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PEOPLE'S REPUBLIC OF BANGLADESH

STUDY REPORT

ON

JAMUNA RIVER BRIDGE CONSTRUCTION PROJECT

FERRY

(FIRST STAGE)

MARCH 1975

JAPAN INTERNATIONAL COOPERATION AGENCY

CENTRAL COUSULTANTS, INC.

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Preface

Among the first stage studies on railways, roads, and ferries of the Jamuna River Bridge Construction Project in The People's Republic of Bangladesh, this report relates to the "Study of Ferry", and mainly includes the evaluation of the present status of the ferry system in the Jamuna River basin and recommendation for its improvement. This survey was conducted from January 1974 by Central Consultants, Inc., upon request of J.I.C.A. (formerly O.T.C.A.)

March 1975

Central Consultants, Inc.

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RECONNAISSANCE SCHEDULE AND TEAM MEMBERS

FERRY RECONNAISANCE SCHEDULE

Jan 17 Departed Tokyo with railway and road teams.

Jan 18 Arrived in Dacca.

Jan 19 Visit to Japanese Embassy and Ministry of Communications.

Jan 20 Meeting with Jamuna Bridge Survey Office personnel regarding reconnaissance schedule and supply of vehicles.

Jan 21 Meeting with counterparts of railway and road teams regarding reconnaissance schedule, collection of reference materials and available assistance from them.

Jan 22 Visit to R & H. Round table discussion with its technical staff.

Jan 23 Visit to R & H Sitalakiya Bridge and ferry.

Jan 24 - 26 Visit to R & H, I.W.T.C. and I.W.T.A. Briefing on the present status and collecting of reference materials.

Jan 28 Preparation for starting reconnaissance of the east bank of the river basin.

Jan 29 Reconnaissance of R & H Mirpur and Nayarhat ferries.

Jan 30 Reconnaissance of a private ferry on the east bank of the river basin.

Jan 31 - Feb 1 Reconnaisance of railway ferry between Bahadurabad and Tistumkh. Briefing on the present status from river transportation concerns, and exchange of opinions with them.

Feb 2 Return to Dacca.

Feb 4 Preparation for starting reconnaissance of the west bank of the river basin.

Feb 5 Reconnaissance of R & H Taraghat ferry, and B.I.W.T.C. Jamuna River route ferry.

Feb 6 - 11 Reconnaissance of a private ferry on the west bank of the river basin.

Feb 12 Reconnaissance of railway ferry between Sirajganj and Jagannathganj.

Feb 13 - 14 Reconnaissance of R & H Bagabari ferry.

Feb 15 Reconnaissance of B.I.W.T.C. Padma River route ferry.

Feb 20 Observation of the river basin from a helicopter.

Feb 21 Preparation for return.

Feb 22 Departed Dacca with railway and road teams.

Feb 25 Visit to Asia Highway Department of ECAFE of the United Nations (Bangkok). Collection of reference materials and exchange of opinions with technical staff.

Feb 26 Arrived in Tokyo.

Ferry survey team

Junichi Shimada, Central Consultants, Inc.

ABBREVIATIONS AND UNITS

Bangladesh	The People's Republic of Bangladesh
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BSC	Bangladesh Shipping Corporation
R & H	Roads and Highways Directorate
JICA	Japan International Cooperation Agency
OTCA	Former name of JICA
HWL	High water level
LWL	Low water level
m	meter
s,sec	second
f, ft,(')	foot
in,(")	inch
mi	mile
hr	hour
mon	month
yr	year
sq	square
cu	cubic
max.	maximum
min.	minimum

1 in = 2.54 cm

1 ft = 0.305 m

1 mi = 1.609 km = 5,280 ft

1 cu. ft = 0.0283 m^3

1 sq ft = 0.0929 m^2

TK1 = ¥36

SUMMARY

Jamuna River which has a large delta area in its downstream, causes flooding during each rainy season, moves sand bars and transforms peripheral topography by repetitive erosion and deposition of the river. This situation makes Bangladesh one of the most difficult deltaic regions in the world.

Ferry transporatation is therefore indispensable in this country, which is fragmented by a number of large and small rivers, both for the transportation of commodities and for the people. However, ferry transportation is disturbed by excessive water in the rivers during the rainy season, and scarce water during the dry season, just as the rivers themselves are at the mercy of the violence of nature. For this reason, ferry operation is under an extremely difficult situation, notwithstanding the great expectations for effective service by ferry transportation.

Ferries operated in the Jamuna River basin, inclusive of its main stream as well as its branches, are classified as B.I.W.T. road ferries, Bangladesh railway ferries, R & H road ferries, and small private road ferries. Most of them are required to change their ghat locations and operation routes in both the rainy and dry seasons because of the unstable geography of the river bank and the river routes, and ghat life on the main stream is normally short. Consequently loading/unloading facilities are generally simple, movable floating pontoons and variations thereof, and it is extremely difficult to provide permanent and efficient facilities.

Additionally, due to flood waters during the rainy season in these areas, it is necessary for the ferries to be moored at the ghats with

their bows pointing upstream, and their structures are of the inefficient side loading/unloading type except for a limited number of R & H road ferries.

This situation has a vital influence over freight wagon transportation by railway ferry. Additionally, shallow water areas appearing during the dry season creates many operation routes and spots where hindrance of ferry operation is remarkable.

These facts are the parmanent obstacles for ferry operations, and the investment environment for the ferry business is essentially poor.

For these reasons, the present level of transportation capability is quite low, and the fluctuation of traffic peaks is treated by a form of wide time allowance.

Looking at this situation from domestic transportation aspects, it can be said that the poor level of ferry services (in terms of time resistance and fare resistance) is restraining the development of land transportation activities between Dacca, the capital, and northwest areas of the country.

Transportation and traffic crossing the Jamuna River in 1969/70, more than half of which was by ferries, are estimated to have been 560,000 tons/year and 2,000,000 passengers/year.

As previously stated, ferries in the river basin have difficult improvement targets. Possible measures for improving transportation presently being considered are in regard to operations aspects such as selection, scheduling and routing of ferries without improving loading/unloading facilities, but only increasing the number of ferries.

Nevertheless, a substantial improvement of ferry operations will be structured on the wide area water control plan. Introduction and

development of high performance ferries and reinforcement of supporting facilities appear to be the only improvement measure until that time.

Since conditions at the merging point of the Jamuna and Ganges rivers, and their west bank areas are comparatively good year-round, reallocation of ferries at the river basins should be studied in relation to future reinforcement of the domestic transportation network.

CHAPTER I INTRODUCTION

1. Purpose

The feasibility study of this project has been executed with a premise for constructing bridges over the main stream of Jamuna River. The Jamuna Bridge Project is proceeding as both a railway and road bridge. It is also planned to construct bridges to cross small and middle sized rivers which cross access routes leading to existing all-weather roads and railways.

However, effective operation of ferry transportaiton on small and middle sized rivers, both in the new transportation network created by completion of Jamuna Bridge and in interconnected local roads, still remains as an important task in the future as supplementary transportation measures.

This is also true for the discussion of ferry service on the main stream of Jamuna River. It might also be pointed out, that the improvement of this ferry transportation service system is an impurtant task to be pursued during the process of Jamuna Bridge construction and transportation system preparation, since the above process may require a considerably long period of time.

This ferry survey has been executed from the above-mentioned standpoint, and its purposes are twofold:

a. Survey on the present situation of ferry service in the transportation system of Jamuna River basin.

b. Review of the improvement scheme of ferry operations on the basis of the above survey.

2. Scope

The first phase survey has been executed for the natural environments in which ferry transportation is practised and their changes, service level, and present status of income-expenditure of ferry operation, as its scope.

Emphasis has been placed on this first phase survey to observe the present situation as it is as much as possible, to collect necessary information for further study and to make field reconnaisance over the Jamuna River basin during about a month's survey period.

Though the information collected was not perfect, the second phase elaboration has been made on the basis of the first phase survey, starting by surveying all problems, and ending in the recommendation for the reinforcement of transportation capabilities at the present time.

Since the prospect for the required transportation scale is not included in the scope of this survey, the following very rough assumption has been made for the purpose.

The required transportation scale during the yenr 1985-1990, when Jamuna Bridge is scheduled to be completed, is assumed to be twice as large as that of the present time by general observations of transportation trends.

By following this observation, the target capacity of transportation in the following study has been assumed to be twice as large as that of the present time.

For the realization of effective ferry transportation service, it is observed from the characteristics of ferry transportation,

that benefits by technical renovation may play an important role other than effective operation. However, the recommendation for improvement by incorporating results of technical renovation, is discussed separately from the improvement for the immediate future, considering that it should be put into the long range project.

Based upon the above-mentioned judgement, the recommendation has been prepared on a step-by-step improvement which is limited to the extent possible to practise, in accordance with the demand for cross river transportation on the basis of observation on the past progress and present status of ferry transportation.

Transportation activity in Bangladesh, especially automobile transportation, is now in the development stage, but there are still many problems left to be solved.

Since there is an economical problem in changing ferry transportation into bridge connections, it is an utmost need to develop more effective ferry transportation in the future, and for that purpose it is considered to be necessary to develop or introduce a drastic new ferry transportation system. A discussion has been made in the last chapter on the technical feasibility of the new system as an approach to this problem.

CHAPTER II

FERRY CROSSING ROUTES AND POINTS

The many ferries that are operated over the main rivers and the tributaries of the Jamuna River may be classified by the operating bodies as follows:

Bangladesh Inland Water Transport Corporation ferry

Road and Highway Directorate road ferry

Private party road ferry

Bangladesh railway river ferry

Others

These ferries cater to the domestic trunk route transportation as well as local transportation. The locations of the routes and the crossing points of these ferries are as shown in Fig. 1-1.

(1) Bangladesh Inland Water Transport Corporation ferry

The Jamuna River confluences with the Ganges River, which flows down from the west, in the vicinity of Aricha, from where the river flows in a shoutheasterly course in the name of Padma River.

The trunk roads which lead from the capital city of Dacca to the northwest and the southwest region of Bangladesh is connected by the ferries operated from Aricha by the Bangladesh Inland Water Transport Corporation, as the Jamuna River and the Padma River route ferries.

A. Jamuna River route

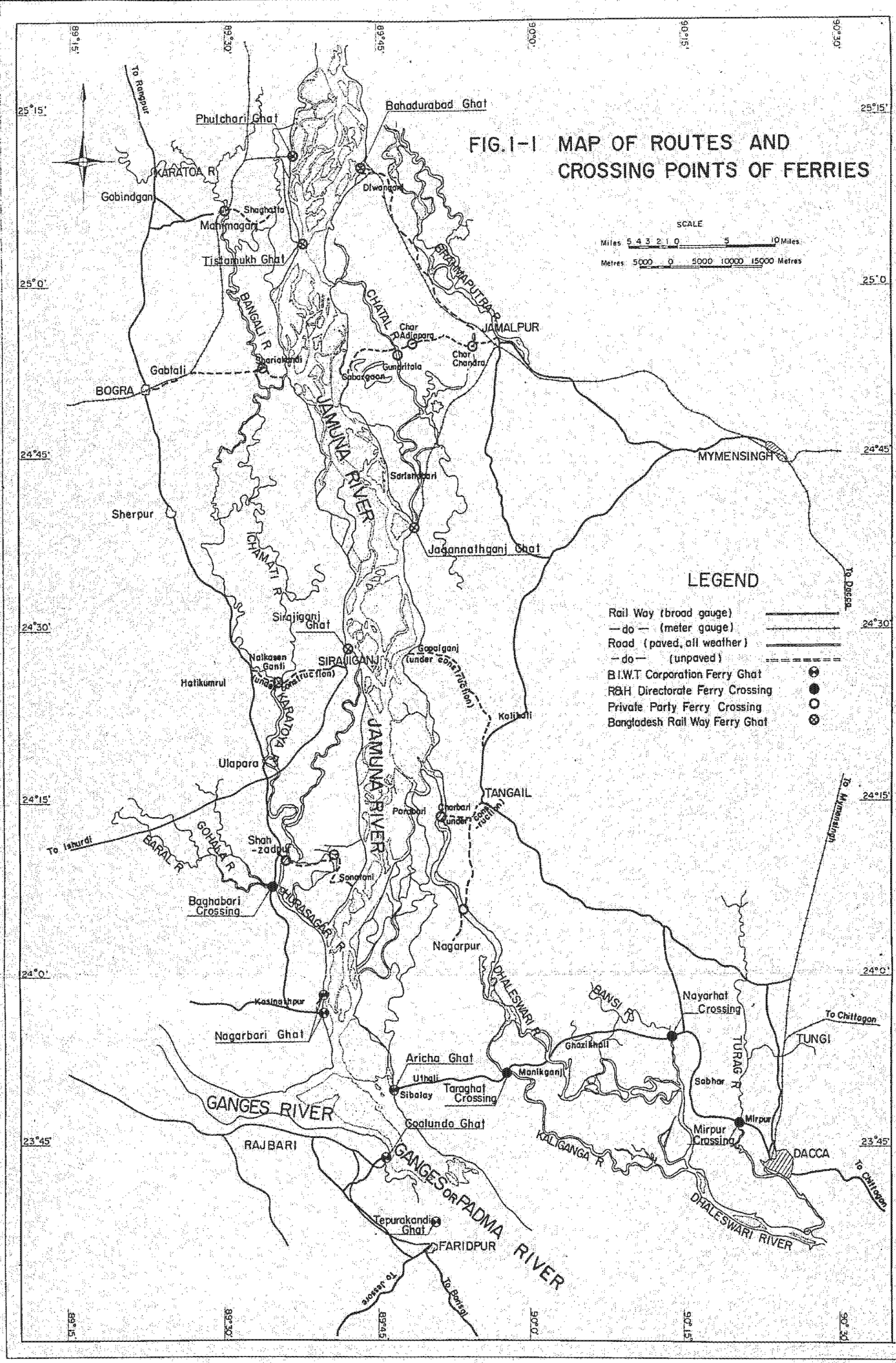
1. Aricha - Nagarbari route

B. Padma River route

2. Aricha - Goalundo (Doulatdia) route

3. Aricha - Tepurakandi route

FIG. 1-1 MAP OF ROUTES AND CROSSING POINTS OF FERRIES



The Jamuna River route connects the Nagarbari-Bogra trunk road at the west bank of the river and is the crossing for the domestic trunk transportation route with the Rajahi Division in the northwest of Bangladesh.

The Padma river route connects the Faridpur-Jessor trunk road of the southwestern Khulna Division at the west bank of the Padma River. This trunk road is also the only land transportation route between Dacca and the other major parts of Bangladesh and for international goods transportation with India.

Consequently, these Bangladesh Inland Water Transport Corporation ferry routes, with Aricha as the concentration point, hold on extremely important position for the nation.

(2) Road and Highway Directorate Road ferry

In August 1973, there were about 40 ferry crossing points of various sizes for the national highway network under the control of the Road and Highway Directorate.

There are no official gradings for these ferry crossings, but they may be graded into three classes according to their importance in transportation.

Class I

These are the crossings for the main trunk roads, and are of the heaviest traffic volumes and traffic density.

Class II

These are the crossings for other trank roads, where the

traffic density is lower although traffic remains heavy.

Class III

These are the crossings of lesser importance for the subsidiary roads. Traffic density is low, and load restriction is imposed for ferry loading and unloading.

The Road and Highway Directorate ferry crossings over the Jamuna River are on the Dacca - Aricha and the Nagarbari - Bogra trunk roads. These crossings are Class I and are operated by the Road and Highway Directorate.

Also, the Road and Highway Directorate is now carrying out construction of all-weather roads to the river banks from the west and east banks of the Jamuna River, where the road network is not well developed, and ferry crossings will be incorporated in some of these routes.

The locations of the routes and ferry crossings are as follows:

East bank region

A. Dacca - Aricha trunk road

1. Mirpur crossing (Turag River)
2. Nayarhat crossing (Bangshi River)
3. Taraghat crossing (Kaliganga River)

B. Tangail - Charbari road (under construction)

C. Tangail - Bogbari - Gopolganj road (under construction)

West bank region

A. Nagarbari - Bogra trunk road

4. Bagabari crossing (Baral River and Gohala River)

B. Mutikumprul - Sirajganj road (under construction)

The above 4 ferry crossings of the trunk roads are crossing points which are playing very important roles in the trunk road transportation in Bangladesh.

However, at these points, permanent bridges are under construction at the Mirpur crossing, the Nayarhat crossing and the Taraghat crossing through a U.S. grant, and these ferry crossings will be closed after the completion of bridges. It is expected that the ferry obstacles along the Dacca Aricha trunk road will be completely removed in two years time.

(3) Private Party ferry

It is natural that under unique physical conditions the road network in the Jamuna River region is completedly undeveloped.

The access to the Jamuna River banks from such trunk roads as the Dacca - Tangail - Jamalpur route on the east bank and the Nagarbari - Bogra - Rangpur route on the west bank are being provided for through the construction of two or three all-weather roads by the Road and Highway Directorate. Other than these, access depends on either the District Council or the Kutcha roads. Bullock carts form the major traffic on these local roads which are utilized only by local traffic between small towns along the main roads making one-day return trips. The road bed and road surface conditions of almost all of these roads are such that vehicle traffic is difficult even during the dry season.

Consequently almost all ferry crossings on these local roads are operated on a small scale by private parties and the objective is no more than serving bullock cart and pedestrian traffic.

The points of ferry operation on the east bank of the Jamuna River are limited to the Dhaleswari River and the Chatal River, while those on the west bank are the Karatoa River, the Bangali River and the Katakari River, all of these being medium size rivers. Ferries are operated during the rainy season across the unknown small rivers, but during the dry season, these small rivers can either be forded or are completely dried up.

(4) Bangladesh Railway ferry

The railway routes of the Bangladesh Railway over the nation may be classified by the gauge of the rail into two classes:

1) Broad gauge

2) Meter gauge

The railway system is separated by the Jamuna River into east and west, and generally the west side is of broad gauge while the east side is of meter gauge.

These two completely divided regions are connected by railway ferries on two river routes.

A. Tistamukh - Bahadurabad route

The Tistamukh on the west bank and the Bahadurabad on the east bank are both terminals of meter gauge. This means that freight wagons may be directly transported across the river by ferry without

the necessity of unloading and reloading the freight at the two terminals. For this reason specific freight ferries are operated. The passenger ferry which was temporarily terminated after liberation is now resumed.

B. Sirajgangj - Jagannathganj route

The Sirajgangj terminal on the west bank is of broad gauge, while the Jagannathganj terminal on the east bank is of meter gauge. Consequently, only passenger ferries are operated across the river route between the two terminals.

CHAPTER III B.I.W.T. CORPORATION FERRIES

1. Padma River Route

This route connects Aricha with the Khulna Division to the southwest, across the Padma River. The existing locations are as shown in Fig. 3-1. The route is further divided into the service routes of:

Aricha - Goalundo (Daulatdia)

Aricha - Teprakandi

The above service routes are mutually complementary to each other according to the changes in condition of operating during the rainy and dry seasons. The water surface width and the water depth of the main stream of Padma River is very favourable for operation during the dry season. However, a flow velocity of 6 knots per hour or more is observed for the flood waters of the rainy season.

From Aricha, these service routes do not cross the river to their respective ghats in a straight line. That is, there is a large char land on the west bank of Padma River and the connecting route to the trunk roads on the west bank becomes very complicated, unstable, and unfavourable for operation as it approaches the char land. This char land is generally high in elevation. However, as it is flooded during the rainy season, the topography of the inland portion of the char land varies from year to year.

The Goalundo route is a long established route starting from Goalundo ghat, traverses through Faridpan, 2 miles southeast of the

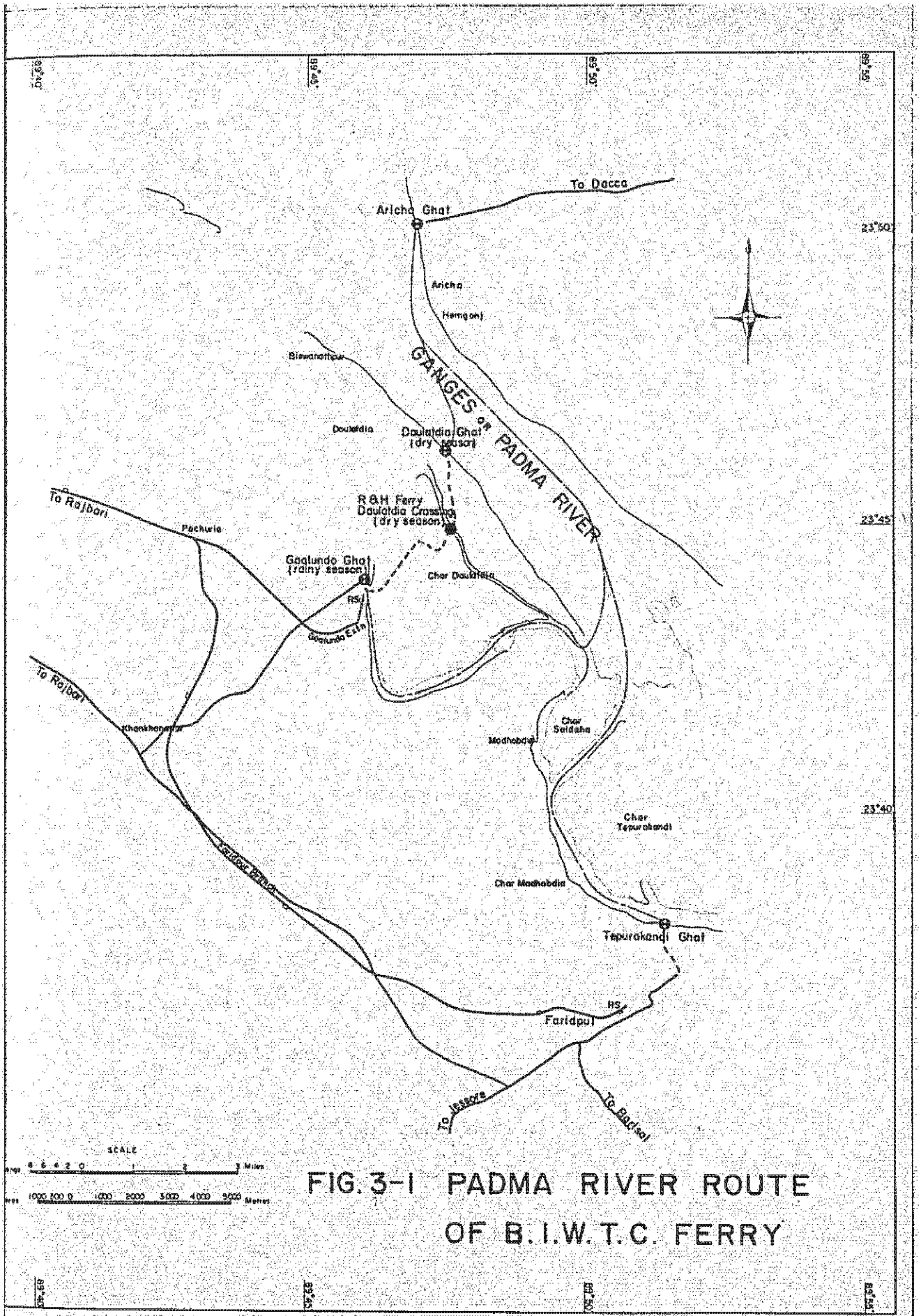


FIG. 3-1 PADMA RIVER ROUTE OF B.I.W.T.C. FERRY

ghat, to connect with the towns of Jessore and Barisal.

However, the route and the position of the ghat has to be greatly changed between the rainy and dry seasons at the Goalundo ghat.

In the dry season, the char land on the west bank of the Padma River dries up for a span of about 3 miles between Goalundo and the main stream of Padma River. Therefore, a new Daulatdia ghat has been newly opened on the bank of the char land about 4 miles downstream from Aricha during the dry season, and the ferry service is operated up to this point. From this point to Goalundo, a dry season road of about 5 miles in length runs over the char land, and then a creek of about 350 ft. in width has to be ferried over by a marboat operated by the Road and Highway Directorate. In other words, a total distance of about 6 miles across the char land has to be travelled for reaching Goalundo from the crossing point. In this way, although the ferry crossing itself is a rather short trip, the overall trip up to Goalundo is a very inefficient one. Also, the ferry service operated by the R & H Directorate at the Daulatdia crossing is seasonal, and the marboat allocated may serve only light vehicles up to small buses and small trucks. Therefore the Aricha - Daulatdia route is a ferry service only for light vehicles during the dry season, and the transportation of heavy vehicles during this period depends on the Archia - Teprakandi route.

During the rainy season the char lands on both banks of Padma River are flooded and the Daulatdia ghat is closed, while a Goalundo

ghat is established at the terminal of the Goalundo - Faridpur road. However, the depth of water over the flooded char land is not sufficient for ferry operation directly from the Padma River main stream to the Goalundo ghat. Therefore the Goalundo route from Aricha first traverses downstream along the Padma River main stream, to a point about 4 miles south of Goalundo, and then takes a detour route upstream through a secondary water channel to reach the ghat, the whole course coming to about 15 miles. This forms the main service route across the Padma River during the rainy season. The secondary water channel to the ghat becomes partially dried up during the dry season and the depth of water is insufficient for ferry operation.

The Teprakandi route is situated along the secondary water channel which cuts deeply across the char land. A dry season road of about 1.5 miles in length connects this point with Faridpur.

The entrance to the secondary water channel is near the entrance of the ferry route to Goalundo ghat and the depth of water often becomes shallow so that dredging by the B.I.W.T.A. is necessary. However, the traffic signalling system for the water channel is well established right up to the Teprakandi ghat.

The service from Aricha along this route is a long route of about 17 miles in length and is operated in both the rainy and dry seasons, but the one-day round-trip operation of the ferry is very straining.

This route forms the main service route of the Padma River route during the dry season, but becomes only a secondary service route during the rainy season due to its being inferior to the Aricha - Goalundo route in travel distance and travel time.

2. Jamuna River Route

(1) Route of operation

This route, as may be seen from Fig. 3-2, joins Aricha on the east bank of Jamuna River with Nagarbari on the east bank about 12 miles upstream.

The Aricha ghat is situated at the terminal of the Dacca - Aricha trunk road on the river bank of the Jamuna River. In the past there has been no changes of physical conditions by erosion or siltation, and the location of the ghat has for a long period remained very stable. The ghat is at the same location for both the rainy and dry seasons.

The bank on which the Nagarbari ghat is situated is a strip of land which has long been under erosion so that it has now been pushed backwards to a point about 3 miles away from the junction of the Kashinathpur road.

The river bank is unstable, and the ghat has to be shifted to and fro along the river bank. At present, the location of the ghat is different between the rainy and dry seasons.

In the rainy season, the terminal of the Nagarbari Bogra trunk road directly faces the Jamuna River. However, in the dry season, the river bank dries up to a great extent and the ghat is closed.

The dry season ghat is established at the end of the dried up zone about 1 mile upstream.

The dry season main stream of the river diverges into the east bank stream and the west bank stream near Nagarbari, but

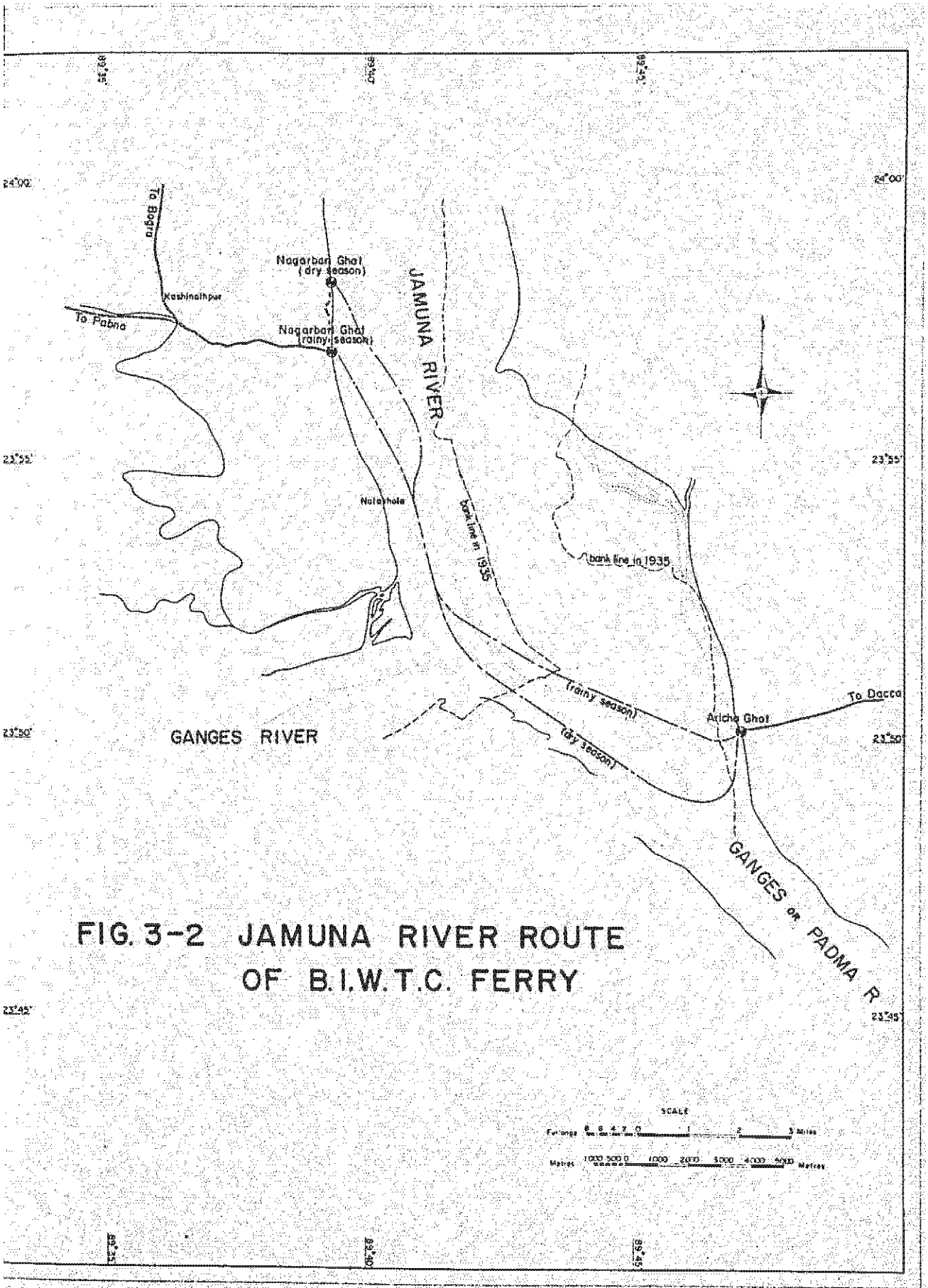


FIG. 3-2 JAMUNA RIVER ROUTE OF B.I.W.T.C. FERRY

confluences again into the west bank stream about 3 miles downstream before converging with the Ganges River to flow in front of Aricha.

The travel distance of this route is about 13 miles during the rainy season.

In the dry season, a number of small chars appear in front of Aricha ghat and the approach route to the ghat has to take a detour course about 2 miles downstream of the ghat, resulting in a route distance of 15 miles.

Along this route, sufficient water depth and navigation width are available for ferry service, and navigation conditions are considered satisfactory.

(2) Present status of ferry operation

Transition of past ferry transportation on both Padma and Jamuna routes are shown in Table 3-1.

Table 3-1

Passenger and Motor Vehicle Traffic Volumes

		Jamuna route	Padma route	Total
1965	Passengers	*67.0	100.0	167.0
	Motor vehicles	4,368	3,785	8,153
1966	Passengers	111.7	161.9	273.6
	Motor vehicles	9,854	8,121	17,975
1967	Passengers	244.6	306.0	550.6
	Motor vehicles	18,991	15,134	34,125
1968	Passengers	307.9	409.4	717.3
	Motor vehicles	25,193	17,461	43,072
1969	Passengers	345.6	417.0	762.6
	Motor vehicles	25,193	15,299	40,492
1970	Passengers	388.2	429.6	817.8
	Motor vehicles	26,011	14,760	40,771

* In thousands.

1965 : 2 ferries + 1 standby ferry

1966 : 3 " + "

After 1967 : 5 " + "

As seen in Table 3-1, the total traffic volume doubled each year until 1967, according to the increase in the number of ferries, but it does not show drastic increases after the number of ferries was stabilized at five.

However, the average annual utilization ratio of ferries after 1967, is estimated to have been a considerably high percentage (50 to 70%), taking the capacity of ferries into account.

From this observation, it may be concluded that potential demand for cross river traffic on Jamuna and Padma routes is considerably high, and that the volume of cross river traffic was always restricted by the capacity of ferry transportation.

Under this situation, the Aricha-Nagarbari portion of Jamuna route is gradually enlarging its importance each year in comparison with Padma route, and it absorbs 40 to 50% of passenger traffic and 55 to 60% of motor vehicle traffic at the present time.

The total number of motor vehicles in Bangladesh in the past is shown in Table 3-2, but the present figure has not yet recovered to the pre-war standard, due to damages caused by the war.

Table 3-2

Total Number of Motor Vehicles (In thousands)

Year	Truck	Bus	Passenger cars	Others	Total
1961	4.6	2.2	8.1	4.6	19.5
1969	8.9	5.5	24.0	27.8	66.2
After 1970	-4.2	-1.9	-	-	-
"	+1.7	+0.6	-	-	-

* Jeeps and station wagons are included in passenger cars.

** The numbers shown in "after 1970" show war damages and replacements for them, by March 1973.

According to B.I.W.T.C., traffic levels in 1973 are expected to be 750,000 passengers/year and 45,000 motor vehicles/year.

To this effect, seven car ferries are presently employed for the Jamuna and Padma river routes, both of which hold Aricha as key transportation base.

All are car ferries which require normal ship operation techniques, and are classified into 140, 120, and 95 ft class, according to the vessels length. Dimensions and nominal load capacities are shown in Table 3-3.

These ferries are of the flat type (140 ft class), or of the boat type (120 and 95 ft class) of steel hull.

Table 3-3 Principal Particulars of B.I.W.T.C. Ferries

Class of Vessel	Dimension of Ferries					Loaded Draft	Dead Weight	Nos. and H.P. of Engine	Carrying Capacity	Total Crews
	Length	Width	Deck	Depth	F.Board					
140 ft class KASTURI KARABI	140'	40'	140'x 40'	abt.7'	-	3'- 6"	-	2-370H.P.(diesel)	14-trucks or 30/35 cars	18 Nos. (2 shifts)
120 ft class DACCA FARIDPUR	120'	30'	120'x 30'	-	-	3'- 6"	44 tons	2-320H.P.(diesel)	6-trucks & 4 cars or 15/16 cars	-
95 ft JAMUNA KARNAFULI GUMTI	95'	27'	abt.60'x 27'	abt.6'	-	4'- 0"	22 tons	2-265H.P.(diesel)	2-trucks & 2 cars or 8/9 cars	15-16 Nos. (2 shifts)

Table 3-4

Normal Services of Ferries During the Dry Season

Route	Operation frequency	Necessary time for navigation toward upstream and downstream
Aricha - Nagarbari		
Two ferries of 140 ft class	Two round trips	Up : 3.5 hours (2.5) Down : 3.0 hours (2.0)
Two ferries of 95 ft class	Two round trips	Up : 3.0 hours Down : 2.5 hours
Aricha - Daulatdia		
One ferry of 95 ft class	Three round trips	Up : 65 minutes (45) Down : 50 minutes (30)
Aricha - Teprakandi		
Two ferries of 120 ft class	Two round trips	Up : 4.5 hours (4.0) Down : 4.0 hours (3.5)

* Times do not include waiting time.

** Times shown in parenthesis are net cruising times.

A typical pattern of such temporary measures is thirteen round trips, by seven ferries, as shown below:

Aricha - Nagarbari

Two ferries of 140 ft class — Two round trips

(Two extra ferries of 140 ft class — Two extra round trips
This service is accomplished by over-time work of above vessels and crews.)

Their superstructures are of single-deck bridges, and passenger cabins are situated in the middle or at the rear of the ships.

All are self propelled vessels, with twin screws.

Loading and unloading of vehicles is by the side boarding system, and substantial steel ramp boards are fixed by hinges at each side of the vessels.

Nine round trips, by seven ferries, are provided for the Jamuna and Padma routes as normal services during the dry season, as shown in Table 3-4.

Though these ferries are operated on a fixed time schedule, delay is remarkable and the schedule is always unstable.

Cycle operation times shown in Table 3-4 is under normal conditions, but it easily fluctuates and increases when the number of mixed loadings of heavy and light vehicles increases, and car accidents and other troubles during loading and unloading occur at the ghats.

For example, at times one cycle time for 140 ft class ferries on the Aricha - Nagarbari route is as much as seven hours and thirty minutes.

Normal ferry services during the dry season on the Jamuna and Padma routes are as stated above, but temporary increase of ferry services, by over-time work, is often employed during traffic peaks.

Two ferries of 95 ft class	Two round trips

Aricha - Daulatdia

One ferry of 95 ft class	Three round trips
(Two extra ferries of 95 ft class This service is accomplished by over-time work of above vessels and crews of Aricha - Nagarbari route.)	Two extra round trips

Aricha - Teprakandi

Two ferries of 120 ft class	Two round trips

The above shows the maximum possible services provided as a temporary measure to meet demands during the dry season on the Jamuna and Padma routes.

At these times, priority is normally given to passenger transportation (passenger cars, buses, etc.) at each ghat, and trucks are often left without being loaded on the vessels.

This results in a river crossing pattern of trucks arriving at ghats in the evening and being loaded on the first vessels the next morning. Taking Aricha - Nagarbari route for example, the number of trucks waiting overnight and arriving early the next morning is 30 to 40 at each ghat.

Trucks waiting overnight total more than 200 at each ghat during extremely crowded periods, and waiting time can extend to 2 to 3 days.

In other words, shortage of ferry transportation capacity results in increased waiting time by vehicles at each ghat, and peak traffic is presently handled in the manner explained above.

(3) Present situation of facilities

Aricha Ghat

The river bank along this region is formed of an erosion type slope of about 25° in gradient.

The water in front of the ghat forms a water channel of about 1,000 ft. in width when the water level lowers in the dry season. This forms the approach channel to the ghat.

The Aricha ghat is the converging point of the Jamuna and Padma routes, and the terminal is very congested with waiting vehicles, passengers, roadside stores ,and vendors.

The terminal is at the junction of the Dacca - Aricha trunk road and a branch of the trunk road, and there is no special provision of plaza facilities for car parking or for waiting.

The two sides of the approach-way to the ghat therefore serves as waiting lanes for vehicles, and during rush hours, there is barely sufficient room for the passage of arriving vehicles unloading from the ferry.

The ground level around the terminal is lower than the level of the road and is flooded during the rainy season. Therefore, improvement of the terminal facilities is of utmost urgency.

With regards to the ghat, three landing pontoons are allocated by the B. I. W. T. A. for specific usage. Of these, the two pontoons on the two ends are for the use of the car ferry, while the central one is used for passengers and small boats. Each pontoon has two cabins, one for the administration of the office and toll gate, and the other serves as a waiting room for passengers.

There is much room for improvement in the method of approach of vehicles to the pontoon. That is, during the dry season, there is a distance of 150 ft. between the end of the road and the edge of the water, and an approach-way of earthen slope is dug from the level of the terminal to the slope of the river bank.

From here, the vehicles move onto the ferry via a 12 ft. gangplank or a 23 ft. steel gangway across the pontoon. In this case, a special steel ramp-board is placed between the ferry and the pontoon.

During the rainy season, the water level rises, and the pontoon is pulled in, up to the edge of the water. After backfilling the earthen slope, the above-mentioned method of construction of the

movable gangway to the pontoon is adopted.

The gangway, therefore, may be said to serve the purpose of a movable bridge. However, to maintain the approach-landing facilities for service throughout the year, very complicated adjustment processes are required, and the condition of maintenance is generally poor for both the rainy and dry seasons.

Thus, during the dry season, the earthen slope of the approach-way is of a height of 17 ft. and a gradient of over 15%, thus forming a steep slope of poor surface conditions. Also, most of the trucks are overloaded so that the occurrence of accidents such as 'engine stop' while going up the slope, thus requiring towing by rope, is quite often.

Nagarbari Ghat

The river bank at the ghat suffers from serious erosion during the dry season, resulting in a steep hanging slope of 20 ft. in height, and the slope is very unstable due to the failing of the slope surface. The water depth attained due to the washing out of the flowing water is made use of as the entrance and exit of the ferry from the ghat.

The terminal is rectangular, and has an area of about 1 acre, with provision of parking area for waiting vehicles. The surroundings of the terminal is lined with shops.

One landing pontoon, of the same type as that at the Aricha ghat, is allocated at the ghat.

The method of approach by vehicles to the pontoon is also the same as that at the Aricha ghat.

During the rainy season, the terminal, as well as the surroundings, is flooded and the ghat is closed, while the pontoon is re-allocated to the rainy season ghat located downstream. The river bank at the rainy season ghat forms a slope which dries up to an extent of 2,500 ft. from the bank during the dry season.

The terminal is formed through the expansion of the roadway of the final section of the Nagarbari - Bogra trunk road, with both sides of the road serving as waiting lanes for vehicles. There are no plaza facilities provided. During the rainy season, the road and the surrounding areas are, needless to say, beneath flood water.
In this way, a very simple structure serving as terminal is found at the Goalundo ghat, the Daulatdia ghat, as well as the ferry crossings of the R & H Directorate across medium and minor rivers, and is the typical feature of a ferry terminal in Bangladesh.

The ghat facilities are as shown in Table 3-5 .

Table 3-5 Inventory of Ghat Facilities on Jamuna Route (Jan. 1974)

Ghat	No. and type of landing facilities	No. and type of gangways	Approach way	Terminal staff	Remarks
Aricha	3 steel pontoons Length 90'-0" Breadth 20'-0" Depth 6'-0" F. Board - Draft -	1 steel Bailey bridge section 2 wooden planks	2 earthen slopes	12 persons	One steel pontoon is provided for the special use of passengers and small boats. A rest house is provided at the terminal for passengers.
Nagarbari (dry season)	1 steel pontoon	1 wooden planks	1 earthen slope	4 persons	A parking space 1 acre in area is provided. The dimension of the ghat is the same as that for the Aricha ghat.

3. Administration

I.W.T.C. was organized and established on March 26, 1972, taking over the road ferries for inland rivers which had been operated by the Bangladesh Shipping Corporation (E.P.S.C. before the war) for some time after the war; it has three commercial routes, Meghna River route between Narayanganj and Daudkandi, in addition to Jamuna River and Padma River routes.

Maintenance of ghat facilities such as landing pontoons, etc., necessary for ferry operations and of navigation channels is performed by I.W.T.A.

Access roads, from general roads to ghats, are controlled by the R & H Directorate. Therefore, in principle, I.W.T.C. takes care of ferry operations.

This separation of control authority creates certain problems such as poor ghat maintenance as seen in Aricha Ghat, and consequently, delay of loading/unloading operations due to vehicle congestion.

The financial status of Jamuna and Padma routes is as follows.

The financial status up to 1970, when operations were performed by E.P.S.C., was extremely good reflecting a high degree of utilization as shown in Table 3-6, and its commercial operation factor was about 0.8.

Table 3-6

Financial Status of Aricha Ferry
(Total of both routes)
(Thousand of Rupees)

	Revenue	Expenditures
1965 - 1966	393.6	370.8
1966 - 1967	790.1	632.9
1967 - 1968	1,394.1	1,163.2
1968 - 1969	1,607.9	1,310.4
1969 - 1970	1,797.9	1,305.4

Present financial status after the post-war reconstruction period (B.S.C. operated period), according to I.W.T.C., was about Taka 23.00 lakhs for the term 1972 - 1973.

Padma route	:	abt. Tk.	8.00 lakhs
Jamuna route	:	abt. Tk.	15.00 lakhs
Total		Tk.	23.00 lakhs

Appropriate information on financial details are not available, but it is supposed that red figures are growing due to high operational cost, since fares are repeatedly escalated.

Recent inflation seems to be playing a major role in the above situation.

4. Comments and Recommendations

(1) Problem points

River

Flow velocity on the Jamuna and Padma River, during the rainy season is 6 kts or more and high skills and techniques are required for vessel operation on open water during monsoon periods. Due to turbulent flow during the rainy season, ferries must be moored with the bow pointed upstream, and as a result this necessitates a side boarding system for loading and unloading of vehicles, which is deemed quite inefficient operationwise. Additionally, strong currents during the rainy season causes erosion, siltation and topography changes of ghat river banks and water front areas.

This has great influence on ferry operations during the dry season. Due to great differences in water levels, which causes considerable erosion and siltation on the west bank of both the Jamuna River and Padma Rivers, water depths in the ghat water area becomes insufficient. This necessitates opening of different ghats at different locations for services during the dry season.

However, ghats for dry season operations cannot be made permanent in nature, because of natural conditions which prohibit the possibility of constructing effective boarding facilities on

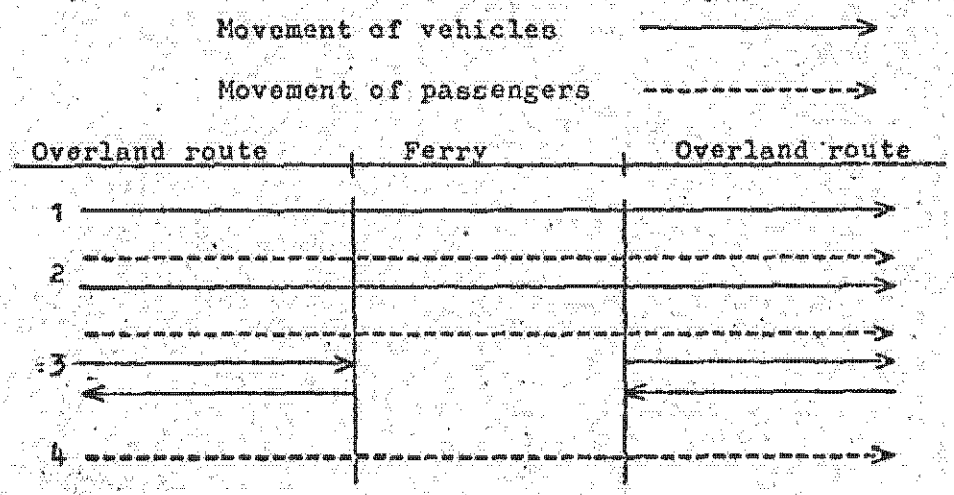
the banks.

Traffic

Cross river passengers on Aricha ferries are divided into those with cars and those without cars. Fig. 3-3 shows passenger crossing patterns.

Fig. 3-3

Passenger Crossing Patterns



1. Trucks
2. Long distance transportation facilities (Inter-city bus services, passenger cars, taxis)
3. Limited distance transportation facilities (City bus services, passenger cars, taxis, auto rickshaws, rickshaws)
4. Pedestrians

It is difficult to make an analysis of the utilization percentage of each pattern in detail, but an outline of the estimated utilization follows.

The percentage of each different vehicle loaded on ferries has great effect on the statistics. A comparison was made in Table 3-7 on the basis of three different surveys; actual site survey, survey at Uthaly near Aricha on the occasion of a traffic census by the R & H Directorate, and data of vehicle numbers.

Table 3-7. Comparision of Various Types of Vehicle

Vehicles	Actual site survey for ferry utilization (1974)	Road traffic Census (1968-1972)	Data of vehicle numbers (1968)
Truck	35%	10 - 20%	23%
Bus	15%	15 - 20%	14%
Other passenger cars	50%	60 - 70%	63%

Therefore, if we assume ferry transportation as 45,000 motor vehicles/year and 750,000 passengers/year as described in Section (2), the weight of each pattern will be calculated as follows:

Truck cargo:

45,000 x (0.2 - 0.35) x 2.5 ton/truck = 23,000 - 40,000 tons/year

Passengers by long distance bus:

45,000 x (0.5 - 0.2) x 40 passengers/bus
= 270,000 - 360,000 passengers/year (42%)

Passengers by passenger cars:

45,000 x (0.5 - 0.6) x 4 passengers/car
= 90,000 - 108,000 passengers/year (13%)

Other passengers:

= 390,000 - 282,000 passengers/year (45%)

Total: 750,000 passengers/year

From these calculations, we can conclude that more than half of the passengers are those who utilize limited distance transportation facilities which shuttle between ghats, or those who come to the ghats on foot.

This inference is in accord with the present situation that passenger cabins are always crowded with passengers, and their number does not correspond with the number of buses and passenger cars loaded on ferries. These passengers will start utilizing long distance bus transportation in the future, and truck transportation of cargo which is only about 45,000 tons/year will gradually increase in the future. In other words, this tendency signifies a requirement for larger ferries according to the increase in the number of large commercial vehicles.

Craft

Ferries of 140 ft class have spacious deck areas, and the decks are rectangular shaped. Therefore, deck areas can be very effectively utilized.

It is possible to load 7 ton trucks, and it is possible to arrange loading of only heavy vehicles. However, the side boarding system is inconvenient for arranging loaded vehicles on deck, and it takes much time and elaboration for the unloading of vehicles. Since the number of vehicles to be handled is large, this situation has considerable impact on time and duration necessary for loading and unloading. Normally it takes 60 minutes to load or unload 28 vehicles when the capacity of each ferry is 14 vehicles. Usually the loading of heavy and light vehicles are intermingled. In this case, the normal number of vehicles loaded on each ferry, of the above capacity, increases to 23 to 24 vehicles. This means the handling of 46 to 48 vehicles, and the time required is about 80 minutes. This forms a good part of the reason for dealy in ferry operation schedules.

Since the vessel bodies of the 120 and 95 ft class ferries are of the deck type, the deck has a parabola shape.

For this reason, the loading of heavy vehicles only is not efficient, and mixed loading of light and heavy vehicles is

In such a case, ferry operations are confused all day. Waiting time at berths is normally 20 to 30 minutes according to our observations during the site survey. In addition, since there is substantially no waiting lanes for vehicles at the ghats loading disorders occur, and this causes another reason for delay in loading and unloading of vehicles.

Poor ghat facilities is the major reason for unstable ferry operations. It is highly desirable to consider fundamental improvements to these facilities, since they must be repeatedly moved and maintained as the water levels of rivers fluctuates.

practised to improve efficiency.

The 95 ft ferry is not efficient, as it requires a crew of 15 or 16, and can load only two trucks and two cars.

Moreover, this class vessel is not of ample tonnage to handle heavy vehicles, and since loading and unloading of heavy vehicles by the side boarding system creates rolling of an amplitude of as much as 0.5 ft, it is impossible to handle 7 ton trucks.

Ghat

The present situation of the ghat system greatly influences ferry operations.

Typical ghat facilities are;

Steel pontoon + Wooden gang planks + Earthen slope.

The earthen slope engraved in the river bank becomes a poor surfaced steep slope during the dry season. This causes remarkably stringent conditions for fully loaded trucks to climb after unloading of the truck from the vessel, and it is not rare that delays of 30 minutes occur due to truck accidents.

Extra ferry services scheduled during cross river traffic peaks are often confused due to the delay of the regular service, and overcrowding of berths as a result of delays which is quite often caused by unstable ferry operations even during normal traffic periods.

(2) Transportation capacity

Present transportation capacity of the Jamuna and Padma routes during the dry season is calculated in the following.

In calculating the transportation capacities of ferries, it is necessary to take into account that ferries of B.I.W.T.C. are of single decks and loading of heavy and light vehicles is intermingled.

For percentage of heavy vehicles such as trucks and buses, the figure of 40 to 50% is applied in the calculation, using the figures shown in Table 3-6. Calculation process for the 40% figure is shown below.

140 ft class ferry

(Apparent) deck area A = 140' x 40' = 5,600 sq. ft

Loading capacity: 14 trucks or 35 cars

Deck area occupied by a heavy vehicle:

$$A_h = \frac{5,600}{14} = 400 \text{ sq. ft/vehicle}$$

Deck area occupied by a light vehicle:

$$A_\ell = \frac{5,600}{35} = 160 \text{ sq. ft/vehicle}$$

If we denote the number of vehicles per ferry as follows,

Heavy vehicle: N_h

Light vehicle: N_ℓ

then, N_h, N_ℓ and total number of vehicles loaded on one ferry are obtained as follows:

$$N_h = 0.4\ (N_h + N_\ell)$$

$$N_h A_h + N_\ell A_\ell = A$$

Heavy vehicle :	N_h =	9
Light vehicle :	N_ℓ =	13
Total	:	22

120 ft class ferry

(Apparent) deck area A = 120' x 30' = 3,600 sq. ft

Loading capacity : 6 trucks & 4 cars or 16 cars

Total number of vehicles loaded on one ferry is obtained as follows (by the same procedure as in the above example):

Heavy vehicle :	N_h =	4
Light vehicle :	N_ℓ =	7
Total	:	11

95 ft class ferry

(Apparent) deck area A = 60' x 27' = 1,620 sq. ft

Loading capacity : 2 trucks & 2 cars or 8 cars

Since the 95 ft class ferry has a deck of special shape and small surface area, percentage fluctuation of mixed loading is small and the number of vehicles loaded is

as follows:

Heavy vehicles :	N_h = 1 or 2
Light vehicle :	N_ℓ = 3 or 2
Total :	4

Therefore, the daily transportation capacity for normal ferry service, as shown in Table 3-4, is about 170 vehicles, as calculated below:

Aricha - Nagarbari

Two ferries of 140 ft class:

2 round trips x 22 vehicles x 2 = 88

Two ferries of 95 ft class:

2 round trips x 4 vehicles x 2 = 16

Aricha - Daulatdia

One ferry of 95 ft class:

3 round trips x 4 vehicles x 2 = 24

Aricha - Teprakandi

Two ferries of 120 ft class:

2 round trips x 11 vehicles x 2 = 44

Total :	9 round trips	172

In the same manner, vehicle transportation capacity is calculated as 160 vehicles where the percentage of heavy vehicle loading is 50%. For actual daily traffic requirements, the following

calculation shows the present status:

For normal traffic:

$$\frac{45{,}000 \text{ vehicles/year}}{330 \text{ days/year}} = 137 \text{ vehicles/day}$$

< Transportation capacity of 160 - 172 vehicles/day

For peak traffic:

137 vehicles/day x 1.5 = 205 vehicles/day

> Transportation capacity of 160 - 172 vehicles/day

In the above calculation, an assumption is made that peak traffic is 50% more than normal traffic.

The above calculation shows that weekday transportation capacity corresponds with normal or average traffic requirements, but it does not satisfy peak traffic requirements due to seasonal fluctuation. This predicted peak traffic is typically represented at each ghat as long queues of trucks waiting for ferry loading.

Improvement of transportation capacity

It is possible to consider increasing the number of ferries as an immediate remedy to improve transportation capacity under the present operation system of ferries and ghat facilities. However, this is not an advantageous solution in terms of

operation expenses. Therefore, it is recommended that the average unit loading capacity be increased by changing from small vessels to larger vessels. In other words, replace the three inefficient 95 ft class ferries with three of the 140 ft class. With the already existing two ferries of the 140 ft class and two of the 120 ft class, this would total ferries in operation to five of the 140 ft class and two of the 120 ft class. It is also recommended that one ferry of the 140 ft class be made available as standby.

Ferry assignment would be as follows:

Aricha - Nagarbari

Two ferries of 140 ft class — Mixed transportation of

One ferry of 120 ft class — heavy and light vehicles.

Aricha - Daulatdia

One ferry of 120 ft class — Exclusively for light vehicles.

Aricha - Teprakandi

Three ferries of 140 ft class — Exclusively for heavy vehicles.

Considering the type and number of loaded vehicles, operation cycle time for each route is assumed as follows, based on data obtained during the survey period.

Aricha - Nagarbari

Ferry: 140 ft class

Number of loaded vehicles: heavy & light vehilces 22

Loading		30 minutes
Cruising upstream	2 hours	30 minutes
Unloading & Loading at ghat (berth occupancy time)	1 hour	15 minutes
Cruising down-stream	2 hours	
Unloading		45 minutes
Total	7 hours	

Ferry: 120 ft class

Number of loaded vehicles: heavy & light vehicles 11

Loading		15 minutes
Cruising upstream	2 hours	30 minutes
Unloading & loading at ghat (berth occupancy time)		40 minutes
Cruising downstream	2 hours	
Unloading		25 minutes
Total	5 hours	50 minutes

Aricha - Daulatdia

Ferry: 120 ft class

Number of loaded vehicles: light vehicles 16

Loading	20 minutes
Cruising downstream	30 minutes

Unloading & loading at ghat (berth occupancy time)		45 minutes
Cruising upstream		45 minutes
Unloading		25 minutes
Total	2 hours	45 minutes

Aricha - Teprakandi

Ferry: 140 ft class		
Number of loaded vehicles: heavy vehicles		14
Loading		25 minutes
Cruising downstream	3 hours	30 minutes
Unloading & loading at ghat (berth occupancy time)	1 hour	
Cruising upstream	3 hours	
Unloading		35 minutes
Total	9 hours	30 minutes

In accordance with operation cycle time necessary, the possible number of services per day is to be determined by establishing an operation schedule.

The total number of landing pontoons is presently assumed to be 5 (2 at Aricha, 1 at Nagarbari, 1 at Dalautdia and 1 at Teprakandi), and maximum utilization of these existing landing pontoons is targeted.

To avoid ferry waiting time at the berths for this number of pontoons, it is necessary to provide ample time from departure of one ferry to arrival of another ferry to the same berth. Observing the actual situation, it is recommended that a longer time than is necessary for normal occupancy of the berth by the departing ferry be scheduled.

Fig. 3-4 shows an operation schedule thus established.

The daily transportation capacity for weekdays during the dry season becomes 400 vehicles by the following calculation.

Aricha - Nagarbari

Two ferries of 140 ft class

4 round trips x 22 vehicles x 2 = 176

One ferry of 120 ft class

2 round trips x 11 vehicles x 2 = 44

Aricha - Daulatdia

One ferry of 120 ft class

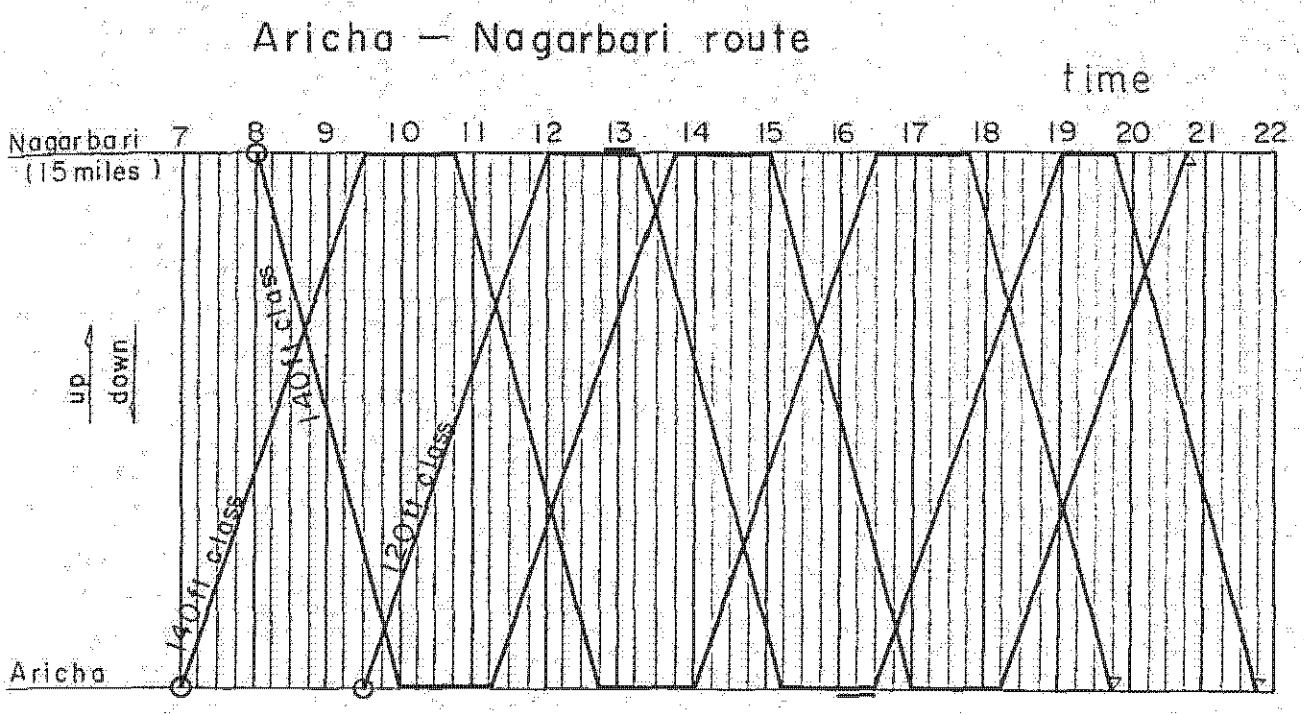
3 round trips x 16 vehicles x 2 = 96

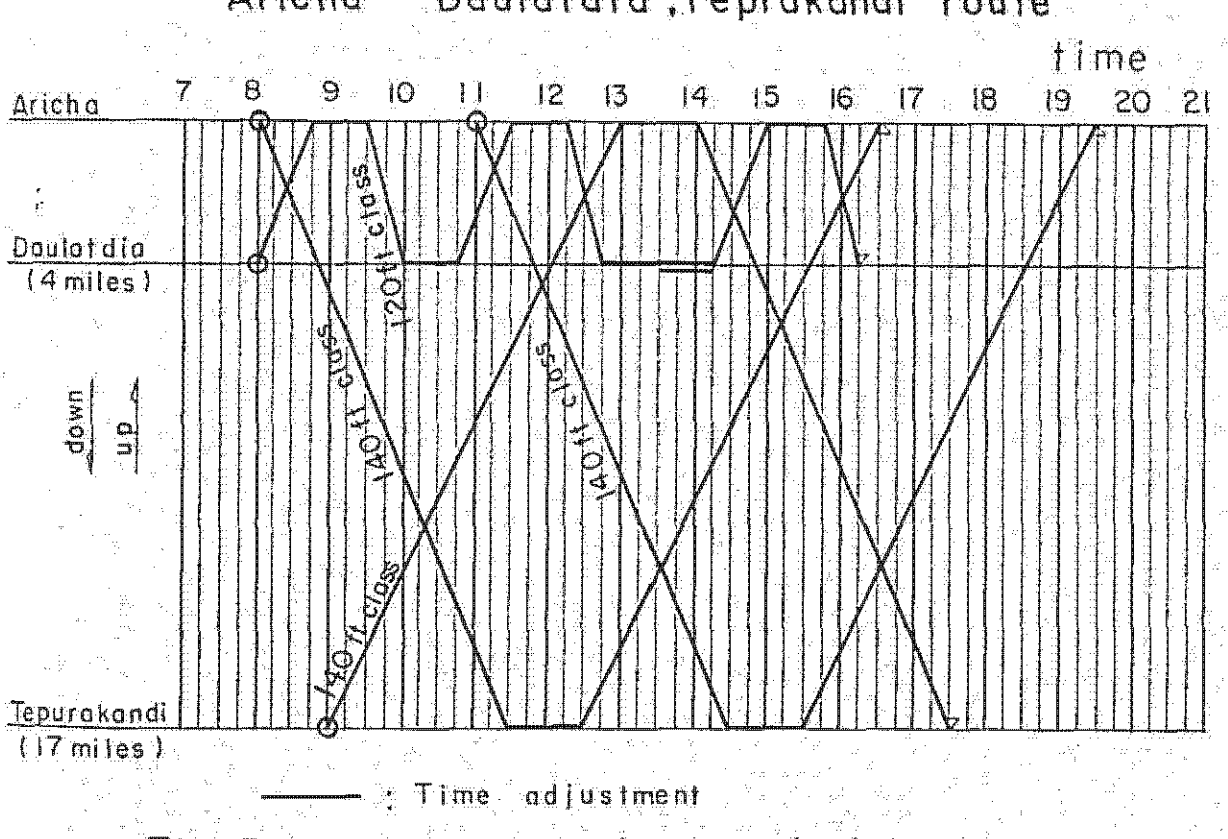
Aricha - Teprakandi

Three ferries of 140 ft class

3 round trips x 14 vehicles x 2 = 84

Total	12 round trips	400 vehicles





——— : Time adjustment

Fig 3-4 Ferry Operation Schedule for Normal traffic during Dry Season

This figure shows an improvement of the transportation capacity by 2.2 times the present figure of 160 to 170 vehicles per day.

During the rainy season, Daulatdia ghat is closed and Aricha - Goalundo route is opened instead. This increases the operation distance and transportation capacity decreases. However, even in this case, it is possible to maintain a transportation capacity of 330 vehicles, which is twice as large as that of the present time.

(3) Recommendations

The best recommendation for fundamental improvements of the B.I.W.T.C. ferries, on the basis of the present operation system, would be reinforcement with larger vessels, using the present 140 ft class ferries as the major force.

a. As an immediate improvement measure, it is recommended that the 95 ft class 3 ferries presently in use be replaced by 3 ferries of 140 ft class.

In other words, it is recommended that a combination of 5 ferries of the 140 ft class, 2 ferries of the 120 ft class, and 1 standby ferry of the 140 ft class be put in service for the Jamuna and Padma routes.

Thus, weekday transportation would be improved to a capacity of 330 to 400 vehicles, which is 2 to 2.2 times more than the present capacity.

During traffic peaks, the standby ferry would be operated by over-time work of crews.

b. For improvement and shortening of cross river time, the shortening of waiting time becomes the object, when no solution is found for shortening and stabilizing loading and unloading times for vehicles.

As a remedy for delays caused by loading and unloading

operations, an operation schedule with appropriate time allowance for the use of pontoons is recommended. Thus, it becomes possible to achieve on-schedule operations, by confining confusion caused by loading and unloading to only a part of the total schedule.

It is also recommended that one landing pontoon each for Aricha and Nagarbari ghat be constructed to cope with extra services during traffic peaks, thereby eliminating waiting time for ferries arriving at the berth.

Additionally, consideration should be given to the introduction of an advance booking or reservation system for vehicles, by the use of a communication network between each ghat and city service centers within the territory of each ghat. This would avoid confusion and long waiting times at each ghat caused by vehicles racing to get ahead of other vehicles to board as soon as possible. This concept would drastically minimize peak traffic of cross river transportation as well as vehicle confusion at terminals, if implemented.

c. The remaining problems are the shortening of cross river time and the development or introduction of an adequate vehicle loading and unloading system for the purpose of stabilizing schedules.

However, it is expected that the technical solution of these problems will not be limited to improvement of the side boarding system and approach ways, but will extend to improvements the ferries, themselves.

d. Taking into consideration the renewal of existing facilities because of life expectancy expiration in addition to establishment of the new facilities, investment to reinforce and improve the transportation capability, previously mentioned, during the period 1985 to 1990 is presently roughly estimated as approximately 82,700,000 Taka, as shown in Table 3-8.

However, this figure does not include investment for terminus improvements, such as closing and movement of ghats due topographic changes in the river basin area, because it is difficult to make a fair evaluation of ghat life expectancy.

Table 3-8 Facility Improvement Items for B.I.W.T.C. Ferry System

(Jamuna and Padma river routes)

(In millions of Taka)

Planning items		Targets of improvement		
[Ferry facilities]				
140 ft class ferries (including one supplementary ship)	6 Nos.	Replacement of existing 95 ft class ferries with larger ones	3 Nos.	@10.00 = 60.00
		Replacement of existing 140 ft class ferries with new ferries of the same scale	2 Nos.	
		Supplement of new ferry	1 No.	
120 ft class ferries	2 Nos.	Replacement of existing 120 ft class ferries with new ferries of the same scale	2 Nos.	@9.30 = 18.60
[Ghat facilities]				
90 ft class loading/unloading pontoons	7 Nos.	Continuous use of existing 90 ft class ferries	5 Nos.	-
(including two supplementary pontoons	2 Nos.	Supplement of new ferries	2 Nos.	@1.20 = 2.40
[Water area facilities]				
1,800 mm ϕ class light buoys	abt.10 Nos.	Supplement of new ferries	10 Nos.	@0.17 = 1.70
Total				abt.82.70

Remark: Light buoys are to be arranged on one side only for the 6 mile Teprakandi Channel on the Padma River route.

CHAPTER IV

ROAD AND HIGHWAY DIRECTORATE FERRIES

1. Dacca - Aricha Road Route

(1) Point of operation

Mirpur crossing

This is the first ferry crossing from Dacca on the Dacca - Aricha trunk road which is authorized as the Asian Highway. At this crossing, there is an old and worn steel bridge, of 10 ft in width, running parallel upstream, this being passable only for light traffic. Heavy traffic of over 5 tons in gross vehicle weight has to cross the river via the ferry.

The distance between river banks is about 700 ft, and the access to the Ghat is provided by an earthen slope made from cutting the embankment.

During the dry season, the span of water surface narrows to 300 ft and the water depth is shallow.

As Ghat facilities, landing pontoons and steel gangways are provided on both banks, and during rainy season the facilities may be brought close to the embankment for adjustment with the rise in water level.

This crossing is only a short distance of 8 km from Dacca, and without provision of space for ferry waiting for vehicles, the point is congested with trucks, buses and pedestrians throughout the day.

Nayarhat crossing

This crossing has a distance of about 600 ft between banks , and

with the river banks forming a slope surface of about 30°, is very stable.

During the dry season the span of the water surface is about 400 ft, and there is sufficient water depth for ferry operation.

The ferry route has separate specialized routes for light and heavy vehicles with landing pontoons provided for both.

Access is by the earthen slope provided at the slope surface of the river banks, and for approach to the pontoons, wooden gangway (light vehicle route) and steel gangway (heavy vehicle route) are used.

This ferry crossing is operated stably throughout the year and is a crossing with few problems.

On the left bank, control of loading and unloading vehicle traffic is effected through median and barrier provided on the road.

Taraghat crossing

This is the last ferry crossing on the Dacca - Aricha trunk road and, of the many road ferry crossings, is the one of the most difficult to operate.

This is due to the characteristics of Kaliganga River at this location.

The Kaliganga River, together with the Dhaleswari River, form the outlet of flood discharge of the Jamuna River. During the raining season, the span of water surface widens, the river flow becomes rough, the flow velocity increases, and both banks are croded by the water.

When the flow velocity reaches 5 knots, ferry operation becomes impossible under such strong current, and service is terminated.

Another characteristic of the Kaliganga River is that during the low water season, new siltations occur at varied locations to render ferry operation difficult during dry season. Consequently, during dry season, most of the river bed is dried up, to form complicated water channels, and the necessary water depth for ferry operation is virtually unavailable, so that it is often necessary to alter the points of river crossing.

At present the distance between banks is about 2,000 ft. But during dry season the river bed from the center to the right bank is almost completely dried up and the water surface along the left bank has only a span of 240 ft.

This left bank is steep and the approach way to the ferry is provided by earthen slope through cutting the river bank. On the right bank, the approach way is provided across the dried up river bed to the water channel.

Stage approaches are provided on both sides of the narrow water channel for loading and unloading. These stage approaches are temporary and serve the purpose of the landing pontoon during the dry season, and new construction is required each year.

(2) Present situation of ferry operation

The traffic volume of motor vehicles on the Dacca - Aricha trunk road, according to the traffic census in 1972, is as shown in Table 4-1.

Table 4-1 Average Daily Traffic Volume on Dacca - Aricha Trunk Road (Aug. 1972)

Location	Heavy Vehicle	Light Vehicle	Total
Kalyanpur	1,231	2,023	3,254
Near Savar Bazar	277	757	1,034
Ghazikhali	145	302	447
Utaly	115	301	416

The corresponding river crossing motor vehicle traffic volumes at the ferry crossings, according to the statement of the Road and Highway Directorate, are as in Table 4-2.

Table 4-2 Daily Average Number of Cross River Vehicles (Aug. 1973)

Crossing	Total
Mirpur	237
Nayarhat	442
Taraghat	256

However, the Mirpur statistics does not include such light vehicles as passenger cars, auto-rickshaws, and motorcycles. Also, it may be seen from Table 4-1 that for the Nayarhat and Taraghat crossings, the share of such heavy traffic as trucks and buses come to about 30% of the total traffic volume. The allocation of vessels for services to the traffic at the ferry crossings is as shown in Table 4-3, and

is composed of the Type C Unifloat ferry, the 36 ft class steel ferry and the powered marboat, being respectively operated at continuous circle.

The operating time of the Road and Highway Directorate ferries is generally from 6 a.m. to 10 p.m. and ferries are operated without a fixed schedule. The ferry crossings along the Dacca - Aricha trunk road are operated 24 hours daily by 3 shifts.

Table 4-3 Inventory of R & H Ferries

on Dacca - Aricha Road Route (Aug. 1973)

(1)

Name of crossing	Location of crossing	Number and type of ferry	No. and H.P. of Engine	Capacity of ferry	Total crew	Remarks
1	2	3	4	5	6	7
Mirpur	Turag R. 8th mile from Dacca	1-Unifloat (Type C)	2 Nos.	3-5 Ton trucks	20 Nos. (3 shifts)	Bridge under construction upstream.
		1-Unifloat (-)	-	-		Light vehicles pass over existing Mirpur Bridge
		1-Steel ferry "MIRPUR" 34'0"x27'6"	2 Nos.	1-3 Ton trucks		
		1-Steel ferry "TURAG" -	-	-		
		1-Marboat* -	-	-		
Nayarhat	Banshi R. 24th mile from Dacca	1-Unifloat (Type C)	2 Nos.	3-5 Ton trucks	52 Nos. (3-shifts)	Bridge under construction upstream
		1-Unifloat (-)	-	-		

1	2	3	4	5	6	7
		1-Steel ferry "BANSHI" 35'0"x25'0"	-	2-3 Ton trucks		
		1-Steel ferry "SHOYKOT" 34'6"x23'0"	-	1-3 Ton trucks		
		5-Marboats -	-	-		
		3-Marboats* -	-	-		
Taraghat	Kaliganga R. 43rd mile from Dacca	1-Unifloat (Type D)	2 Nos.	6-5 Ton trucks	53 Nos. (3-shifts)	Bridge under construction downstream
		1-Unifloat (Type C)	2 Nos.	3-5 Ton trucks		
		9-Marboats -	-	-		
		1-Marboats* -	-	-		

* Ferry out of order

The ferries operated by the Road and Highway Directorate on the domestic minor trunk roads and subsidiary roads may be divided into the Unifloat ferry, Steel ferry and the Marboat. The structure, major elements and present situation of usage are as described below.

Unifloat ferry

This ferry is a box type vessel made through the assembly of 6 to 9 rectangular steel floatation tank units each with a length of 17'4", a width of 8'0" and a depth of 4'0". Ramp units used for loading and unloading of vehicles are connected with a hinge structure longitudinally at both ends of the assembled raft. On both gunwales of the raft are each affixed a propulsion unit of one-engine one-propeller in structure, so that the propulsion system of the ferry is of two-engines two-propellers. Also, the propellers may respectively be horizontally rotated at 360° to any direction, and with two engine drivers equally controlling the body of the vessel, it can be guided to any desired direction.

For this reason, the travel route of the Unifloat ferry between the two banks is in the to-and-fro way and the loading and unloading of vehicles are by the bow-stern boarding system.

The reverse side of the ramp unit is provided with grooves which will fit into the grooves of the ramp of the landing pontoon for connection.

The Unifloat ferry is divided into Type D and Type C according to the dimension of the deck.

The Type D ferry has three floatation tank units arranged in the longitudinal direction and three rows in the lateral direction, so that including the ramp unit the total dimension of the vessel comes to 80' in length and 24' in width. The propulsion units are affixed to the gunwales in a cantilever saddle structure.

The Type C ferry has three floatation tank units longitudinally and two rows laterally for a dimension of 80' in length and 16' in width. Floatation tank units are attached to both gunwales as propulsion units.

The elements and the nominal capacity of the various types of ferries are as shown in Table 4 - 4.

Although these Unifloat ferries also cater to light vehicles at Class II ferry crossings, they are used solely for transportation of heavy vehicles at Class I ferry crossings of trunk roads. This is the only type of ferry that may safely serve the heaviest vehicle now in use. (pay load: 7 ton; gross vehicle weight: 10 tons).

Since the Unifloat ferry has sufficient weight against the load by the vehicles transported, and the landing pontoon is in one unified body with the vessel, the ferry is also highly safe for the rolling on and off of vehicles. Together with the shortening of the river crossing time, this ferry provides satisfactory service for the transportation of heavy vehicles.

Table 4-4 Principal Particulars of Unifloat Ferries

Class of Vessel	Dimension of Ferries					Loaded Draft	Dead Weight	Nos. and H.P. of Engine	Carrying Capacity
	Length	Width*	Deck	Depth	F.Board				
Type D	80'-0"	24'-0"	80'x24'	4'-0"	2'-6"		50 tons	2-75 H.P.(diesel)	6-5 Ton trucks or 15 cars
Type C	80'-0"	16'-0"	80'x16'	4'-0"	2'-6"		47 tons	2-60 H.P. (do.)	3-5 Ton trucks or 10 cars

* Not including the width of propulsion units at both gunwales.

Table 4-5 Principal Particulars of Steel Ferries

Class of Vessel	Dimension of Ferries					Loaded Draft	Dead Weight	Nos. and H.P. of Engine	Carrying Capacity
	Length	Width	Deck	Depth	F.Board				
52 ft class	52'-6"	33'-6"	-	7'-0"	4'-0"	4'-4"	-	2-220 H.P.(diesel)	3-3 Ton trucks or 8 cars
47 ft class	47'-0"	32'-0"	30'x32'	5'-3"	3'-0"	4'-4"	-	2-225 H.P.(do.)	2-3 Ton trucks or 6 cars
36 ft class	36'-6"	25'-6"	-	5'-6"	2'-8"	3'-10"	-	2-28 H.P. (do.)	1-3 Ton trucks or 4 cars

Table 4-6 Principal Particulars of Marboats

Class of Vessel	Dimension of Ferries					Loaded Draft	Dead Weight	Nos. and H.P. of Engine	Carrying Capacity
	Length	Width	Deck	Depth	F.Board				
50 ft.class	50'-0"	24'-6"	20'x28'	4'-9"	2'-9"	3'-4"	-	1-60 H.P.(diesel)	4-cars or 1-3 Ton truck
45 ft.class	45'-0"	25'-0"	20'x25'	4'-0"	2'-8"	2'-9"	-	1-50 H.P.(do.)	do.
small class	-	-	20'x14'	-	-	-	-	Without engine	2-cars

Steel ferry

This is a double steel hull catamaran type vessel with the top of the two hulls connected to form the upper structure of the loading deck and with the bridge placed at the rear of the vessel. Compared to the marboat which is wooden, this ferry is made of steel and is generally called the Steel ferry.

The propulsion system is by two twin screw engines.

The rolling on and off of vehicles is of the side boarding system whereby multiple number of vehicles may load and unload at the same time. Also, the height of the dry gunwales is variable at the bow and the stern of the vessel so that the height of the ferry deck may be adjustable according to the height of the pontoon deck.

Due to this reason almost all the ferries are worn out at the hinged steel gangplanks at the deck side, and, they have been removed from the vessels. The loading and unloading of vehicles are now carried out by the old fashion method of manually placing wooden planks to the vessel.

The steel ferry fleet of the Road and Highway Directorate are classified into the 52 ft class, the 47 ft class and the 36 ft class according to the dimension of the vessels. The typical elements and the nominal capacity of the ferries are as shown in Table 4 - 5.

These steel ferries are allocated to the Class I ferry crossings of the trunk roads and are used specifically for the

transportation of heavy vehicles.

The allocation of the ferries is the 52 ft class ferries for the Dacca - Chittagon trunk road, the 36 ft class for the Dacca - Aricha trunk road and the 47 ft class for the Nagarbari - Bogra trunk road.

The nominal weight of vehicles served is up to 3 tons. However, in actual fact, many of the heavy vehicles running along the trunk roads are trucks of 5 tons in pay load, with occasional presence of 5.8 ton petroleum tank lorries. Consequently, due to a shortage of unifloat ferries, the ferry crossings are forced to carry loads beyond the nominal capacity of the vessels.

Especially during loading and unloading, due to the insufficient weight of the ferry and to the adoption of the side boading system, very vigorous rolling (amplitude of vibration at the gunwale side being about 1 foot) of the ferry occurs, and put all the vessels and passengers aboard in a very dangerous state.

Marboat

This ferry is the double wooden hull catamaran type vessel with the upper part of the hulls connected to form the loading deck and the propulsion effected by manual rowing. This is the traditional type of ferry and is generally called the marboat. The marboats allocated to the ferry crossings at the trunk roads are mechanically propelled, with the engine room at the bow and steering rudder at the rear of the vessel.

Loading and unloading of vehicles are by the side boarding system

through the use of wooden gangplanks.

The marboat fleet of the Road and Highway Directorate are classified into the 50 ft. class, the 45 ft. class and the 'small' type according to the dimensions of the vessel. The typical elements and nominal capacity of the various types of vessels are as shown in Table 4 - 6.

The marboats allocated to the Class I ferry crossings are used specifically for the transportation of light vehicles.

The nominal capacity is 4 cars. However, during peak hours of traffic 6 cars are loaded. Although the deck becomes crowded, there is no problem of safety during loading and unlaoding or during the running of the vessel.

However, at Class II and Class III ferry crossings, the marboats also have to handle heavy vehicles, and this is very dangerous during the loading and unloading of vehicles.

2. Nagarbari - Bogra Road Route

(1) Point of Operation

Bagabari crossing

This ferry crossing is the only cross river point along the Nagarbari - Bogra trunk route without a bridge and is situated some 7 miles south of Ulapara.

At this point, the Gohal River and the Baral River flow downstream parallelly from west to east, with a river span of respectively 500 - 600 ft, sandwiching a span of char land of about 400 ft. in width for a 2,000 ft. river section during dry season.

Further downstream the two rivers confluence into the name Hurasagar River before flowing into the Jamuna River.

The water depth of the two rivers at this point is rather shallow during dry season and both the banks are very stable. However, this is a very difficult crossing for ferry operation due to the presence of the char land lying between the rivers.

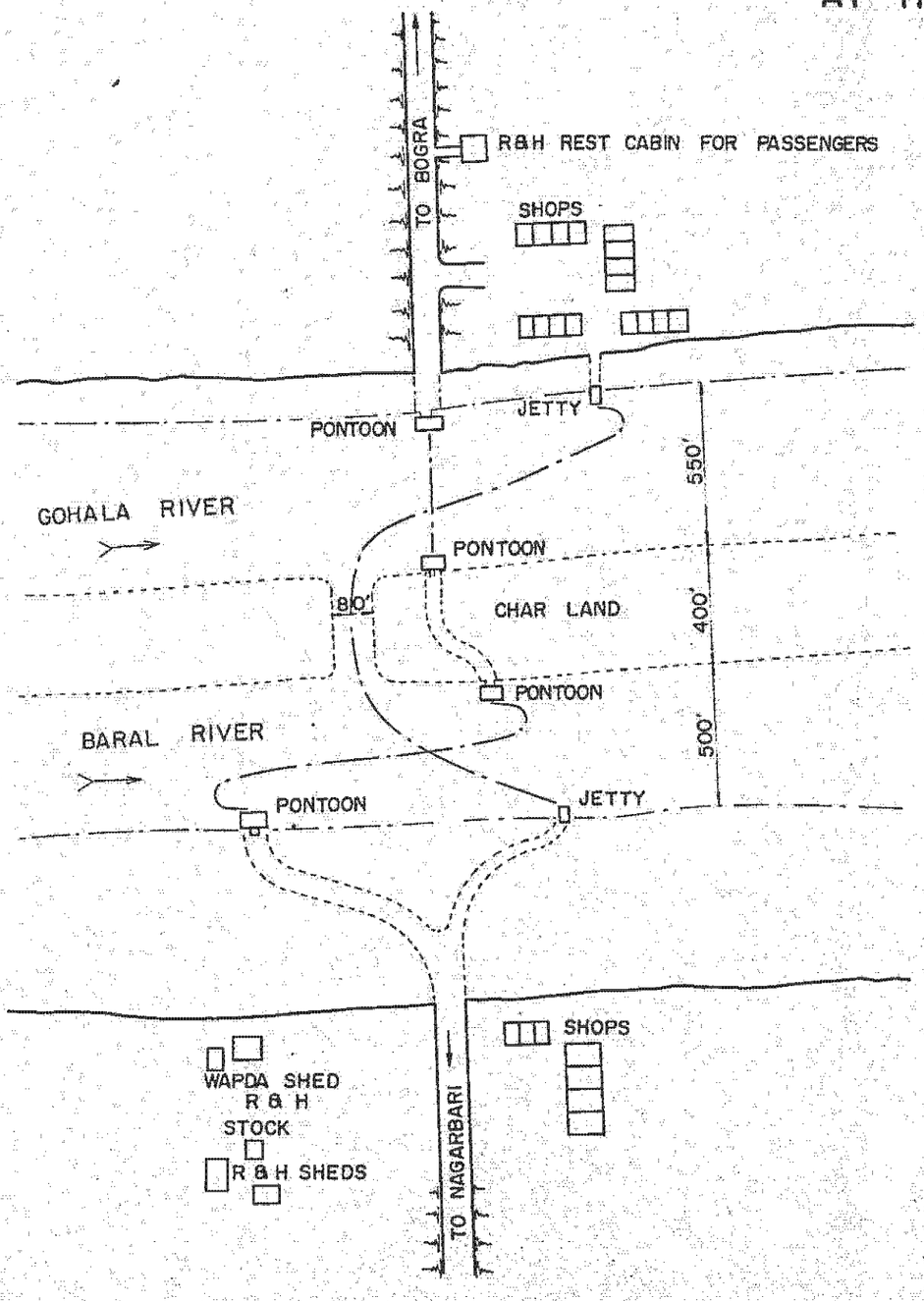
Up to today, at this crossing, besides operating the two-ferry two-crossing routes across the char land, operation of the detour single-crossing route about 1 mile downstream of the river at the confluence point of the rivers was also carried out. But both methods of crossing incur very heavy loss in time.

Nowadays, a channel of 80 ft. in water surface span is dug across the char land to connect the two rivers during dry season.

Nevertheless it is not possible to maintain a water depth of over 4 ft. for this connecting channel during dry season.

The situation of the river bank and the allocation of Ghat facilities are as shown in Fig. 4 - 1.

FIG.4-1 THE SITUATION OF THE RIVER BANKS AND THE ALLOCATION OF GHAT FACILITIES AT THE BAGHABARI CROSSING



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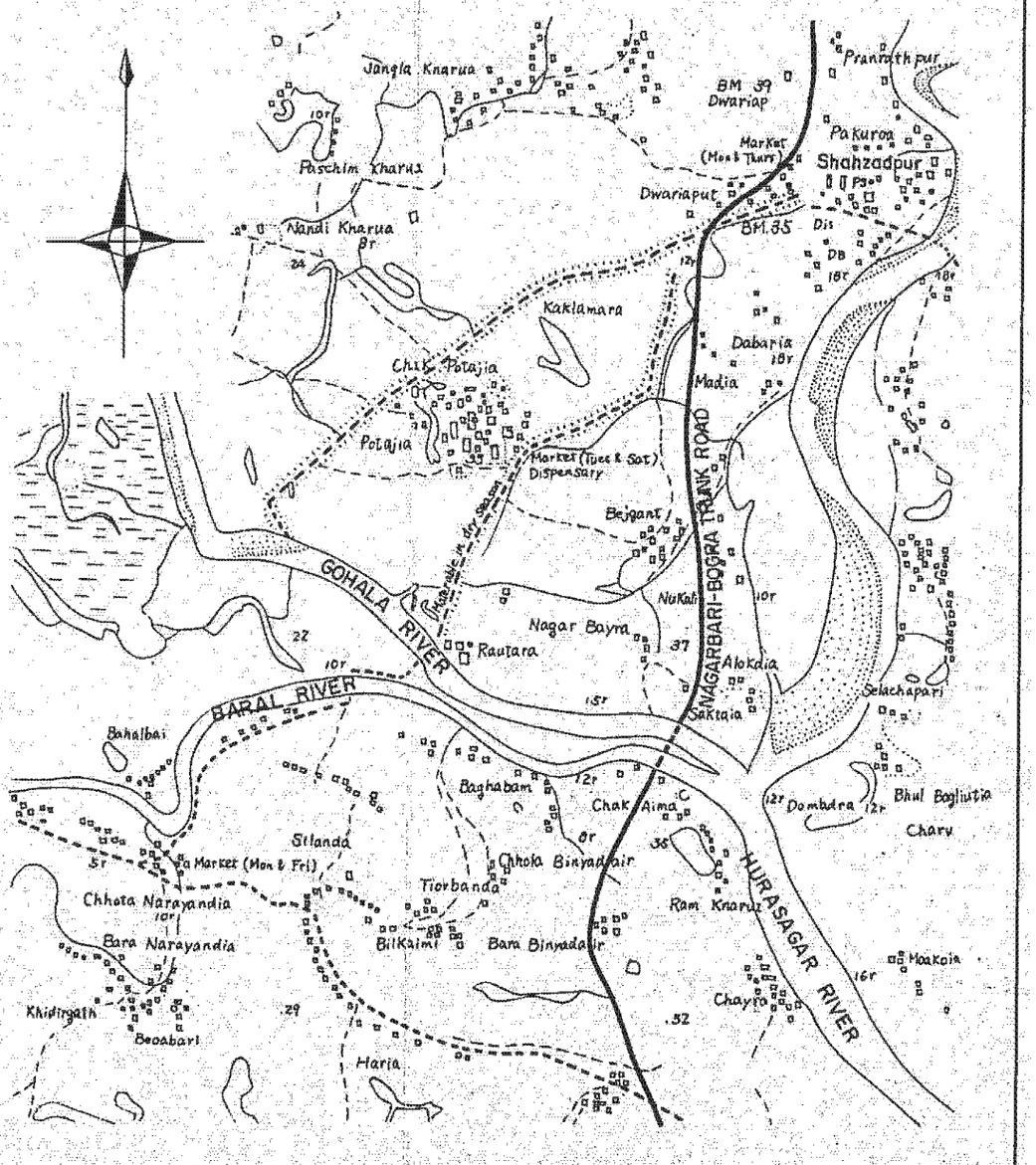


(2) Present situation of ferry operation

The traffic volumes of motor vehicles across the Bagabari crossing, according to the traffic census in 1973, are as in Table 4 - 7.

Table 4 - 7 Average Daily Traffic Volume (July 1973)

Direction	Heavy vehicle	Light vehicle	Total
Kashinathpur	62	62	124
Shahazadpur	64	61	125
Total	126	123	249

To cope with this traffic demand, 11 ferries are allocated to this ferry crossing and operated in 2 shifts from 6 a.m. to 10 p.m., as shown in Table 4 - 8.

The situation of operation during the dry season is as follows. That is, light vehicles are transported by marboats through the connecting water channel so that the right bank of Baral River and the left bank of Gohala River are directly connected. For the transportation of heavy vehicles, a steel ferry is allocated at the Baral River and a unifloat is allocated at the Gohala River, and the central char land is traversed on land to form a two-ferry two-crossing system. In other words, the connecting water channel does not have sufficient width for the travel of multiple ferries, the water depth is not sufficient for the sailing of steel ferries and the channel is used primarily for light vehicles. This culminates

Table 4-8 Inventory of R & H Ferries

on Nagarbari - Bogra Road Route (Jan. 1974)

Name of crossing	Location of crossing	Number and type of ferry	No. and H.P. of engine	Capacity of ferry	Total crew	Remarks
1	2	3	4	5	6	7
Baghabari	Gohala R. & Baral R. 13th mile from Kashinathpur	1-Unifloat "URMI" (Type D)	2-75 H.P.	6 - 5 Ton trucks	49 Nos. (2-shifts)	Vessel operated according to demand.
		1-Unifloat "HAANSHA" (Type C)	2-75 H.P.	3 - 5 Ton trucks		
		2-Steel ferry "BORAL" & "ARABEEL"* 47'0"x32'0"	2-225 H.P.	2 - 3 Ton trucks		
		1-Steel ferry "BOLAKA" -	1-270 H.P.	2 - 3 Ton trucks		
		1-Steel ferry "TARANGA"* 39'6"x26'0"	2-225 H.P.	2 - 3 Ton trucks		
		3-Marboats 45'0"x25'0"	1-50 H.P.	4-Cars		
		2-Marboats* -	1-30 H.P.	4-Cars		

*Ferry under repair.

in overburden of the heavy vehicle route so that the deficiency in transport facility of the steel ferries of Baral River becomes a bottle neck at the crossing, and during peak hours congestion occurs and the crossing of the river takes more than 40 minutes.

The service elements during dry season are as shown in Table 4 - 9.

Table 4 - 9 Service Elements (Dry season)

Route	Frequency	Time required for Crossing
Light vehicle	50 return trips/day	10 - 30 minutes
Heavy vehicle	80 return trips/day	40 - 70 minutes

In this way, the problem of transport congestion at the Bagabari crossing is not solved and today remains a big river gap on the Nagarbari - Bogra truck road. Toll is not levied on this ferry crossing by reason of its poor efficiency. However, during rainy season the water level raises to over 10 feet above the char land, and it is possible for both light and heavy vehicles to be ferried directly across the river.

(3) Existing facilities

At the Baral River and the Gahala River terminals, no plaza facilities are provided for waiting purpose and the terminal straight section of the trunk road serves as the waiting traffic lane. The ground at the vicinity is flooded during rainy season.

At the right bank of the Baral river, the section from the end of the road to the dry season water front is a gradual slope, while on the left bank of Gohala River, the section from the end

of the road to the dry season water front is a slope of 100 ft. in length and 25° in inclination.

For the heavy vehicle route, steel landing pontoons made to serve the arrival and departure of unifloat are provided along the right bank of Baral River, the left bank of the same river (on the char land), the right bank of Gohala River (on the char land) and the left bank of the same river, one at each bank, as Ghat facilities.

These pontoons each have a deck area of 1,800 sq. ft., and with little rocking during loading and unloading of heavy vehicles, are considerably satisfactory facilities.

These pontoons are also used for the arrival and departure of catamaran type steel ferries. However, in this case, both the ferry and the pontoon suffer heavy rocking.

For loading and unloading of vehicles on steel ferries, the wooden gangplank method is also used.

Loading and unloading of vehicles on steel ferries do not proceed smoothly and is one of the reasons for time loss.

As for the access from the river bank to the pontoon, during dry season, the dried up slope of the river banks becomes the approach space and access is accomplished through the use of planks of about 12 ft. in length.

Steel gangways of 25 ft in length are equipped, one each, on the right bank of Baral River and the left bank of Gohala River for use during the rainy season. However, due to the condition of

the slope surface these are not used in the dry season.

For the light vehicle route, temporary jetties of about 15 ft. in length and with wooden decks are equipped, one each, on the right bank of Baral River and the left bank of Gohala River. Loading and unloading on the marboats are effected through manually handled planks which are easily handled without mishap. However, several reassembly of the fixed deck will be necessary to meet the pace of rise in water level.

The moving of motor vehicles to the pontoon remains a troublesome problem here, just as in other ferry crossings.

The Ghat facilities are as shown in Table 4 - 10.

Table 4 - 10 Inventory of Ghat facilities of Baghabari crossing (Jan. 1974)

River Bank	No. and type of landing facilities	No. and type of gangway	Approach way	Terminal staff	Remarks
Baral R. (right)	2 - steel pontoons Length 64'-0" Width 28'-0" Depth 5'-0" F. Board 3'-0" Draft 2'-0" 1 - Wooden deck	1 - steel latice Capacity 10 ton 1 - wooden plank	2 - earthen slopes	3 Nos. (both sides)	Wooden deck used for light vehicles. Steel gangway used during rainy season
Gohala R. (left)	do.	do.	do.		do. a waiting room for passenger is provided.

3. Administration

Management of R & H ferry operations, which was committed to private enterprises until 1970, is completely controlled by the R & H Directorate. Actual operations are conducted by the local subdivision offices, together with the administration of the roads and highways.

Fig. 4-2 shows an example of the administrative organization of R & H ferry operations for the trunk roads between Dacca and Aricha, and Nagarbari and Bogra.

Table 4-11 shows the financial status of ferry operations for the period 1972 - 1973.

Table 4-11

Expenditure & Revenue Earning of R & H Ferries (Jan. 1974)

(Thousands of Taka)

	Revenue	Expenditures (a)	Expenditures (b)
Mirpur	-	370.2	2,850.0
Nayarhat	488.8	609.5	
Taraghat	419.1	365.4	
Bagabari	-	411.5	450.0
	(2,115.8)	(4,983.0)	(7,073.0)

Note: Item (a) of expenditures consists of expenses for ferry operations and minor access maintenance. Item (b) of expenditures consists of expenses for replacement of ferries, pontoons and gangways, and overhauling of ferries.

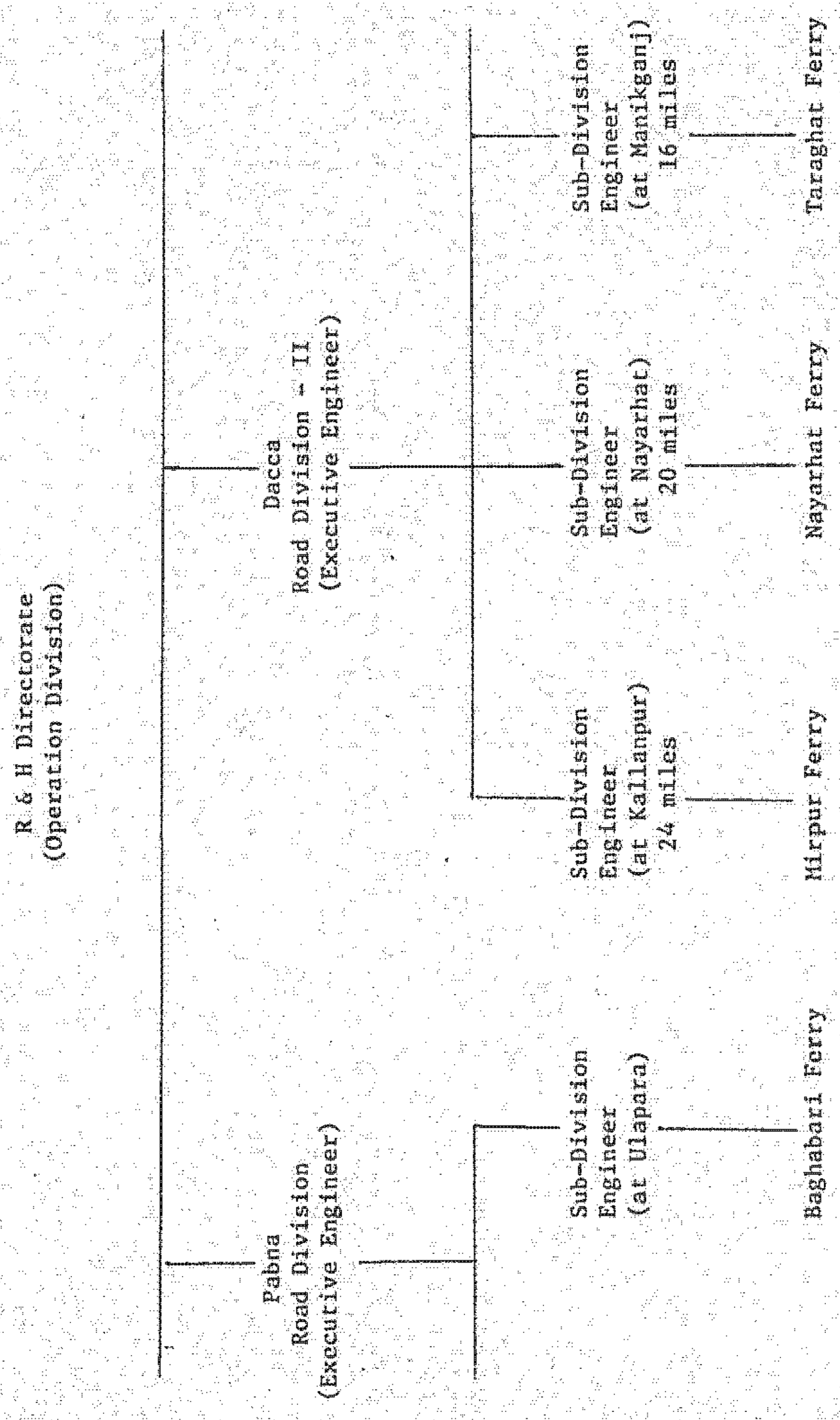


Fig. 4-2 Administrative Organization of R & H Ferry Operations

Figures in parentheses at the bottom of Table 4-11 show the total revenue and expenditures, inclusive of those for 18 different Class I and II crossings in addition to the 4 crossings shown in the table. These figures clearly show that R & H ferry management is no better than before 1970, as shown in the large deficit.

The fare system is not uniform and is different at each crossing. There are also many free crossings. The R & H Directorate does not collect fares for these crossings from the public transportation standpoint, because time loss at these crossings is great.

Under this deficit, these free crossings must be gradually switched to fare collecting crossings in order to improve the financial status of ferry operations.

4. Comments and Recommendations

(1) Problems

River

Along the Dacca - Aricha trunk road and the Nagarbari - Bogra trunk road of the Jamuna River region, during the dry season, the volume of water flow of the medium and minor rivers at which the crossing points of the ferries operated by the Road and Highway Directorate are situated decreases very drastically and the velocity of water becomes almost stagnant. There is generally a deficiency in water depth for ferry operation. As a result, at some crossings, the ghat facilities have to be seasonally moved to more favourable locations.

On the other hand, during the rainy season, due to the discharge from the Jamuna River, the water level at the crossings rises by some 20 feet. This hinders any attempts for the modernization of the ghat facilities. Also, at some crossings, the operation of ferry service is difficult due to the water current strength.

Traffic

The majority of the heavy vehicles running on the trunk roads today are trucks of 5-ton capacity. Sometimes, 7-ton trucks or oil tanker lorries, of the long haulage type, are also in use.

Capacity specifications and gross vehicle weight of the various types of heavy vehicles are as shown in Table 4 - 12.

Table 4 -12 Capacity and Gross Vehicle Weight of Heavy Vehicles

Type of vehicle	Capacity	Gross vehicle weight
3-ton truck	6,720 lbs	13,500 lbs (6 tons)
5-ton truck	11,200 lbs	18,600 - 19,500 lbs (8.3 - 8.6 tons)
7-ton truck	15,680 lbs	22,600 lbs (10.02 tons)
1,000 gallon lorry	8,560 lbs	19,000 lbs (8.62 tons)
1,500 gallon lorry	10,200 lbs	20,000 lbs (9.07 tons)
2,000 gallon lorry	13,000 lbs	21,000 lbs (9.53 tons)

There is a shortage in the number of vehicles for goods transportation, and overloading is a common practice, so that the five-ton trucks carry a load of 8 tons (G.V.W.: 11.2 tons) while the 7-ton trucks carry a load of 10 tons (G.V.W.: 13.2 tons).

The demand for larger vehicles is therefore very strong irrespective of the transport capacity of the steel ferries.

Vessel

When marboats are mechanically equipped, they are agile and easy to operate. These vessels are economical for the transportation of light vehicles, and are used along the trunk roads specifically for the transportation of light vehicles, in supplement to the lighters and steel ferries which are used for transporting heavy vehicles. This division of vessel usage is highly commendable.

However, the engine power of the marboat is small, and, being a wooden vessel, it is not equipped with permanent ramp boards.

It is dangerous for operation in rough water or in poor weather.

Also, the draft of the vessel is deep, so that at the crossings where the depth of water becomes shallow during the dry season, the usability of this vessel is greatly reduced.

Steel ferries were introduced into service in 1960, and have since played an important role at road ferries of medium and minor rivers, along with the wooden marboat.

Steel ferries have been in service for 13 years, but are suitable for safe transportation of vehicles of only up to 3-tons.

The use of steel ferries for the transportation of heavy traffic is already exceeding safety limits from the point of increase in traffic volume. Today, the operation of the ferry service is in a very dangerous state, and does not match the demand for heavy vehicles.

(a) Vigorous rolling occurs during the loading and unloading of heavy vehicles, and the situation is extremely dangerous.

(b) The difference in height between the ferry deck and the pontoon deck is not uniform along the whole length of the vessel. For this reason, the method of using wooden gangplanks is time consuming and is also dangerous.

(c) Since the loading and unloading of vehicles is through the side boarding system, the direction of the ferry has to be adjusted according to the direction of the vehicles when it pulls alongside. The vessel therefore has to cross the river in an S-shaped route, which is very time consuming.

This adverse effect is all the more prominent when the width of the river is small, and operating efficiency is greatly reduced.

For all these reasons, use of the steel ferries for transportation of heavy vehicles is dangerous and inefficient.

Also, the vessel draft is deep, so that at the crossings where the depth of water becomes shallow during the dry season, the usability of this vessel is greatly reduced.

However, engine power is large, and is at present the only type of vessel that may be operated, even in the strong current, during the rainy season.

The unifloat, as a vessel capable of handling heavy vehicles, was introduced into service immediately after the liberation. The vessel is robust, stable and agile, and its service drastically reduces travel time for river crossing. In river crossing, this vessel now forms the most up-to-date transportation system.

The to-and-fro method of operation is most effective during the dry season, when the width of the water surface narrows and the distance between banks is short. Also, the draft is shallow, and operation is possible in shallow water during the dry season.

Ghat

Regarding ghat facilities; due to the drastic seasonal change in water level, it is not possible to provide permanent facilities, and all the existing facilities are in very poor condition.

As described below, ghat facilities are greatly varied, and differ according to the crossings or, even at the same crossing, according to whether it is a heavy vehicle route or a light vehicle route. Variations are also made to suit the topographical conditions.

a. Steel pontoon + steel gangway + earthen slope

b. Steel pontoon + wooden gangplanks + earthen slope

c. Wooden deck jetty + earthen slope

d. Earthen stage approach + earthen slope

All these approach-landing facilities are of the movable type, and must be adjusted to the changes in water level between the dry and rainy seasons. Installation of steel gangway is difficult.

Although this approach-landing system does not result in any loss of time, it is the main cause for increased maintenance costs. Improvements to cut down costs (an important problem) should be seriously tackled.

(2) Transport capacity

A calculation is made here of the transport capacity and the time required for river crossing at the Baghabari crossing, based on the results of an on-site survey.

Daily traffic volume:

Light vehicles	123 vehicles
Heavy vehicles	126 vehicles
Total	249 vehicles

a. Heavy vehicle route

It is assumed that the route consists of:

500 ft in crossing the Baral River on a 46 ft class ferry

400 ft of crossing the char land overland for the vehicle

550 ft in crossing the Gohala River on a Type C Unifloat ferry.

Time factors for the steel ferry are as follows:

Loading: 4 minutes

Running: 5 minutes

Unloading: 4 minutes

Time factors for the Unifloat ferry are as follows:

Loading: 1.5 minutes

Running: 3 minutes

Unloading: 1.5 minutes

Time required for a one-way trip across the Baral River is

4 + 5 + 4 = 13 minutes (26 minutes for a round trip)

One-way trip time across the char land:

1 minute

Time required for a one way trip across the Gohala River is

1.5 + 3 + 1.5 = 6 minutes (12 minutes for a round trip)

Time required for crossing the river:

Waiting time for the steel ferry at the right bank of the Baral River

Maximum: 5 + 4 + 13 = 13 minutes

Minimum: 0 minute

Time required for a one-way trip across the Baral River

Average: 4 x 1/2 + 5 + 4 x 1/2 = 9 minutes

One-way trip time across the char land

1 minute

Waiting time for the Unifloat ferry at the char land

Maximum: 3 + 1.5 + 6 = 10.5 minutes

Minimum: 0 minute

Time required for a one-way trip across the Gohala River

Average: 1.5 x 1/2 + 3 = 1.5 x 1/2 = 4.5 minutes

Total 14.5 - 47 minutes

(Average: 30 minutes)

As shown above, due to the disadvantage of having to use two ferries, it takes an average of about 30 minutes to cross the river.

This route consists of 3 sections of different transport capacities, and the overall capacity is decided by the transport capacity of the steel ferry across the Baral River.

In the calculation, to be in line with actual conditions, it is assumed that the transport capacity of the 47 ft class steel ferry is 3 vehicles. The transport capacity of a Unifloat is three 5-ton trucks.

Transport capacity per hour:

60 minutes/hour ÷ 26 minutes/round trip = 2.3 round trips/hour

∴ 2.3 round trips/hour x 6 vehicles/round trip = 13.8 vehicles/hour

Daily transport capacity:

The operating time of ferry service at this crossing is 16 hours per day. However, assuming a practical traffic hour

of 12 hours per day, the daily transport capacity is:

∴ 13.8 vehicles/hour x 12 hr/day = 165 vehicles/day.

Therefore there is no problem as far as daily total capacity is concerned. The problem is during peak hours:

Assuming the peak hour traffic rate to be 15% of the daily traffic volume, the peak hour traffic demand is:

126 vehicles x 15% = 17.8 vehicles/hour.

The results showthat there is a deficiency in the peak hour transport capacity, so that waiting time is increased, resulting in heavy congestion at the crossing.

This is due to the deficiency in transport capacity of the steel ferry across the Baral River, and the queue waiting on both banks is usually 4 - 6 vehicles respectively.

When the waiting queue is converted into the number of trips made by the steel ferry across the Baral River, it comes to:

$$\frac{2(4 \sim 6 \text{ vehicles})}{6 \text{ vehicles/round trip}} = 1.3 \sim 2.0 \text{ round trips.}$$

This means that the vehicle waiting at the end of the queue will have to wait for an equivalent of one round trip (13 x 2 = 26 minutes) before being able to board the ferry for crossing the river. Therefore the required time for the heavy vehicle during the peak hour will be

(14.5 ~ 47) minute + 26 minutes = 40.5 ~ 70 minutes.

The average time required is estimated to be about 55 minutes.

b. Light vehicle route

It is assumed that the route consists of:

500 ft in crossing the Baral River

400 ft in traversing the connecting water channel

550 ft in crossing the Gohala River

and that 1 marboat (loading capacity 4 cars) is in operation. The time factors for the marboat are as follows:

Loading: 2 minutes

Running: 7 minutes

Unloading: 2 minutes

Therefore the time required for a one-way trip is:

2 + 7 + 2 = 11 minutes (22 minutes for a round trip)

Time required for river crossing.

Ferry waiting time

Maximum: 7 + 2 + 11 = 20 minutes

Minimum: 0 minute

One-way trip time

Average: 2 x 1/2 + 7 + 2 x 1/2 = 9 minutes

Total: 9 - 29 minutes

(Average: 19 minutes)

Transport capacity per hour:

60 minutes/hour ÷ 22 minutes/round trip= 2.7 round trips/hour

2.7 round trips/hour x 8 vehicles/round trip = 21.6 vehicles/hour

This is the hourly traffic volume that may be handled at this ferry crossing during peak hours.

c. Overall transport capacity of the crossing

The overall transport capacity, including both the light and heavy vehicle routes, is summarized below. The results clearly indicate the inefficiency of the crossing.

Hourly transport capacity:

21.6 + 13.8 = 35.4 vehicles/hour

Time required for river crossing:

Normal period: 19 - 30 minutes

Peak period: 19 - 55 minutes

Transport capacity increase

To remedy this inefficient method of transportation, the immediate and practical improvement steps for increasing the transport capacity of the crossing would be to develop direct routes connecting the right bank of Baral River and the left bank of Gohal River, by widening the water channels for both light and heavy vehicle routes, though it sounds like a rather course solution.

Secondly, it is recommended that 3 marboats be provided for transporting light vehicles, and 2 Type D and 1 Type C Unifloat ferries be provided for transporting heavy vehicles.

Thirdly, the operation of these ferries must be applicable even during peak traffic periods of cross river transportation.

In other words, it is recommended to operate 2 marboats and 2 Type D Unifloat ferries in eight hour shifts during normal traffic periods. This is the same operation as that of the present time. One marboat and 1 Type C Unifloat ferry which are not in service,

are to be reserved as stand-by ferries for service during peak traffic periods.

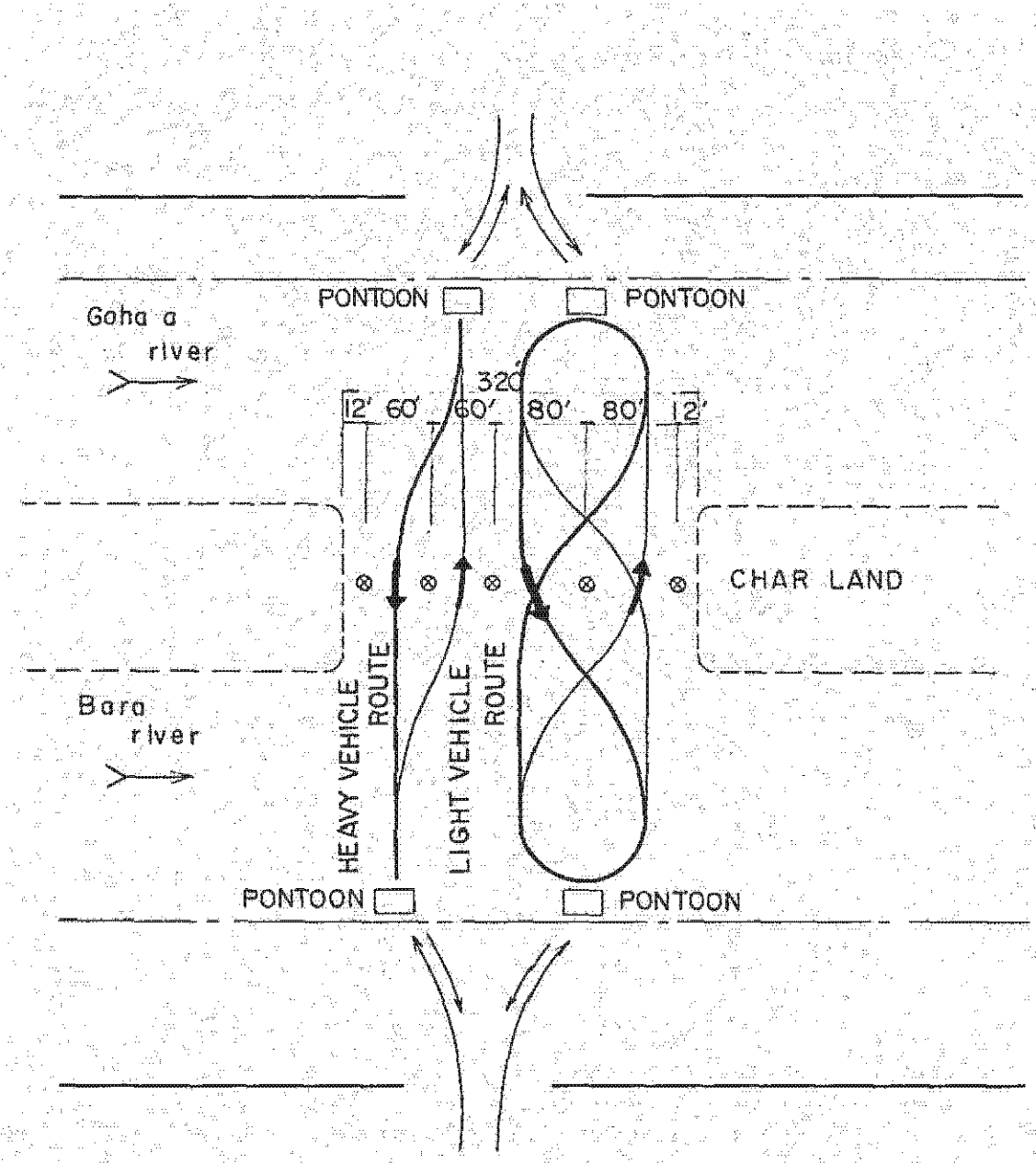
However, to avoid traffic jams of cross river transportation during peak traffic periods, a transportation system of "one route - two ferries" is recommended. Since good effects, as explained later, can be expected, if 2 marboats on the light vehicle route, and 1 Type D and 1 Type C Unifloat ferry on the heavy vehicle route are operated with a half-cycle time lag.

In this operation, it is necessary for two ferries on the same route to coordinate their departure time, from the opposite ghats, by telecommunications, or other methods.

Therefore, to apply this system for the Bagabari crossing, the char land channel connecting both rivers must be widened to safely accomodate the simultaneous operation of four ferries. The widening of the channel should be kept to the necessary minimum. Fig. 4-3 depicts this situation.

According to this scheme, the present channel (80 ft. wide) must be widened to approximately 320 ft. This will require excavation and dredging of about 1,500,000 cu. ft. of earth.

It will also be necessary to install light buoys to separate the four lanes of the channel, to assure safe operations at night.



: Ferry service during normal traffic periods

: Extra ferry service during peak traffic periods

: Light buoy

Fig 4-3 Proposed New Ferry Transportation System at Bagabari Crossing

Transport capacity increase and shortening of cross river time, in accordance with the above-mentioned concept for improving and reinforcing transport capacity will be calculated as follows:

a. Light vehicle route

Normal traffic periods:

Ferry: 1 marboat

Number of loaded vehicles: 4 vehicles/ferry

Hourly transport capacity: 21.6 vehicles/hour
(See previous section)

Average time required for crossing: 19 minutes
(See previous section)

Peak traffic periods:

Ferry: 2 marboats

Number of loaded vehicles: 8 vehicles/2 ferries

Hourly transport capacity: 21.6 x 2 = 43.2 vehicles/hour

Average time required for crossing:

Ferry waiting time:

Minimum: 0 minute

Maximum: 7 + 2 = 9 minutes

One way trip:

Average: 2 x 1/2 + 7 + 2 x 1/2 = 9 minutes

Total: 9 - 18 minutes (Average 14 minutes)

b. Heavy vehicle route

Normal traffic periods:

Ferry: 1 Type D Unifloat

Number of loaded vehicles: 6 vehicles/ferry

Loading	3 minutes
Running	7 minutes
Unloading	3 minutes
Total	13 minutes

(26 minutes for a round trip)

Hourly transport capacity:

60 minutes/hour ÷ 26 minutes/round trip = 2.3 round trip/hour

2.3 round trip/hour x 6 vehicles x 2 = 27.6 vehicles/hour

Average time required for crossing:

Ferry waiting time:

Minimum: 0 minute

Maximum: 7 + 3 + 13 = 23 minutes

Trip for one way:

Average: 3 x 1/2 + 7 + 3 x 1/2 = 10 minutes

Total: 10 - 33 minutes (Average 22 minutes)

Peak traffic periods:

Ferry: 1 Type D and 1 Type C Unifloat ferry

Number of loaded vehicles: 6 + 3 = 9 vehicles/2 ferries

Hourly transport capacity:

2.3 round trip/hour x 9 vehicles x 2 = 41.4 vehicles/hour

Average time required for crossing:

Ferry waiting time:

Minimum: 0 minute

Maximum: 7 + 3 = 10 minutes

One way trip:

Average: 3 x 1/2 + 7 + 3 x 1/2 = 10 minutes

Total: 10 - 20 minutes (Average 15 minutes)

c. Overall transport capacity of the crossing

Hourly transport capacity:

Normal traffic periods: 21.6 + 27.6 = 49.2 vehicles/hour

Peak traffic periods: 43.2 + 41.4 = 84.6 vehicles/hour

Average time required for crossing:

Normal traffic periods: 19 - 22 minutes

Peak traffic periods: 14 - 15 minutes

Overall transport capacity, calculated above, shows a capacity increase of about 1.4 - 2.4 times the present hourly transport capacity of 35.4 vehicles/hour, and shortening of average crossing time by 25 - 50% (19 - 30 minutes during peak traffic periods).

Additionally, by comparing hourly transport capacity, we find that the new figures show an increase of about 2.3 times the present figures, as calculated in the following:

Normal traffic periods:

$$\frac{249 \text{ vehicles/day}}{12 \text{ hours}} = 20.7 \text{ vehicles/hour} < 49.2 \text{ vehicles/hour}$$

Peak traffic periods:

249 vehicles/day x 15% = 37.3 vehicles/hour

< 84.6 vehicles/hour

(3) Recommendations

In accordance with the above review and analysis, recommendations for the improvement of ferry transportation at the Bagabari crossing are as follows:

a. Ferry crossing routes (light and heavy vehicle routes) should be direct routes, connecting both terminals by widening the width of the present water channel at the char land.

b. Of the 11 ferries presently in service, it is recommended that 4 steel ferries and 2 marboats be replaced with 1 Type D Unifloat. That is, the recommended ferry allocation is:

For light vehicle transportation: 3 marboats

For heavy vehicle transportation: 2 Type D and 1 Type C Unifloat ferries.

For the operation of these 6 ferries, an operations system consisting of normal and peak traffic transportation is recommended, with 16 hour service each day.

Normal traffic service:

1 marboat

1 Type D Unifloat ferry

Peak traffic service:

2 marboats

1 Type D and 1 Type C Unifloat ferries

For peak traffic service, a "one route - two ferries" system should be applied for both the light and heavy vehicle routes.

c. By implementing these recommendations, hourly transport capacity will be improved to 49.2 - 84.6 vehicles/hour, which is approximately 2.3 times the present figures for normal and peak traffic periods.

Taking into consideration the renewal of existing facilities because of life expectancy expiration in addition to establishment of the new facilities, investment to reinforce and improve the transportation capability, previously mentioned, during the period 1985 to 1990 is presently roughly estimated as approximately 5,520,000 Taka, as shown in Table 4-12.

Table 4-12 Facility Improvement Items for R & H Bagabari Crossing

(In millions of Taka)

Planning items		Targets of improvement		
[Ferry facilities]				
Unifloat ferries, type D	2 Nos.	Replacement of existing type D with new ferry of the same type Supplement of new ferry	1 No. 1 No.	@1.40 = 2.80
Unifloat ferriy, type C	1 No.	Replacement of existing type C with new ferry of the same type	1 No.	@0.92 = 0.92
45 ft class Marboats	3 Nos.	Replacement of existing 45 ft class with new ferries of the same scale	3 Nos. X 3 times	@0.15 = 1.35
[Ghat facilities]				
64 ft class loading/unloading pontoons	4 Nos.	Continuous use of existing 64 ft class ferries	4 Nos.	-
[Water area facilities]				
Charland crossing water channel	320 ft wide	Enlarging the width from present 80 ft to 320 ft	1,500,000 cu ft	0.35
Small light buoys	5 Nos.	Supplement of new ferries	5 Nos	@0.02 = 0.10
Total				abt. 5.52

Recommendations on Overall R & H Ferry Operations

In this survey, R & H ferry operations, except for the Jamuna River basin, has not been investigated. However, it is pointed out that each of the 3 crossings on the Dacca - Aricha trunk road and the Bagabari crossing show different features.

Therefore, judging from the results of the investigation and analysis so far made, we may conclude that the immediate steps for improving R & H ferry operations, all over the country, should basically be centered on the choice of the type of vessels, as well as allocation of the vessels.

a. From the point of efficient use of the vessel decks of ferries transporting heavy vehicles, the method of separating the light vehicle route from the heavy vehicle route should be maintained, ans specific vessels should be operated for the respective routes.

b. The economic advantage of the marboat should be exploited, and employment of the marboat for light vehicle routes should be continued.

c. The existing steel ferries may be temporarily used, but should be gradually phased out.

d. Introduction of Unifloat ferry for heavy vehicle transportation should be effected, and the vessel should be used to form the main type of vessel for road ferries.

However, at the crossings where operating conditions are unfavorable, it is necessary to provide special consideration towards the ferry formation to be adopted, apart from the above-mentioned basic formation.

e. During the dry season, at the crossings where sufficient water depth is not available, a Unifloat should be introduced for transportation of light vehicles in place of the existing marboat which is of a deeper draft.

f. At crossings where the water flow conditions are unfavorable during the rainy season, the steel ferry, which is more adapted to rough water, may be temporarily used to provide separate services on the light and heavy vehicle routes. The steel ferry adopted should be of the 52 ft - 47 ft class, weigh restriction on heavy vehicles should be imposed, and regulations on the loading capacity of the ferry should be strictly observed to ensure safe transportation.

Therefore, points to be solved for effective operation of the present ferry system are as follows:

g. New types of vessels which are capable of serving even the heaviest vehicles, of larger capacity and suitable for safe operations in rough water during the rainy season, should be introduced.

h. Development of new facilities which are safe for the running and transferring of vehicles, and are low in maintenance costs, is necessary to replace the existing approach - landing facilities.

The above are recommendations in terms of safe transportation, rapid service and some increase in transport capacity under present levels of cross river transportation.

For the recommendations for improving transport capacity, it is possible to make the following consideration.

That is, as seen in the analysis of the Bagabari crossing, it is necessary to ensure simultaneous operation of at least 2 marboats and 2 Unifloat ferries to cope with peak traffic at the crossings of major trunk roads.

A "One route - two ferries" system which enables simultaneous operation of four ferries, as shown in Fig. 4-3, is only an example under a special condition, and this system cannot be applied for all crossings. Carrying systems should be reviewed and decided according to specific conditions at each crossing.

At the crossings where the width of the water channel is narrow during the dry season, it would be necessary to open four routes for 4 ferries.

However, problems arise at crossings as specified in Items e and f above.

At the crossings where there is not sufficient water depth during the dry season, it is not possible to operate a number of ferries simultaneously even when Uniflouts are operated, since water surface area which makes operation of vessels possible, is extremely limited. At the crossings where strong currents are expected during the rainy season, it is quite dangerous to operate a number of steel ferries simultaneously.

Taraghat crossing, where a cross river bridge is presently under construction, is a typical example of such crossings and increase of transport capacity can in no way be expected at such

crossings. It may be said that at such crossings, inefficiency or limitation of ferry crossing methods will be more and more recognized in the future.

CHAPTER V

PRIVATE PARTY FERRIES

(1) Point of operation

East Bank Region

Tangile - Nagarpur road route

The section of this route from Tangile to the 4th mile is brick pitching road of one lane in width and the traffic is composed of bullock carts, motor cycles and rickshaws.

From this point to Nagarpur town, the route is of gravel kutcha road, and the traffic volume, mainly of bullock cart traffic, is rather heavy.

The ferry crossing on this route is at the Dhaleswari River. The distance between the banks of the river is about 3,300 ft. The right bank is steep and hanging, while on the left bank an extensive siltation is underway. During the dry season the span of water surface is about 500 ft., and a water depth of about 12 ft., while the water remains virtually stagnant.

At this point there are at present two marboats in operation to serve the traffic of cattle, horses and pedestrians.

Tangile - Charbari road route

This road is an all-weather road under construction by the Road and Highway Directorate. Work on the road body is almost completed and work is underway for brick pitching.

At present the traffic volume on this route is extremely small. But plans are underway to open up ferry service across the Jamuna

River to the Sirajganj on the west coast.

Between Charbari, the terminal of this route, and Porabari on the char land, private party ferries are now operated during the rainy season.

The distance between banks is about 3,300 ft., but the water surface span of about 170 ft. may be forded during dry season.

Jamalpur - Gabargaon road route

This route traverses through a char land zone, and since there is little population concentration, the traffic volume is small. The road body is of gravel kutcha road which is not well constructed and traffic is limited to bullock carts and pedestrians.

There are three ferry crossings along this route. The first crossing is at char chandra, 3 miles from Jamalpur and is served by 1 marboat. At a distance of 6 miles from this point there is a ford at Char Adiapara, where ferry service is operated during rainy season. During the dry season a temporary road across the ford is established by private party.

The last crossing is at Chatar River 1 mile further away from this point.

At the place where the road route crosses the river, siltation is occuring and the ferry crossing is located 1 mile downstream, resulting in a great detour for the road.

At the crossing, the distance between banks is over 3,300 ft. It is very shallow along both banks and the water surface span is about 300 ft. during dry season. A marboat is being operated here.

Jamalpur - Bahadurabad road route

This route runs parallel to the branch line of the Bhadurobad railway and the old Brohmaptura River. A great portion of the road body is bad, and the road surface is gravel kutcha road of very poor condition. It is barely usable for travelling between villages and the traffic volume is small, being limited only to bullock carts and pedestrians.

On this road there is a ford at Char Bani, 4 miles from Jamalpur which is served by ferry during rainy season. During dry season the ford is traversed by a temporary road established by private party.

A full list of the private party ferry crossings in the east bank region of the Jamuna River is as shown in Table 5 - 1.

West Bank Region

Shahzadpur - Sonatani road route

The ferry crossing on this route is at Karatoya River which is only one mill from Shahzadpur.

The distance between banks is about 900 ft. The left bank is of slope surface while the right bank is very shallow. The water surface span during dry season is about 250 ft. and the water depth is shallow.

Traffic demand at this crossing is big, and 1 marboat as well as one single boat are in operation for the transportation of bullock carts and pedestrains.

The section from this point to Sonatani is a gravel bullock

Table 5-1 Inventory of Private Party Ferries

in the East Bank Region of Jamuna R.

(1)

Route	Location of crossing	Number and type of ferry	No. and H.P. of engine	Capacity of ferry	No. of crew per each	Remarks
1	2	3	4	5	6	7
Tangile-Nagarpur road	Dhaleswari R. 9th mile from Tangile	2 - Marboats	Without engine	2-bullock cart or 15-persons	-	Operated over all seasons.
Tangile-Charbari road	near Porabari 3rd mile from Tangile	-	-	-	-	Operated during rainy season and forded during dry season.
Jamalpur-Gabargaon road	Char Chandra 3rd mile from Tamalpur	1 - Marboat	Without engine	1-bullock cart or 15-persons	-	Operated over all seasons.
	Char Adiapara 9th mile from Jamalpur	-	-	-	-	Operated during rainy season and forded during dry season.

(2)

1	2	3	4	5	6	7
	Chatal R. 10th mile from Jamalpur	1 - Marboat	Without engine	1-bullock cart or 15-persons	-	Operated over all seasons.
Jamalpur-Bahadurabed road	Char Bani 4th mile from Jamalpur	-	-	-	-	Operated during rainy season and forded during dry season.

cart road passable to traffic only during dry season. The road is left without maintenance, and as it nears the river. Many portions are worn and broken so that traffic is virtually non-existent.

At Hurasagar N River, 6 miles from Shahzadpur, the river bed dries up during dry season, but ferries are operated during rainy season.

Hatikumrul - Sirajganj road route

Up to now, traffic from the Ulapara - Bogra section of the trunk road, on the way to Sirajganj, was diverted to the railway at Ulapara Station. However the Road and Highway Driectorate is improving the existing route into the only all weather road to Sirajganj. Work on the road body is nearly completed and work is underway for brick pitching and the construction of structure works for water drains.

The ferry crossing is at Nalkasenganti of Karatoya River, 3 miles from Hatikumrul. This point is immediately downstream of the confluence of Karatoya River and Ichamati River, and the distance between banks is about 2,300 ft. During dry season, the water flows along the left bank while the right bank forms a very gradual slope. The water surface span is 500 - 700 ft., the water is almost stagnant, and the water depth at the crossing is rather shallow.

At this point 1 marboat and 1 single boat are being operated by private party for the transportation of bullock carts and pedestrains, and the demand is quite large.

On completion of the road construction work, a ferry service will be operated here by the Road and Highway Directorate.

Bogra - Shariakandi road route

This route is a Bogra District road and the Bogra - Gabtali section is a one-lane brick pitching road. Bullock carts, hand drawn carts, pedestrians, bicycles and buses ply this section to Bogra as this is the road for goods transportation and for commuting from the vicinity of Gabtali. The section from Gabtali to Shariakandi is a gravel road of wide roadway which is well maintained, and the traffic consists mainly of jute transportation by bullock carts and of pedestrians.

The ferry crossing is at the Bangali River, 8 miles from Gabtali.

The distance between banks is about 600 ft. During dry season the water surface span is about 250 ft., with extensive siltation on the left bank and steep and hanging cliff-like surface on the right bank. Water flow during rainy season is strong.

A marboat is allocated here by the Bogra District Council for the transportation mainly of bullock carts. Besides this, a single-boat is operated by private party.

Gobindganj - Shaghatta road route

The town of Mahimaganj which is 7 miles from Gobindganj is a town with a railway station. A sugar factory is situated here, and a one-lane concrete paved road links it with Gobindganj.

The road from Mahimagnj to Shaghatta, however, is a bullock

cart road passable only during dry season. The road surface is poorly maintained and traffic is virtually non-existent.

The ferry crossing is at Katohari River, 1 mile from Mahimaganj.

The distance between banks is about 800 ft. During dry season, the water surface span is about 250 ft., the water is almost stagnant, and the slopes on both banks are very gradual. The water flow is not strong even during rainy season.

One marboat is now operated here for the transportation of bullock carts and pedestrian, but the demand is small.

A full list of the private party ferry crossings in the west bank region of the Jamuna River is as shown in Table 5 - 2.

(2) Present situation of ferry operation

The traditional manually rowed Catamaran type vessels called marboats form the main stream of the ferries are now operated by private party, and are used for the transportation of bullock carts and pedestrians. This vessel has a wooden double hull body of 33 - 40 ft. in length with a bamboo deck, and is not suitable for transportation of motor vehicles.

This may be said of the present situation of ferry allocation. In the east bank region of the Jamuna River, reflecting the low traffic demand, almost all the ferry crossings are using 1 marboat for service. Traffic demand is comparatively larger in the west bank region, so that besides 1 marboat, a single type wooden boat is supplementarily used specifically for transportation of pedestrians. These are about the standard ferry vessel allocation

Table 5-2 Inventory of Private Party Ferries

in the West Bank Region of Jamuna R.

(1)

Route	Location of crossing	Number and type of ferry	No. and H.P. of engine	Capacity of ferry	No. of crew per each	Remarks
1	2	3	4	5	6	7
Shahzadpue - Sonatani road	Karataya R. 1st mile from Shahzadpur	1 - Marboat	Without engine	2-bullock carts or 25-persons	4 Nos.	Operated over all seasons.
		1 - single boat	do.	10-persons	2 Nos.	
	Hurasagar N.R. 6th mile from Shahzadpur	-	-	-	-	River bed dries up druing dry season. Operated during rainy seasons.
Hatikumrul -Sirajganj road	Karatoya R. 3rd mile from Hatikumrul	1 - Marboat	Without engine	2-bullock carts or 25-persons	4 Nos.	Operated over all seasons.
		1 - single boat	do.	-	-	

1	2	3	4	5	6	7
Bogra - Shariakandi road	Bangali R. 8th mile from Gabtali	1 - Marboat	Without engine	2-bullock carts or 30-persons	4 Nos.	Operated over all seasons.
		1 - single boat	do.	-	-	Marboat is operated by Bogra District Council.
Gobindganj -Shaghatta road	Karatoa R. 1st mile from Mahimaganj	1 - Marboat	Without engine	1-bullock cart or 15-persons	2	Operated over all seasons.

in this river region.

The operation by private party is generally from 5 a.m. to 11 p.m. on a two shift system to meet actual traffic demand and without a fixed schedule. The frequency of service of a marboat at a typical ferry crossing is about 50 return trips per day.

However, in the medium and minor rivers in the Jamuna River region, many suffer drastic reductions of water during the dry season, so that ferries cannot be operated, and the crossings are turned into fords.

At crossings where the water depth at the fords presents difficulties of crossing by bullock carts and pedestrians, it is customary for some embanking to be carried out by private party to establish temporary roads in the place of ferry service and tolls are charged for the crossings.

During the rainy season (May - November), ferry operation is said to be possible even when the water current is strong. However, at the peak of the rainy season, at the crossings where the road condition is poor, such as in the east bank region, traffic comes to a stop, while at other crossings, the operation of the ferry service is intermittent.

Also, at these local roads, there are many obstacles due to the wearing of road surface or the breaking down of minor bridges, and the traffic situation of these places during rainy season is unknown.

(3) Comments

Construction is under way in earnest for the construction of permanent bridges at 3 ferry crossings on the Dacca-Aricha trunk road and at the Katchpur crossing (Sitalakhya River) of the Dacca-Chittagon trunk road. Obstacles encountered with the ferries should disappear in several years' time.

As the ferry crossings of the medium and minor rivers along the trank roads are gradually replaced by bridges, the operation of the R. & H. ferry will also be shifted to the ferry crossings of subsidiary roads.

The Kucha road of the Jamuna River region, which is at present used only by bullock carts and pedestrians, will also eventually be included in the overall development plan for the establishment of a transportation network in the region; just as the Hatikumrul-Sirajganj road which is presently under construction by the R. & H. Directorate.

In place of the private party ferries of a very small scale, which are currently filling the river gaps of the subsidiary roads, plans should be contemplated for the provision of R. & H. ferry service capable of handling vehicle traffic.

An assessment of the possibility of future development of the R. & H. ferry is made as follows:

The river crossing of the medium and minor rivers of the Jamuna River region may be classified into 3 types on the basis of channel stability and ferry operation facilities, as observed by site investigation.

(1) Stable river type

The course of the river is meandering, but is generally stable. As general characteristics of meandering rivers, sandbars are formed on one side of the river during the dry season and the channel takes a course on the opposite side.

The current flow velocity is not great during the rainy season, and the water is sufficiently deep during the dry season so that an all season ferry operation is possible.

It is noteworthy that this type of crossing is found on rivers west of the Jamuna River, where a flood control embankment is provided ..... Karatoya River, Bangali River, Karatoa River.

(2) Variable-river-bed type

The strong current during the rainy season causes erosion of the river bank and also brings large volumes of sand and silt from upstream, resulting in changes in the location of sandbars after each flood.

Consequently, during the dry season, the river channel is meandering, and sometimes the river has a dual flow.

All season operations of the ferry is generally possible, but during the rainy season, the operation is sometimes disrupted by strong currents. During the dry season, due to the unstable channel, the course and position of the ferry has to be constantly changed to correspond with the locations of deep water.

This type of crossing is generally found on the minor rivers east of the Jamuna River ..... Dalheswari River, Chatal River.

(3) Dried-up-river-bed type

During the dry season, the water volume decreases drastically, resulting in the water becoming shallow, or in extreme cases the river bed completely drying up. Ferry operations are therefore possible only during the rainy season.

This type of crossing is found in the charland region which is situated between the Jamuna River and the old Brahamaptra River ..... Char Chandra, Char Adiapra, Char Bani, Hurasagor NR.

As may be seen from the above classifications, the conditions east of the Jamuna River are generally unfavourable for ferry operations.

Just as the Taraghat crossing on the Dacca-Aricha trunk road, the variable-river-bed type crossings cannot be expected to provide efficient ferry operations. For the dried-up-river-bed type crossings, provision of bridges will be necessary.

However, at the crossings west of the Jamuna River, where the channels of the river are stable, operation of ferry services by the R. & H. ferry is possible.

Chapter VI Bangladesh Railway Ferries

1. Sirajganj-Jagannathganj River Route

(1) Operation Route

As shown in Fig. 6-1, this is a long passenger ferry route connecting Sirajganj on the west bank of the Jamuna River with Jagannathganj which is 13 miles upstream on the east bank..

The Sirajganj Ghat is situated on the bank of the Ranigram at a point 2 miles upstream of the Sirajganj Railway Station.

Since the river bank upstream of Sirajganj has been undergoing continuous erosion, the ghat has had to be constantly moved backwards.

In the 1950's the ghat was situated on the bank about 4 miles upstream and north of Sirajganj Station, but was moved back to a 3-mile location after the completion of a flood control embankment in 1968.

Subsequently, a new railway branch line was constructed from Sirajganj Station for a distance of about 2 miles towards Ranigram so that the line directly faces the river bank. The ghat was then re-established at the terminal on the river bank. As a result of a flood in 1972, the river bank collapsed over a 1 km segment to a depth of 500 m inland. Consequently, the ghat and embankment were both washed away. The present ghat was originally the diversion point of the Ranigram River. The location of the present ghat is the same during both the dry and rainy seasons.

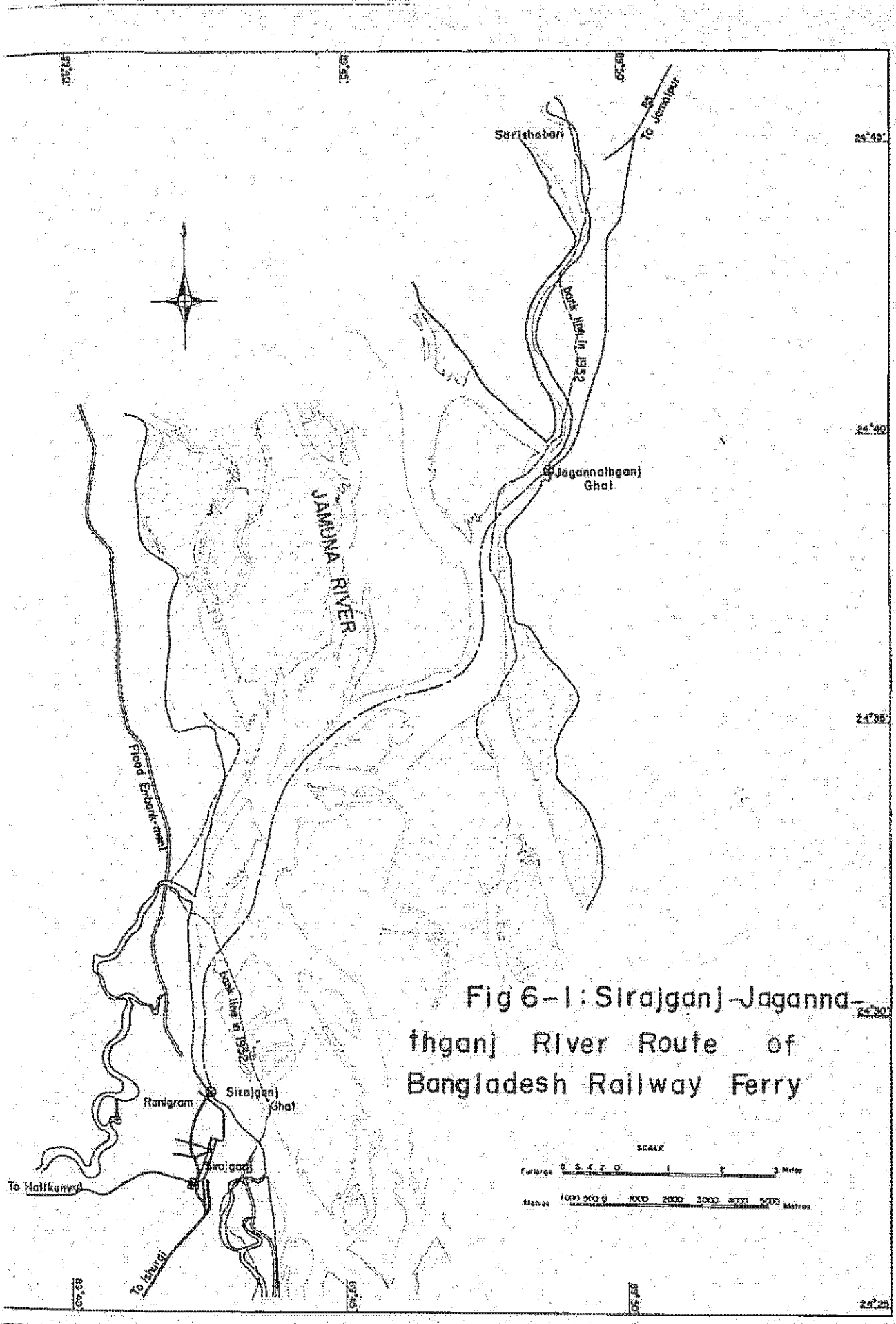


Fig 6-1 : Sirajganj-Jaganna-thganj River Route of Bangladesh Railway Ferry

Jagannathganj is situated on the river bank about 8 miles south and downstream of Sarishabari Station, and on the branch railway line from Jamalpur. This is the point where a tributary of the Jamuna River rejoins the main stream after making a detour around the Sarishabari Charland.

Until the 1950's, the eastern ghat of this route was situated at a point 1.5 miles downstream and south of Sarishabari Station, and faced the main stream of the Jamuna River. The subsequent development of a large charland in front of the Sarishabari Ghat resulted in a branching of the river and the ghat was closed.

The present Jagannathganj Ghat was established in 1960, and although the river bank is undergoing a slow process of erosion, the position of the ghat is comparatively stable. The location of the ghat remains the same during both the dry and rainy seasons.

The width of the river at the river basin between Jagannathganj and Sirajganj is wider than at other river basins during the dry season. For this reason, the river bed tends to remain unchanged, and during the dry season the depth of the water becomes extremely shallow with many chars of various sizes appearing in the middle of the river.

During the dry season the main stream of the river flows amidst the char clusters from Jagannathganj towards Sirajganj on the opposite bank. The effective breadth of the water for ferry operations is very limited and the vessels have to meander through the depths formed from the washings of the chars.

The distance travelled by the ferry along this route is about 14 miles.

(2) Present Situation of Ferry Operations

There are no firm data on the past transportation of passengers by the railway ferry. However, according to the Bangladesh Railway, the number of passengers along this route in 1973, was about 40 thousand per month (or about 480 thousand per year).

As for service facilities, there is at present one set of passenger ferry vessels comprised of one tug and one boat allocated for this route. The dimensions of the vessels are shown in Table 6-1.

The passenger boat is a dumb vessel of the inland flat type, and the upper deck is of the double deck structure.

The tug boat has a rectangular body. In tugging, it is tied to the side of the passenger boat.

An inland steamer of the coal burning, paddle type is allocated as a standby vessel for this route.

The services offered on this route are shown in Table 6-2. Two round trips are made each day, according to a fixed time schedule which is coordinated with the departure and arrival of the train. The scheduled travel time, according to the time table, is 2 hours and 30 minutes for the upstream trip and 1 hour 30 minutes for the downstream trip.

Table 6-1 Principal Particulars of Passenger Ferry

Sirajganj to Jagannathganj River Route

(Jan. 1974)

Vessel	Dimensions of vessels				Loaded draft	Tonnage	No. and H.P. of main engine	Carrying capacity	Total crew
	Length	Width	Depth	F. Board					
1 passenger boat	182'-0"	34'-4"	5'-6"	3'-8"	2'-6"		-	1,000 persons	
1 tug boat	152'-0"	30'-8"		fore 4'-8" aft: 3'-4"	fore 5'-0" aft. 4'-0"		2-720 H.P. (diesel)	-	32 persons (2 shifts)

Table 6-2 Ferry Service Schedule

d: Departure

a: Arrival

Sirajganj Ghat			Jagannathganj Ghat	
(9:10)	8:30	a	d 7:00	(6:20)
(11:55)	12:25	d	a 15.00	(15:45)
(17:30)	17:00	a	d 15:35	(15:05)
(19:45)	20:30	d	a 23:00	(23:40)

N.B.: ( ) indicates arrival/departure time of train.

Due to habitual unpunctuality of trains, as well as other reasons, the ferry service is usually behind schedule.

Dacca and Chittagon in the eastern part of the nation are connected with Kulna on the west by ferry across the river. The long distance trains between these two regions usually arrive at the ghat of the ferry from 30 minutes to 2 hours and 30 minutes behind schedule and the ferry has to wait for their arrival. The train, principally for passenger traffic, also has two to three coaches for freight service. As shown in Table 6-2, the schedule provides 30 to 45 minutes for passenger and freight transfer from the train to the ferry. The transfer of passengers is usually completed within 15 minutes. However, the manual transfer of freight requires much longer, and in practice, a 40 to 70 minute transfer time is usually required.

Moreover, during the dry season, the conditions are highly unfavourable for ferry operations, and incidents of ferry vessels running aground are quite common.

All these factors culminate in the delay of the ferry service, from 30 minutes to as long as 10 hours.

(3) Existing Facilities

Sirajgani Ghat

This ghat is situated on the river bank which receives the direct impact of the current and is a typical erosion prone bank, which extends for about 5 km.

Further downstream, embankment works have been underway for the past 3 or 4 years for river bank protection and the bank is quite stable. However, upstream, erosion is still in progress.

During the dry season, the river bank becomes a steep cliff of about 22 feet in height, and a large scale charland appears in front of the eroded bank. The width of the channel is about 2,700 feet. This channel is the main stream of the Jamuna River during the dry season and is the access for the ferry to the ghat.

The ghat is located at the terminal yard of the railway and remains in the same location during both the dry and rainy seasons. The reason that the ferry can reach the ghat during the dry season, when the water is generally shallow, is that the strip along the bank is eroded and deepened during the rainy season.

According to a very crude measurement made during our site investigation, the water flow velocity during the dry season was about 0.7 m/sec at the ghat.

At the terminal, there are no passenger service facilities such as an embarking and disembarking terminal building, ticketing office, waiting room, or baggage room. There is only a very simple station office. This is the same at all other terminals.

At the ghat, an old and unusable sea-going, flat type, passenger boat is anchored, which serves as the landing pontoon for passengers and also as the buoying station for the ferry vessel. This pontoon has a shelter, and also serves as the waiting room and baggage room. However, passengers usually do not wait for the ferry on the pontoon during the dry season, but linger at the passage or the shops lining the terminal yard.

The method of embarking and disembarking is different for the dry and rainy seasons. As the bank is eroded, the distance from the end of the railway track to the water front is only about 20 feet, and there is no approach way to the pontoon during the dry season. Therefore, the approach way is established in the area which is lower than the terminal yard by cutting an earthen slope along the slope of the river bank. The pontoon is stationed a little distance away from the railway track terminal. Passengers walk from the approach way to the pontoon along a gangplank about 23 feet in length. Freight is also carried along this passage way on the shoulders of laborers.

During the rainy season, the water level rises and the approach way, as well as the surrounding area, is submerged. The pontoon is moved to the water in front of the terminal, and passengers move directly from the terminal yard over a gangplank to the pontoon.

This method is generally adopted for ghats at river banks under serious erosion and may also be seen at the passenger ferry ghat at Bahadurabad.

Jagannathganj Ghat

The river bank here is eroded and has a slope gradient of about 40°. The tip of the char formed during the dry season extends to the water in front of the terminal, and the channel between the char and the river bank is about 1,000 feet in width. The main stream of the river is on the other side of the char.

The ghat is located at the railway terminal and remains there during both the dry and rainy seasons.

At the ghat, an obsolete passenger boat of the inland flat type has been allocated to serve as a landing pontoon. This type of boat is totally roofed, and on the deck there is a cabin which is divided into three compartments. The cabin is used for station administration and communications, as well as a ticketing gate and an accomodation room for the staff. Part of the remaining deck area is used for baggage handling, which leaves very little room for waiting passengers.

The ghats facilities are shown in Table 6-3.

Table 6-3 Inventory of Ghat Facilities for Passenger Ferry on Sirajganj to Jagannathganj River Route (Jan. 1974)

Ghat	No. and type of landing facilities	No. and type of gangway	Approach way	Terminal staff	Remarks
Sirajganj	1 steel pontoon Length 170'-0" Breadth 34'-6" Depth - F. Board 6'-0" Draft -	1 wooden plank	1 earthen slope		A sea-going flat type boat is converted into a steel pontoon. A workshop pontoon is provided at the ghat.
Jagannath-ganj	1 steel pontoon	2 wooden planks	2 earthen slopes		An inland flat type boat is converted into a steel pontoon.

2. Bahadurabad-Tistamukh River Route

(1) Operation Route

As shown in Fig. 6-2, this is a passenger and wagon ferry route along a long waterway connecting Bahadurabad on the east bank of the Jamuna River with Tistamukh on the west bank.

The Bahadurabad Ghat is at the terminal of the branch railway line which branches out northward from Jamalpur Railway Station and faces the Jamuna River.

The river bank undergoes serious erosion during the rainy season resulting in drastic topographical changes, so that the railway terminal and the ghat have to be shifted to new locations every few years.

The location of the Tistamukh Ghat, on the west bank, is significantly changed between the rainy and dry season.

During the rainy season, the ghat is situated on the river bank about 3 miles downstream and to the south of Phulchari. There, the branch railway line from the Santahar-Kaunia Loop Line turns south after extending east towards the Jamuna River.

The ghat is situated at a level high enough to avoid damage from floods during the rainy season. However, during the dry season, a large scale char is formed in front of the ghat, and the channel to the ghat becomes very narrow. Being unfit for ferry operations, the ghat is closed.

The dry season ghat is situated about 9 miles further downstream and on a branch line which runs parallel to the Jamuna River from the rainy season ghat.

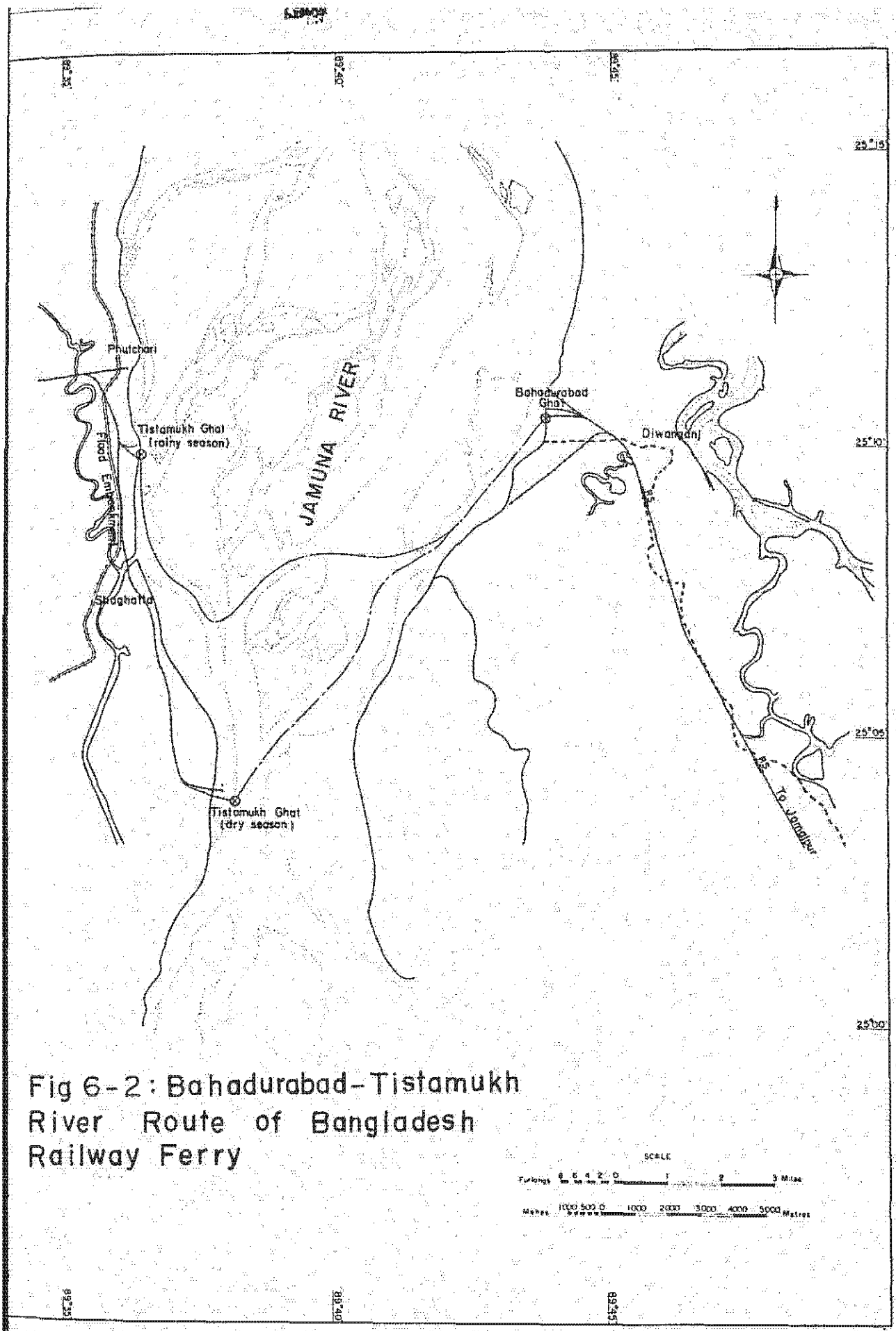


Fig 6-2 : Bahadurabad-Tistamukh River Route of Bangladesh Railway Ferry

The location of this dry season ghat is at the southern tip of the char and is so located, that it may be reached directly by ferry vessels from Bahadurabad. However, the river bank is a sandy area, and topographically, the location is not suitable as either a terminal or a ghat.

Due to the low level of the terminal yard, this ghat is flooded during the rainy season and is not serviceable.

The channel from the Bahadurabad Ghat to the Tistamukh Ghat tends to become shallow during the dry season.

The total distance over this route is about 9 miles.

During the rainy season, the Tistamukh Ghat is situated upstream. However, the water in front of the ghat is over a submerged char and the depth of the water is insufficient for ferry operation, so that it becomes necessary to detour this route around the submerged char. That is, the vessel from Bahadurabad has to travel downstream for about 7 miles before turning upstream towards the ghat. As a result, the total distance of the route is increased to about 12 miles.

The river flow velocity at this section was recorded as 5 knots at points of deep water and 2 to 4 knots at other points.

(2) Existing Operation Situation

a) According to the Bangladesh Railway, the traffic volume across this route was 60,000 passengers per month (720 thousand passengers per year) in 1973.

As for the vessels allocated here, the formation, structure and dimensions of the passenger ferries are almost identical to those at the Sirajganj-Jagannathganj route.

The dimensions of the vessels are shown in Table 6-4, and the daily service schedule is shown in Table 6-5. Two round trips per day are scheduled. However, operational delay is the same as that of the route mentioned previously.

Table 6-5 Ferry Service Schedule (Dry Season)

d: Departure

a: Arrival

Tistamukh Ghat			Bahadurabad Ghat
(9.50)	9:10	a	d 7:40 (6:55)
(11:55)	12:25	d	a 14:55 (15:30)
(18:00)	17:20	a	d 15:50 (15:00)
(20:00)	20:45	d	a 23:15 (23:55)

N.B.: ( ) indicates arrival/departure time of train.

Table 6-4 Principal Particulars of Passenger Ferry on Bahadurabad to Tistamukh River Route (Jan. 1974)

Vessel	Dimension of vessels				Loaded draft	Tonnage	No. and H.P. of main engine	Carrying capacity	Total crew
	Length	Width	Depth	F. Board					
1 passenger boat	226'-4"	39'-0"	8'-4"		3'-6"		-	1,000 persons	
1 tug boat	142'-0"	30'-0"	7'-6"		5'-0"		2-500 H.P. (diesel)	-	31 persons (2 shifts)

Table 6-8 Principal Particulars of Wagon Ferry on Bahadurabad to Tistamukh River Route (Jan. 1974)

Vessel	Dimension of vessels				Loaded draft	Tonnage	No. and H.P. of main engine	Carrying capacity	Total crew
	Length	Width	Depth	F. Board					
3 wagon boats	180'-0"	76'-8"	7'-8"		3'-8"		-	39 wagons (940 tons)	
1 tug boat	152'-0"	30'-8"		fore 4'-8" aft. 3'-4"	fore 5'-0" aft.4'-0"		2-720 H.P. (diesel)	-	

(b) The past traffic volume statistics on this route are shown in Table 6-6.

Table 6-6 Wagon Traffic

Year	Up via Bahadurabad		Down via Tistamukh	
	Trips	Wagons	Trips	Wagons
1964	1,953	54,742	1,963	53,665
Average daily	5.3	150.0	5.3	147.2
1965	2,132	57,524	2,131	56,014
Average daily	5.8	157.6	5.8	153.4
1966	2,087	51,088	2,054	51,985
Average daily	5.7	140.0	5.6	142.4
1967	2,086	51,983	2,096	52,331
Average daily	5.7	142.0	5.7	143.3
1968	1,854	49,136	1,858	47,971
Average daily	5.1	135.0	5.1	131.4
1969	-	-	-	-
Average daily	4	130	4	135
1970	-	-	-	-
Average daily	4	135	4	132

Until 1970, the ferry fleet was comprised of 4 tugs and 7 barges, and the maximum number of trips possible per day was 7 round trips. However, as shown in Table 6-6, until 1968 the actual service was only 70 to 80% of the maximum number of trips possible. In 1969 and 1970, the rate fell to about 60% because of the difficulties in operation caused by strong currents in the rainy seasons. The average number of wagons transported per trip was about 25 to 28 vehicles up to 1968, and 32 to 34 vehicles for 1969 and 1970.

The freight volume transported by this wagon ferry is shown in Table 6-7. The total volume was about 535 thousand tons in 1969, and the trend of travelling in empty coaches was prominent from Tistamukh to Bahadurabad.

Table 6-7 Volume of Goods Transported (1969)

Unit: thousand tons

Up via Bahadurabad	Down via Tistamukh	Total
354.5	180.0	534.5

The wagons used may be classified into large wagons of 17 3/4 tons capacity and small wagons of 13 to 14 tons capacity. However, as shown in Tables 6-6 and 6-7, the average tonnage per vehicle came to only 5.5 tons for both directions in 1969.

This railway ferry was nearly totally destroyed during the liberation war in 1971. The subsequent replacement of vessels did not proceed smoothly, and in 1973 the ferry fleet consisted of only 1 tug and 3 barges.

One wagon ferry unit is comprised of one tug boat and one wagon barge. The barge is hauled from its side by the tug. This is the tug-barge system.

The dimensions of the vessels are shown in Table 6-8. The wagon barge is a rectangular, flat type dumb barge of a single deck structure. The upper deck of the barge has a bridge and a steering room at the rear.

Loading and unloading of the wagons is by the side boarding system, and there are 13 rail tracks for this purpose.

The loading capacity of each rail track is 3 wagons making a total capacity of 39 wagons per barge.

The tug boats structure is identical to that used for the passenger ferry service.

The wagon ferry is on a non-scheduled service and is operated 24 hours per day.

Details of the present wagon service are shown in Table 6-9.

Table 6-9 Service Details

Frequency	Service Details	
	Dry Season	Rainy season
3 to 7 one way trips/day	Up 3.5 hrs (2 hrs 45 min)	Up 4.0 hrs (3 hrs 15 min.)
	Down 2.5 hrs (1 hrs 45 min)	Down 3.5 hrs (2 hrs 45 min)

( ) indicates net running time.

The total travel time in the above table includes both the net running time and the waiting time of the tug boat at the ghat.

The frequency of service varies greatly, and ranges from 3 trips in the rainy season to 7 trips in the dry season. This is because in the rainy season the total travel distance increases, resulting in a longer operating cycle time. Moreover, the operation of the wagon ferry is often disrupted by strong currents during this season.

(3) Present Facilities

Bahadurabad Ghat

The river bank where this ghat is situated suffers from serious erosion during the rainy season and the ghat has to be moved backwards each rainy season.

For instance, the position of the ghat in January 1973 was about 2,600 feet in front of the present (January 1974) position. The former position is now under water during the rainy season, and emerges from the water as a char during the dry season.

The erosion progress during the 1973 rainy season was continuously observed and recorded, and according to the record, the daily erosion rate was 10 to 20 ft/day, while the maximum was 52 ft/day. The total amount of erosion for the season was 2,632 ft. During the same period, the maximum rise in the water level was recorded at 24.9 feet on 9 August, 1973. (The high water level was 68.90 feet while the standard low water level was 44.0 feet.) The water flow during the dry season was observed at a rather high velocity of 1.0 m/sec during the site survey.

The river bank is a cliff of 20 feet in height during the dry season, and the level of the area around the river bank is about the same. During the rainy season, the entire area around the ghat is submerged except for the terminal yard which remains dry.

a. The ghat facilities, the method of transfer of passengers to the pontoon and the methods of loading and unloading of parcel freight are exactly the same as those at the Sirajganj Ghat which also suffers serious erosion of its river bank.

An obsolete inland type passenger boat is allocated here to serve as a landing pontoon.

b. The terminal yard for freight trains is situated about 400 feet away parallel to the passenger terminal yard, and is at a right angle to the river bank.

The yard, which is about 300 feet in width, is constructed in terrace form to enable loading and unloading of wagons throughout the year regardless of the water level. It consists of an upper and middle embankment layer for rainy season use and a lower layer which serves as an approach way to the landing pontoon during the dry season.

The approach way used in the dry season is formed on the ground level by excavating an earthen slope at a gradient of 1/200, extending for 2,000 feet towards the river bank. A single rail track is provided, and the landing pontoon is anchored at the water front during the dry season.

During the rainy season, the pontoon is shifted to accompany the rise in the water level. In the process of shifting the pontoon inwards, part of the excavated approach way is temporarily refilled so that it may continue to be serviceable, or alternatively, a new approach way for the rainy season is excavated. This process of maintaining a serviceable approach way of a considerable length is a very time consuming and troublesome task.

At the ghat, a steel landing pontoon, 120 feet in length and 40 feet in breadth, is allocated for exclusive use. Wagon barges which wait at other berthing pontoons are shifted to is pontoon for loading and unloading. For this purpose, a steel girder of about 55 ft in length is connected to the landing pontoon from

river bank. This is connected to the single rail track.

This girder is attached to the pontoon by a hinge structure, and on the river bank side it is laid and supported on sleepers.

The distance between the bank and the landing pontoon with the built-in steel girder is maintained by pulling the pontoon towards the bank with a rope which is tied to the pontoon.

Two operations are necessary for loading and unloading of wagons to the barges via this landing pontoon.

Thirteen rail tracks are provided on the deck of the wagon barge perpendicular to the axis of the barge. The joining of these rail tracks with the landing pontoon is accomplished by consecutively shifting the barge carefully to the proper position. This operation is conducted manually by using a capstan. When the barge is tightly tied to the pontoon, a short steel girder is then spanned between the two. This movable girder is fixed to the pontoon at one end by a hinge.

The other end of the girder is fitted with a portal type tower which is raised to rest against the landing pontoon while not in use, and is lowered by a pulley and adjusted to rest against the rail track of the barge for putting it into use. The operation is carried out manually.

As the capacity of each rail track is 3 wagons, the loading and unloading of the wagons to the wagon barge is carried out by grouping them into units of 3 wagons per unit and towing the units with a locomotive.

With this method, the movement of wagons between the landing

pontoon and the train yard, and the shunting of wagons within the yard, is very time consuming. As a result, the total time required for loading and unloading a barge load of 39 wagons comes to about 3.5 hours or more.

Tistamukh Ghat

The topographical conditions of the river bank at which this dry season ghat is situated are completely different from those at the Bahadurabad Ghat. Here, a sandbar of about 2,000 feet in width was constructed so thast the river bank looks like a seashore.

The passenger and freight train terminal yards are situated on an embankment and are perpendicular to the river bank. The height of the embankment is only about 10 feet above the water level during the dry season, and in the rainy season the yard is submerged under flood waters.

Siltation is still in progress at the location of this ghat and the ghat facilities are located at the water front which is about 500 feet away from the end of the terminal yard.

a. At the ghat, an obsolete sea-going, flat type, passenger boat is allocated to serve as a landing pontoon.

Passengers walk along on approach way which is an earthen slope built between the terminal yard and the water front and then board the pontoon across a gangplank.

During the rainy season, the landing pontoon is moved to the rainy season ghat which is located about 9 miles upstream. Prior to the rainy season, the embankment at the approach way is continuously filled with earth to increase the height in

accordance with the rise in the water level.

b. The ghat facilities for the wagon ferry are identical to those at the Bahadurabad Ghat, also having one landing pontoon of the same dimensions.

The approach way to the landing pontoon of the freight train terminal yard is provided by a gradual gradient slope leading to the water front. A single rail track is provided here.

The ghat facilities for the passenger and wagon ferry are shown in Tables 6-10 and 6-11.

Table 6-10 Inventory of Ghat Facilities for Passenger Ferry on Bahadurabad to Tistamukh River Route (Jan. 1974)

Ghat	No. and type of landing facilities	No. and type of gangway	Approach way	Terminal staff	Remarks
Bahadurabad	1 steel pontoon Length 200'-0" Breadth 25'-0" Depth 4'-4" F.Board 3'-0" Draft -	2 wooden planks	2 earthen slopes		The steel pontoon is converted from an inland flat type boat.
Tistamukh (dry season)	1 steel pontoon	1 wooden plank	1 earthen slope		The steel pontoon is converted from a sea-going flat type boat. At the ghat one pontoon each is allocated to serve respectively as the workshop and the office.

Table 6-11 Inventory of Ghat Facilities for Wagon Ferry on Bahadurabad to Tistamukh River Route (Jan. 1974)

Ghat	No. and type of landing facilities	No. and type of gangway	Approach way	Terminal staff	Remarks
Bahadurabad	1 steel pontoon Length 120'-0" Breadth 40'-0" Depth 7'-0" F.Board 5'-8" Draft -	1 steel girder	1 earthen slope		The rail track which leads from the approach way via a girder to the pontoon is a single rail track. At the ghat a separate berthing pontoon is provided.
Tistamukh (dry season)	1 steel pontoon	1 steel girder	1 earthen slope		The dimensions and equipment of the steel pontoon are the same as those at Bahadurabad Ghat. At the ghat a separate berthing pontoon is provided.

3. Comments and Recommendations on the Passenger Ferry

(1) Problems

River

The water channels of the Sirajganj-Jagannathganj and Bahadurabad-Tistamukh routes are classified as channels of 6 feet in depth, according to the I.W.T.A. classification. The depth of the water is particularly shallow for the former route during the dry season. Conditions are highly unfavourable for ferry operations and extreme care must be taken in the operations of vessels. It is necessary for the vessels to travel along the bank in a zig-zag pattern, maintaining a constant distance from the char. Operation is solely dependent on the captain's knowledge of the waters and his decision.

Buoys and other navigational aid facilities along the water channels are altogether lacking, so that aid by illumination of search-lights from the vessels to the banks of the chars is necessary for operation at night.

Under such conditions, incidents of vessels running aground while travelling at night during the dry season are not uncommon. This results in great disturbances or disruption of the ferry service.

Traffic

From the view point of maintaining regularity of the railway service, the maintenance of a reliable operations schedule of the railway passenger ferry is of utmost importance.

However, in actual practice, because of unstable train operations, it is common for the ferry to be delayed due to waiting for the arrival of trains.

..... Ferry

The passenger ferry is comprised of a passenger boat and a tug boat, with the passenger boat tied to the side of the tug boat. During the rainy season the operation rate is high with such a formation.

However, the provision for standby vessels is insufficient, with only one steamer allocated to the Sirajganj-Jagannathganj route as a standby. This steamer is at present out of service due to a shortage of coal, which is used for fuel.

Ghat

The passenger train is composed of passenger coaches connected to parcel freight wagons. Due to a lack of storage facilities for parcel freight at the terminal and at the ghat, the freight is transported by the passengar ferry.

However, due to topographical conditions and the fact that parcel freight is manually conveyed between the train and the ferry, speeding up the process is difficult and the delay in ferry operations is increased.

The existing landing approach facilities for the transfer of passengers is considered adequate.

(2) Carrying capacity

Present passenger transportation capacity for the routes between Sirajganj and Jagannathganj, and Bahadurabad and Tistumkh is calculated to be 216,000 passengers/month.

2 roundtrips/day x 2 boats x 1,000 passengers/boat x 30 days/month x 0.9 x 2 routes = 216,000 passengers/month.

This capacity is nearly double the present number of passengers, i.e., 40,000 passengers/month for S-J route and 60,000 passengers/month for B-T route.

It was observed during the site survey that there are many over-loaded boats. This comes from loading full train loads of passengers, during rush hours, and in such case the passenger load factor is considered to be about 1.5.

9 trains x 80 allowable passengers/train x 2.0 times

= 1,440 passengers/train

$$\frac{1,440 \text{ passengers}}{1,000 \text{ allowable passengers/boat}} = 1.5 \ .$$

Improvement of carrying capacity

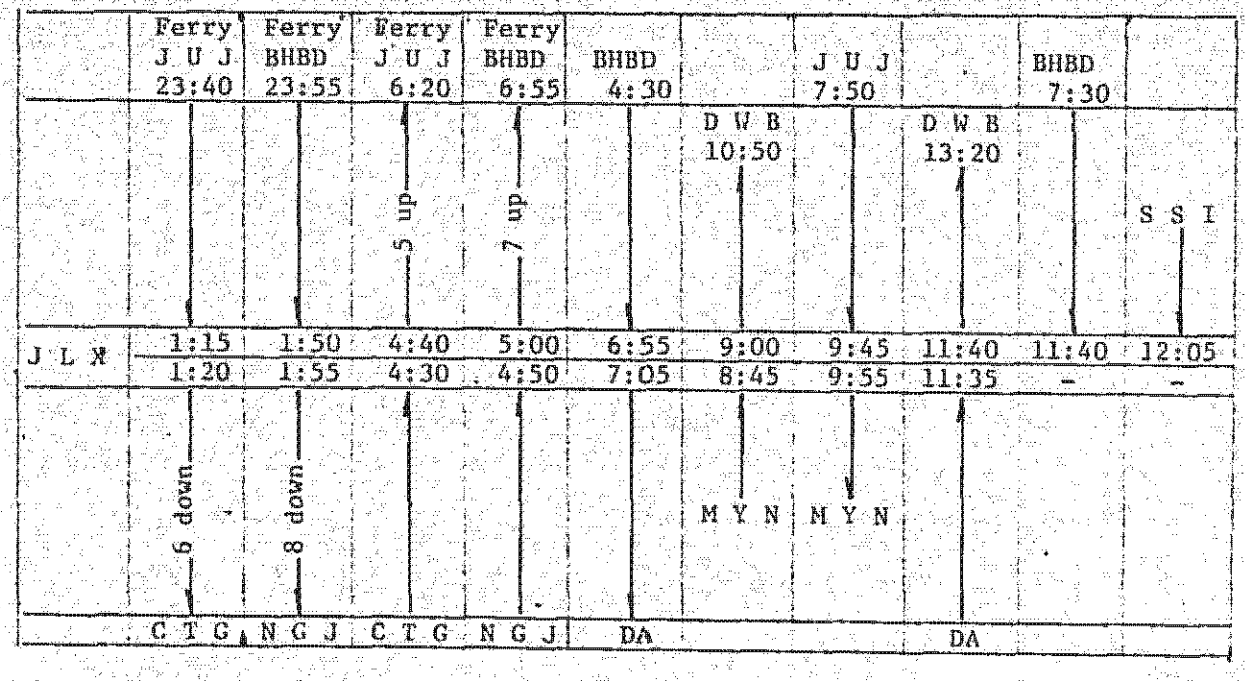
Additional maximum services to the present 2 roundtrip ferry operations are calculated as 4 roundtrips/route from its cycle time.

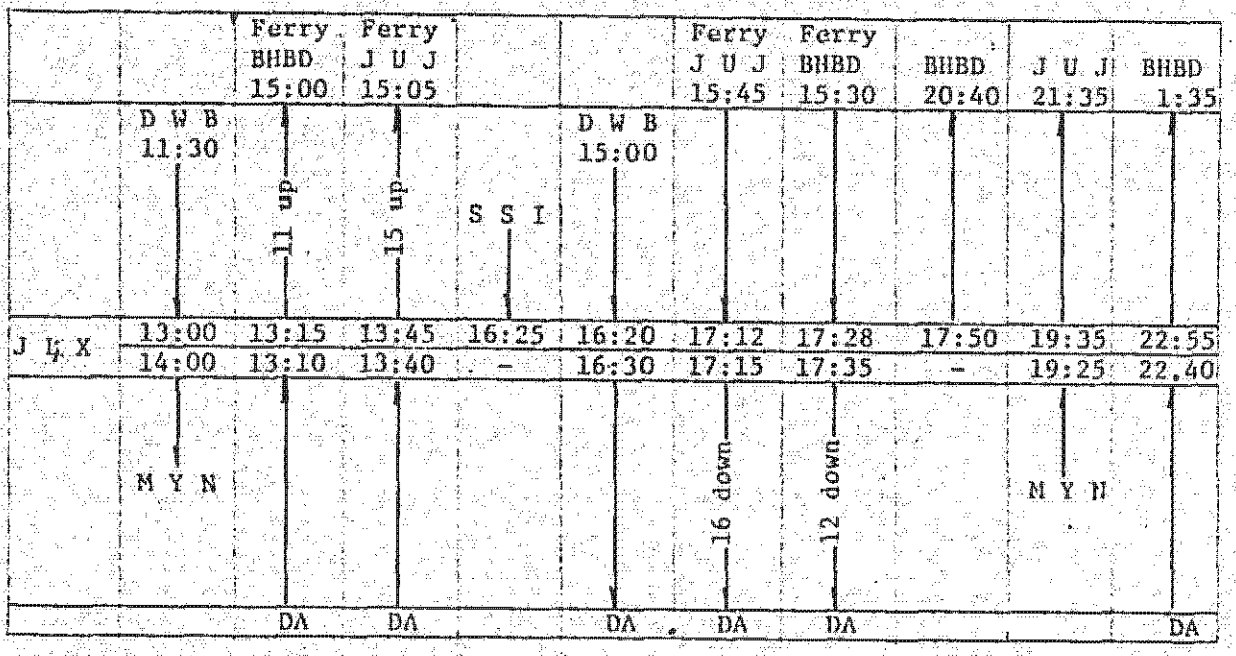
Running (down)	1 hr. 30 min.
Loading/unloading of passengers (and luggage)	1 hr. (actual time)
Running (up)	2 hrs. 30 min.
Loading/unloading of passengers (and luggage)	1 hr.
Total	6 hrs.

$$\frac{24 \text{ hrs/day}}{6 \text{ hrs/roundtrip}} = 4 \text{ roundtrips/day.}$$

Railroad ferries must meet the operation schedules of railroads. Therefore an increase in ferry services of the above maximum is dependent upon operation capacities of connecting trains.

Fig. 6-3 shows an example of present train density of a trunk railroad for Jamalpur Town where the trunk line from Dacca branches off in 2 directions towards Jagannathganj and Bahadurabad.





J L X : Jamalpur Town

J U J : Jagannathganj

B H B D : Bahadurabad

D W B : Dewanganj Bazar

C T G : Chittagon

N G J : Narayanganj

D A : Dacca

Fig. 6- 3 Train Schedule at Jamalpur Station

This figure shows only passenger trains, but looking at the present train operations level which habitually causes delay in the schedule it appears to be difficult to expect much increase in long distance trains over the present level of 12 (among these 12, 8 trains connect with ferries), even if the demands for freight trains toward Bahadurabad ghat increases.

Since there are 4 trains not connecting with ferries at present (which is equal to 2 roundtrips of a ferry), it is possible to increase by one roundtrip/day/route which makes a total ferry operation of 3 roundtrips/day possible even if 1 tug - 1 ferry operations are assumed.

Thus, the carrying capacity of 324,000 passengers/month for 2 routes means an improvement of 1.5 times over the present capacity of 216,000 passengers/month.

3 roundtrips/day x 2 boats x 1,000 passengers/boat x 30 days/month x 0.9 x 2 routes = 324,000 passengers/month.

(3) Recommendations

Even if the construction of a ferry system (1 tug - 1 boat per route) and the train operations level are maintained the same as at present, 3 roundtrips/day of passenger ferries can be operated and the passenger carrying capacity will be improved to about 300,000 passengers/month which is 1.5 times over the present capacity.

As a general trend, long distance bus transportation will start playing an important role in the future, and it is considered that the increase of railway passengers does not necessarily require a drastic reformation of the present passenger ferry system.

Therefore, the improvement target for passenger ferry operations

is to assure on-time operations which is a fundamental requirement for railway service.

This naturally requires a premise that trains are operated on time, but basic conditions regarding only ferries themselves will be summarized as follows:

a. It is necessary to improve navigationnl facilities, since poor navigational conditions are responsible for most delays in the ferry schedule.

   Above all, it is necessary to prepare sufficient light buoys to cope with dry season conditions. This will greatly decrease the ferry schedule delays caused by striking shoals.. It is also pointed out that these light buoys must be well maintained; they must be removed during the rainy season and repositioned during the dry season according to the situation at the time.

b. Handling of passenger train luggage is also an item for improvement. It may be recommended to simply unload and pile up parcel freight at the pontoon without loading them on the connecting ferry, but to load them on the next ferry, since by nature handling time is not constant. By doing so, the ferry berth time can be reduced to the minimum level of constant and stable 30 minutes, which is required for approaching/departing the berth and loading/unloading passengers and luggage.

c. Taking into consideration the renewal of existing facilities because of life expectancy expiration in addition to establishment of new facilities, investment to reinforce and improve transportation capability previously mentioned, during the

period 1985 to 1990 is presently roughly estimated as approximately 73,880,000 Taka, as shown in Table 6-12.

However, this figure does not include investment for terminus improvements, such as closing and movement of ghats due to topographic changes in the river basin area, because it is difficult to make a fair evaluation of ghat life expectancy.

Table 6-12 Facility Improvement Items for Railroad Passenger Ferry

(Routes between Sirajganj and Jagannathganj, and between Bohadurabad and Tistumkh)

(In millions of Taka)

Planning items		Targets of improvement		
[Boat facilities]				
152 ft class tug boats (including one supplementary boat)	3 Nos.	Replacement of existing 152 ft class boats with new boats of the same scale	2 Nos.	@ 6.66 = 19.98
		Change of existing steamer with different type	1 No.	
226 ft class passenger boats	2 Nos.	Replacement of existing 226 ft class boats with new boats of the same scale	2 Nos.	@20.00 = 40.00
[Ghat facilities]				
Inland type loading/unloading pontoons	4 Nos.	Continuous use of existing inland type	2 Nos.	-
		Change of existing sea-going type with different type	2 Nos.	@3.55 = 7.10
[Water area facilities]				
1,800 mm ϕ class light buoys	40 Nos.	Supplement of new buoys	40 Nos.	@0.17 = 6.80
Total				abt.73.88

Remark 1. Supplementary tug boat for spare is to be used for both routes.

Remark 2. Light buoys are to be arranged on one side only, 30 for the 14 mile section between Sirajganj and Jagannathganj, and 10 for the 9 mile section between Bohadurabad and Tistumkh.

4. Comments and Recommendations on the Wagon Ferry

(1) Problems

River

The channel conditions at the Bahadurabad-Tistamukh ferry route are highly unfavourable for ferry operations because of rapid currents during the rainy season and shallow waters during the dry season.

The topography of the river bank at the ghat and the river in front of the ghat are greatly altered by the strong current during the rainy season. It is therefore very difficult to establish efficient and permanent facilities for loading and unloading freight wagons at this location.

Ferry

The loading and unloading of wagons at a wagon ferry should, in principle, be performed by the bow-stern boarding system to enable the movement of a larger number of wagons for each trip made by the locomotive.

However, due to the strong current, the ferry must berth with the bow facing upstream. Consequently the less-favorable side boarding system was adopted for the wagon ferry.

Moreover, with the present ghat facilities, the time required for loading or unloading a ferry load of wagons fluctuates greatly and usually comes to more than 3 1/2 hours. The reason is that, to increase the efficiency of the engine, the tug and barge system is used in the ferrying of freight wagons. This means that the ferry unit is comprised of a tug boat and a dumb barge on which wagons are loaded.

The barge is tied to the side of the tug when hauling cargo, giving the total wagon ferry unit a length-to-breadth ratio of 2:1. This "basin shape" formation of the wagon ferry greatly decreases steering efficiency in the strong currents of the rainy season, resulting in great difficulties in ferry operations.

This is the major reason that the annual average rate of operation of the wagon ferry was recorded at only 60 to 70% of the maximum number of trips possible.

Another reason for the low capacity in wagon ferrying is a general shortage of tug boats and wagon barges as compared to the ghat facilities.

Ghat

The present structure of the ghat facilities are such that a fixed girder, pontoon, and movable girder are provided between the approach way from the yard and the barge stationed at the landing pontoon. This has resulted in many flexing points for the rail track within a short distance. This change in gradient of the railway track makes moving the wagons to the barge a very dangerous operation. The floating capability of the landing pontoon is a determining factor in the operation.

Since the capacity of the rail track on the barge is 3 wagons, they are loaded and unloaded in units of 3.

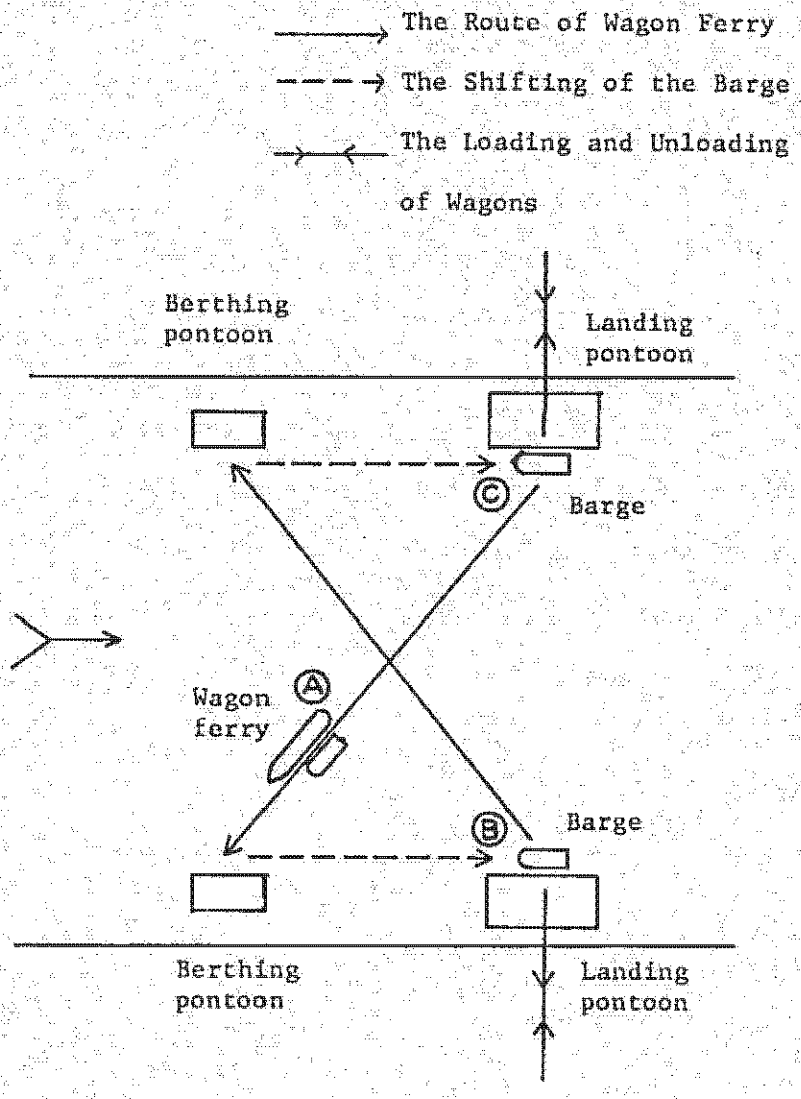
Between the locomotive and the 3 wagon units to be moved, three empty unroofed wagons are inserted so that when the wagons are loaded on the barge the weight of the locomotive will not be exerted directly on the fixed girder.

In other words, the weight limit of the landing pontoon is confined to 3 loaded wagons, and it is not possible to increase or improve the wagon loading and unloading capacity of the ghat facilities.

(2) Transportation Capacity

Fig.6-4 shows graphically the present pattern of wagon ferry operations under the 1 tug-3 barge system.

Fig. 6-4 Pattern of Wagon Ferry Operation



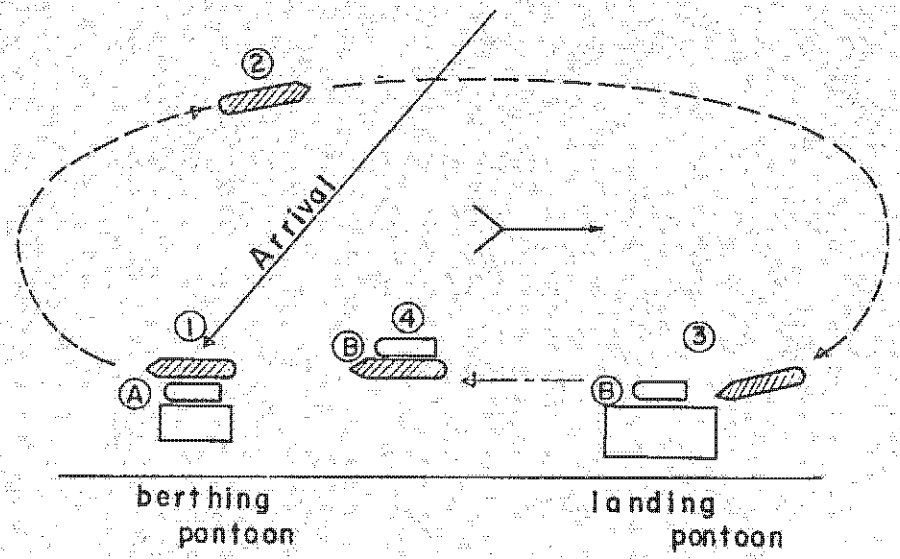
Each of the two ghats are provided with a berthing pontoon and a landing pontoon. When a wagon ferry unit is cruising towards the opposite bank, one barge is stationed at each of the two pontoons to perform the loading and unloading operation. As previously mentioned, this operation of loading and unloading 39 wagons from each barge takes about 3 1/2 hours. When the ferry arrives at the ghat, the barge is closed in at the berthing pontoon where the exchange of barges is carried out.

As shown in Fig. 6-5 , after the exchange of barges, the newly arrived barge is then shifted to the landing pontoon.

The whole process is performed with the same tug boat which is used for transportation, and the tug boat operation is very complicated.

During the whole process of arrival and departure of barges at the pontoons, the bow of the barge must always be facing upstream, and this operation takes about 45 minutes This time waste is due to the fact that there are no other vessels or methods which can be used in the shifting of the barge.

a. Exchange of barge



b. Shifting of barge

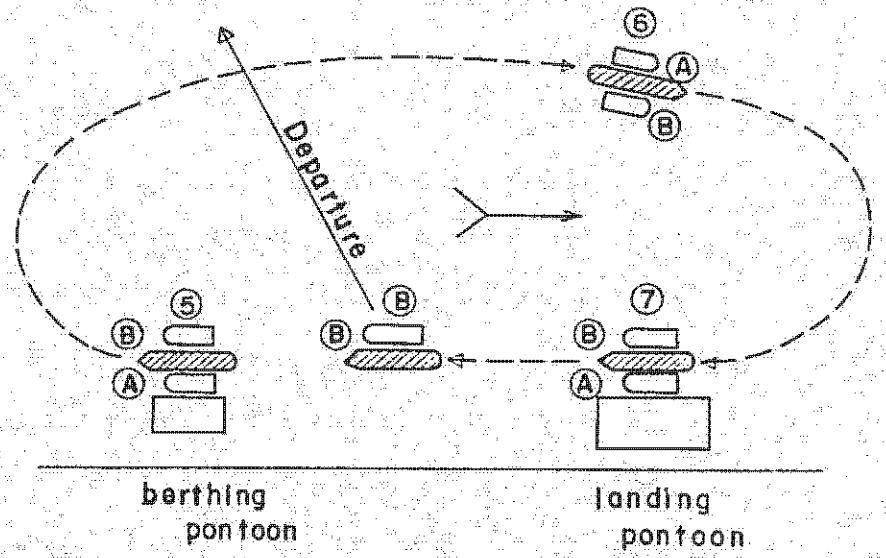


Fig 6-5 The Process of Operation of the Barge at the Ghat

As shown in Table 6-9 the total cycle time of a wagon ferry, including the waiting time of the tug boat at the ghat, is about 6 hours during the dry season and about 7 1/2 hours during the rainy season. This is much longer than the 3 1/2 hours required for the loading and unloading of a barge at the ghat.

Consequently, under the present system and ferry formation, the maximum possible number of trips that may be made can be calculated as follows:

$$\text{Dry season: } \frac{24 \text{ hours/day}}{6 \text{ hours/round trip}} = 4 \text{ round trips/day}$$

$$\text{Rainy season: } \frac{24 \text{ hours/day}}{7\ 1/2 \text{ hours/round trip}} = 3 \text{ round trips/day}$$

With an existing rate of operation of 70%, the practical annual average number of trips is as follows:

$$\frac{(4 + 3) \text{ round trips/day}}{2} \times 0.7 = 2.5 \text{ round trips/day}$$

(5 one way trips/day)

This agrees with the actual trips shown in Table 6-9.

At the 1973 level of freight transportation, whereby 25 wagons of 5.5 tons average load per wagon were transported in each barge, the annual volume of freight was 250 thousand tons/year or about 50% of the volume of freight before the liberation war.

25 wagons/barge x 5 barges/day = 125 wagons/day

125 wagons/day x 365 days/year = 45,500 wagons/year

∴ 45,500 wagons/year x 5.5 tons/wagon = 250,000 tons/year.

Carrying capacity becomes 195 wagons/day.

39 wagons/barge x 5 barges/day = 195 wagons/day.

Improvement of carrying capacity

To improve the present carrying capacity, the first thing to do is to decrease the cycle time for loading/unloading of wagons to/from the barge.

By doing so, the barge utilization will be improved and thus increaed ferry operations will be made possible.

According to this philosophy, the following method for loading 3 wagons onto the train on the track, which has just unloaded 3 different wagons, is proposed as a feasible solution.

a. To lay double tracks for the approachway on the landing pontoon, where a locomotive can pull wagons on loading and unloading tracks by way of a switch point.

b. To load and unload with one barge unit of 39 wagons. For this purpose, a pontoon with sufficient buoyancy, for the wagon load on the girder between the bulkhead and pontoon, must be used.

Fig. 6-6 shows a model of such unloading/loading system. Time savings by this system can be calculated as follows:-

Number of shuntings

39 wagons/barge x 1/3 wagons/time = 13 times

Unloading

13 times x 6 min./time x 1/2 = 39 min.

Loading

13 times x 12 min./time x 1/2 = 78 min.

Total 117 min. ≒ 2 hrs

Barge shift shall be done within the loading/unloading cycle time,

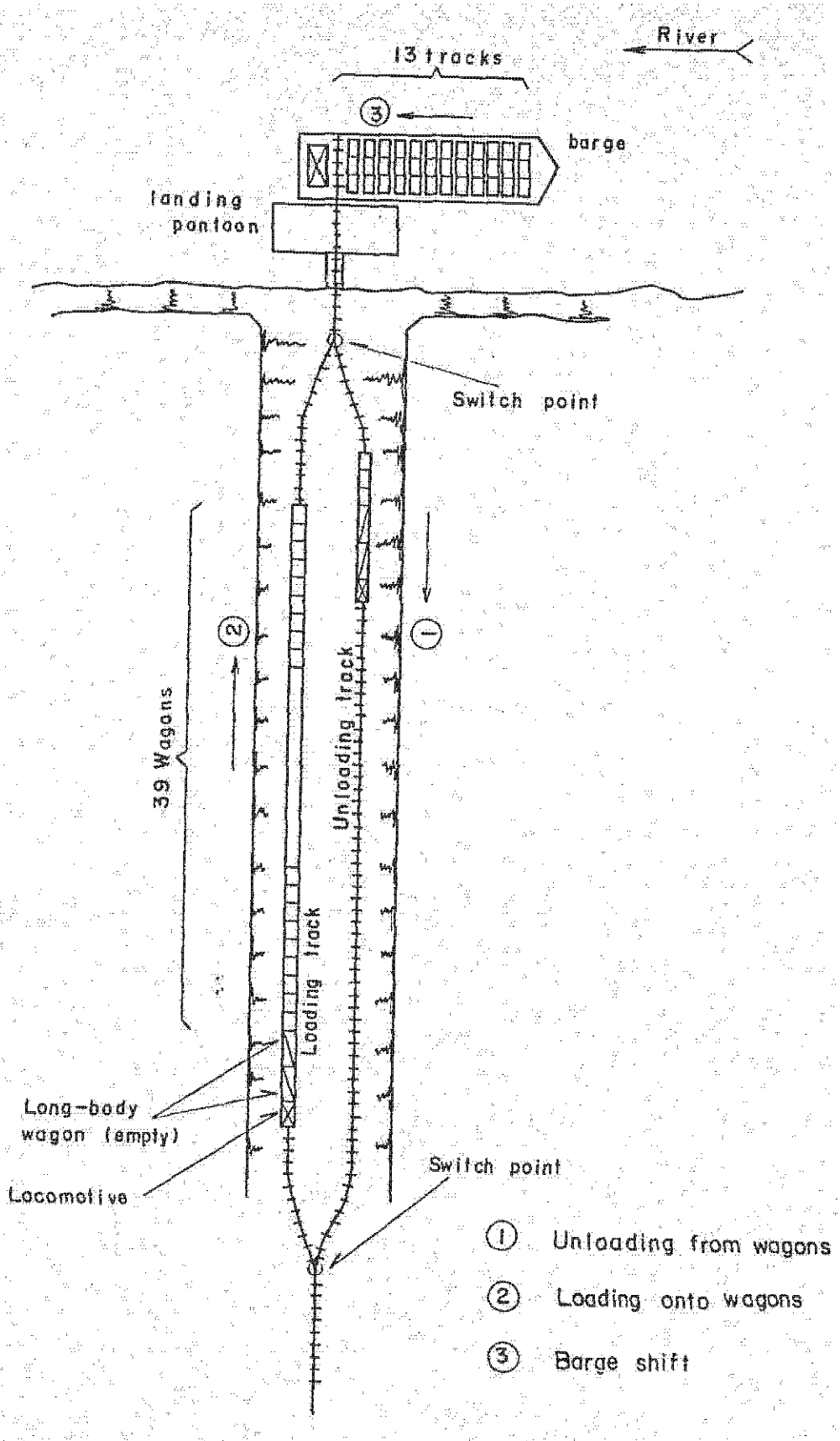


Fig 6-6 New wagon loading/unloading system at ghat.

i.e., 3 + 6 = 9 minutes.

As compared with the time required under the present system (which is more than 3.5 hrs.), this system results in a remarkable saving of time.

Tug boat operations cycle time shall remain as is. The following is obtained from Table 6-9.

Running (up)	2 hrs	45 min.
Barge change		45 "
Running (down)	1 hr.	45 "
Barge change		45 "
Total	360 min	= 6 hrs.

Therefore, if we apply the 2 tugs - 4 barges system, maximum possible ferry operations by the abovementioned improvement is obtained from the schedule shown in Fig. 6-7 as 8 roundtrips/day.

During the rainy season, Tistumkh ghat will be opened at the upper stream and the operations cycle time will increase as shown in Table 6-9 due to detouring. Even in this case 6 roundtrips/day are possible.

Therefore, average daily operations are as follows if the yearly operation factor is assumed to be 0.7.

$$\frac{(8 + 6) \text{ roundtrips/day}}{2} \times 0.7 = 4.9 \text{ roundtrips/day}$$

This is a capacity increase of 1.96 times over present average operations of 2.5 roundtrips/day.

Carrying capacity of wagons by the above assumption is as follows:-

4.9 x 2 barges x 39 wagons/barge = 382 wagons/day.

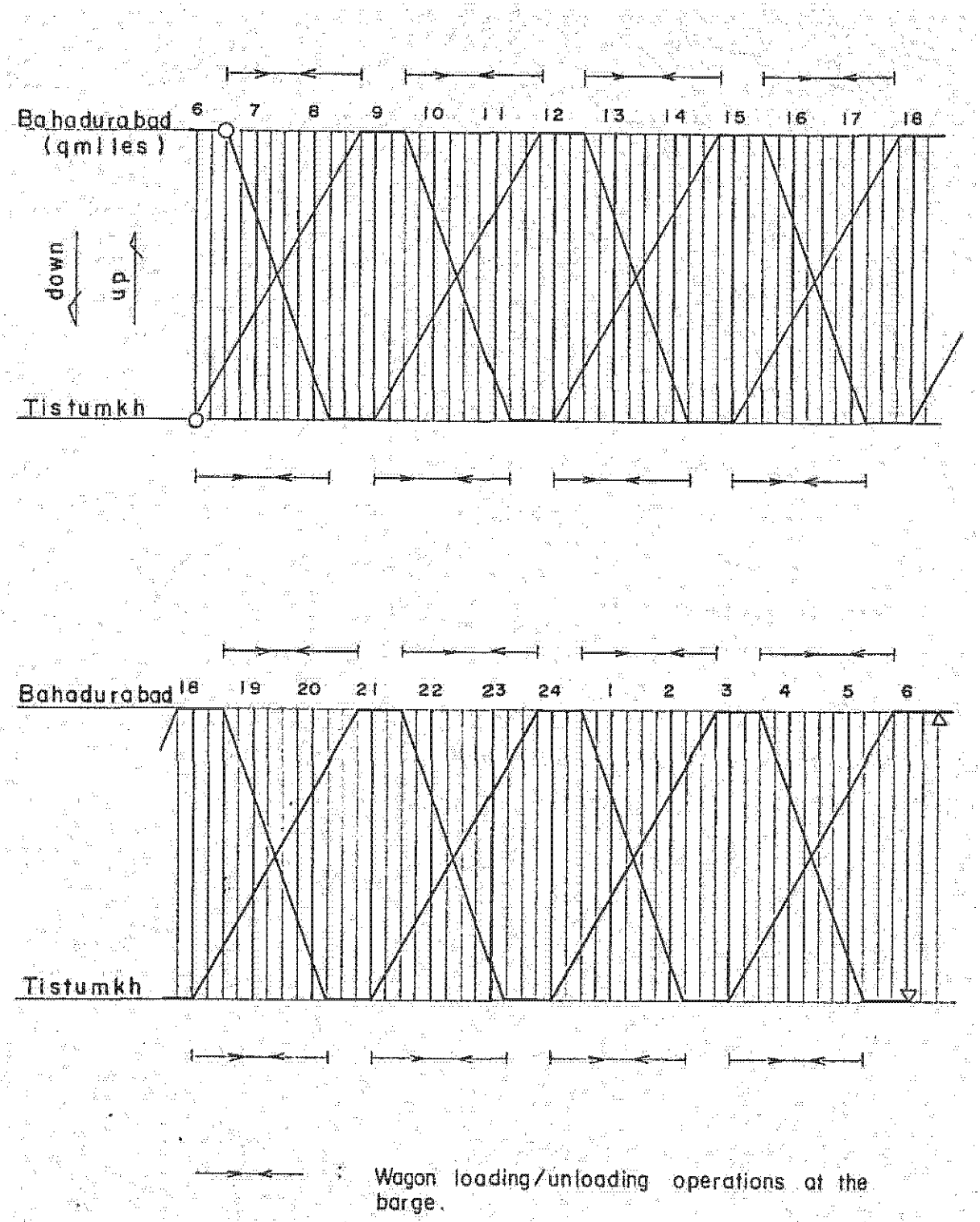


Fig 6 – 7 Dry Season Operations Schedule.

(3) Recommendations

The method for improvement of wagon ferry operations on the premises of the present carrying system, is based upon shortening of wagon loading/unloading time at the barge, and the supplement of tugs and barges for this purpose.

a. To establish double tracks comprising loading and unloading tracks at the approach way to the landing pontoon, and to accommodate or discharge wagons alternately by use of a switch point. Accommodation of wagons to the barge by the locomotive is to be made in a unit of 39 wagons which is the maximum capacity of the barge.

For this purpose, present landing pontoons must be replaced with new pontoons which have sufficient buoyancy for the wagon load.

The pontoon configuration at each ghat is not to be changed, and the present configuration of one berthing pontoon and one landing pontoon will be retained.

The operation system of 1 tug - 3 barges shall be changed to 2 tugs - 4 barges by supplementing one tug and one barge.

Thus, wagon carrying capacity will be improved to an average of 380 wagons/day which is about double the present level.

b. Taking into consideration the renewal of existing facilities because of life expectancy expiration in addition to establishment of the new facilities, investment to reinforce and improve transportation capability, previously mentioned, during the period 1985 to 1990 is presently roughly estimated as approxi-

mately 51,280,000 Taka, as shown in Table 6-13.

However, this figure does not include investment for terminus improvements, such as closing and movement of ghats due to topographic changes in the river basin area, because it is difficult to make a fair evaluation of ghat life expectancy.

The above carrying capacity will further be improved to a certain extent by automation of barge shifting operations at loading and unloading.

However, a drastic improvement of carrying capacity will not be achieved unless the ferry operation factor is improved by the development of a tug boat which has sufficient power against opulent river flows during the rainy season, and at the same time has a capability to pass shallow parts of rivers during the dry season, as long as wagon loading/unloading operations at barges are not drastically improved.

Self-propelling of wagon ferry operations cannot be adopted as long as the facility utilization remains at the present low level.

The double tracking concept of the present system will end in lack of economical advantages, because approach ways must be constructed at remarkably unstable riverbanks.

The fluctuation of carrying capacity due to unavoidable seasonal changes in river routes between Bohadurabad and Tistumkh cannot be eliminated.

Table 6-13 Facility Improvement Items for Railroad Freight Ferry
(Route between Bohadurabad and Tistumkh)

(In millions of Taka)

Planning items		Targets of improvement		
[Ship facilities]				
152 ft class tug boats (including one supplementary boat)	3 Nos.	Replacement of existing 152 ft class boat with new boat of the same class	1 No.	@ 6.66 = 19.98
		Supplement of new boats	2 Nos.	
180 ft class freight barges	4 Nos.	Continuous use of existing 180 ft class barges	3 Nos.	-
		Supplement of new barge	1 No.	@12.00 = 12.00
[Ghat facilities]				
180 ft class freight pontoons	2 Nos.	Replacement of existing 120 ft class with larger type	2 Nos.	@9.65 = 19.30
Ferry approach pontoons	2 Nos.	Continuous use of existing pontoons	2 Nos.	-
Total				abt.51.28

Remark: As to buoys in the water area facilities, the same ones used for passenger ferries on this route shall be utilized.

CHAPTER VII

FUTURE DIRECTION OF FERRY SYSTEM

Up to the last chapter, we have made an analysis of the present status of ferry transportation in the Jamuna River basin, and made efforts to propose effective countermeasures, at the present time, on the basis of this analysis.

The answer to this problem is mainly to improve ferry operations and to increase transportation capability by augmenting the number of ferries rather than improving loading/unloading facilities; since it appears difficult to establish efficient ghat facilities and to introduce large ferries due to adverse natural conditions.

However, for the purpose of providing rapid service required by customers it is necessary to constantly maintain a high level of transportation capability, notwithstanding the many problems to be solved. As a consequence, substantial improvement of ferry operations is always postponed.

Therefore, for future ferry operations, based on improving the present system, it is not only necessary to operate more frequently and regularly, but also necessary to study relocation of ferry routes and key facilities in connection with the reinforcement plan for the Jamuna River crossing route in the domestic transportation network.

1. Improvement and Follow-up of the Present System

For the purpose of achieving more frequent and regular ferry operations, it is essential to improve and reinforce the supporting facilities whether they are directly or indirectly connected with ferry operation, in addition to upgrading the ferry itself.

a. Development and introduction of ferries with higher capabilities.

Introduction of ferries with powerful steering control against strong currents during the rainy season and with the capability to navigate shallow water during the dry season.

b. Improvement of supporting facilities

Wide ranging improvement of buoys and route signs, as well as reinforcement of maintenance efforts.

c. Modernization of operations

Modernization of operations such as night operations or search for shallows by use of electrosonic technics, automatic measurement of draft, and the use of other modern equipment..

d. Establishment of maintenance shops

Establishment and operation of floating, pontoon-type maintenance shops to service ferries in the Jamuna River basin.

Funds for new ferries and improvement of supporting facilities are to be covered by an increase in revenue from river crossing customers, in principle.

It is also not fundamentally feasible to continue ferry operations in areas where conditions are not favorable..

Looking at the main stream from this stand-point, the only area where conditions are satisfactory throughout the year is the vicinity of the merging point to the Ganges River which is the northern end of the tidal basin area, and it appears that upstream railway ferries will have problems at present, as well as in the future, with respect to elimination of operations obstacles.

In contrast with this, for downstream ferry operations there are

many points which can be improved, such as supplementation with B.I.W.T. ferries and improvement of rapid service by mutual agreement with them.

In this sense, the route selection (in the vicinity of Aricha) of the newly planned railway between Dacca and Pabna (with wide track and crossing the Jamuna River by ferries) planned in 1963 is worthwhile calling attention to.

It is expected that the ferry operated by R & H Directorate at the river gap of the trunk roads around the river basin will be shifted to the supplementary road network of the area, along with the development of bridges. However, this trend should be limited to branches in the west bank basin where flood embankment and operation conditions are satisfactory.

By the various measures mentioned above, ferry operations in the Jamuna River basin will be greatly improved, however, improvement of loading/unloading facilities which is the key to the development of ferry operations is still pending.

Technical solutions to this problem are not easy, because this is directly connected with the stability of embankments. Therefore, it is hoped that a revolutionary transportation method will appear for the future of the ferry system.

2. Transformation to a Revolutionary Transportation Method

Present ferry operation systems on the Jamuna River can be classified as a self-propelled system and a tug and barge system by the method whereby the water and land are connected.

a. Self-propelled system

Ferries are self-propelled and vehicles are loaded/unloaded on

the shore. (Private ferry, R & H road ferry, and railway passenger ferry).

b) Tug and barge system

In this system, the dumb barge is moored to the bank after it is separated from the tug, and vehicles are loaded/unloaded as if the land area extended over the water area. (Railway wagon ferry.)

Therefore, as a revolutionary system for replacing the existing one, the extension of the operations area up to the land area comes into the picture, apart from the conventional notion of ferries "to travel on the water."

Such system can be realized by development and introduction of large hovercraft featured as amphibian and by high speeds.

Under the present level of technology, it is assumed that 5,000 ton hovercraft will be within the capability of commercial production.

The kind presently in operation has a maximum capacity of 170 tons, (length 40m), with maximum passenger loading of 254, and maximum vehicle loading of 30.

Fig. 7-1 shows the concept of operations after introduction of hovercraft to the Jamuna River mainstream.

The terminus will be located in the hinterland area with good geographical conditions, and therefore does not require the conventional type of ferry ghat.

The operation of hovercraft will not be influenced by the ever-changing river route and the life of the route will increase greatly.

Since it has a high speed, it makes shuttle operations possible, which results in a remarkable increase in transportation capability as well as reduction in transportation costs.

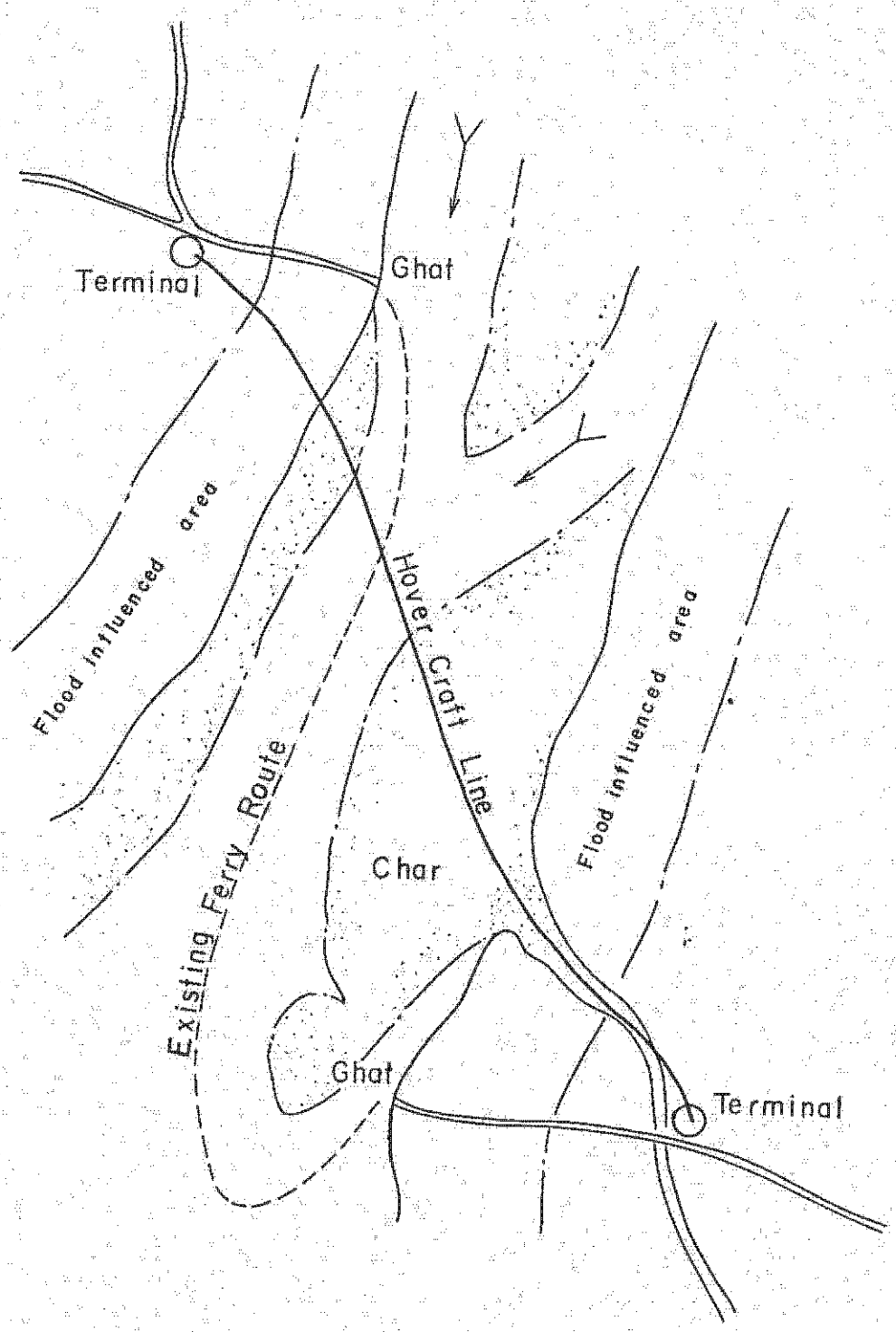


Fig 7-1 Transportation System by Hovercraft Operation

Increase of hovercraft and employing a hovercraft oriented transportation system will be a future subject, but as previously mentioned, this concept is worthwhile studying as a solution for the present ferry system which involves various technical problems.

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