government publication further adds "1300 railway employees including experienced officers and skilled workers lost their lives."
- Since the war of liberation lack of capital and scarcity of foreign exchange has constrained the railway maintenance

program to "25% of maintenance work that could be carried out."

The conclusion of the consultants, based on data research and site evaluation was that for the immediate near term rail transportation would not be the primary method for distribution from the proposed bulk handling facility. The consultants do not preclude the eventual greater long term utilization of rail as a primary transportation mode. In this connection the Government of Bangladesh has outlined a planned "Railway Rehabilitation Program". The basic elements of this program are detailed in the Government document entitled: "Requirements for external assistance for the rehabilitation and development of surface transportation and communications; Government of the People's Republic of Bangladesh" (20th August, 1976).

This conclusion was reinformed by two other major constraints:

- The geographic cleavage of the country into a series of segmented sub regional transportation systems, without connecting bridges to facilitate the smooth flow of freight tonnage; and
- A two guage rail system (meter and broad). This dichotomy of the rail system imposes economic costs necessitated by freight transfers from one guage system to the other.

The broad guage line between Khulna and north Bengal provides the basis for a north south corridor. This link will become more valuable with the development of Mongla Port and bridging of the Hugli River. However, in the time-frame of this study it has a limited use for a primary distribution system.

TABLE NUMBER 2.8

Route mileage and stations by gauge of Bangladesh Railway, 1964-65 to 1973-74.

Year	Broad gauge		Metre gauge		Narrow gauge		Total	
	Station	Route mileage	Station	Route mileage	Station	Route mileage	Station	Route mileage
1964-65 ...	140	546	284	1,147	10	19.75	434	1,713
1965-66 ...	141	546	289	1,147	10	19.75	440	1,713
1966-67 ...	141	554	292	1,139	10	19.75	443	1,713
1967-68 ...	141	554	299	1,178	10	19.75	450	1,752
1968-69 ...	141	554	300	1,178	10	19.75	451	1,752
1969-70 ...	156	573	310	1,202	...	...	466	1,775
1970-71 ...	156	595	311	1,181	...	...	467	1,776
1971-72 ...	156	595	311	1,181	...	...	467	1,776
1972-73 ...	159	610	312	1,176	...	...	471	1,786
1973-74 ...	161	610	314	1,176	...	...	475	1,786

Source : Bangladesh Railway.

Source Bangladesh Statistical Digest 1974 -75

TABLE NUMBER 2.9

Rolling stock of Bangladesh Railway by gauge and type or category, 1964-65 to 1973-74.

Year	Locomotives.							Coaching vehicles		Freight wagons	
	Broad gauge		Metre gauge		Narrow gauge		Total	Passenger carriages	Other coaching vehicles	Unit	Four wheelers
	Steam	Diesel	Steam	Diesel	Steam	Diesel					
1964-65	133	...	243	102	7	...	485	1,295	495	19,509	22,682
1965-66	133	...	240	102	7	...	482	1,346	485	19,303	22,481
1966-67	133	18	237	102	4	...	494	1,278	479	18,792	21,907
1967-68	131	18	235	101	4	...	489	1,240	457	18,306	21,396
1968-69	121	18	229	101	4	...	473	1,208	483	17,582	20,523
1969-70	121	18	222	125	6	...	492	1,192	479	16,835	19,628
1970-71	118	27	222	125	6	...	498	1,189	468	16,290	18,979
1971-72	118	30	222	125	6	...	501	1,179	460	16,071	18,720
1972-73	115	34	223	128	...	...	500	1,195	479	16,100	18,667
1973-74	115	34	223	144	...	...	516	1,247	453	16,081	18,573

Source : Bangladesh Railway.

Source Bangladesh Statistical Abstract 1974-75

TABLE NUMBER 2.10

-Freight carried by Bangladesh Railway classified by commodity, 1970-71 to 1973-74

('000' Tons)

Commodities	1969-70		1970-71 (July-June).		1971-72 (a) (July-June).		1972-73 (July-June).		1973-74	
	Tons	P.C.	Tons	P.C.	Tons	P.C.	Tons	P.C.	Tons	P.C.
1. Rice ...	452	9.41	...	...	270	25.16	157	5.55	...	..
2. Paddy ...	71	1.48	...	...	43	4.00	42	1.48	...	..
3. Wheat ...	613	12.8	...	...	281	26.19	670	237	...	..
4. Provisions ...	98	2.04	...	...	22	2.05	59	7.09	...	...
5. Other grains ...	...	...	...	...	7	0.65	39	1.38	...	..
6. Fruits and vegetables, fresh	248	5.16	...	...	79	7.36	91	3.22	...	.
7. Sugar refined and unrefined	85	1.77	...	...	16	1.49	49	1.73	...	..
8. Salt ...	99	2.09	...	...	28	2.61	66	2.33	...	..
9. Vegetable Oil ...	12	0.25	...	...	3	0.28	2.3	0.81	...	.
10. Molasses ...	24	0.50	...	...	11	1.03	2.0	0.71	...	..
11. Livestock ...	1	0.02	...	...	2	0.19	2	0.07	...	..
12. Gram and pulses	53	1.10	...	...	16	1.49	1.4	0.49	...	..
13. Tobacco ...	20	0.42	...	...	1	0.09	2	0.07	...	..
14. Jute, raw ...	654	13.6	...	...	80	7.46	355	12.5	...	..
15. Military traffic	16	0.33	...	...	1	0.09	9	0.32	...	..
16. Jute, manufactured	46	0.96	...	...	3	0.28	16	0.57	...	..
17. Cotton, raw ...	33	0.69	...	...	2	0.19	3	0.11	...	...
18. Cotton, manufactured	3	0.06	...	...	2	0.19	4	0.14	...	..
19. Coal ...	136	2.83	...	...	11	1.03	175	6.18	...	..
20. Cement ...	287	5.98	...	...	17	1.58	112	3.96	...	.
21. Iron and steel wrought	184	3.83	...	...	13	1.21	51	1.80	...	.
22. Firewood and other fuel	22	0.46	...	....	2	0.19	6	0.21	...	.
23. Wood, unwrought	55	1.15	...	...	3	0.28	18	0.64	...	.
24. Fuel for the Railway	...	...	...	...	26	2.52	103	3.82	...	...
25. Fodder ...	5	0.10	...	...	2	0.19	6	0.21	...	...
26. Marble and stone	137	2.85	...	...	5	0.47	150	5.30	...	...
27. Oil fuel ...	152	3.17	...	...	16	1.49	47	1.66	...	..
28. Petrol ...	19	0.40	...	...	1	0.09	5	0.13	...	..
29. Oil seeds ...	18	0.37	...	...	3	0.28	21	0.74	...	..
30. Railway stores and materials other than fuel.	363	7.56	...	...	18	1.68	129	4.55	...	...
31. Kerosene oil ...	191	3.98	...	...	13	1.21	76	2.69	...	
32. All other commodities	705	14.7	...	...	76	7.08	205	10.8	...	.
Total	4,802	...	3,347	...	1,073	...	2,830	...	...	..

Notes : Percentage to the total tonnage carried. (a) Fgures from 16—12—71 to 30—6—72.

Source : Bangladesh Railway.

Source Bangladesh Statistical Digest 1974-75

2.3.2.3 The Waterway System

Bangladesh is divided by four main rivers, The Ganges, Jamuna, Padma and Meghna.

Under favorable geographic and hydrological conditions there are 3,352 miles of perennial and 1,695 miles of seasonal waterways in Bangladesh. Table No.2.11, "Water Transport Operations under Bangladesh Inland Water Transport Authority, 1964 to 1973-74," relates the historical evolution (during the nine year period) of the waterways to; 1. Navigable waterways (miles), and 2. Volume of cargo handled. For the period for which data was available inland water transportation performed an average of 2.75 million tons of cargo handled. During this period (1964-65 - 1970-71). Variation in tonnage carried was small, indicative of this was the small standard deviation computation of 0.13 million tons. What appears relevant from these statistics is that transport flows on inland waterways are static but also stable as indicated in the 1970-71 figures. In addition to the inland system there are approximately 200 miles of coastal water ways.

In 1967 a system of classification of waterways was developed by NEDECO. This system is based on the concept that routes should have guaranteed channel depths, and where "economically

justified" be equipped with navigational aids. The Bangladesh Inland Water Transport Authority (BIWTA) has followed this system of classification.

Waterways are classified into the following three groups

- Class I routes - waterways for which specific depths are (or should be guaranteed).
- Class II Route - waterways for which depth estimates are given and regularly checked, and for which navigational aids are (or should be) provided.
- Class III routes - Routes of local importance, for which only approximate depths are providing.

The major inland waterways link the inland ports of Dacca, Narayanganj, Chandpur, Barisal, and Khulna together with the maritime ports of Chittagong, Chalna, and the Outer Anchorage. Also, it is envisioned that the proposed port at Mangla (Chalna Anchorage) will become a major inland river/maritime interface. These existing routes are all Class I waterways which have an estimated year round depth of 12 feet. The Mongla-Chaalakhali Canal has recently been improved to the point where it is reported to be able to handle boats with a minimum draft of twelve feet on a year round basis.

Other routes which are significant for inland distribution by route and classification are:

- Goalundo ghat to Nagarbari ghat
  - Class I River but difficulty is encountered in maintaining it in the dry season due to siltation.
- Goalundo ghat to Chilmari - Class III Route along the river Padma River with a natural minimum draft clearance of six feet as far north as Bahadurabad.
- Chatak to Fenchuganj - is the main water way in north-east Bangladesh and is classified as a class III system using the Surma and Kushiyara Rivers. The draft on these rivers is often 3 feet or less, constraining the use of inland water transportation from the Fenchuganj Fertilizer Factory.

A whole spectrum of vessel ply the inland waterways. These range from hand propelled country boats up on through to larger type coastal craft of 500 tons displacement. These crafts are both public and privately owned. The main public entity utilizing riverine craft is the Bangladesh Inland Water Corporation (BIWTC). In 1972 the BIWTC acquired 603 vessels with an aggregate capacity of 144,726 tons (average of 238 tons/craft) and by 1976 they had added an additional 161 water-

craft with a tonnage capacity of 55,000 tons (341 tons/craft). However, many of these vessels are old and are being disposed of (200 with a tonnage of 30,000 tons).

The Ministry of Communications comments that of the total registered inland waterway fleet - "about 25% of them remain non-operational all the time due to the nonavailability of replacement engines and other major component parts. Existing repair workshop facilities in the country are very much inadequate to cater for the demands for such a cargo fleet. Moreover, the workshop machineries and equipment had become obsolete and worn out and as such are required to be replaced on an urgent basis." In the content of sustaining and development projects the Ministry notes; "There are about 19 on-going projects and 10 new development projects in the IWT sector involving an estimated total cost of Tk. 706.80 million including Tk. 296.3 million in foreign exchange and Tk. 544.74 million including Tk. 59.00 million in foreign exchange respectively."

In terms of use of waterways the consultants noted the following advantages.

- The natural low cost, easily accessible nature of waterways provided by the delta geography of Bangladesh.

- The existence of a large number of craft of varying sizes in both the public and private sector. These craft have considerable flexibility in regard to various volume demands.
- The low unit cost per ton of cost generated by use of river craft - especially when there was a low time constraint (cost, rate-volume effect).

However against these advantages the consultants observed that

- Acquisition of new motorized craft and maintenance on existing vessels required substantial capital outlays in foreign exchange.
- Dredging for larger craft which could take advantage of the inherent cost savings in water craft, was costly and again required the importation of foreign machinery and technical assistance.
- River craft (both motorized and non-motorized) were not found as flexible as motorized trucks in absorbing the impact of sudden changes in demand. For freight haulage this was because of the physical constraints of time related waterway operations.

From an analysis of the Inland Water Transport system, it was determined that it would provide an excellent mode for

both primary and secondary distribution of fertilizer. However, is believed that it will have to serve in a complementary role to rail and especially road transport. Conditions as described above are expected to persist for the next 5 to 10 years. It was in this content that the new facility criteria analysis vis-a-vis the role of waterways in intermodal transportation for the new site was evaluated.

TABLE NO. 2.11

Water transport operation under Bangladesh Inland Water Transport Authority, 1964-65 to 1973-74

Year	Navigable water ways (miles) (a)			Volume of cargo handled. (e) (million tons)				
	Perennial	Seasonal (b)	Total	Inland	Overseas	Foreign (d)	In transit	Total
1964-65	3,341	1,643	4,984	0.36	1.68	0.14	0.76	2.94
1965-66	3,352	1,643	4,995	...	...	...	...	...
1966-67	3,352	1,643	4,995	0.40	2.30	...	...	2.70
1967-68	3,352	1,643	4,995	0.36	2.24	(c)	...	2.60
1968-69	3,352	1,643	4,995	0.32	2.41	...	...	2.73
1969-70	3,352	1,643	4,995	0.33	2.53	...	...	2.86
1970-71	3,352	1,643	4,995	0.32	2.32	...	...	2.64
1971-72	3,352	1,695	5,047	...	...	...	...	...
1972-73	3,352	1,695	5,047	...	...	...	...	...
1973-74	3,352	1,695	5,047	...	...	...	...	...

Notes: (a) Navigable, (b) Seasonal, (c) By I.W.T. mechanised fleet. (d) Traffic suspended since 1965.
(e) The number of passenger boats is about 200,000 with capacity of about 1.5 million. The number of cargo boats is about 100,000 with capacity of about 1.2 million tons according to estimates made by district officials in 1958.

Source: Bangladesh Inland Water Transport Authority.
Source: Bangladesh Statistical Abstract 1974-75.

2.2.2.4 The Ports

Bangladesh depends almost entirely upon her maritime ports for handling international trade. Bangladesh has two deepsea ports:

- The Port of Chittagong
  Located on the River Karnafuli, and
- The Port or Anchorage of Chalna
  Located on the Pussur River near Mongla
  in the Khulna District.

ONLY the port of Chittagong has direct access to all modal types; rail, road, and inland waterways. Ships anchored at Chalna must offload onto barges or other boats for transshipment to road and rail freight sources.

Presently, there is an ongoing project at Mongla to develop a 9 jetty port facility. This site is located on the east side of the river. Currently, there exist no rail or road system from this site to the hinterland. The main focal point for road and rail (broad gauge) facilities in West Bangladesh are found at Khulna on the west bank of the Pusur river. In that it will exceed the time constraints of this Study to fully implement the Mongla project (port and land transport facilities), further consideration to this port was not given as a potential site for the proposed bulk handling/storage/bagging facility.

Table No. 2.12, "Commodity-wise Import Tonnage Handled in the Ports of Chittagong and Chalna" present on a comparative basis an evaluation of the relative importance of each port to the Bangladesh economy. In 1972-73 Chittagong handled 4.8 million tons (15%) against .82 million tons for Chalna; in 1973-74 the figure were respectively 3.3 million tons (82.5%) to .70 million.

A review of Table No. 2.13 indicates that Chittagong performed the greatest share of fertilizer tonnage hauled. It is interesting to note that when aggregate tonnage dropped by - 46.3%, tonnage hauled at Chalna only fell by - 4.2% against - 55.33% for Chittagong. A review of the site conditions at both ports and discussions with officials, indicates that Chittagong does indeed experience wider swings in export/import flows for various commodities.

From this analysis it was determined that Chittagong was the only maritime port responsive enough to very cargo handling rates to account for such annual and seasonal changes. It was observed (see Table No. 2.14) that road transportation was the mainstay in permitting Chittagong to accommodate such sharp fluctuations. In this context, the lack of a land

transportation interfaces caused the anchorage at Chalna to be excluded as a possible site for the proposed bulk storage facility.

Table 2.14 presents an overview of the historical trends in fertilizer distribution from Chittagong by the three systems. From this table it is observed that road tonnage increased during the period 1970-71 to 1975-76 from 175,550 tons to 225,965 in 1975-76. This represented an average annual increase of 17.8%. Rail tonnage during the same period declined from 176,395 tons to 28,093 tons in 1975-76; an annualized decrease of -20.5%. Water transport showed a slight increase of 2.0%. Water carried tonnage of fertilizer went from 32,556 tons in 1970-71 to 35,936 tons in 1975-76. Of significance in these statistics, as provided by the Port of Chittagong, is that road transportation's share of the fertilizer distribution tonnage went from 41.9% in 1970-71 to 75.6% in 1975-76. Water carriers share remained relatively stable; 15.6% to a lower 13.7%. However, rail transportation decreased significantly from 42.4% to 10.7%. As noted earlier, and stressed in this report; these type figures pointed up the flexibility and versatility of road transportation.

Data for the Port of Chittagong was readily available. The tables presented in the Appendix 7 provided an excellent basis for complementing the on site evaluation of the port of Chittagong as a potential candidate for the proposed facility. The tables presented in Appendix 7 are listed below.

- Import and Export handled - 1970/71 to 1975/76
- Commodity-wise Imports handled - 1970/71 to 1975/76
- Commodity-wise Export handled - 1970/71 to 1975/76
- Principal Commodity-wise clearance of dry imports from the port - 1970/71 to 1975/76
- Principal Commodity-wise clearance of dry imports by rail - 1970/71 to 1975/76
- Principal Commodity-wise clearance of dry imports by road
- Principal Commodity-wise clearance of dry imports by river

TABLE 2.12

Commodity-wise import tonnage handled in the ports of Chittagong and Chalna.

(Tons)

Commodity	1972-73		1973-74	
	Chittagong.	Chalna.	Chittagong.	Chalna.
Foodgrains ...	23,36,012	5,78,883	13,25,673	5,82,167
Sugar ...	76,818	2,685	39,756	—
Chemicals ...	—	—	26	—
Coal ...	5,189	—	1,29,920	—
Cement ...	2,45,128	93,990	1,09,106	19,424
C.I. sheet ...	29,156	20,512	8,058	3,533
Cotton yarn and piece goods ...	464	—	8,689	—
Iron and Steel ...	47,227	400	49,308	—
Cotton ...	38,960	19,761	25,400	—
I.C.I. products	7,500	—	—	—
Oil in drum ...	61,707	—	16,813	—
Timber ...	—	—	787	—
Paper ...	691	38	796	—
Fertilizer ...	2,29,329	48,894	1,02,553	46,804
Pulls (in bulk) ...	—	—	10,900	—
Tobacco ...	16,090	1,245	7,574	279
Oilseeds ...	85,234	4,502	56,351	1,735
Betelnuts ...	106	—	—	—
C.P. Goods ...	918	—	—	—
G/Cargo/Sundries	5,21,382	32,199	3,60,327	34,564
S. Oil ...	5,205	8,097	—	—
Machinery ...	—	* 4,958	—	5,648
Bitumen ...	—	—	—	6,615
Wax ...	—	—	20	—
Pig iron ...	—	1,038	—	—
Bulk oil ...	1,143,455	—	—	—
Total	4,850,571	8,17,202	3,295,006	7,00,769

Sources : Chittagong Port Trust and Chalna Anchorage.

Source Bangladesh Statistical Digest 1974-75

Table No. 2.13

Fertilizer handled in the ports of Chittagong and Chalna
1972-73 and 1973-74

(Tons)

Port	1972 - 73		1973 - 74		%
	Tons	Percent	Tons	Percent	Change
Chittagong	229,329	82.4	102,553	68.7	- 55.3
Chalna	48,894	17.6	46,804	31.3	- 4.2
Total	278,223	100.0	149,357	100.0	- 46.3

Source: Bangladesh Statistical Abstract 1974-75

Table 2.14

FERTILIZER SHIPMENTS FROM CHITTAGONG BY MODAL TYPE 1970-71 - 1975-76

(Tons)

Year	Rail		Road		Water		TOTAL	
	Tonnage	%	Tonnage	%	Tonnage	%	Tonnage	%
1975-76	28,093	10.73	197,872	75.55	35,936	13.72	261,901	100%
1974-75	10,547	4.27	202,858	82.15	33,543	13.58	246,948	100%
1973-74	16,398	16.48	66,834	67.18	16,248	16.56	99,480	100%
1972-73	25,306	11.05	143,193	62.54	60,472	26.41	228,974	100%
1971-72	7,873	11.46	50,006	72.82	10,793	15.72	68,672	100%
1970-71	88,178	42.37	87,372	41.98	32,556	15,64	208,106	100%
TOTAL	176,395	15.83	748,135	67.15%	189,548	17.01%	1114,078	100%
Average Per Year	29,399		124,689		31,591		185,680	
Annual % Change	20.5%		17.8%		2.0%		4.7%	

Source: Port of Chittagong, Bangladesh, Year Book 1975-76, Pages 72-74

Section 3

Analysis of Alternatives

3.1 Alternative Sites

The scope of work called for the examination of various feasible alternative plans for importing TSP and MP in bulk into Bangladesh, in order to provide a system of fertilizer import best serving the needs of the country over the period 1978 through 1987. Eight alternative sites were considered. These alternatives are shown on Table 3.1, which lists the comparative advantages, disadvantages and physical limitations of each. Within the time period under consideration (1978-1987), only one feasible alternative can be found. This is the TSP plant site at Chittagong. All of the other alternatives fail due to physical limitations or time and cost considerations. Table 3.2 shows a preliminary estimate of capital cost for establishment of the required facilities on the various sites, and Table 3.3 summarizes the advantages and disadvantages of the five primary sites under consideration. Alternatives other than those listed are discussed in Section 3.3.

TABLE NO.3.1

BANGLADESH BULK FERTILIZER IMPORT ALTERNATIVES

Site Feasibility Comparison

Description of Alternative	Ability to berth Deepsea vessels		Availability of site		Compatibility with adjacent facilities	Available Experienced labor/mgt	Access to Hinterland		
	Draft	Yes/No	Now	Future			Road	Rail	Water
Chittagong: 1. TSP Plant	22' to 30'	Yes	Now		Yes	Yes	X	X	X
2. Cement Plant	22' to 30'	Yes	By conveyor across two properties		No	Yes	X	X	X
Port Trust Site 3. Existing Port	22' to 30'	Yes	Would consider		No	Yes	X	X	X
4. Proposed Port	to 40'	Yes	Indefinite future		Yes	Yes	Not known		
5. Chalna	26'	Yes	No		No	No	No	No	X
6. Khulna	12'	No	Now		Yes	No	X	X	X
7. Mongla	35'	Yes	1979 earliest		No	No	No	No	X
8. Narayangenj	12'	No	No. Congested Requires search		No	No	X	X	X

(continued.....)

TABLE NO. 3.1

BANGLADESH BULK FERTILIZER IMPORT ALTERNATIVES

Site Feasibility Comparison (continued)

Description of Alternative	Transhipment required to reach storage	Alternative likely to be acceptable to BADC	Estimated cost (Table 3.2)	Feasible Alternative now	R E A S O N
Chittagong: 1. ESP Plant	No	Yes	8	Yes	- Completely compatible - Fits all requirements - Offers future advantages
2. Cement Plant	By long conveyor	No	10	No	- Not compatible with cement operation - Also conflicts with grain silo property
Port Trust Site 3. Existing Port	No	No	20	No	Not a compatible activity
4. Proposed Port	No	No	N/A	No	May never be built
5. Chalna	Yes	No	N/A	No	No land site No rail or road
6. Khulna	Yes	No	10	No	- Not on deepwater - Requires transhipment
7. Mongla	No	Yes in future	8	No	- Not available for indefinite time - Present layout not compatible - No rail or road access
8. Narayangenj	Yes	No	12	No	- Not on deepwater - No site - Requires transhipment

Table 3.2

Preliminary Estimate of Capital Cost per Site

Establishment of Bulk Fertilizer Import Handling and Bagging Facilities

Proposed Site	Estimated Capital Cost
Chittagong	
- TSP Plant	3.0 1/
- Cement Plant	10.0 2/
- Port Trust Site	20.0 3/
- Proposed Port	Project not yet confirmed 4/
Chalna	No land site 5/
Khulna	10.0 6/
Mongla	8.0 7/
Narayanganj	12.0 8/

NOTE: Costs rated on a scale of 1 to 20 for estimating purposes
Estimated costs above subject to review by consultants Cost Estimating Section on return to Home Office

1) Utilizes existing jetty, but requires facilities shown in Section 4.

2) Utilizes existing jetty but requires prox. 1/3 mile of addl. conveyor, on acquisition of additional property.

3) Preliminary information indicates new site, new jetty and all new installation.

4) Feasibility study now in early stages. This location would require complete new development. In addition, would also require investment in coastal vessels and barges for transfer to inland ports, also requiring additional capital cost for development (See Section 3.2.1)

5) No possible development here. An anchorage only (See Appendix 2, site questionnaire).

6) Would require complete new development cost, and could be served only by barges, thus requiring additional discharge facilities and costs at deep water. This site would further require additional equipment and cost to transfer goods to eastern section. Facility would not serve entire needs of country. See Appendix 2, Site Questionnaire.

7) Assumes utilize jetty constructed by others and road and rail connection provided by others without cost.. However, no site for required facility is available and road and rail not connected (See Section 3.2.1).

9) Requires complete new installation, plus likely demolition of existing property. Facility would not serve entire needs of country, and requires additional investment in fleet of barges and coasters to be served. Also requires discharge facilities and services at deepwater. (See Section 3.2.1).

Table 3.3

Summary of Advantages and Disadvantages

The Five Primary Sites

	Alternative Sites	Comment
1	Chittagong	- has a developed harbor and port facilities - has available land on channel - has trained labor force - has existing fertilizer production - now studying development of deepdraft facility
2	Chalna	- has only an anchorage - no available land - no developed port facilities - no trained labor force - all product must move by water to rail or truck
3	Khulna	- has developed port facilities - has some trained labor - has rail and road connection - has available land - but cannot be reached by ocean vessels
4.	Mongla	- Port facilities available in 1979 (if schedule maintained) - no suitable facility for bulk storage until later in plan - indefinite. - no trained labor force - no rail or road connection for indefinite future - all product must move by water until such time
5.	Narayanganj	- cannot be reached by ocean vessels - congested and limited land available - has good rail, road and water connections

3.2.1 Micro/Macro Economic Implications

The consultants analysed the local and national economic impact of locating the bulk storage and bagging facility at the following sites:

- Chittagong
- Chalna/Mongla
- Khulna
- Narayanganj

Employment and Income Effects

From a "Micro" economic analysis it was determined that there would be an employment and income effect. This would have the primary effect of creating additional jobs and income. The secondary effect would be expenditure of this income within the community. This latter effect is referred to as the income and employment multiplier. It was concluded that this impact would be nearly similar at each site. This point is noted in Table No. 3.4.

Table No. 3.4

Economic Implications Related to Each Site Selection

Proposed Site	Employment and Income Effect	Learning curve least Costs	Currency Exchange Benefits	Least Capital Invest Costs	Summed Rankings	Ranking
Chittagong	Equal (1)	1	1	1	4	1
Chalna/ Mongla	Equal (1)	4	4	4	13	4
Khulna	Equal (1)	2	2	2	7	2
Narayanganj	Equal (1)	3	3	3	10	3

Scale Rankings

1 Least cost or highest benefit
2 -
3 -
4 Highest cost or lowest benefit

- Learning Curve Costs

A cost consideration that is implicit in any consideration of a site selection is the availability of skilled and semi-skilled labor. In Table No.J.4, the consultants have ranked each proposed site in terms of least "learning curve costs" that would be related to developing the facility at the location. This criterion was generated by on site visits, conferences with local officials, and reference to source documents.

- Foreign Exchange Benefits

In terms of "Macro" or national level impact, the most obvious effect would be an easing on foreign exchange requirements by using local labor and material to perform the bagging operation. This is in contrast to the present method of bringing in fertilizer in bags from overseas suppliers. However, because of the various time lags related to operationizing a bulk handling facility at each site the present value of these foreign exchange benefits would vary. Table No.J.4, ranks the site by highest present value of exchange rates saved. (foreign exchange benefits).

- Capital Development Expenditures

Another major "Macro" impact upon the foreign exchange reserves, would be the demand for foreign capital related to modifying or developing the transportation infrastructure necessary to facilitate the distribution of the bagged fertilizer. In Table No.J.4, the consultants ranked each site by the least

capital expenditures required to develop a complementary transportation infastructure.

The overall ranking, as shown on the table, indicate that in all categories Chittegong has the highest economic criteria valuation. The rankings are:

(1) Chittagong, (2) Khulna, (3) Narayanganj, and

(4) Chalna/Mongla as indicated in summary form on the table.

3.2. The Feasible Alternative

A system of fertilizer import best serving the needs of Bangladesh for the next ten years (1978-87) would be one based on services facilities, management, labor and transport to be in existance now or known to expandable or available within the initial (at least the last 5 year) period of the 10 year time frame. It should also be a system which will not work at cross purposes with existing or planned programs, and it should be compatible with and complementary to existing and planned programs and present and future requirements of the country. There is only one site for bulk fertilizer import which can be recommended as best serving the needs of Bangladesh for the next ten years. This site is the TSP Plant at Chittagong.

Location of bulk fertilizer storage and bagging facility at this plant best serves the needs of Bangladesh for the following reasons:

- Least Capital cost
- Existing bulk fertilizer handling equipment
- Existing experienced labor
- Existing experienced management
- Use of land is compatible with existing operations
- Import materials supplement and complement the existing production
- Availability of MP at this location will permit the production of compound fertilizers

- Existing harbor facilities
- Improvements to the facilities (adding handling equipment, lengthening and or deepening berth) enhance the capability of the existing facility
- Utilization of existing facility is enhanced with economic benefit of economies of scale.
- Complete system of rail, road and water transport is already available in existence and is expandable (road and water)
- Electric power and local infrastructure is available
- Import fertilizer handling and bagging is completely compatible with existing operation
- Compound fertilizer production is a future requirement of the country, location here facilitates development of such products
- Additional bagging capacity supplements existing plant capacity
- Storage facilities can be complementary between the plants
- Organizational and management relationships are compatible.

3.2.1 Future Expansion of the System

As the road, rail and water transport capabilities of Bangladesh increase and improve, as the use of fertilizer increases, and as familiarity with the handling of fertilizer increases, there should be further opportunities for savings by the utilization of bulk storage and handling in other ports of Bangladesh. Bulk transport and handling equipment will be required for the successful extension of bulk fertilizers into the interior of the country. Training of labor and management in the skills required for the safe and efficient storage and handling of bulk fertilizers will also be required. Three locations in particular should be considered for fertilizer bulk handling and storage facilities in the future, and at two of these, bagging facilities should be included. These locations are the following:

- Proposed Deepwater Port at Potenga (Entrance to Chittagong Harbor)

A team from the Netherlands Economic Institute has studied 9 potential deepwater port sites suggested by an earlier British study to determine the most economically and technically practical site for a deepwater port for Bangladesh. Team members have indicated to these consultants that the only one of the 9 sites economically feasible is the Potenga site. Technical feasibility is now being determined. It was indicated that it should be economically feasible to berthvessels up to 50,000 DWT at Potenga, despite heavy dredging cost. Should such a port be

constructed in the future, consideration should be given to constructing a bulk fertilizer storage and transfer facility there. With such a facility, vessels exceeding the draft limits of the TSP berth could be lightened at Potenga. The tonnage offloaded there could go directly to storage, for subsequent shipment by water to the TSP plant, or to other bulk facilities which may be developed. Bagging facilities should not be required at this location.

- The New Port of Mongla

The new port of Mongla will require the development of road and rail links to the interior, probably at Khulna. The port facilities presently under construction provide for a bulk cargo berth at berth No.9 as can be seen on the Port layout on Figure 3.1. The layout of this berth, in the opinion of these consultants, does not lend itself to the establishment of a bulk storage and bagging facility. However, the second phase development of berths 12 and 13 would provide sufficient space for such a facility. When more information is available about the development of land links, and of sufficient open space for bulk storage and bagging facilities, this port should be considered as the logical site for establishment of the second bulk fertilizer storage and bagging facility. With the ability to receive vessels of drafts up to 35 feet, and located west of the Ganges, it will be important to develop this facility to serve the future fertilizer needs of the north and south western sections of Bangladesh.

Development of bulk storage and bagging facilities at Khulna in lieu of facilities at Mongla could be considered but depth of water at Khulna of 12 feet, would not permit ocean vessels to deliver directly to the facility. Therefore, it is felt that Khulna should be served by bagged delivery from Chittagong, or by continuation of bag fertilizer purchases for that port until such time as facilities at Mongla can be developed.

- Narayanganj

Reference to the Site Questionnaire in Appendix Section 1, will show the general conditions at this river port today. Extremely congested, with the town encroaching on the present port facilities, an adequate site for a both storage and bagging facility adjacent to any existing jetties within the vicinity of direct road and rail access. Nevertheless, the port can be reached by light coaster vessels and barges, and its central location, with good access to road, rail and upcountry water routes suggest the general area as a potential site for additional bulk storage and bagging facilities. The area is also likely to have a more skilled labor force for manning the requirements of such a facility. However, in the future, as fertilizer consumption increases and in the event that a deep draft terminal for handling berth cargo is constructed at the entrance to Chittagong harbor, (or elsewhere), and there is available an adequate fleet of suitably designed bulk cargo

coastal vessels and barges, then Narayanganj should be considered as the site of the port inland bulk fertilizer storage and transfer facility. Locating a proper site on water, with access to rail and road, in that area may require demolition of existing facilities, and relocation of roads and residential and commercial facilities.

3.3 Discussion of Other Alternatives

3.3.1 The Alternative of Inaction

One additional alternative which could be considered would be to do nothing now, and defer any decision on the location of the facility until such time as the following factors are determined.

(1) When it has been determined whether a new deepwater facility will be constructed at the entrance to Chittagong harbor. Should a favorable decision is forthcoming on such a facility, to be served by adequate road, rail and water connection, then the advantages of this locations deepwater offer the advantage of use of larger vessels. This consultant does not feel that even this advantage would be sufficient to override the advantage of integrating bulk fertilizer material imports with the existing TSP plant production.

(2) When it has been determined when road and rail connections will be provided to the new port of Mongla. For serving the area west of the Jamuna-Ganges Rivers with imported TSP, MP, (and including imported urea and compound fertilizers) this port offers the preferred location for the future. But uncertainty [illegible] about its completion date, its ultimate layout, and the certainty that road and rail connections will not be provided for a good number of years causes this consultant to rule out this facility from present planning. Ultimately it is expected that a second fertilizer facility would be located here.

3.3.2 Alternatives Discarded

In addition to the alternatives indicated above, there are also a larger number of further possible solutions and combinations of solutions, to the point of rendering a rational conclusion extremely complex. All of these have been discarded by the consultants as being beyond the capability of current Bangladesh present or planned infrastructure and technology during the period under consideration. The observations and analyses contained in Section 2 convinced the team that any of the following alternatives are technicallyimpractical for the immediate future. Discussions with Bangladesh officials also confirmed a similar feeling among those individuals knowledgeable in Bangladesh transport and operating capability today. Among the discarded alternatives were the following.

- Bulk imports to Chittagong (and Chalna) with bulk storage and bagging at Narayanganj and Khulna: Discarded due to requirement to ship bulk by water, to unload at inland ports in bulk, to store in bulk and bag. See Table 3.1.

- Bulk imports to main ports. Bulk shipment by water and land to interior points inside Bangladesh: Discarded because of lack of bulk transport equipment, water or land, also high risk of excessive losses in transport. Lack of know how as well. The transport system is not seen as being ready for such form of shipment within the study time frame.

- Acquire a floating bulk unloader to the old Chittagong (or Chalna/Mongla) and discharge to barges in bulk: Discarded due to limited capability of Bangladesh barging system. Coordination of barges with ship arrival (as in US Mississippi River, and Rotterdam Rhine system) requires a very large fleet of hopper type barges in regular services. Without this, inability to coordinate ship arrival with barge availability (where no shore storage also exists) results in excessive lost time on vessels awaiting barges. At Chittagong, it was also learned that weather conditions do not permit safe year round lying off in the Bay of Bengal.

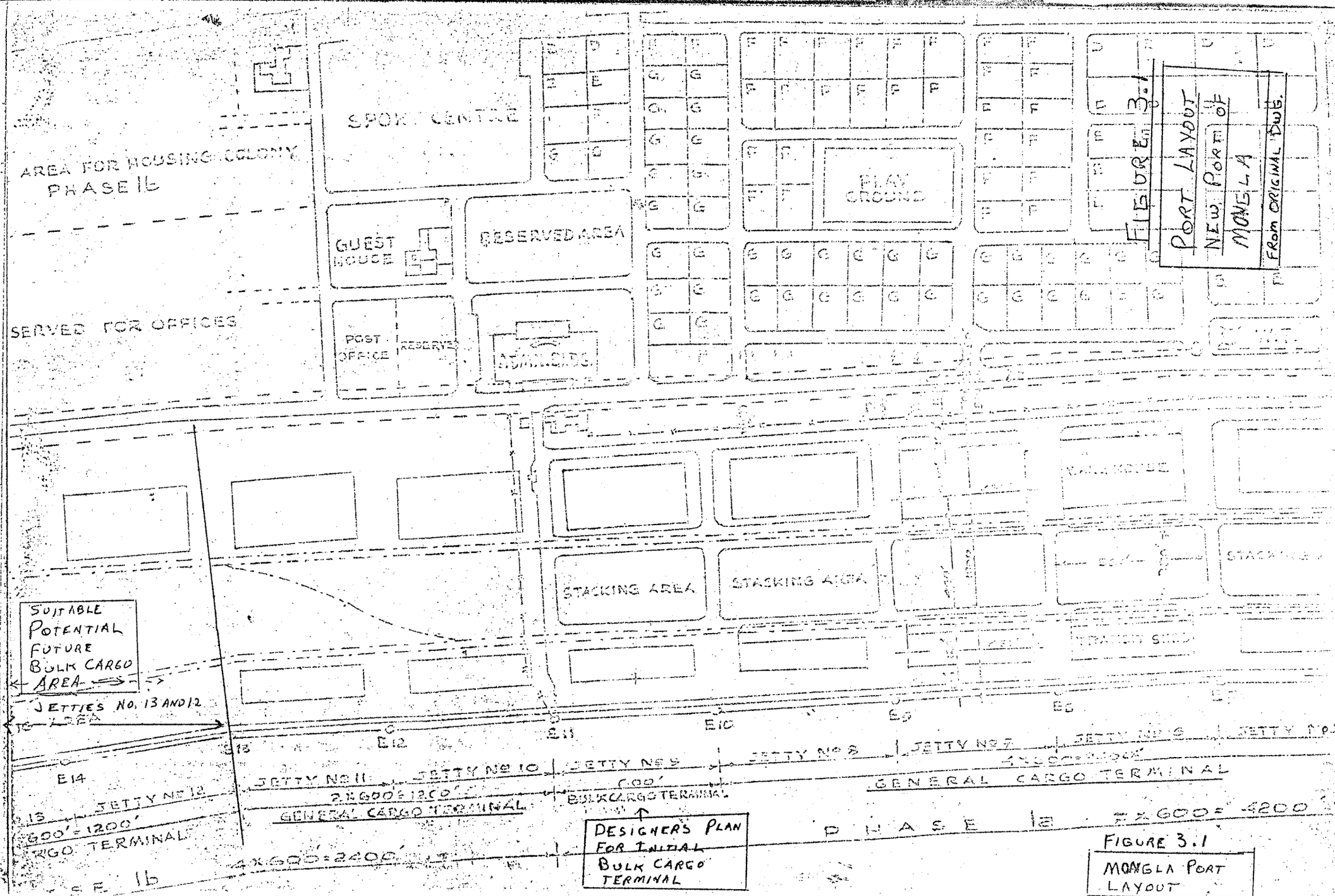
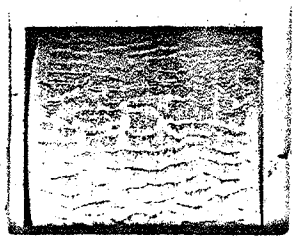
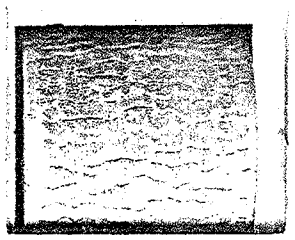


FIGURE 3.1
MANGLA PORT LAYOUT





Section 4

Recommendations

4.1 The Recommended Solution

It is recommended that initially only one port location be established for the unloading, storage, bagging and shipment of imported TSP and MP fertilizers. A discussion of future extension of bulk fertilizer handling is contained in Section 3.2.1., Analysis of Alternatives.

4.2 The Recommended Location

The location recommended for the construction of bulk fertilizer storage and bagging facilities is on the property of the Chittagong TSP Plant, as shown on Figure 4.1. It's geographical location in Bangladesh is shown on Figure 4.2.

4.3 The Recommended System

The bulk storage and bagging facility would be located on the Chittagong TSP property in the general area indicated (Figure 4.1). Further evaluation of the exact site and configuration would be carried out in a later phase of this program. In connection with the development, a number of new installations will be required, together with improvements to existing facilities to be jointly used by the TSP plant and the Bulk/Bagging plant.

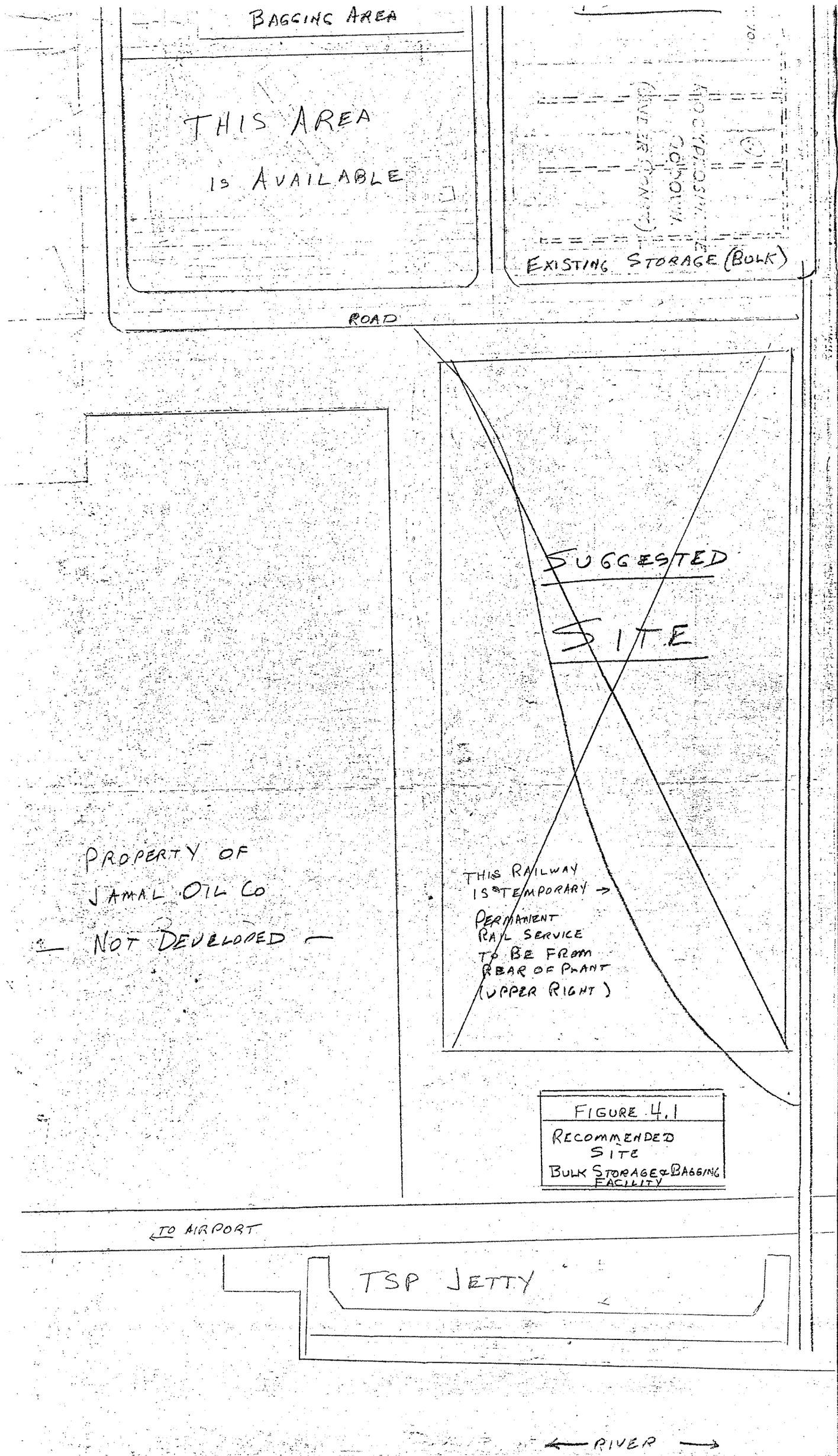


FIGURE 4.1
RECOMMENDED SITE
BULK STORAGE & BAGGING FACILITY

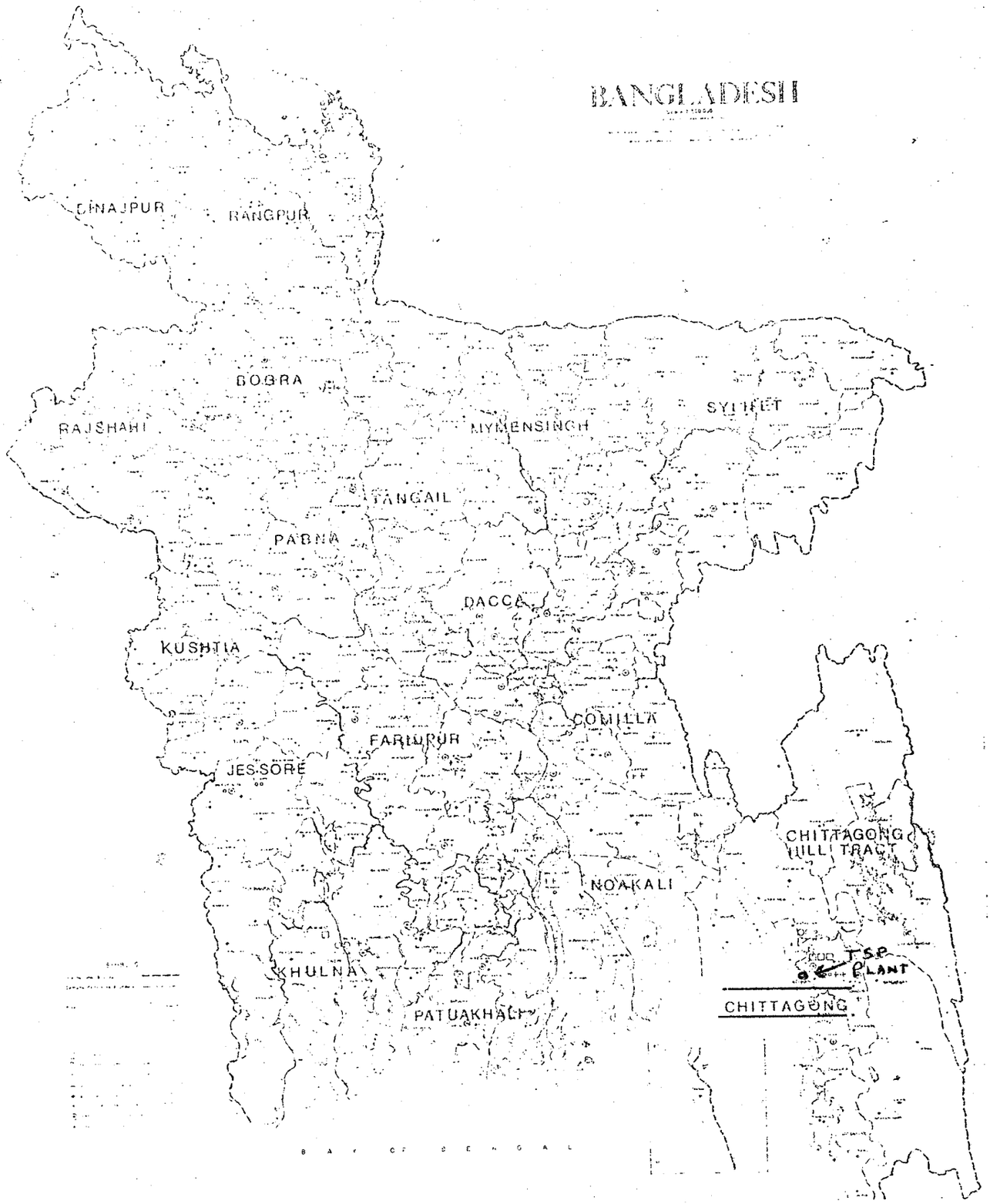


FIGURE 4.1

TSP PLANT LOCATION
CHITTAGONG, BANGLADESH

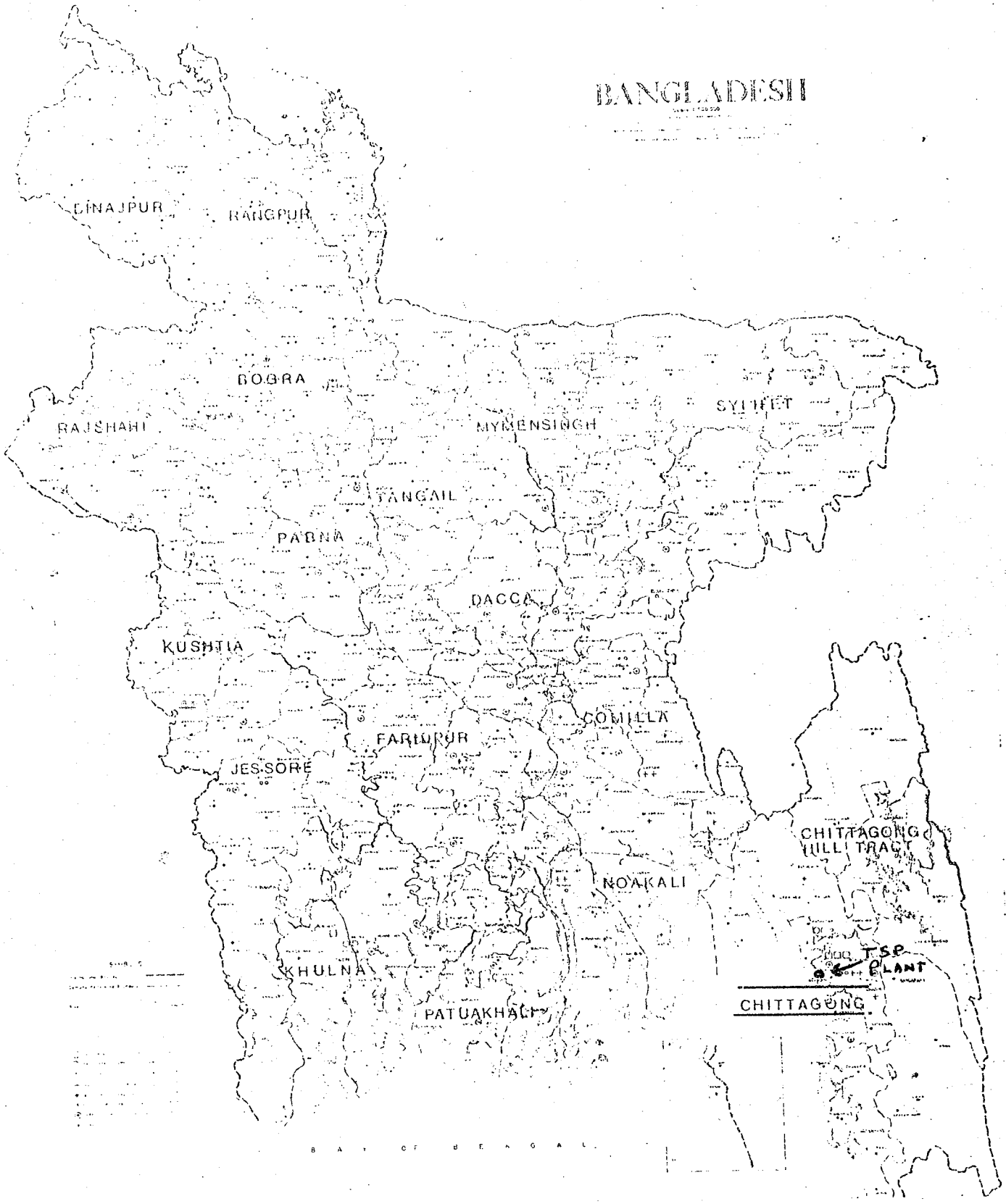


FIGURE 4.1

TSP PLANT LOCATION
CHITTAGONG, BANGLADESH

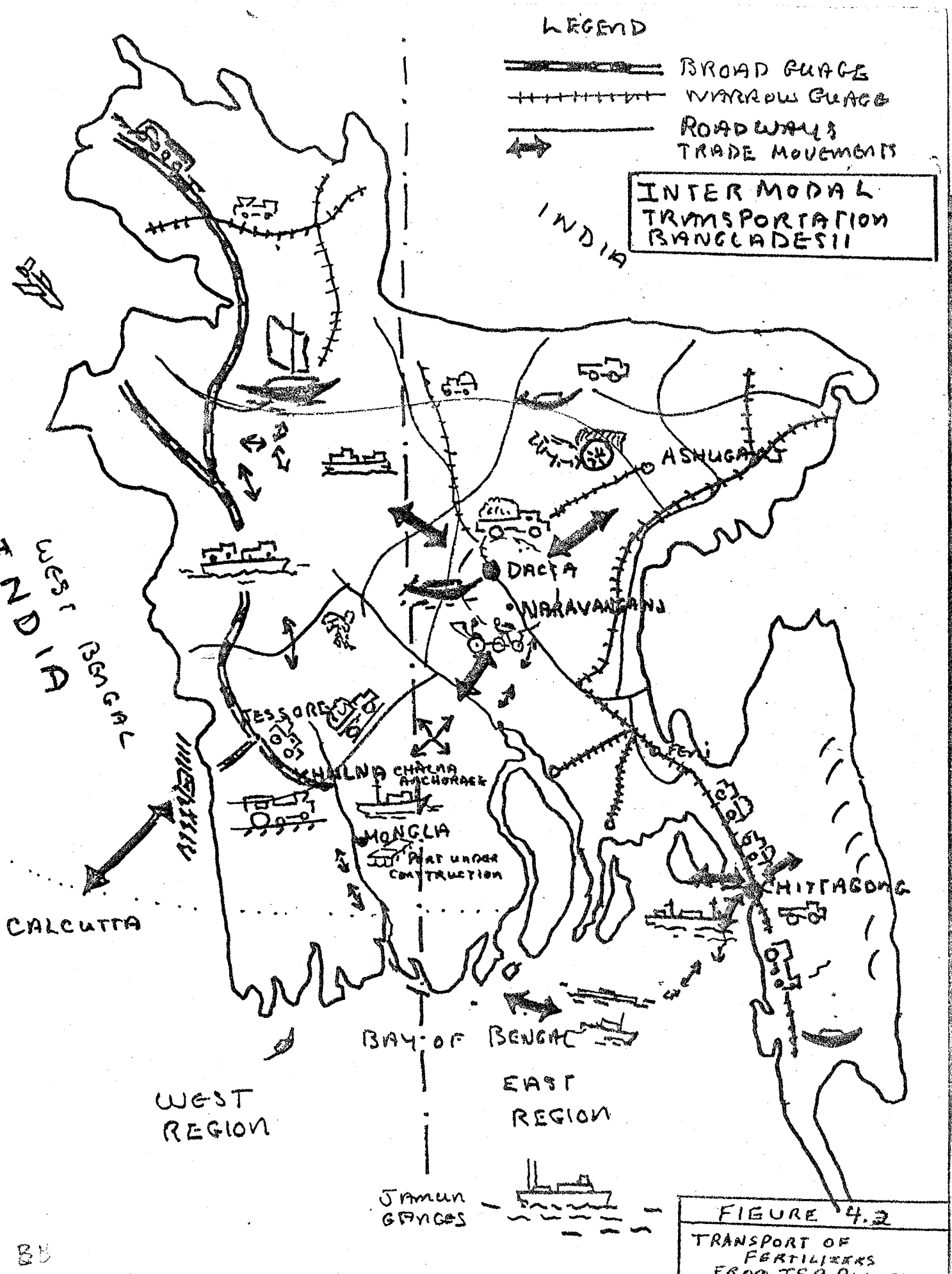


FIGURE 4.2

TRANSPORT OF FERTILIZERS FROM TSP PLANT

3.1 Design Requirements

Detailed design requirements, draft proposal documents and estimated costs will be prepared in USA during the second phase of this study. A general description of the required facilities is shown below.

3.1.1 The Storage Area

Specific requirements will include the following:

- Bulk Storage Building

  Covered storage of sufficient size to accomodate $2\frac{1}{2}$ vessel load of each commodity (TSP and MP) with asphalt topped concrete floor, to be loaded by overhead conveyor with reclaim by front end loader. Building material to be resistant to corrosive nature of the fertilizer materials. Design should consider the possibility that in addition to TSP and MP, other materials such as Urea, DAP, and compound fertilizers may be stacked in the building.

- Bagging facilities and Warehouse for Bagged Storage

  Located adjacent to the bulk storage, the facility should provide sufficient bagging capacity (open mouth packer [illegible] or similar) with elivator or conveyor feed, vibrating screen, and sewing machine (Union Special or similar) and sewing line conveyors, delivery to hand truck line, for

transfer to truck or rail or to bagged storage area. Size of bagged storage to be determined. The bagging and bagged storage area should be located at rail gate/rail door height. Included in the bagging and warehouse area should be adequate space for empty bag storage.

- Maintenance and spare parts facilities for mobile equipment, and general maintenance should be provided.
- Rail facilities should be integrated with the TSP trackage and adequate car storage provided. In plant switching equipment (Trackmobile) should be provided if not available from TSP plant. (A switcher was observed at the TSP plant).
- Adequate road and truck line up area must be provided to minimize congestion and facilitate loading and despatch.
- Office and despatch facilities must be provided.

4.3.1.2 Conveying between the Jetty and the Storage Area

Evaluation of the existing conveyor system will be required to ascertain sufficient capacity to handle the new requirements, as related to improvements recommended at the jetty. A new and separate conveying system may be required.

4.3.1.3 The Jetty Area

- Installation of a Crane unloading system capable of handling at least a 4 yard clamshell bucket is most desirable. Jetty design should be investigated to determine whether rail gantry mount or crawler design is preferable. If smaller crane required, then two units should be provided.
- Hoppers to be fed by crane buckets, with gate control to feed conveyors will be required. Conveyor improvements indicated above must be considered.
- Present jetty length of 400' could be improved. Consideration of adding additional mooring dolphins or increasing wharf length to accomodate longer vessels should be examined. Such installation has to be coordinated with increasing the draft capability beyond the present 21'.
- Berth depth can be increased to 30', it is indicated by port officials. Verification of this is vital as a 21' limit is not suitable for the development of the facility. Preliminary investigation of this question elicited firm assurance that deepening can be accomplished

without difficulty, but ability to dredge the berth is vital to the selection of the site and must be verified. Dredging depth will have to be coordinated with depth of water at the bar crossing.

- Barge and coaster loading facilities should be investigated, with truck delivery of bagged fertilizer from the bagging plant.

4.3.2 Transport Capacity

Study of the capacity of the region's transport system as discussed in Section 2, indicates that the increased fertilizer imports through the port of Chittagong are within the present and potential capacity of the existing and developing cargo transport system in the area. Figure 4.3, presents a visual concept of the flow of fertilizers from the recommended location, and projected volume is shown in Table 4.1.

Table 4.1

Forecast of Chittagong Fertilizer Traffic

1977-78 to 1987-88

('000 Tons)

Year	Urea Imports	Required TSP & MP Imports	Domestic TSP Production	Total Tonnage
1977-78	36	121	60	217
1978-79	54	146	60	260
1979-80	69	176	60	305
1980-81	88	210	60	358
1981-82	113	250	60	423
1982-83	140	295	60	495
1983-84	169	347	60	576
1984-85	202	407	60	669
1985-86	237	477	60	774
1986-87	273	556	60	889
1987-88	313	640	60	1013

Source: Appendix 1

It is forecasted that fertilizer throughputs for the Port of Chittagong will increase from 217,000 tons in 1977-78 to approximately one million tons by 1987-88. Most of this tonnage increase will come from imports. It is projected that domestic production will remain relatively stable at 60,000 tons. The consultants believe that available transport capacity in the Chittagong area would be capable of meeting requirements through 1979-80.

In the longer term it is expected that most of the primary distribution of fertilizer from Chittagong will be by road. As shown in Section 2, road transportation has the flexibility to absorb freight increases above that which could be carried by rail and water. Also, with the proposed "rehabilitation" of the railway system, it is expected that the downward trend in freight mile tonnage of this mode will be reversed. It is expected that water transportation from the primary source to major distribution centers will increase slightly. However, all modes will be more effectively utilized, and their ton mileage load factor increased, due to greater scheduling flexibility related to the proposed development.

4.4 Cost/Benefit Analysis

A cost/benefit analysis of the recommended installation was undertaken using a twenty year useful life for the facilities and allowing a 5% salvage value. Annual volume was based on the projections for TSP and MP imports used in Section 2.1.1.1, Potential Cost Savings (Table 2.2). The analysis utilized the $20.00/ton saving attainable by switching from bagged imports to bulk, as shown on Table 2.1 (also calculated similarly by AID in an earlier analysis).

Cost for the installation of the facility was taken from Table 3.2 investment ratings, and for purposes of this analysis a weighting of $1.0 million was utilized for each rating point. (i.e.: 8 = $8,000,000). Further verification of actual construction costs will have to be undertaken later. The cost/benefit analysis shown on Table 4.2 indicates an undiscounted net benefit over the 10 year study period of $44,688,000, and as can be seen, is even able to generate a saving of $1,956,000 during its first year of operation. (No discount rate was applied in this first analysis, using as an assumption that AID funded projects have no alternative opportunity cost. Also no interest on indebtedness was included).

Table 4.2

Cost Benefit Analysis

Bulk Handling and Bagging Facility, Chittagong
1977/78 thru 1986/87

($,000)

Years	Tonnage [1]	Savings per ton [2]	Gross savings per year	Depreciation [3]	Other Costs [4]	Total Costs	Net Benefit [5]	Present value net benefits [6]
1) 1977-78	0	0	0	0	0			
2) 1978-79	146,000	20	2,920	380	584	964	1,956	1,617
3) 1979-80	176,000	20	3,520	380	704	1,084	2,436	1,830
4) 1980-81	210,000	20	4,200	380	820	1,200	3,000	2,049
5) 1981-82	250,000	20	5,000	380	900	1,280	3,720	2,310
6) 1982-83	295,000	20	5,900	380	990	1,370	4,530	2,557
7) 1983-84	347,000	20	6,940	380	1,094	1,474	5,466	2,805
8) 1984-85	407,000	20	8,140	380	1,214	1,594	6,546	3,054
9) 1985-86	477,000	20	9,540	380	1,354	1,734	7,806	3,311
10) 1986-87	556,000	20	11,120	380	1,512	1,892	9,228	3,558
Total							44,688	23,091

1) Table 2.2
2) Table 2.1 (Constant 1977 Dollars)
3) Estimated cost from Table 3.2. Factor of 8- assumed to be equivalent to $8.0 million for this analysis. Salvage value allowed - 5%.
4) Operating, administrative and overhead costs as follows:
   1st 200,000 tons @ $4.00/ton (Minimum 200,000 tons).
   All above 200,000 tons @ $2.00/ton
5) No discount applied and no interest assessed.
6) Discount rate 10%.

Table 4.3

Cost Benefit Analysis

(Discounted to Present Value with Interest and Amortization)

Bulk Handling and Bagging Facility, Chittagong
1977/78 thru 1986/87

($000)

Years	Tonnage [1]	Savings [2] per ton	Gross savings per year	Amortization [3] schedule	Other [4] Costs	Total Costs	Net Benefits	Present [5] Value
1) 1977-78	-	-	-	-	-			
2) 1978-79	146,000	$ 20	2,920	927	584	1,511	1,409	1,165
3) 1979-80	176,000	20	3,520	927	704	1,631	1,889	1,419
4) 1980-81	210,000	20	4,200	927	820	1,747	2,453	1,675
5) 1981-82	250,000	20	5,000	927	900	1,827	3,173	1,970
6) 1982-83	295,000	20	5,900	927	990	1,917	3,983	2,248
7) 1983-84	347,000	20	6,940	927	1,094	2,021	4,919	2,524
8) 1984-85	407,000	20	8,140	927	1,214	2,141	5,999	2,799
9) 1985-86	477,000	20	9,540	927	1,354	2,281	7,259	3,079
10) 1986-87	556,000	20	11,120	927	1,512	2,439	8,681	3,347
Total							39,765	20,226

1) Table 2.2

2) Table 2.1 (Constant 1977 Dollars)

3) Estimated cost from Table 3.2. Factor of 8 - assumed to be equivalent to $8.0 million for this analysis. Investment amortization at 10% over 20 years.

4) Operating, administrative and overhead costs as follows:
1st 200,000 tons @ $4.00/ton (Minimum 200,000 tons)
All above 200,000 tons @ $2.00/ton

5) Discount rate 10%.

The last column of Table 4.2 shows the discounted net benefit at 10%.

A second cost/benefit analysis was calculated, utilizing a 10% discount factor, and 10% interest on unamortized debt. This analysis as shown on Table 4.3. In this case, over the 10 year study term a saving of $20,226,000 is attained. Again, there is a first year saving, in the amount of $1,165,000. It should be recognized that all the above figures are based on an assumed 6 = $1.0 million ($8,000,000) investment cost, (which figure will require further engineering study), on an estimated $20.00/ton saving, and upon present best forecast of volume.

4.5 Recommended Additional Technical Assistance Considerations

It is also recommended that consideration be given to a technical evaluation of the merit of the below listed project proposals for the Chittagong TSP plant which are reported to be awaiting a source of funding by the Bangladesh government.

- TSP Granulation Unit: Estimated Cost $3.0 million
- Gypsum Disposal System: Estimated Cost $2.0 million

It is further recommended that consideration be given to funding a study of providing road and rail connection to the new port of Mongla, including the bridging of the Pasur River. Each of these potential capital development requirements is closely related to the long term agricultural and fertilizer development programs here concerned. These requirements and considerations are discussed in Section 5.

SECTION 5

OTHER RELATED CAPITAL DEVELOPMENT POSSIBILITIES

5.1 Other Related Capital Development Possibilities

In the course of study of this project certain additional capital development prospects relating to fertilizer production, agriculture and transportation were observed. It is the consultants conclusion that the following programs should be considered for study and possible assistance in the interest of fertilizer and agricultural development, and related port and transport requirements.

5.1.1 Granulation (and Ammoniation) Unit - TSP Manufacturing

Bangladesh production of TSP is presently not in granular form due to lack of a granulation unit at the Chittagong plant. Imported TSP is in granular form, which permits ease of handling and broad-casting by the farmer. Powdered TSP results in skin burn and breathing discomfort due to dust in handling powdered TSP, in addition to serious product set up problems. Thus farmer preference is for the granular product. Bangladesh Chemical Industries Corporation (BCIC) officials report that project papers in the amount of $3.0 million have been prepared for the installation of a granulation unit at the TSP plant, but that lack of funding has prevented implementation of the program. It has been suggested by United Nations Development Program (UNDP) experts in Dacca, and by the Economics Intelligence Unit Study of the Bangladesh Fertilizer Industry that an ammoniation unit be included in conjunction with the installation of a granulator.

this would permit the production of ammoniated phosphates and by the addition of KCl, should it be available at the TSP plant would provide Bangladesh with its first compound fertilizer manufacturing installation.

5.1.2 Gypsum Disposal System - TSP Manufacturing

BCIC officials also reported that project papers and plans have been prepared in the amount of $2.0 million for the installation of a gypsum disposal system at the Chittagong TSP plant. Gypsum disposal is a problem common to phosphoric acid production. Management at the Chittagong plant reported that there is available on present plant property room for only one more years production of gypsum and that without a long term solution to the gypsum problem, the plant would be forced to close down for lack of disposal area. Efforts have been made to sell this byproduct gypsum or to develop uses for it. Limited use has been made of the product at the adjacent cement plant. The long term solution described to the consultants involved the pumping of the residue gypsum to a nearby depression where the product would collect, settle out and subsequently could be reclaimed after ageing. A German process for recovering the sulphur have the gypsum by the production of Ammonium Sulphate is reported to be a part of the program under consideration by BCIC. Ammonium Sulphate would be utilized as a source of nitrogen for direct application and in the production of compound fertilizers.

5.1. Road and Rail Connection to new port at Hiron

Section 2.1.2 describes the development of the new deepwater port of Mongla in southwest Bangladesh. Its location is some 50 miles

south of Khulna, the rail head for the broad gauge railroad to north west Bengal and transfer point for the present lighterage traffic of Khulna. Located on the opposite side of the Pusur River, from Khulna, there is no connection by rail or road between this new port and the overland transport system west of of the ganges. The first five berths of the new port are expected to be completed by the end of 1978 or early 1979. Effective integration of this first class modern port facility will require the bridging of the Pusur river and establishment of rail and road connections. Foreign development loan assistance is expected to be required to accomplish this program. If a study of Mongla is undertaken consideration should be given to modifying the present plan, to accomodate fertilizer and grain handling in bulk early in the port's development rather than in the second phase. Consideration should also be given to relocating the planned workers town, so that it does not occupy the space between the port and the canal.

APPENDIX

TABLE OF CONTENTS — SECTION

APPENDIX SECTION I

FORECAST OF FERTILIZER REQUIREMENTS

BANGLADESH FERTILIZER FORECAST
- 1977/78 to 1987/88
(000 Tons)

	Urea			T S P			M P		
	Demand	Domestic Production	Import Req.	Demand	Domestic Production	Import Req.	Demand	Domestic Production	Import Requirement
1977-78	371	300	71	144	60	84	37	-0-	37
1978-79	402	300	107	161	60	101	45	-0-	45
1979-80	437	300	137	180	60	120	56	-0-	56
1980-81	475	300	175	201	60	141	69	-0-	69
1981-82	525	300	225	229	60	169	80	-0-	81
1982-83	578	300	278	260	60	200	95	-0-	95
1983-84	638	300	338	296	60	239	111	-0-	111
1984-85	704	300	404	337	60	277	130	-0-	130
1985-86	774	300	474	384	60	324	153	-0-	153
1986-87	847	300	547	433	60	373	183	-0-	183
1987-88	927	300	627	489	60	429	211	-0-	211

SOURCES: AID Project Papers
Economist Intelligence Unit, Ltd. January 1977
Bangladesh Fertilizer Marketing and Distribution Study, Interim Report.

	Combined TSP and MP			Total	Total	Total Imported
	Demand	Domestic Production	Import Req.	Demand All Fertilizers	Domestic Fertilizer Production	Requirements All Fertilizers
1977-78	181	60	121	552	360	192
1978-79	206	60	146	608	360	249
1979-80	236	60	176	623	360	263
1980-81	270	60	210	745	360	385
1981-82	310	60	250	834	360	474
1982-83	355	60	295	933	360	573
1983-84	407	60	347	1045	360	685
1984-85	467	60	407	1171	360	811
1985-86	537	60	477	1311	360	951
1986-87	616	60	556	1463	360	1103
1987-88	700	60	640	1627	360	1267

APPENDIX SECTION 2

Site Questionnaires

- Chittagong TSP Plant
- Chittagong Cement Plant
- Chittagong Main Port
- Khulna/Chalna Port
- Mangla New Port Site
- Narayanganj Port

Site Questionnaire

Bangladesh Bulk Fertilizer Handling and Bagging Study

Date: 20 April 1977

Name of Site: TSP Plant/BCIC

Location: Chittagong Port, Bangladesh

Estimated Cost or Value: 40,000 Taka/Acre

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1. Landside Requirements

- Size and availability of land: 6 - 10 acres

  Could be made available - also the other parts as on drawing.

- Right of way: Yes - direct access to planned roads and to highway

- Inland Transport Capabilities: Full capacity of rail, highway and waterway system to entire Bangladesh

- Inland Transport Requirements: Must have access to road, rail and water transport

- Apparent Soil Conditions: Area is same elevation as planned. Some drainage problems. Elevation about 3 - 4 meters. Adjacent property is able to carry heavy industrial plant and bulk commodity loads.

- Compatibility with adjacent facilities: Entirely compatible as both TSP Production and fertilizer imports are compatible.

- Environmental Concerns: This is industrial area - environmental concerns of fertilizer imports same as others here. TSP Plant, Cement Plant, Grain Silo and Refinery

2. General Description of the Site:

See Drawing of the site.

Facility has jetty for ocean vessels, but no shore equipment for unloading bulk cargo. Conveyor system connects jetty to plant storage.

3. Waterside Requirements:

- Ability to accomodate required vessel size: 21' draft maximum now. Jetty is 400' in length. Can moor vessels to 520'.
- Navigational Access:
  - Depth of Water: 21'
  - Tidal rise: 8' normal to 18' (extreme)
  - If river, low water problems: No. Min. draft winter 21 - 25, After May 23-30
  - Ease of Navigation & time required: 1 hour from bar, no restrictions except length of vessel 520'.
- Berth Conditions:
  - Depth of Water: 21' draft (present) can be dredged to 30'
  - Siltation and Dredging Concerns: Some, but controlled by regular dredging
  - Safety of Berth:
    - Harbor Protection: Yes - river location
    - Current and Wind Conditions: River limits fetch from opposite jetty to about 500 yards. Severe river currents to 8 knots during monsoon
    - Tide: 8 to 18 feet (as above)

4. Berth Requirements and Waiting Time:

- Discharge rate (Fertilizer): Normal average is 1800 tons/day. Bulk Phos Rock
- Present Annual Tonnage: 250,000 tons (125 days work)
- Proposed Annual Tonnage: 400,000 tons (200 days work)
- Average Waiting Time (present): No waiting reported
- Average Waiting Time (proposed): to 1 days
- Comments: Berth should probably be dredged to 30' as part of project. Also should consider providing a crane and hopper system for increased discharge rate.

Site Questionnaire

Bangladesh Bulk Fertilizer Handling and Bagging Study

Date: 19 April 1977

Name of Site: Cement Plant

Location: Chittagong

Estimated Cost or Value: Estimated 40,000 T/Acre (Based on TSP Plant)

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1. Landside Requirements

- Size and availability of land: Yes - vicinity of cement plant is open property - up to 20 acres - partly occupied by athletic field. Would require approval of cement company
- Right of way: For connection to TSP Plant requires crossing both cement company property and grain silo property plus highway
- Inland Transport Capabilities: Location offers direct access to Highway and rail. Water delivery would require truck haul for bagged fertilizer.
- Inland Transport Requirements: Estimated annual volume of 300,000 T moving by rail, highway and water.
- Apparent Soil Conditions: Existing berth piling mounted. Area is supporting cement plant with adjacent grain silo - looks OK
- Compatibility with adjacent facilities: General area is industrial. Compatibility of cement and fertilizer dubrous, but handling facilities are compatible
- Environmental Concerns: Not significant at this time

2. General Description of the Site: Concrete berth of 450' with open 1 meter 20^{o} idler conveyor belt delivery to silo storage for cement clinker. Belt capacity reported as 600 T/M, but doubt it. For cement more likely 400 T/M. Large athletic field is on opposite side of road adjacent to cement plant. Distance from this wharf appears to be about 1/2 mile and any transfer conveyor must go under or over grain silo conveyor. A bucket wheel unloader is on this wharf. Not used, but now under repair

3. Waterside Requirements:

- Ability to accomodate required vessel size: Yes - Berth is about 450' - accommodates vessels to 550'
- Navigational Access:
  - Depth of Water: To 30 feet - but limited by bar-crossing 15' & tide
  - Tidal rise: 8 to 18'
  - If river, low water problems: No
  - Ease of Navigation & time required: River easily navigable, but berthing in high current may be difficult. Time prox 1 hour
- Berth Conditions:
  - Depth of Water: 22' prox (could be dredged to 30')
  - Siltation and Dredging Concerns: Some silting - Port Trust dredges
  - Safety of Berth:
    - Harbor Protection: River location offers good protection for berth
    - Current and Wind Conditions: Oct & Nov - subject to cyclonic winds. Current heavy at times - 3-4 kts normal - up to 8 kts or higher
    - Tide: 8 to 18 feet tides depending on season

4. Berth Requirements and Waiting Time:

- Discharge rate (Fertilizer): Bucket wheel unloader not successfully run as yet - no information
- Present Annual Tonnage: 1975 - 16,000 tons, 1976 - 7,000 tons
- Proposed Annual Tonnage: 300,000 T plus above
- Average Waiting Time (present): None
- Average Waiting Time (proposed): 1 Berth 320,000 T & 2,000 T/day = 160 days Est. waiting time prox 8 hr avg
- Comments: Depth of water over bar at present limits. Vessel drafts to 15' bar draft plus 8' or more (seasonal) max draft win 21 - 25 ft., after May 23 - 30 ft.

Site Questionnaire

Bangladesh Bulk Fertilizer Handling and Bagging Study

Date: 4/21/77

Name of Site: Chittagong Port Trust Main Port

Location: Chittagong, Bangladesh

Estimated Cost or Value: Not indicated

1. Landside Requirements

- Size and availability of land: No site specified or found Available. Port officials would agree to consider a site.
- Right of way: Would require passage through main port gate
- Inland Transport Capabilities: Complete access to road Rail and Water. Rail limited to meter gauge system - East Bangladesh
- Inland Transport Requirements: Require access to water rail and road.
- Apparent Soil Conditions: Port property already supporting heavy warehouse loads. Soil conditions appear acceptable
- Compatibility with adjacent facilities: Property is major General cargo facility. Bulk fertilizer dust would be a hazard.
- Environmental Concerns: Fertilizer dust could encroach on nearby housing across road from port.

2. General Description of the Site: No site specified. If selected, would require discussion with port officials. Indications are that entirely new site with new berth and full water port construction would be required

3. Waterside Requirements:

- Ability to accomodate required vessel size: Maximum length without notice 585', with notice 605'
- Navigational Access:
  - Depth of Water: 30 to 40', but bar crossing 15' , tide of 8 to 18 feet
  - Tidal rise: 8 to 18'
  - If river, low water problems: No low water problems
  - Ease of Navigation & time required: River easily navigable, requires 1 hour from bar, but bar crossing requires height of tide
- Berth Conditions:
  - Depth of Water: 30' (subject to special tide conditions)
  - Siltation and Dredging Concerns: River is self cleaning. Some siltation at the Jetty heads. Maintained by port dredger.
  - Safety of Berth:
    - Harbor Protection: No breakwaters at harbor entrance, but port location in river is protected
    - Current and Wind Conditions: Oct. & Nov. subject to cyclonic winds. April NW winds to 30 -40 kt gusts. Current heavy at times. Normal 3 - 4 kts up to 8 to 14 kts maximum
    - Tide: 8 to 18 ft. tides depending on season

4. Berth Requirements and Waiting Time:

- Discharge rate (Fertilizer): Not available, only handled in bags
- Present Annual Tonnage: See port statistics
- Proposed Annual Tonnage:
- Average Waiting Time (present):
- Average Waiting Time (proposed):
- Comments: This location not recommended unless no alternative exists

Site Questionnaire

Bangladesh Bulk Fertilizer Handling and Bagging Study

Date: 4/22/77

Name of Site: Khulna Port and Chalna Anchorage

Location: Southwest Bangladesh on Pusur River

Estimated Cost or Value: Reportedly not expensive per Port Director

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1. Landside Requirements

- Size and availability of land: There are river sites available for new facilities. Present port not suitable.
- Right of way: New site would require investigation
- Inland Transport Capabilities: Khulna offers access to road and broad gauge rail to Northwest Bengal and by protected inland water to Dacca and Narayanganj.
- Inland Transport Requirements: Suitable as above
- Apparent Soil Conditions: Observation indicates acceptable conditions - piling probably required in any case
- Compatibility with adjacent facilities: No site specified. Open land available thus compatibility would be acceptable
- Environmental Concerns: If new site, no particular concern

2. General Description of the Site: Khulna port has two facilities. One operated by the port, with wide apron and serving modern transit sheds. But suitable only for barges and lighters. BIWTC operates an antiqualed facility near town where lighters handled.

3. Waterside Requirements:

- Ability to accomodate required vessel size: No. River location of Khulna does not permit ocean vessels
- Navigational Access:
  - Depth of Water: 12' feet maximum
  - Tidal rise: Reportedly 8 - 12 feet
  - If river, low water problems: No
  - Ease of Navigation & time required: Easily navigable 65 miles from mouth.
- Berth Conditions:
  - Depth of Water: Maximum 12 feet
  - Siltation and Dredging Concerns: Northern part of river is subject to siltation.
  - Safety of Berth:
    - Harbor Protection: Yes, by river banks
    - Current and Wind Conditions: Up to 5 knots current, normal 3 - 3-1/2 kt. Winds unknown.
    - Tide: 8 - 12 feet

4. Berth Requirements and Waiting Time:

- Discharge rate (Fertilizer): Not applicable at Khulna
- Present Annual Tonnage:
- Proposed Annual Tonnage:
- Average Waiting Time (present):
- Average Waiting Time (proposed):
- Comments: Chalna anchorage has about 450 ships per year and 1.5 million tons of cargo/year. Neither Chalna nor Khulna are suitable. Chalna - no berths. Khulna - no water depth.

Site Questionnaire

Bangladesh Bulk Fertiliser Handling and Bagging Study

Date: 4/23/77

Name of Site: New port site of Mongla

Location: Port 8 miles south of Chalna on East bank of Pusur River Bangladesh

Estimated Cost or Value: Not available

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1. Landside Requirements

- **Size and availability of land:** See drawing for details

  Port now under construction

- **Right of way:** Would be within port boundaries

- **Inland Transport Capabilities:** No connection with rail or road, and

  well require bridging of Pusur river to connect

- **Inland Transport Requirements:** Should have access to rail water and road, particularly access to broad gauge rail system at Khulna for shipment to north west Bengal.

- **Apparent Soil Conditions:** Sandy soil at about 3 - 4 meters elevation -

  created by fill from dredging canal

- **Compatibility with adjacent facilities:** Layout of port shows bulk terminal

  between two general cargo berths - not compatible

- **Environmental Concerns:** Layout shows town constructed just behind port.

  Fertilizer dust would be a concern

2. **General Description of the Site:** A very fine looking construction job with concrete filled steel piling construction, concrete deck-wide 30 meter apron (prox). Transit sheds open storage and warehouses to be constructed. Will be a major general cargo port, but lack of land connection not resolved.

3. Waterside Requirements:

- Ability to accomodate required vessel size: Pusur river reported plan to be maintained to 35'. Would accommodate vessels to 25 - 30,000 DWT
- Navigational Access:
  - Depth of Water: 35' draft alongside
  - Tidal rise: Estimated to be about 8 feet (Port Director says 8 - 12 feet)
  - If river, low water problems: 12' change during monsoon
  - Ease of Navigation & time required: Port is about 20 miles from river-mouth. Access reported good.
- Berth Conditions:
  - Depth of Water: 35' alongside MLW
  - Siltation and Dredging Concerns: River moderately silt laden. Port Director indicated they plan to have two dredgers to maintain channel
  - Safety of Berth:
    - Harbor Protection: Westerly fetch of about 1/2 mile. A river location.
    - Current and Wind Conditions: Current to 5 knots, normally reported to be 3 - 3-1/2. Wind conditions unknown.
    - Tide: Reported as 8 to 12 feet

4. Berth Requirements and Waiting Time:

- Discharge rate (Fertilizer): New Port not yet completed
- Present Annual Tonnage:
- Proposed Annual Tonnage:
- Average Waiting Time (present):
- Average Waiting Time (proposed):
- Comments: Lack of connection to land plus the planned layout limits suitability. Berths 11 and 12 would be considered in the future for bulk cargo site.

Site Questionnaire

Bangladesh Bulk Fertilizer Handling and Bagging Study

Date: 16 April 1977

Name of Site: Fertilizer Wharf

Location: Narayanganj, Bangladesh

Estimated Cost or Value: Unknown (Area is heavily developed)

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1. Landside Requirements

- **Size and availability of land:** No land available within reach of main wharf. Land is low and . Some vacant land across river
- **Right of way:** Main roads encroach on port property and city lies adjacent
- **Inland Transport Capabilities:** Excellent road connections, meter gauge rail, this side of river only. Water transport available by country craft - sail and poll powered
- **Inland Transport Requirements:** Must have access to rail, highway and water
- **Apparent Soil Conditions:** Bearing capability appears limited. Across river appears worse-
- **Compatibility with adjacent facilities:** Heavily developed area with dwellings and shops all around. Fertilizer facilities for bulk would not be compatible here - would need new location
- **Environmental Concerns:** Definite environmental concerns here from dust of handling and run off to river.

2. **General Description of the Site:** Narayanganj is a crowded bustling river port area with many people wandering around, much rickshaw and vehicle traffic. Land area viewed virtually fully utilized. Would require demolition of buildings, relocation of road and major rearrangements to locate in vicinity of both rail and water.

3. Waterside Requirements:

- Ability to accomodate required vessel size: No. Cannot berth deepsea vessels. Depth of water reported to be max. 12' with additional problems during low water season. Minimum depth unclear.
- Navigational Access:
  - Depth of Water: 12'
  - Tidal rise: No tide
  - If river, low water problems: Yes
  - Ease of Navigation & time required: Can be reached by coasters, but none observed during visit. Appears tobe largely a barge port and country craft interchange
- Berth Conditions:
  - Depth of Water: 12' to less (Reliability of this number doubtful)
  - Siltation and Dredging Concerns: Unknown
  - Safety of Berth:
    - Harbor Protection: No applicable
    - Current and Wind Conditions: High winds and cyclone conditions. Also gusty winds in premonsoon period
    - Tide: No

4. Berth Requirements and Waiting Time:

- Discharge rate (Fertilizer): Not applicable
- Present Annual Tonnage:
- Proposed Annual Tonnage:
- Average Waiting Time (present):
- Average Waiting Time (proposed):
- Comments: This port is geographically well situated for secondary distribution facility, should adequate coaster and barging capacity be found. Preference would be to utilize this for bagged cargo transfer, not bulk.

APPENDIX SECTION 3

Survey Report: Bucket Wheel Unloader

Chittagong Cement Plant

SURVEY REPORT

BUCKET WHEEL UNLOADER

CHITTAGONG CEMENT PLANT

CHITTAGONG, BANGLADESH

DATE 19 APRIL 1977

Survey Team:

E. Ball, Frederic R. Harris, Inc., New York
H. Dare, Frederic R. Harris, Inc., Chittagong

Requested by:

USAID Mission, Dacca, Bangladesh

Authorized by:

Mr. Aziqur Rahman, Manager, Chittagong Cement Plant

Summary of Findings:

No repair assistance required. Necessary parts for repair are now on hand. Electrical controls are now completing test. Mechanical parts being installed and unit scheduled for activation on or before 1 May 1977. Repairs being performed by cement plant staff.

Survey Report: Bucket Wheel Unloader

Cement Plant, Chittagong

1. The survey of the bucket wheel unloader at the Chittagong Cement Plant was requested by the USAID Mission to Bangladesh in the interest of determining the scope of repairs required to place the unit in operation, in order that it might be considered for handling imported fertilizer materials in bulk.

2. The survey team inspected the machine during the afternoon of 19 April 1977. The findings are as follows:

3. On arrival at the site the team found cement plant maintenance personnel working on the unloader. Covers were off the electrical control boxes and breaker panels. Electricians there reported they were megger testing the electrical system and drying out the controls, preparatory to placing the unit in operation. The maintenance supervisor arrived and advised that the unloader had operated only once, during its initial use in 1975. The unit had run for approximately 60 hours during discharge of cement clinker, when the main shaft coupling on the bucket elevator failed. No spare was available and a dispute arose with the French supplier over repair and replacement parts. As a result, the plant was enjoined from using the unit.

4. During the 60 hours of performance by the unloader, approximately 30 hours were devoted to cargo handling. (The remainder being used for cooling). Performance was reported as averaging about

400 T/hour, although rated at 600 T/hour. The maintenance manager advised that the unit never performed at full rate, and was operating at limited load when it broke down. When operating the bucket wheel and elevator feeds to a 1 meter 20° idler conveyor belt system rated at 600 T/hr., but judged by the survey teamd to have a more likely rating of approximately 400 T/hr.

5. Manufacturer of the unloader is as follows:

Present Name of Company: Fives-Coil-Babcock (FCB), France

Previous Name: Fives-Lillie-Coil (FLC), France

6. Repair parts and other services required to place the unit in operation:

None

Within the past month, the dispute between the parties has been resolved and a replacement main shaft coupler for the bucket elevator has been received. The part was in the process of being installed at the time of the survey, and, as reported, the electrical system being checked. It was indicated that during the time of inactivity the electrical system was tested regularly and was in good order.

7. The maintenance supervisor stated that the unit was scheduled for operation on or about May 1, and that no assistance was required.

Respectfully submitted

R. E. Bell

APPENDIX SECTION 4

CONSIDERATIONS REGARDING DISCONTINUING TSP PRODUCTION

Considerations Regarding the Discontinuance of TSP Production

The project scope of work called for considering, in light of cost and other factors, the alternative of using the TSP factory entirely for bulk handling (bagging plus granulating and/or mixing) and discontinuing use of the factory for manufacturing.

After the various factors presented, it is the consideration of these consultants that at this time there is merit to continuing the local production of TSP. Should the establishment of a bulk fertilizer handling and bagging facility be undertaken in conjunction with the TSP operation, the facility as a whole will benefit from greater utilization of assets. In addition, the combination of facilities there will constitute the nucleus for a compound fertilizer plant, as discussed in the body of the report heretofore.

Meanwhile, the question of continued production of TSP here can be further addressed.

There follows a review of specific factors herein considered.

The TSP Plant's Operating History

It should be realized that the Chittagong TSP Plant actually is only operating in its third year of production, and to write off this investment of capital and know-how after such a short term seems hasty. The plant experienced start-up difficulties with the French

Unit, and in addition is reported to have suffered periodic shutdowns due to lack of raw material. Running out of raw material, if due to lack of foreign exchange on the part of the government, can hardly be held against the production record of the plant operation. In addition, the plant has started operating during a particularly precipitous pricing period for fertilizers and raw materials.

TVA Judged Local Production Cheaper than Import (1974)

The question of producing TSP in Bangladesh has already been studied by experts from the Tennessee Valley Authority. From their study, "The Bangladesh Fertilizer Situation (1974)" EIU (in their 1977 Study of the Fertilizer Industry) states that "TVA concluded that local production of TSP would be cheaper than importing TSP". They also mention the proposal to use ground rock for direct application combined with local TSP production. These consultants have no indication that the suggested introduction of the ground rock has been attempted, but the above points out expert opinion on continued operation (with alternatives for improvement), said opinion presented during a period of unusually high fertilizer prices.

Cost Comparison, Local Production versus Import (1977)

Utilizing cost information from the 1977 EIU study above referred to, Table A4-1 shows the present disadvantage suffered by local production as compared with todays import price. According to the EIU numbers, local product can be expected to be produced at from $100/ton to $150/ton higher than present import prices. A primary cause of unprofitable operation is high raw material cost. Establishment of long term contracts for supply, and investigations of more favorable freight charters through improved unloading rates (as envisioned by the fertilizer handling and bagging proposal) could improve to some degree the cost disadvantage.

Advantage of Continuing Production

Table A4-2 compares some of the advantages of continuing production, against the limited number of disadvantages.

Reference to Table A4-1 shows the present cost disadvantage and its foreign exchange effect.

Table A4-1

Chittagong TSP Cost versus Imported TSP
(1975-76 cost)

Plant operating rate 60,000 Tons/Year (EIU Medium Cost Level)

Raw Material Cost	Taka (Per ton of TSP)	$ US	Estimated Foreign Exchange Cost/ Ton	CIF Cost per ton of Raw Materials
Phosphate Rock	1992	132.80	133 -	82.00
Sulphur	333	22.20	22 -	55.00
Bags	200	13.33	-	
Other Variables	367	24.47	-	
Total Variable Cost	2892	192.80	155 -	
Labor	169	11.27	-	
Maintenance	194	12.93	6 -	
Admin. O/H and Ins.	232	15.46	5 -	
Interest	345	23.00	23 -	
Depreciation	564	37.60	-	
Total Fixed Cost	1504	100.26	34 -	
Total Cost	4396	$ 293.07/ton	189 -	
Estimated C&F Price Imported TSP (average of below costs)		155.00	155 -	
Difference		$ 138.07/ton	34 -	

"While there is no doubt scope for cost reductions at the TSP plant through economies in administration, staff and overhead costs, it is clear that its product cost will remain high, probably in the region of $200-300 per ton ($ = Tk 15). Although fob prices exceeded this level during the exceptional market conditions of 1974-75, Bangladesh should be able to obtain imported TSP much of the time at a normal c & f price of $130 - $180/tonne (see Section 3.4)".

Source: Economist Intelligence Unit, Ltd.
1977 Fertiliser Marketing Study (Preliminary Report)
Costs in Table are from EIU Table 67
Above quotation is from page 157 of that Report.

Table A4-3

Advantages and Disadvantages of Continuing TSP Production

Advantages	Disadvantages
Local employment stimulus	Higher Cost
Training in technical skills	Foreign Exchange Loss (See Table A4-1)
Payroll and purchases of benefit to local economy	
Avoids total dependence on import sources (Ratio between raw material cost and finished product may change). Continuing operation permits the option of buying raw material and continuing to produce, or to buy finished product.	
Maintains skills and permits development of compound fertilizer industry.	
Continues to make contribution to interest on debt	
Utilizes the existing investment Development of Oil industry could provide a source of sulphur for the future. Phosphate seeds could be found.	

The Consultants Considerations

It can be seen by the cost figures shown on Table A4-1 that when compared with the various estimates of the prices of imported TSP, it appears that local product is more costly. Yet the 1974 study by the Tennessee Valley Authority "The Bangladesh Fertilizer Situation, 1974" concluded that "local production would be cheaper than importing TSP".

The picture is unclean to the consultants regarding the actual cost of production at the present plant. At the same time it is difficult to predict the future prices of imported TSP or phosphate rock and sulphur. Therefore the consultant considers this unclear picture as a further advantage for the establishment of the bulk fertilizer handling and bagging facility at the TSP plant in Chittagong. Should it eventually be decided to discontinue use of the factory for manufacturing TSP, the fact that the fertilizer bagging and handling facility is located at the plant permits the conversion of a significant proportion of the investment in the TSP plant to continued use. Facilities for the berthing of vessels containing imported

fertilizers, for the storage and bagging of these products, all remain of value. In addition there is the potential utilization of plant machinery and buildings for compound fertilizer blending, granulating and manufacture.

In light of cost and other factors, the alternative of using the TSP factory entirely for bulk handling is considered as a viable alternative in the event that TSP production should be discontinued.

With regard to the decision to continue or discontinue production, consideration should be given to a separate study by fertilizer production and raw materials procurement specialists (in conjunction with the appropriate Bangladesh Government Organization) to review and determine the continued viability of local production of TSP.

APPENDIX SECTION 5

List of Data Sources provided by AID and BDG

AID PID for Bulk Fertiliner Handling and Bagging Project

AID Exhibits for Project Paper, April 1977

AID Subject Files; Fertilizer handling, Fertilizer Forecasts etc.

Economist Intelligence Unit Reports:

Bangladesh Transport Survey, 1974

Bangladesh Fertilizer Industry Study, 1977 Interim Report

Bangladesh Statistical Abstract, 1975

Ministry of Communications:

Requirements for Rehabilitation of Surface Transport, 1976

List of Reported Data Sources not Located

L.Buerger Study of Chittagong Port, 1976

World Bank Study of Transport System of Bangladesh

Transport Map of Bangladesh (Source Unknown)

APPENDIX SECTION 6

CONSULTANTS REVIEW

OF HISTORICAL DEVELOPMENT OF FERTILIZER

DEMAND AND AVAILABLE DEMAND FORECASTS

FERTILIZER DEMAND, PRODUCTION, AND IMPORT REQUIREMENTS

Table No. A 4-1, "Bangladesh Fertilizer Forecasts - 1977/78 to 1987/88" illustrates the demand and production of fertilizer in Bangladesh during the ten year period 1977-78 to 1987/88. Demand for all fertilizer is calculated to increase at 11.2% per annum, while production will remain static at 360,000 MT per annum. This will cause a widening in the import requirements of 192,000 in 1977/78 to 1,267,000 tons in 1987/88 if all forecast demand requirements are to be met. Of special interest to this study is the fact that both TSP and MP import requirements increase significantly as shown on the Table.

EIU Table 1 "Fertilizer Consumption in Bangladesh by Volume, 1962/63 to 1975/76", traces the historical evolution of fertilizer demand, production and importation during the thirteen year period specified. Aggregate demand for fertilizer of all types grew at an annual rate of 15.2%, from 73,000 tons in 1962/63 to 458,000 tons in 1975/76. In this period TSP use increased from 3,000 tons to 111,000 tons, growing from 4% of the total fertilizer use to 24% in 1975/76. It grew at a high demand factor of 32% per annum. MP also showed a healthy growth in demand from 2,000 tons to 27,000 or 5% of the total demand. This represented an annual growth factor of 20%.

Table 4 of the EIU Study (Appendix Section 6) "Index of Growth in Fertilizer Consumption - 1962/63 to 1975/76", highlights the increase in use of fertilizers in Bangladesh over this period. With a base year of 1962/63 = 100; TSP had the most significant growth from 100 to 3,667, followed by MP; 100 to 1100; and urea 100 to 778. Important to this report, as noted above is the growth in demand for TSP & MP and concommitant impact upon domestic (TSP) supply and imports. The latter element having negative implications regarding foreign exchange.

The Table, "Projection of Fertilizer Demand - EIU Study," and as well as, The Projection of Local Fertilizer Production, as contained in Annex B6, of the project paper (Source: Bangladesh Chemical Industries Corporation (BCIC), and AID Mission 1977) were used to determine the forecasts presented in Table No. A7-1. The medium demand forecast by EIU was the basic criterion used in the demand projections for this study.

The consultants reviewed available forecasts as presented in Table 21, "Bangladesh Fertilizer Demands". Additionally, they performed their own preliminary quantitative analysis. The forecast resulting from the consultant's historical "least

squared time series" analysis is shown on line 18. USAID least squares time series regression computations considered the addition of exogenous effects such as "the war of liberation.... acute rises in international prices for fertilizer associated with the oil price hike, and finally in 1974 [by] the explosion at the Chorasal Plant.". This model by dropping out "off" years produced a result that was more explanatory of the historical evolution of "normal" year fertilizer demand. The forecasts generated by this model are shown on line 19. The increase in the statistical significance of the "high" USAID model (Line 19), where more explanatory factors were considered indicates additional statistical investigation be undertaken. One suggested approach is to directly introduce more explanatory variables by use of multivariate techniques such as multiple regression.

BANGLADESH FERTILIZER DEMAND FORECASTS [1]

	Area (000) Base Year Actual 1975-76	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
1. IMD (1974)	458	401(-6.4)	438(-1.5)	478(1.1)	521(2.6)	569(3.6)	620(4.2)			
2. IMD (1972)	458						882(9.3)			
3. Energy (1970) Low *2	438			491(2.9)					765(6.4)	
4. Energy (1970) High *2	438			601(8.2)					1252(12.1)	
5. Energy (1970) Medium *2	438			561(6.4)					1115(10.6)	
6. FAO (1974)	458			373(-5.0)						
7. Five Year Plan (1973)	458	548(9.4)								
8. Revised Five Year Plan (1976)	458	327(-15.5)			(539)*(3.3)			(942)*		
9. TVA (1974) Conservative	458		395(-4.8)					582(1.9)		
10. TVA (1974) Liberal	458		437(-1.6)					794(7.1)		
*11. USAID (1976)	458	288(-20.7)			433(-1.1)	492(1.2)	561(2.9)	648(4.3)		
12. FAO (1971)- 'Requirements' (a)	458			1462(33.9)					1724(15.9)	
13. FAO (1971) - 'Requirements' (b)	458			1094(24.3)						
14. USAID PP (1976) *2	438	282(-19.8)			425(-.6)			639(4.8)		
15. ADAP 'Requirements" for Foodgrain only	458			488(1.6)						
16. EIU Medium	458				363(-4.5)					644(3.5)
High	458				428(-1.2)					869(6.6)
Low	493				295(-8.3)					448(-.2)
17. EIU No. 2 (CAW, 1977) High	458	591(13.6)	673(13.7)	769(13.8)	879(13.9)	1015(14.2)	1173(14.4)	1357(14.5)	1570(14.7)	1817(14.8)
Medium	458	552(9.8)	608(9.9)	633(8.0)	745(10.2)	834(10.5)	933(10.7)	1045(10.9)	1171(11.0)	1307(11.1)
Low	458	509(5.4)	547(6.1)	582(6.3)	621(6.3)	674(6.7)	731(6.9)	794(7.1)	862(7.3)	938(7.4)
18 Regression Line Forecast (Low)	458	464(.7)	490(2.3)	516(3.0)	542(3.4)	568(3.7)	594(3.8)	620(3.9)	648(3.9)	672(3.9)
19 Regression Line Forecast *3		533(7.9)	567(7.4)	600(7.0)	635(6.8)				768(5.9)	802(5.7)

1) Figures shown in brackets ( ) represent annualised growth rates for the stated period.

*2 Excludes Potash

*3 AID high regression forecast

Summary of Recommendations

Bangladesh Bulk Fertilizer Handling and Bagging Study

May 2, 1977

1. Study Period

During the period in Bangladesh beginning 13 April through 1 May, 1977, the study team reviewed available data, met with US AID, UN, UK, and BDG Government officials, undertook field trips to the ports and prepared a draft site recommendation report for locating a facility for the importation, storage and bagging of bulk fertilizers into Bangladesh.

2. Conclusions

Following observation and study of the Bangladesh fertilizer transport system and examination of alternative sites for location of bulk storage and bagging facilities, the consultants concluded that in order to provide a system of fertilizer import best serving the country's needs over the period 1978 through 1987, there is only one feasible solution. That solution is the importation of TSP and MP in bulk and the establishment of a bulk storage and bagging facility on the grounds of the TSP plant in Chittagong.

2.1 Internal Distribution in Bags or Bulk

The team observed and studied the present transport and storage system of Bangladesh and investigated future planning for the project period. They observed a lack of internal transport equipment for and experience in the handling and control of bulk materials. Based on these observations, it was concluded that fertilizers should be bagged at the port prior to shipment, and that internal transport should be in bags. Transport in bulk to inland storage and bagging facilities should not be considered at this time.

3. Alternative Sites

The scope of work called for the examination of various feasible alternative plans for importing TSP and MP in bulk into Bangladesh. [illegible] Eight alternative sites were considered.

3.1 The Feasible Alternative

A system of fertilizer import best serving the needs of Bangladesh for the next ten years (1978-87) would be one based on services, facilities, management, labor and transport to be in existance now or known to be expandable or available within the initial (at least the 1st 5 year) period of the 10 year time frame. It should also be a system which will not work at cross purposes with existing or planned programs, and it should be compatible with and complementary to existing and planned programs, and present and future requirements of the country. There is only one site for bulk fertilizer import which can be recommended as best serving the needs of Bangladesh for the next ten years. This site is the TSP Plant at Chittagong.

Location of bulk fertilizer storage and bagging facility at this plant best serves the needs of Bangladesh for the following reasons:

- Least capital cost
- Existing bulk fertilizer handling equipment
- Existing experienced labor
- Existing experienced management
- Use of land is compatible with existing operations
- Import materials supplement and complement the existing production
- Availability of MP at this location will permit the production of compound fertilizers
- Existing harbor facilities
- Improvements to the facilities (adding handling equipment, lengthening and/or deepening berth) enhance the capability of the existing facility
- Utilization of existing facility is enhanced with economic benefit of economies of scale.
- Complete system of rail, road and water transport is already available in existance and is expandable (road and water)

- Electric power and local infrastructure is available

- Import fertilizer handling and bagging is completely compatible with existing operation

- Compound fertilizer production is a future requirement of the country; location here facilitates development of such products

- Additional bagging capacity supplements existing plant capacity

- Storage facilities can be complementary between the plants

- Organizational and management relationships are compatible.

4. The Recommended Site

The bulk storage and bagging facility should be located on the Chittagong TSP property. Further evaluation of the exact site and configuration would be carried out in a later phase of this program. In connection with the development, a number of new installations will be required, together with improvements to existing facilities to be jointly used by the TSP plant and the Bulk/Bagging plant.

4.1 Design Requirements

Detailed design requirements, draft proposal documents and estimated costs will be prepared in USA during the second phase of this study.

4.2 Transport Capacity

Study of the capacity of the region's transport system indicates that the increased fertilizer imports through the port of Chittagong are within the present and potential capacity of the existing and developing cargo transport system in the area.

5. Recommended Additional Technical Assistance Considerations

It is also recommended that consideration be given to a technical evaluation of the merit of the below listed project proposals. In the interest of fertilizer and agricultural development, and limited port and transport requirements.

5.1 Granulation and Ammoniation Unit - TSP Manufacturing

Bangladesh production of TSP is presently not in granular form due to lack of a granulation unit at the Chittagong plant. Imported TSP is in granular form, which permits ease of handling and broadcasting by the farmer. Powdered TSP results in skin burn and breathing discomfort due to dust in handling the material, in addition to serious product set up problems. Thus farmer preference is for the granular product. It has been suggested that an ammoniation unit be included in conjunction with the installation of a granulator. This would permit the production of ammoniated phosphates and by the addition of MP, should it be available at the TSP plant, would provide Bangladesh with its first compound fertilizer manufacturing installation.

5.2 Gypsum Disposal System - TSP Manufacturing

BCIC officials also reported that project papers and plans have been prepared, in the amount of $2.0 million, for the installation of a gypsum disposal system at the Chittagong TSP plant. Gypsum disposal is a problem common to phosphoric acid production. Management at the Chittagong plant reported that there is available on present plant property room for only one more years production of gypsum and that without a long term solution to the gypsum problem, the plant would be forced to close down.

5.3 Road and Rail connections to the New Port of Mongla

Located on the opposite side of the Pusur River from Khulna, there is no connection by rail or road between this new port and the overland transport system west of the Ganges. Effective integration of this first class modern port facility will require the bridging of the Pusur river and establishment of rail and road connections. Foreign development loan assistance is expected to be required to accomplish this program. If a study of Mongla is undertaken consideration should be given to modifying the present plan, to accomodate fertilizer and grain handling in built early in the port's development rather than in the second phase. Consideration should also be given to relocating the planned western town, so that it does not occupy the space between the port and the canal.