PLANNING FOR A SUSTAINABLE WATER SUPPLY SYSTEM FOR BARISAL POURASHAVA

BY

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THESIS

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Candidate's Declaration

It is hereby declared that this Thesis Report is prepared and submitted in partial fulfillment of the requirement for the degree of Master of Urban and Regional planning and that the whole thesis or any part of it has not been submitted elsewhere for award of any Degree or Diploma.

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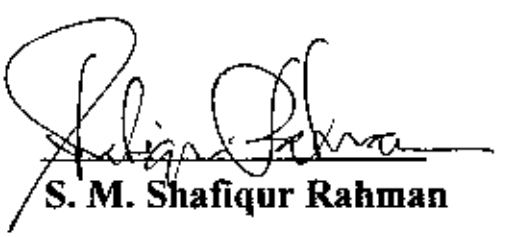

S. M. Shafiqur Rahman

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KEYWORDS

URP	Urban & Regional Planning.
BBS	Bangladesh bureau of statistics.
KG School	Kinder Garden School.
WDB	Water development board .
D.C	Deputy commissioner.
PDB	Power development board.
BIWTA	Bangladesh inland water transport authority.
BIWTC	Bangladesh inland water transport corporation.
RHD	Roads & highway department.
LGPM	Lakks gallon per month.
LPCD	Liter per capita demand.
WHO	World health organization
LG	Laks gallon.
S/H	Street hydrant.
LGRD	Local government & rural development.
WASA	Water & Sewerage authority
DPHE	Department of Public Health Engineering.

BSCIC	Bangladesh small & cottage industries corporation.
UNDP	United nation development project.
UDD	Urban development directorate
Km	Kilometer.
Nos	Numbers.
GPH	Gallon per hour.
G.L	Ground level.
PW	Production well.
HC	House connection.
HTW	Hand tube well
NPV	Net present value.
BCR	Benefit cost ratio.
IRR	Internal rate of return.
EPCB	Environment population control board, Bangladesh

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ABSTRACT

The extent of availability of drinking water supply is an indicator of the standard of quality of life in an urban area. About 20.1 percent population of Bangladesh live in urban areas and only 44.01 percent of the urban people are served with tap water supply (BBS, 1995). Rest of them depends on other sources like tube-wells, ponds, shallow tube-wells, rivers and canals to meet their water demand which are hazardous to health and sometimes insufficient and expensive. The scarcity of drinking water results in water borne diseases, out break of epidemics and polluted environment in the urban centers The lower income people are the worst sufferer because they cannot avail safe drinking water.

Barisal Municipality was established in 1876. Barisal town known as the Venice of the East was declared as a Divisional Headquarters on January 1, 1993. About four hundred thousand people of different income groups are now living in this city. A combination of economic social and political factors has created a high growth rate in Barisal and its environments. As a result the capacity of the urban infrastructure has been strained to the limit, with population growth out pacing the development of physical and social facilities. The present study carries out an analysis and evaluation of the water supply system currently available and their probable alternatives with the objective of finding out a suitable water supply system plan for the people of different income groups of Barisal Pourashava.

The findings of the research showed that about 87.5 percent people of Barisal Pourashava have the demand for municipal water supply. Accordingly a sustainable water supply system plan has been developed consisting of hand pump tubewells and piped water supply system along with the cost estimate and an implementation schedule. Considering type of income group ability to pay and Pourashava required revenue to make the system sustainable a tentative water rate for the future years has also been recommended.

Title of the thesis :	Planning for a Sustainable Water Supply System for Barisal Pourashava.
Thesis Supervisor :	Dr. Sarwar Jahan, Professor & Head of the Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology, Dhaka.

CHAPTER I

INTRODUCTION

1.1 Background and Present State of the Problem

The extent of availability of drinking water supply is an indicator of the standard of quality of life in an urban area. About 20.1 percent population of Bangladesh live in urban areas and only 44.01 percent of the urban people are served with tap water supply (BBS, 1995) Rest of them are to depend on the sources like tube-well, ponds, shallow tubewells, rivers and canals to meet their demand which are hazardous to health and sometimes insufficient and expensive as well. The scarcity of drinking water results in water borne diseases, outbreak of epidemics and polluted environment in the urban centers. The lower income people are the worst sufferers because they cannot avail safe drinking water (Muhibullah, 1989).

Barisal Municipality was established in 1876. Barisal town, known as the "Venice of the East", was declared as a divisional headquarters on January 1, 1993. About four laks people of different income groups are now living in this city. A combination of economic, social and political factors has created a high growth rate in Barisal and its environs. As a result the capacity of the urban infrastructure has been strained to the limit, with population growth outpacing the development of physical and social facilities. The scarcity of safe water supply is already being experienced by the city dwellers. Barisal Pourashava with its limited resources in trying to increase this facility to its inhabitants, but due to many constraints such as scarcity of water sources, inadequate planning and technical assistance, limited financial capability etc. can not provide safe water supply to its inhabitants properly. Recognizing the limitations and constraints the need of the time calls for an economic, efficient and appropriate planning for a sustainable water supply system for Barisal Pourashava which could fulfill the need of the people in the future. In this study, more attention has been given to the socio-economic and management aspects of the water supply system of Barisal Pourashava while making recommendations for a sustainable water supply system for the city.

1.2 Objective and Scope

The general objective of the study is to find out the opportunities and constraints along with a plan for an appropriate and reliable water supply system for different income groups of Barisal Pourashava upto the year 2020 AD.

The scope and objectives may be outlined as follows:

(i) To study present population of the city, trend of its growth and existing water demand and supply with special reference to different income groups.

(ii) To examine the existing sources of water and water distribution system for different income groups.

(iii) To estimate yearly income, operation and maintenance cost of existing water supply system.

(iv) To identify system loss and its management level problems.

(v) To formulate guidelines for sustainable water supply system for Barisal Pourashava.

1.3 Research Methodology

In order to attain the mentioned objectives, the methodology of the study consists of three parts.

1. Information collection (Survey by random sampling)
2. Analysis of collected information.
3. Formulation of guideline for planning a sustainable water supply system for Barisal Pourashava.

Information collection

a. Collection of information from secondary sources.

Information & data were collected from literature & available secondary sources like books, Journals, government documents, research works, newspaper & other printed materials.

b. Collection of information from primary sources.

Information for the study mainly comes from primary sources. For obtaining information the following methods were used.

1. Field observation: An extensive field investigation was required to know the existing condition of the study area. For these purpose necessary notes & field level practical conditions were taken as record.
2. Interviews: Interviews with the water consumers gave valuable information regarding the existing condition of water supply system. It was helpful to identify key factors, to plan a sustainable water supply system for Barisal Pourashava.
3. Land use survey: A land use survey was conducted to get information on existing community facilities & land use pattern of the study area.
4. Household survey: A simple random sampling household survey was conducted in the study area for better understanding about the crisis of supply of water & their demand. Through this survey needs, priorities & problems of the consumers were identified. It also helped to plan a sustainable water supply system for Barisal Pourashava according to consumer's demand.

Analysis & Formulation Guidelines

The collected information from primary & secondary sources were analyzed statistically & presented in tabular forms which were prepared to show the existing condition & demand for quality & quantity of water by the consumers of Barisal Pourashava.

1.4 Background of Barisal Pourashava

The Barisal municipality was first constituted in 1876 (District Gazatter, Bakerganj) The area within municipal limit was 7.5 square miles. Barisal municipality was reconstituted as Municipal committee with 16 union committees as per provision of the municipal administration ordinance of 1960. The municipal Committee was responsible for water supply, sanitation and conservancy of the town and for maintenance of its roads and street lighting. In 1972 it was reconstituted as a Pourashava and its area was 9 square miles.

Through a gazette in June 1986, the area of Barisal Pourashava was further extended towards east, south and west and the Pourashava was upgraded to category 1 and consisted of 10 wards.

Barisal Pourashava had an area of 16.09 km^2 with a population of 159258 in 1981. Now according to the land use plan the study area covers an area of 6500 acres ($28km^2$) with an estimated population of about 2,50,000 (1998).

Chapter II

DESCRIPTION OF STUDY AREA

2.1 Geographical location and Regional Importance

Barisal town is situated about 227 Km south of the capital city, Dhaka. It lies between $22^0 37'$ & $22^0 43'$ north latitudes & between $90^0 16'$ & $90^0 32'$ east longitudes. It is important as the administrative center of Barisal division and well known center of higher education .The geographical location of the Barisal zilla and its regional setting are shown on the location map (Fig-1)

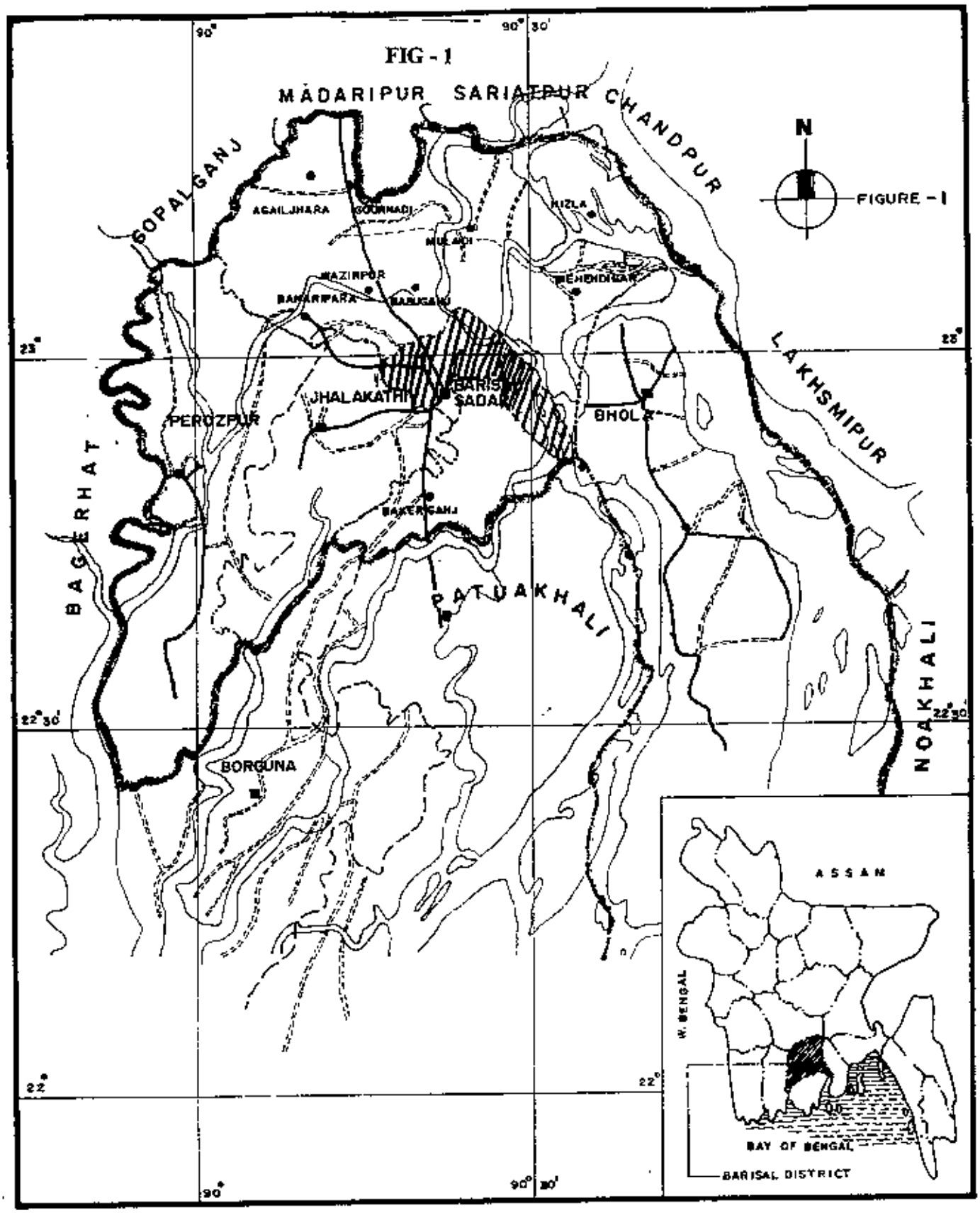
Barisal has a good waterway link to Dhaka and is about 7 hours journey on national highway to Dhaka, with good links to Patuakhali and Jhalokati to the south and to other surrounding cities.

The present Barisal Pourashava area is about 16.09 km^2. The river Kirtonkhola flows through the eastern periphery of the Pourashava. There are many khals flowing through the Pourashava. For that reason it was once known as the "venice of east". The city is well connected by water ways with the southern cities of the country. The study area of Barisal Pourashava is shown on the location map (Fig-2)

2.2 Climate:

The district is damp throughout the year and has an equitable temperature. The cold season lasts from the month of November to end of February and rain occurs only occasionally. The winter nights are foggy till sea breeze begins to blow.

The average maximum temperature in the summer ranges from 30^0c to 35^0c and in the winter from 25^0c to 28^0c. The highest temperature recorded was 41.1^0c in April 1960 and the lowest was 5.6^0 c in February 1905. The average annual humidity is 75% and it



LEGEND

- DISTRIC BOUNDARY
- ZILA HEADQUARTER
- UPAZILA HEADQUARTER
- PUCCA ROAD
- OTHER ROAD
- RIVER
- BARISAL SADAR UZ.
- BARISAL ZILA

FIGURE – 1

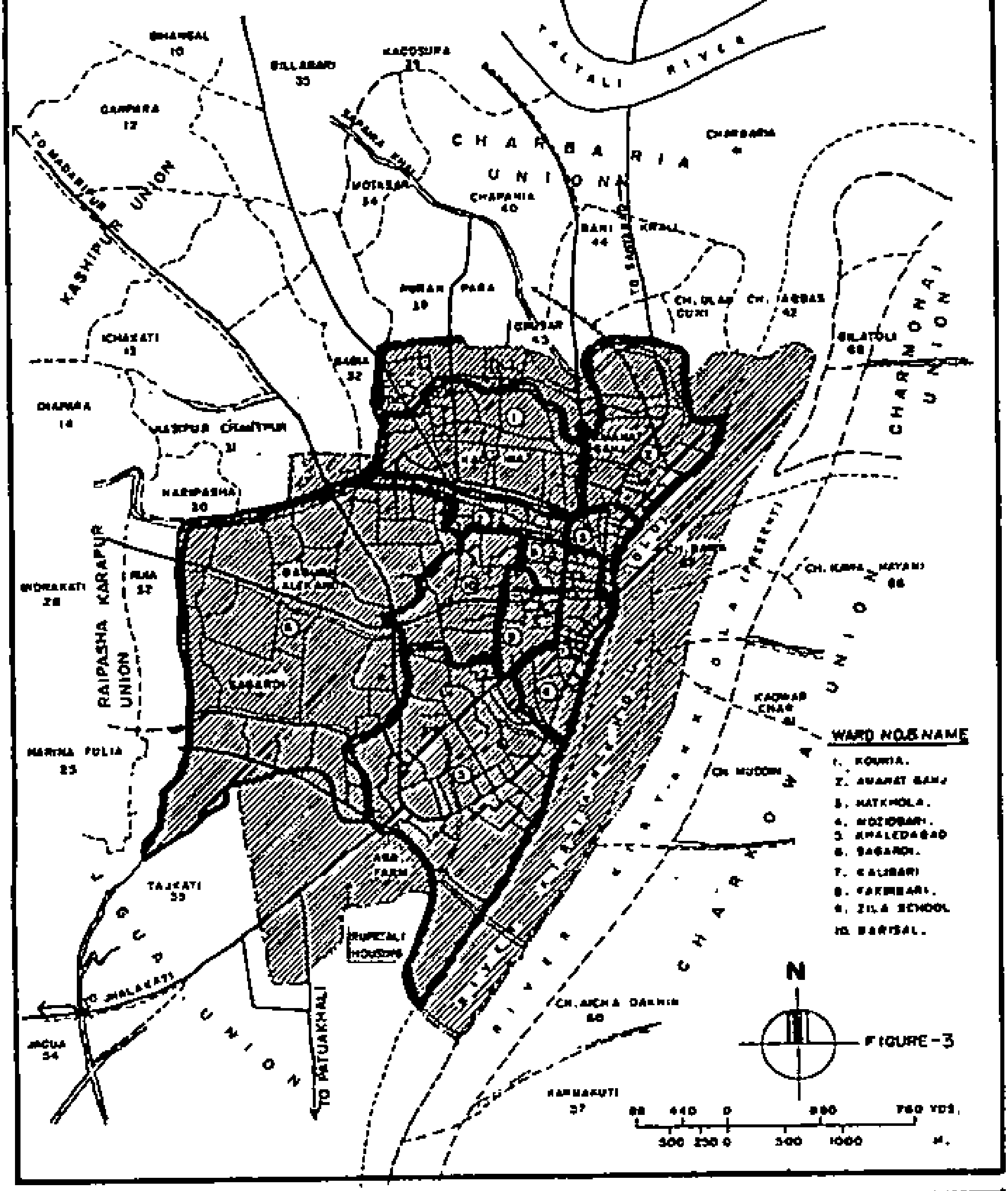
REGIONAL SETTING

4 2 0 4 8 MILE

6 3 0 6 12 KILO METER

MARCH 1991

FIG - 2



LEGEND

POURASHAVA BOUNDARY

WARD BOUNDARY

MOUZA BOUNDARY

ADJ. AREA INCLUDED IN PLAN AREA

WARD NO

MASTER PLAN AREA

SCALE 1" = ·75 MILE OR 1:48000

MARCH 1991

remains high in monsoon months. The average maximum rainfall ranges from 216 mm to 519 mm for the month from June to August and the rainfall is minimum in November and December. Squalls and cyclonic storms sometimes pass over the area in the month of May, June, September and October and the worst of the types is accompanied by tidal surges. In recent years low atmospheric pressure in the Bay of Bengal frequently caused storms which resulted in caused considerable damage to life and property in the district.

2.3 Geological and Hydro-geological Conditions:

Bangladesh is part of one of the largest alluvial basins in the world formed by the vigorous actions of the ancestral and present Ganges, Brahmaputra and Meghna river system, which eventually fall into the Bay of Bengal. The streams, starting deep in the Himalaya, continue to transport and deposit along their courses tremendous volume of alluvial materials. The thickness of the material auditing the earlier on deposit in the Pleistocene time and the younger one in the recent epoch, varies from a thin film near the mountainous area in the northern mast area up to 10,000 ft. in the southern part of the Bengal Basin. It is at least 2000 ft. thick near Dhaka.(Muhibullah,89)

The alluvial deposits are underlain by the tertiary sediments of mostly sand stone or shale, part of which is marine nature. These sediments are reportedly based on complex geology comprised of rocks ranging form the Mesozoic to the Precambrian time.

The whole district lies within the lower delta that is to say, within the area in which the beds of the water courses are below the level of the sea at high water.

Throughout the country for ages, ground water in the alluvial deposit. Particularly younger ones occurring at a shallower depth has been sources of supply immediately available is quality, with a relatively high precipitation and closely interconnected network of surface water as recharge sources, the whole country depend upon the ground water with monitoring system of the water table fluctuation throughout the country. This is also the case with the district and Barisal including the study area. The central low lands where Barisal lies are thickly masked with recent flood deposit, consisting of

clayey soil and sand. In and around the study area, beneath the surface cover of clayey soil of about 60-70 ft. in thickness sand, medium to coarse in grains, makes a good water table aquifer varying from 100 to 130 ft. in thickness. Though thickness subject to direct rainfall or regional rainfall.

Though there may be slight variation in the nature of the material or thickness, the shallow aquifer is estimated to extend over most part of the region as is testified by the existing drilling records.

All of the existing water wells stays the said aquifer, with their discharge varying widely. From the analysis of these data, the recommendable yield from a well is estimated to be 25000 to 30000 LGPH.

Ground water flow from north to south appear quite regular and constant. Judging from the record of the nation wide water level fluctuation monitoring which shows the average annual water level during the past 10 years marked no significant change. It indicates at the same time the influent and the effluent of groundwater flow well balanced on the annual basis.

Rainfall in the area further reinforces the mechanism of recharge. As a guideline to suggest the quantity of recharge, the annual fluctuation of the water level can be an indicator.

According to the record mentioned above, the average annual difference in the water level is about 16 ft. to maximum 23 ft. (1990). The calculation leads to the assistance of ample recharge to meet the planned demand in the year 2020.

CHAPTER III

LAND USE PATTERN OF BARISAL POURASHAVA

Existing Land Use

A detailed survey of the land use of the study area revealed some important features. (Table 3.1) Out of total 1834 Hectares, 65.30% is Residential, 0.32% Educational, 1.90% Industrial, 19.60% Agricultural, 1.45% Hospital, 1.15%commercial and 0.82% are unused (Master plan of Barisal Pourashava,90).

3.1 Comparative Land Area

Table 3.1Comparative Land Use of Barisal Pourashava.

SL. No.	Land use	Area Ha	% of total
1	Residential	1198	65 30
2	Educational	65	0 32
3	Socio-culture	6	0.32
4	Urban source	90	4.90
5	Health	27	1.45
6	Industrial	35	1 90
7	Commercial	21	1.15
8	Agricultural	358	19 60
9	Vacant Land	15	0 82
10	Open recreation water bodies others	19	1.0
	Total	1834	100 00

Source : Bangladesh Bureau of Statistics (1981-1991) and Barisal Pourashava (1996).

3.2 Existing Landuse Pattern of Barisal Pourashava.

There are 10 wards & 38 Mahallas in Barisal Pourashava as per 1996 population census of Pourashava. The total service facilities of the Pourashava are mainly concentrated in the core area and are mostly dispersed in the peripheral zones.

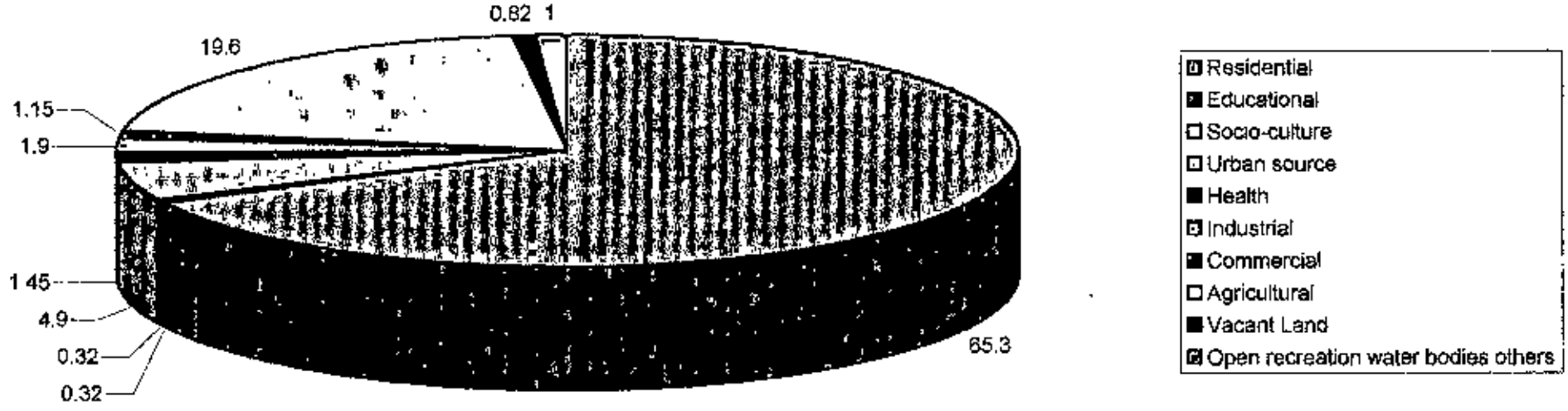
Existing land use pattern found in the recently concluded Drainage Master Plan Study is given in table 3.2.

Table 3.2 Existing ward basis land use pattern of Barisal Pourashava.

	Category	Area distribution in Acres										Adjoining area Acres	Study Area Acres	Percent of Total
		W.I	W.II	W.III	W.IV	W.V	W.VI	W.VII	W.VIII	W.IX	W.X			
1	Residential	437.5	235.5	42.0	89.65	295.5	557.62	114.95	35.0	39.05	242.65	366.31	2455.28	42.88
2	Commercial	1.50	3.25	6.40	1.99	13.00	2.00	5.80	0.80	0.40	1.50	3.00	40.04	0.70
3	Industrial	4.50	28.65	1.20	9.70	47.50	—	1.20	—	4.80	0.50	87.00	185.05	3.22
4	Public Building	6.85	20.25	12.05	113.9	111.2	33.50	8.45	3.82	16.55	5.85	28.50	360.61	6.30
5	Educational	2.50	5.45	0.70	2.07	29.90	40.00	1.45	5.03	10.85	50.41	31.00	480.36	3.15
6	Park and open space	75.35	84.00	8.00	51.60	169.08	817.63	30.00	6.85	16.75	54.50	1061.89	2375.65	41.48
7	Linear services	10.65	10.25	4.30	11.50	13.50	25.00	8.15	2.50	6.25	9.61	11.25	113.06	1.97
8	TOTAL	545.00	390.00	75.00	280.00	680.00	1476.0	170.0	54.0	98.0	370.0	1589.0	5727.00	100%

Source : Field Survey, February, 1990

Fig-3: Comparative land use of Barissal Pourashava



CHAPTER IV

SOCIO- ECONOMIC ASPECTS

4.1 Occupational Pattern and Employment

Occupational involvement of the population gives a picture of the nature, type and distribution of the economic activities carried out in the area. Information on occupational pattern helps in determining the current trend of employment of the prospective economic activity that may become dominant for the future development of the area. It has been found from the study that the people are usually divided into a number of occupational activities. The table below shows the distribution of households according to the category of occupation.

Table 4.1 Distribution of households according to category of occupation.

Occupation	Frequency	Percent
Govt. Service	112	28.0
Semi Govt. Service	70	17.5
Private Service	91	22 8
Business	87	21 8
Student	3	0.8
Daily labour	18	4.5
Unemployed	1	0.3
Other	15	3.8
Total	400	100.0

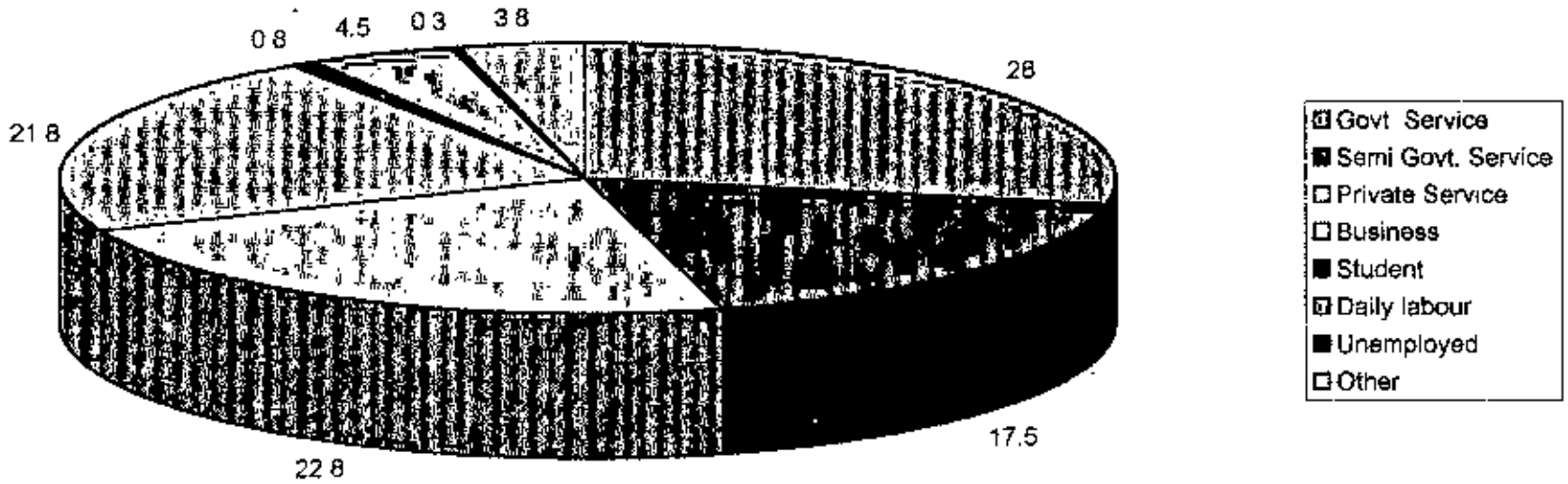
Source: Field Survey 2001.

Table 4.1 shows that the principal occupation of the people of the shahar area is service (63.3% of the households) followed by business (21.8% of the households). About 4.5% of the households are engaged in daily labour.

4.2 Income Levels

The average monthly household income in Pourashava in 2001 is estimated to be Tk. 6441.75. Field survey shows that about 37.6% of the household is in the middle income

Fig-4: Distribution of households according to category of occupation



group (Tk. 4,001-6,000) 8 3% in the lower income group (Tk. 3,000 and below) and 27.6% in the higher income group (Tk.6001 and above). Details of the income group distribution are shown in Table. 4.2.

Table 4.2 Income Groups:

Income	Frequency	Percent
Upto 1000	11	2.8
2001-3000	22	5.5
3001-4000	107	26.8
4001-5000	87	21.8
5001-6000	63	15.8
6001-7000	17	4 3
7001-8000	26	6 5
8001-9000	14	3.5
9001 and above	53	13 3
Total	400	100.00

Source . Field Survey 2001

4.3 Housing Sector Studies

Field survey 2001, shows that about 29.3% residential buildings in Barisal Pourashava are found to be permanent or pucca, 65.5% as semi pucca and 14.3% as kutcha. The classification of houses according to construction material is shown in table 4.3.

Table 4.3 Category distribution of households according to construction

Category of house	Frequency	Percent
Pucca	117	29.3
Semi-pucca	226	56 5
Kutcha	57	14 3
Total	400	100 0

Source : Field survey, 2001.

Fig-5: Disribution of people by Income Groups

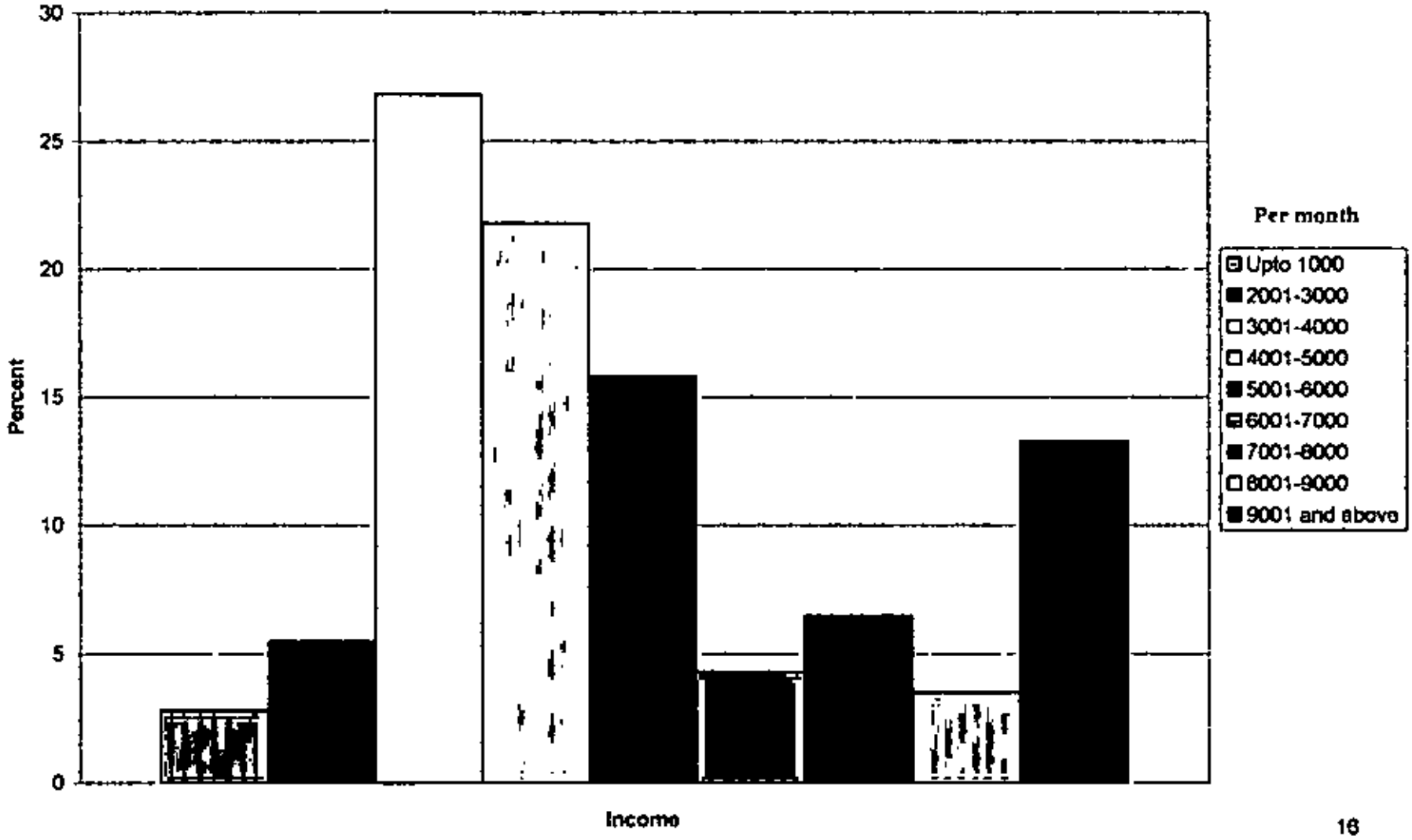
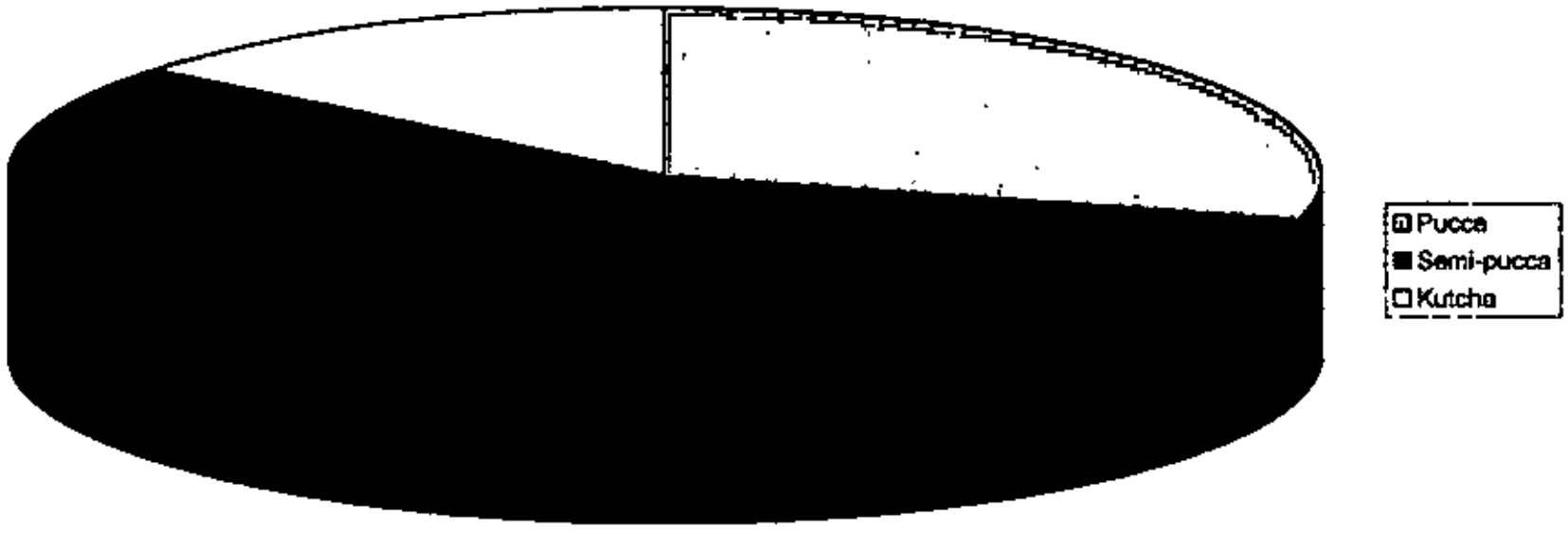


Fig-6: Distribution of households according to construction type of houses



Most of the pucca buildings are located within the core area of Barisal Pourashava while majority of the houses of semi-pucca and kutcha in nature are located in the fringe areas of the Pourashava. Type of structure of dwelling units may also be considered as indicator of income levels in Barisal Pourashava.

4.4 Industrial and Commercial Activities

4.4.1 Industrial Activity

The geographical location of Barisal town is not suitable for industrial establishments of different nature. Road communication from Barisal to the capital city and other parts of the country is not good. This explains the lack of significant progress in the field of industry in the town.

There are only six heavy industries and 64 light and small industries in the Pourashava and in adjoining areas. The small industries are mostly located within the residential area. Most of the prominent industries are located primarily in two areas that is BSCIC industrial estate located in Kawnia area in the northern periphery of shahar and Rupatoli area which is located beyond present Pourashava but within potential area of immediate expansion limit of the shahar.

There are three well- reputed pharmaceutical factories. These are the Opsonine chemical industries, the Medimate pharmaceuticals and the Rephco laboratories Ltd.

There are also other industrial units such as Rice and flour mills, saw mills, timber products, Biri factories, printing presses, general engineering and metal products, soap factories in the poura area.

4.4.2 Storage and Warehouse Facilities

The storage and warehouse facilities in Brisal Pourashava are found to be very limited. Some food godowns and fertilizer godowns are located in the Pourashava area. Some Government and autonomous agencies such as Public Works, Department, BIWTA, Roads and Highway Department, Bangladesh Power Development Board. Bangladesh Water Development board etc. who have their own storage and warehouse facilities.

Some private storage facilities are also available on rental basis for commercial purpose in the commercial area.

4.4.3 Commercial Activities

There is only one shopping commercial center known as chawk Bazar in Barisal Pourashava. Branches of several banks, the booking offices of Dhaka Barisal launch and airplane services are located in this shahar. Barisal New market and some super markets are located in Sadar Road, the only main road of Barisal. Daily kutcha or vegetable markets and fish markets are located in different part of Barisal shahar though Puran Bazar and Natun Bazar are however the main Bazars of Barisal shahar. Barisal town basically is not important for trading due to lack of proper communication. The main articles that are locally manufactured pharmaceutical goods, bread, biscuits and some other consumer articles. There are 20 residential hotels with an average capacity of 22 beds and 60 registered restaurants mostly located in and around the city center. There are also 4 cinema halls with capacity ranging from 300 to 500 seats.

4.5 Social Services and Infrastructure

4.5.1 Education

There is one university College (Braja Mohan College) popularly known as B.M. College Once called as oxford of Bengal it is located in the heart of the shahar. Other educational institutions includes one medical college named Shere-e-Bangla medical college, eight degree colleges,two Intermediate colleges including one Govt. women college, one law college, one polytechnic institute, two govt. vocational and commercial institute, one primary school training institute, one Alia Madrasha, one Homeo College, eighteen Boys high school, five Girls high schools and forty nine primary/K.G. School.

4.5.2 Religious Facilities

There are 90 Mosques, 11 Eid gahs, 3 Graveyards, 14 Mondirs, 2 Charches and one cemetery in the shahar area. These are distributed within the wards to serve different communities in the study area.

4.5.3 Urban Services

Most of the urban facilities though insufficient and unsatisfactory exist in the Master plan area to cater to the needs of the urban dwellers as well as people of adjoining rural areas. The Master plan area which also the zila shahar contains almost all the regional administrative offices. The Zilla Parishad, D.C. office, Pourashava authority, Upazila Parishad, Zila court and other government, semi-government and autonomous agencies like LGED, RHD, PWD, BIWTC, PDB, WDB etc. are functioning and carrying out their services in the zilla Barisal. In Barisal town there are two telephone offices, 20 post offices, three bus terminals, 3 baby taxi / tempo stands. Water supply system with 7 Nos of O/H tanks and 24 nos. of production wells. One fire service station, one garbage and sewage disposal center, electrical supply substations with two no power generation station & One police line and a number of police outposts.

There is no public sewerage system in Barisal Pourashava. Only 49 3% of household sanitation serviced by septic tank and the rest by pit service latrines and kutcha latrines.

Total drainage system in the Pourashava is open, in which only 9.2 km is pucca and 43.2 km is kutcha.(Master plan of Barisal Pourashava,90)

4.6 Public Health and Incidence of Fire

The only medical college hospital in the southern region of the country Sher-e-Bangla medical college hospital of 500 beds is within the shahar. Without this there are another 100 beds general hospital, 20 beds T.B. Hospital and veterinary hospital and 10 nos. of private clinic in this shahar.

There is one fire service station in Barisal shahar. In the year 1999-2000, Bangladesh fire service of Barisal responded 69 reported incidence of fire, 58% of which occurred within the poura area.

The total loss in the year due to fire as estimated was about Tk. 4.5 million. There are no operational fire hydrants available for support of fire suppression activities in the Pourashava. The pond which can be found in all parts of the town are the principal sources of water for all fire suppressions

CHAPTER V

DEMOGRAPHIC ASPECTS

5.1 Past and Present Population

The total population of the study area is 150288 as per population census 1981 of which 86661 were males and 63627 were females. There were 136 males for every 100 females in the master plan area as against 105 for the Zila and 106 for the nation. The population of the master plan area has been increasing rapidly, the growth rate for periods 1961-74, 1974-81 and 1961-81 have been worked out as 2.65%, 5.42% and 3 61% respectively. According to the formula adopted by BBS/UDD-UNCHS for the preparation of the outline national physical plan (UNDP), the rate of migration in the area is about, 50% during last 20 years period. In fact a significant fraction of the urban population within the town came from rural area.

Table 5.1 Area, population, density and variation of population of Pourashava study area during 1974-81.

Area in sq km.	Population		Density per km	Variation in 1981 over 1974
	1974	1981		
16 09	104628	159298	9900	52 25%

Source: Land use plan UDD 1988.

5.2 Projected Population

The population of 1991 census has been treated as the base population (170232), for the purpose of projection. Three levels of projection were made in the land use plan by UDD, with growth rate 2.65% (assumed) 3.61% (1961-1981 growth rate) and 5.42% (1974-81 growth rate) as low, medium, high projection respectively. The three levels of projection for the years 1991,1996,2001, 2006 and 2011 A.D. in the study area are shown in table 5.2.

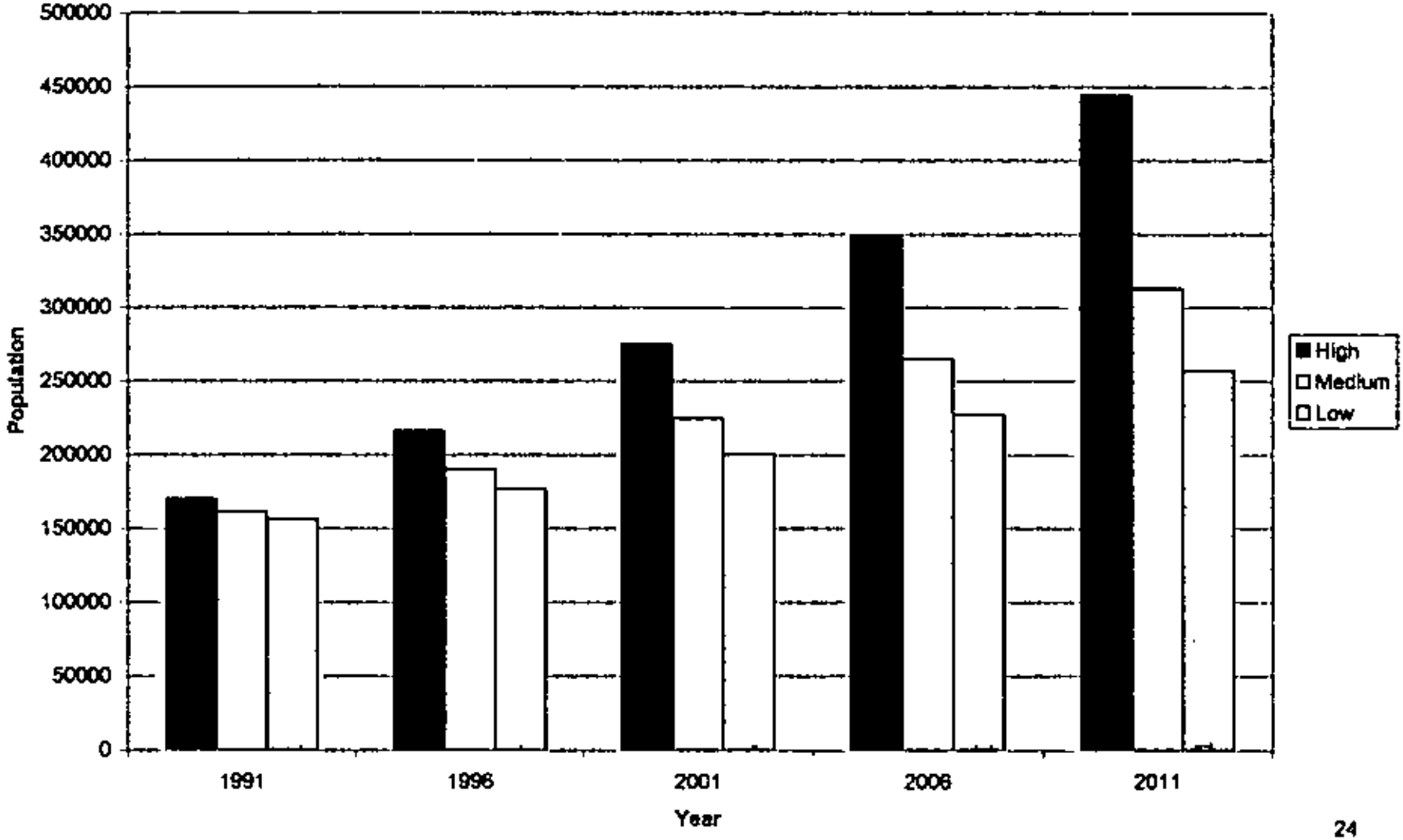
Table 5.2 Projected Population:

Year	High	Medium	Low
	Population growth rate (1971-81) = 5.42%	Population growth rate (1961-81) = 3.61%	Population growth rate assumed = 2 65%
1991	170232	161250	156500
1996	216364	190355	177236
2001	274998	224714	200719
2006	349522	265274	227314
2011	444242	313156	257433

Source: Land use plan UDD 1988.

In the preparation of land use plan population on the medium level projection was considered while 10% of the total area in the plan was kept as urban deferred to cater for possible needs if the medium projection turns out to be an under estimate. But while planning for utility services system the capacity of the system cannot be efficiently increased beyond its designed limit wherever required. To overcome this limitations the high level projection has been taken into account for planning of the water supply system up to the end of the plan period.

Fig-7: Projected Population of Barisal Pourashava



5.3 Density

Population density analysis was the basic technique used to forecast the geographical distribution of population within the study area for the year 2020. The population densities and residential land requirements in the year 2020, as adopted in the land use plan of urban development directorate, provided the basis of distribution of the projected population within the study area according to each of the 10 wards. Future population distributions thus determined, together with population densities are shown in table 5.3

Table 5.3 Classification Of Wards Population Based On Area, Population Distribution And Density

Ward no and name	Area in hector	Population distribution			Population density
		1974	1981	1991	
01 Kawnia	220.6	15574	2721	29144	13 68
02 Amanatganj	157.9	10837	19229	24809	14.68
03 Hatkhola	30 4	1195	17707	15978	39.94
04 Mshzidbari	113.4	8071	17177	17277	14.27
05 Alekanda	275.3	13962	19527	23588	83.35
06 Sagoradi	597.8	10169	137378	20247	47.07
07 Kalibari	68 8	10017	10754	13390	11.44
08 Fakirbari	21.9	5767	6352	5793	14.48
09 Zila School	39.7	3539	3652	5388	13.47
10 Barisal	149.8	8996	31250	14618	77.34

Source. B.B.S 1981 and 1991.

CHAPTER VI

BACK GROUND AND PRESENT STATUS

6.1 Historical Development

The water supply system of Barisal Paurashava was first introduced in 1911-12. The water supply was obtained pipe from the river kirtonkhola at Amanatganj and was distributed by standard pipes in the street after purification. The water works were constructed in 1911-12 and its costs was Rs. 1,60,000 of which Gov. contribution was Rs. 60,000 and Rs. 30,000 was obtained from private subscription, the district board gave a donation of Rs. 35,000 and the rest was obtained form the municipality's own resources. Later in 1961 –62 six Nos. of 6" dia deeptubewells each of about 10,000 gallons capacity per hour were installed. The capacity of that treatment plant was 2 laks gallons per day. One overhead tank (iron made) of one lakhs gallons per day, one clorineation chamber for water purification of one lakhs gallons capacity, 24 miles of pipe lines of different diameter (8", 6", and 2" respectively) and 250 street hydrants. Two other overhead tanks having capacity of 1,80,000 gallons were also constructed in that time one at Kawnia and another at Kizipara DPHE compound.

In 1986-90 another project named Five districts town water supply project was taken in Barisal town for better water supply for the city dwellers. In that project 12 nos of 6"dia production well capacity of 25,000 gallons per hour and 5 Nos of overhead tank capacity of 2,20,000 gallons located in different part of the town were constructed. After completion of that project the municipal authority closed the only treatment plant.
After completion the five districts town project DPHE handed over the operation and maintenance of the water supply system to the Pourashava in 1993. But that five district water supply project was a complete failure project due to lack of proper supervision by DPHE.

Now Pourashava authority is facing a lot of problems with that hazardous unplanned water supply system. Among the production wells of the project 2 Nos. of production wells pumps were not installed due to insufficient water production capacity. Now in

fact 3 Nos. of production wells are running properly to meet the demand of water for the dwellers, which is very negligible. There are 14 Nos. of production wells running but in fact 10 Nos. of production wells are producing (2000-5000) gallons per hour. One overhead tank located at Gorostan road still now unusable since construction.
Regeneration of well was done in 1992 and 1995 for three wells by DPHE. But no development was by regeneration.

In Barisal Pourashava now there are 140km of pipeline of different sizes. Total 756 nos. of street hydrants are in Barisal Pourashava. With addition to this there are 350 Nos. of hand tube well of 1 5"dia in different part of the town as another source of water.

6.2 Source of Supply

Field survey in the study area shows that only 68.8% of the households use supply water as their source of drinking water, 22.3% of household get water from hand tubewells 8.3% uses other sources like street hydrant, ponds, water vendors etc.

Table 6.1: Distribution of Households According to source of drinking water

Sources	No. of Households	Percentage of total Households
Supply water	337	84 3%
Hand pump tubewell.	30	7.5%
Street hydrent & others	33	8.3%
Total	400	100%

Source: Field survey, 2001

6.2.1 Existing Water wells as sources

At present water supply system of Barisal Pourashava is entirely by under ground water. There were 24 Nos. of production tubewells among which 14 Nos of production wells are running. In fact only 3 Nos of production well are running properly. The wells are mostly installed in a natural packed condition because of higher depths. The slot opening of the screen are also varies from 10 to 12 slot. As a result the maximum expected discharge from a production well is 68 m^3/h.Out of 14 wells 3 are operating at higher discharge rate from 86m^3 /h to 91m^3/h. For longer life of the well the entrance velocities should be kept

within acceptable limit, as such the over abstraction from the well should be avoided. Existing wells of Barisal Pourashava, year of installation and discharge capacity are given below in table 6.2.

Table 6.2 Existing wells of Barisal Pourashava, year of installation and discharge capacity:

Well No	Location	Year of Installation	Operation Period	Current discharge GPH
1	Bagura Road	1960	--	-
2	Zilla School	1961	16	700
3	Shitlakhola	1963	--	--
4	Police line	1965	--	--
5	Amanatganj	1979	8	200
6	Kazipara	1982	--	--
7	Line Road	1987	--	--
8	New Vatikhana	1990	22	15,000
9	North Ananathganj	1990	16	10,000
10	Nozirmahalla	1990	--	--
11	New Maylakhola	1986	22	12,000
12	Mohila college	1989	--	--
13	Hamio College	1989	22	10,000
14	Natullabad	1989	23	16,000
15	Stadium	1989	23	20,000
16	Zero point	1989	22	11,000
17	Shagardi Madrasha	1990	18	3,000
18	Kawnia Tank (New)	1990	--	--
19	Sayed Hatem Ali	1990	18	6,000
20	Kawnia Tank (old)	1961	--	--
21	Shaw Road	1961	--	--
22	Thana Pump (New)	1998	20	17,000
23	Zilla School	1999	23	12,000
24	Gorostan pump	1999	18	2,000

Source: Field Survey, 2001

6.2.2 Assessment of Existing Wells

Data of the existing wells were collected and the field conditions were examined during the survey period 2001. The characteristics of those wells described and analyzed are as follows:

1. **Aquifer Tapped**

Almost all of the wells unconfined alluvial 80 ft to 120 ft. The water aquifer provides an appreciable yield with less draw down. Depth between 930′ to 1100′ below G.L giving a good yield.

2. **Structure of Well**

All the wells of Barisal Pourashava are gravel packed well. Stainless steel strainers were used in all the wells. Screens were about 5% opening are usually installed at the lower portion or bottom of the well against the whole thickness of the aquifer, in smaller diameter (6″ or 8″) than the upper casing (12″ to 14″ dia) in which a pump of locally developed turbine type is housed. The more efficient screens and the more appropriate design of screens positioning to fit to the characteristics of the unconfined aquifer would have given one solution to various problems encountered in operation.

3. **Discharge from well**

The discharge from maximum wells decreased considerably and the authority was forced to abandon some well because of the inefficiency and incapability of operation.

The decision to abandon a well is suspected to be derived from clogging of pores of water bearing aquifers of slot opening of wells screen by finer sand and from incrustation. This is estimated to cause partly by a high velocity of ground water flow through screen opening due to over pumping and partly by water quality.

6. 2.3 Feasibility of Existing wells for the Projects

Well No. 3 was working for 36 years for an average of 12 to 18 hours a day but since January 1999 it is not in operation due to choked up. Well no 2 is still now in operation since 1961 but its current discharge is 7000 gph.

Discharge of well no 13 reduce to 10,000 gph and well no 10 and 12 abandon after regeneration in June 1993 and June 1995 due to wrong procedure of construction. Well No. 8, 14, 15 and 22 are running in good condition and can be safely taken into account for planning purpose of water supply system.

6. 2. 4 Operation life of Existing Wells

The well may enjoy nearly everlasting life as long as the circumstantial conditions do not suffer if properly designed, constructed and maintained. The existing wells cannot be said to be in such an ideal condition in every respect. It has been conceived necessary to predict the life of the wells though on a safe side as follows:

(a) well no. 3 worked for 36 years for and average of 12 to 18 hours a day

(b) well no. 2 is still working since 1961. It is working for 41 year

(c) well no 14,15 and 22 are running in good condition since 2001. It can be assumed that it will work up to 2005 for supplying the constant optimum discharges

6.3 Water Quality

Water samples from different supply location (wells,stand pipes,house connections etc) were taken at regular intervals and tested in DPHE laboratories in Khulna. The results of water quality analysis are shown in Table 6.3

Table 6.3 Water Quality Analysis

SL. No	Item	Unit	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
	Date	25.5.00	25 5.00	25.5 00	25.5 00	25.5.00	25 5.00	25.5.00	25 5.00
	Source		HC	PW	PW	PW	HC	PW	SH
1	Temperature	(c^0)	27	27	27	27	27	27	27
2	Electrical conductivity	(us/cm)	749	779	746	758	755	812	820
3	Turbidity	(NU)	1	1	1	1	1	1	1
4	p^H		8 6	8 5	8.7	8 2	8.7	8 2	8 3
5	Iron	(mg/L)	0.13	0 15	0.16	0 13	0 14	0.12	0.11
6	Manganese	(mg/L)	0 04	0 54	0.45	0.37	0 68	0.73	0 45
7	Ammonia Nitrogen	(mg/L)	1 1	1.1	1.0	1.0	1.1	1.0	1.0
8	Nitrite Nitrogen	(mg/L)							
9	Acidity as	(mg/L)	40	51	46	48	52	38	39

	$Caco_3$								
10	Methyl Orange Alkalinity as $Caco_3$	(mg/L)	640	430	680	658	568	618	595
11	Total hardness as $Caco_3$	(mg/L)	220	214	216	226	198	210	203
12	Magnesium hardness as $Caco_3$	(mg/L)	11	9	10	8	7	12	13
13	Calcium Hardness	(mg/L)	180	206	134	165	180	212	216
14	Ammonia NH_3		1.1	1.0	1.0	1 1	1.1	1.0	1.0
15	Chloride CL	20	102	118	115	118	122	130	88
16	Total Coliform		4	Nil	Nil	2	3	Nil	3

Source:Field data 2001.

The ground water of Barisal Pourashava appears clean without turbidity or colour. PH value ranges from 8 5 to 8.7..Total hardiness (as $caco^3$) is within the lower side (average 144mg/L). Ammonia, Nitrogen nil, Chloride (cl^-) content is also nil. The iron (FE^{++}) and manganese (Mn^{++}) content are also with the limit of both EPCB and WHO standard.

Bacteriological test shows nil coliform in all the samples. But the samples of S/H of kalibari Road and Barisal club show higher nos, of coliform (52 & 12 per 100 ml) which should have been disinfected by chlorinating before supply. However no case of contamination have been reported yet. Samples taken before from the same sources did not show any coliform. Further samples are required to be tested and water should be treated before supply, if required. The reason for showing coliform is most probably due to leakage in pipe and joints. Where water is contaminated and flow as back into the main pipeline during off supply period. Consumers of own hand pump tube wells user have no complain. Laboratory test result shows HTW Kawnia Manik Miah school and HTW Vatar Khal Basti water pH value ranges form 8.5 to 8.7. Chloride (Cl^-) content is higher but negligible (max86-120 mg/1). No complain about excessive iron and manganese. Arsenic content is within limit (0.1mg/1).

6.4 Distribution System

There are seven overhead tanks in Barisal poura water supply system. Among which six are running and one is unused located at Gorostan road from the beginning due to lack of sufficient production wells. In that area water is supplied directly into the pipeline from two wells. Rest part of the town well water is pumped up into six O/H tanks from 15 Nos of production wells is supplied to the town by gravity. There is no disinfecting system or any other treatment process throughout the supply system. Appendix ii-B shows the general plan of existing water supply system of Barisal Pourashava. Though there are several valves for controlling water of 4,6,10,12 inch dia different distribution pip lines

6.5 Water Production and Usage

The existing water supply system of Barisal Pourashava does not have any effective measuring equipment to measure consumption directly and there is no much reliable data available there off. Though production data is available in Pourashava as each production well have flow meter to measure production. So system loss cannot calculate exactly. The daily pumping hours of the wells as obtained from Pourashava is shown in table 6.5.The total daily production can be calculated.

Table 6.5 Present total daily production of water by BarisalPourashava Water Supply System.

Well No	Actual discharge gph	Daily running hours of production well	Total daily production in gallon
2	7000	16	112000
5	2000	8	16000
8	15000	22	330000
9	10,000	16	160000
11	12,000	22	264000
13	10,000	22	220000
14	16,000	23	368000
15	20,000	22	440000
16	11,000	22	242000
17	3,000	18	54000
19	6000	18	108000
22	17,000	20	340000
23	12,000	22	264000
14	2000	10	20000
Total			2700000

Source: Barisal pourahava 2001

The condition of water supply of Barisal Pourashava is very poor. Authority can supply maximum 27 laks gallons whereas demand is more . Daily authority can supply only 4 hours water to the consumers which is very poor to fulfil the demand. The amount of pressure could not be exactly ascertained due to non availability of pressure records & pressure meter. But it is true that at longer distance from source of even in some cases at shorter distance face problems by getting much lower pressure. In fact people of Barisal Pourashava are suffering from shortage of supply water seriously. Consumers in some part of town cannot derive the desired benefit form the supply system. However, leakage and wastage both from supply and consumption side have also much affect on it.

6.6 Wastage and leakage

Due to lack of measurement instrument installed, the quantity of wastage and leakage could not be measured directly. Though wastage of water is very poor due to crisis of water. Because of very insufficient supply and leakage are repairing by authority continuously after detection. But some hidden leakage are still now in here which cannot be detect and cannot be repair. Estimation of loss of water through wastage and leakage were done in the following way.

6.6.1 Wastage

(i) It was found wastage from a $^1/_2$" dia pipe was measured 3 gallons per minute. Wastage through 350 nos. of stand post and 500 nos of house connection during 4 hours supply hours was found to be 612000 gal.

(ii) Over flow: Loss of water for 50 Nos. of overflow Pipes were calculated. It was considered that 70% supply time was taken to fill up the tank and 30% supply was misused through overflow. Loss of water estimated was 108000 gal.

(iii) Broken tap: Misuse of water through 300 Nos. of Broken tap was surveyed. Loss of water through broken tap was estimated as 64800 gal.

6.6.2 Leakage

There are two types of leakage in pipe line and sluice valves, visible and invisible, visible leakage are repairing by the authority But invisible leakage are remaining and wasting water.

(i) Through pipe joints: Loss of water through pipe joints of 30 Nos was estimated as 21600 gal.

(ii) Through Sluice Valves: Loss of water estimated for leakage of 40 Nos. sluice valves was as 28800 gal.

(iii) So water loss through different kind of wastage and leakage are

Wastage	=612000+10800+64800= 687600
Leakage	= 21600+ 28800 = 50400
Total	= 738000

About 27.33% of the total daily supply.

6.7 Summary of Water Usage

The present water supply of Barisal Pourashava is 27 LGD. Regarding water consumption only about 69% of the total supply is used by the consumers while 27.33% of water is lost through wastage and leakage and about 3.67% of water remains unknown or unaccounted for which is caused mainly through unauthorized connection and hidden leakage. Table 6.6 shown the summary of water uses.

Table: 6. 6 Summary of water uses in 2001

Particular	Unit	Quantity	Total	%of total supply	Remark
A. Area survey		1527			
B. Population in area served		603000			
C. Population served		27800			
D. Domestic Consumption				49.21	
(i) Public stand		534.330		19.79	Estimated
Pipe Population served					
Per capita demand consumption					
(ii) Service Connection		1328.670			Estimated
Population served					
Per capita demand consumption					
Sub- Total (1)					
Non domestic consumption (2)					
Wastage		687.00		25.46	Estimated
Stand pipe					
House connection					

Sub total (3)					
Unknown (4)		990.90		3.67	Calculated
Leakage(5)		50.400		1.86	Estimated
TOTAL: 1+2+3+4+5		2700000		100	Measured

Source: Field Survey, 2001

6.8 Operation and Maintenance

Operation and maintenance work of Barisal Pourashava water supply system is done by 95 personnel headed by an Assistant Engineer who is directly controlled by the chairman of the Pourashava. A few years ago public health engineering department was responsible for this but now after completion of five districts town project the Pourashava is solely responsible for the water works operation and maintenance

6.8.1 Operation

In Barisal Pourashava well water is pumped up into six overhead tanks from 14 Nos. of production wells and is supplied to the town by gravity and two wells directly supply water through pipeline. Maximum wells are running 20 to 22 hours per day. Pump operator are operating the pumps timely and operation of valves by the valve operators in supply time.

6.8.2 Maintenance

Maintenance is the periodical activities (e.g, daily, weekly, monthly or yearly) which are required to conserve the system in normal operating condition preventing from break down. A general maintenance schedule is maintained for the smooth operation of the water supply system of Barisal Pourashava.

Petty maintenance, normal servicing and greasing every seven days are done for all pumps. The overhead tanks are cleaned and washed by bleaching powder per month regularly Maintenance of service connection joints with distribution lines are also done on receiving complain from the consumer. With this one supervisor and one Inspector are engaged full time for repair of sluice valve leakage and other hidden leakage There are also one tubewell mechanics who is responsible for repair of tubwells when required. Table 6.7 shows the organogram of Barisal Pourashava water supply system.

Table 6.7 Organogram of Barisal Pourashava Water Supply Section

No	Description	No
01	Assistant Engineer	1
02	Water works superintendent	1
03	Pump driver	15
04	Assistant pump driver	14
05	Valve operator	12
06	Supervisor	1
07	Inspector	1
08	Plumber	4
09	Tubewell mechanics	1
10	Pipe line labour	10
11	Bill clerk	10
12	Office staff	15
13	M.L. S. S	2
	Total	95

Source: Barisal Pourashava 2001

6.9 Water Tariff and Revenue Earning

6.9.1 water Rate

In fact no metering system was introduced in Barisal water supply system. Only 100 meters were introduced in five districts town water supply project on test basis. For that water rate in Barisal Pourashava is flat rate based on the size of the pipe and the type of connection. The monthly rates range Tk. 40/-to 1600/- in residential and commercial basis. Government, Institutions, Educational institution, Banks, Hotels, Restaurant, Industries etc. are under commercial category. New connection fees are adopted by Barisal Pourashava according to the size, type and length of connection. The applicant pay 500/-as security money on behalf of pourashava. The applicant also pays for all the labour and material costs incurred for the pipe line in his premises up to the nearest distribution pipe line of Barisal Pourashava. The current water tariff are given below:

Table 6.8 House connection fee and Monthly rates.

Sl NO	Pipe Size (inch)	Connection Fee Tk		Monthly Rates	
		Domestic	Commercial	Domestic	Commercial
01	½"	1000/-	1500/-	40/-	80/-
02	¾"	1500/-	2000/-	80/-	200/-
03	1"	2000/-	2000/-	200/-	400/-
04	1½"	2000/-	2000/-	400/-	1200/-
05	2"	2000/-	2000/-	1200/-	1600/-

Source: Barisal Pourashava 2001.

Though connection fee depends upon the valuation of the holding. With this all the holding within the Pourashava are levied with a water tax depending on the annual valuation assessment of the holding (currently 7% of the assessed value), irrespective of the holding having piped water connection or not.

6.9.2 Revenue Earning And Expenditure

Barisal pourashava at present earn revenue from water supply sector under the following heads:

1) Holding tax (7% water tax quarterly payment)
2) Service connection fee (paid once during new connection)
3) Road restoration cost (paid during new connection or shifting and dia change)
4) Water rate (Quarterly payment)
5) Shifting charge (when consumer want to shift his connection for better service)
6) Dia change charge (when consumer want to increase or decrease dia of his connection)

Yearly water bills are normally prepared at the start of the fiscal year and distributed to the consumers by 10 bill clerks. The consumers pay their bill to four branches of a scheduled bank. Now collections are separated with other funds of pourashava but some time it is utilized for other non-water utility needs of Pourashava. In fact water account should separate for its emergency need. For this very often cash shortfalls in water supply emergency operation and maintenance.

The service connection status of Barisal Pourashava are given below in table 6.8.1

Table 6.8.1 Service connection status of Barisal Pourashava 2001

SL NO	Size inch	Domestic connection	Commercial / Industrial connection	Public sand posts (No)
01	2" dia		2	
02	1 ½"		8	
03	1"	44	19	
04	¾" dia	1356	267	
05	½"dia	5101	669	756
Total		6501	965	756

Source: Barisal Pourashava 2001

No water rate is collected from religious institutions and public stand posts. From Table 6.8.2 the yearly revenue earning of Barisal Pourashava water supply system can be roughly estimated.

(a) Revenue from Water Rates

Table 6.8.2 Estimation of Revenue earning from Barisal Pourashava water supply system.

Sl. No	Size of pipe dia in inch	Domestic (a)			Commercial (b)		
		No of Connection	Rate Tk.	Total Rev, Tk	No of Connection	Rate Tk.	Total Rev. Tk
01	2"	–	--	--	2	1600	3200
02	$1^1/_2$"	–	--	--	8	1200	9600
03	1"	44	200	8800	19	400	7600
04	¾"	1356	80	108480	269	200	53400
05	$^1/_2$"	5101	40	204040	669	80	53520

Total Monthly 448640 Total yearly 5383680 Taka

(b) Estimate revenue from Service connection fee

It was observed that the number of new connections per year ranges from 100-150 obtained from the received of last few years. So considering 150 Nos. of new connection per year the estimated revenue comes as:

150 x 2500/-= 3,75,000/-(including 500/- as security money)

(c) Estimation of revenue from holding fax (7% of water tax).

In the year 1999-2000 budget the collection of 1808200/- was in this account Total estimated minimum annual revenue;

(A+B+C)= 53,83,680/-÷1808200/- 375000/- =7566880/-

Actual revenue collection and expenditure of water supply system of Barisal Pourashava during the last two fiscal year (1998-2000) are given below in table 6.9.1 & table 6.9.2 respectively.

Table 6.9.1 Actual Income of Barisal Pourashava.

Sl. No.	Items	1998-99 Taka	1999-2000 Taka
O1	Service connection fee	256500	280500
O2	Water rate	4230250	4850780
O3	Holding (Water tax part)	1402550	1808200
	Total	5889300	6939480

Table 6.9.2 Actual Expenditure of Barisal Pourashava.

Sl. No.	Items	1998-99 Taka	1999-2000 Taka
(a)	Operation and Maintenance work		
i.	Establishment (Manpower etc)	22,70,153/-	24,56,130/-
ii.	Electricity	51,00,000/-	51,00,000/-
iii	Chemicals	10,000/-	12,000/-
iv	Petty maintenance	2,00,190/-	2,50,300/-
(b)	Development Work		
i.	Physical	1,00,000/-	1,50,000/-
ii.	Mechanical / Electrical	34,500/-	35,200/-
iii.	Replacement and Rehabilitation work	-	-
iv.	Regeneration work	-	-
(c)	Contingency	46,119/-	51,000/-
(d)	Others	1,00,000/-	1,40,000/-
	Total	78,60,962/-	81,94,630/-

From the above table it is observed that in 1998-99 and 1999-2000 there remain deficit if we pay electricity bill. On the other hand water bill and poura tax are remaining unrealized Only 40-50% holding tax can be collected and 70-80% water bill can be collected

So for Barisal Pourashava the average operating cost per 1000 gallon of water is

$$Tk.\frac{81,94,630}{27,00,0000\times 365} = 8.31 \; per \; 1000 \; gallon$$

But this water selling rate by Pourashava actually :

$$Tk.\frac{6939480}{2700000\times 365} = 7.04 \; per \; 1000 \; gallon$$

CHAPTER - VII

WATER SUPPLY SYSTEM OF BARISAL POURASHAVA

7.1 Problems And Prospects of The Existing Water Supply System

Problems and prospects of the existing water supply system are analyzed on the basis of production, supply and consumption component of the system which includes:

(i) Production wells
(ii) Pumping facilities
(iii) Overhead tanks
(iv) Distribution pipe network
(v) Water quality
(vi) Leakage and Wastage
(vii) Operation and maintenance
(viii) Financial management
(xi) Water rates.

7.1.1 Production Wells

In Barisal Pourashava all the existing wells are operating excessively. 20-22 hours operation of well is very harmful for its estimated life. It occurs opening of well screens and seldom faults of pump and well. Therefore, it is proposed that the present discharge of each well be reduced to the recommended level as soon as possible. Performance of Existing Tubewells and Aquifer of Barisal Pourashava is given in table 7.1.

Table 7.1 Performance of Existing Tubewells and Aquifer

Tubewell No	Location	Depth (m)	Screen length (m)	Discharge "Q" (m3/h)	Draw down (m)	Initial SP Capacity (m3/h/m)	Pumping level (m)	Transmisivity "KD" (m2/h)	Conuctivity (m/d)	Aquifer condition
Well No 1	DPHE Bogra Road	245 50	24 35	--	11.58	--	--	--	--	Replace
Well No 2	Zilla School	245.35	24.38	3 18	7.70	12.08	15.80	434	13	Moderate
Well No. 3	Bogra Road	245 35	24.38	--	6.09	--	--	--	--	Replace
Well No 4	Police line	245 35	24.38	--	15 46	--	--	--	--	Replace
Well No 5	Amanath ganja	287 10	24 59	9.09	16.24	9.73	18.23	350	105	Moderate
Well No. 6	Kazipara	287.60	24.36	--	10 29	--	--	--	--	Replace
Well No 7	Line Road	-	-	--	7 94	--	--	--	--	Replace
Well No.8	New Vati khana	295 32	28 85	68 18	4 36	16 88	13.21	508	16	Good
Well No.9	Shaycsta bad	203	28.85	45 45	9.27	7 90	16 14	300	8	Moderate
Well No 10	Nazir Mohalla	297 92	28 85	--	7 71	--	--	--	--	Replace
Well No 11	Janokishingh road	369.75	28.85	54.75	21 70	3.41	15.43	285	9	Moderate
Well No.12	Women's College	295.22	23.67	--	--	--	--	--	--	Replace
Well No.13	Hornio College	298.05	28.85	45.45	9.34	7 71	16 14	285	9	Moderate
Well No.14	Barisal bus stand	265.64	28.85	72 72	10 75	6 88	15 84	428	11	Good
Well No.15	Stadium	390 03	28.85	90 90	18 68	6 94	21 33	250	7	Good
Well No 16	Zero point	302 15	28.85	50 04	6.02	12.29	16 10	440	12	Moderate
Well No.17	Madrasha	300.96	28.85	13.68	7.23	10.24	18.55	370	10	Moderate
Well No. 18	Not in Operation		N A	N.A	N A	N A	N A	N A	N.A	N A
Well No 21	Not in Operation		N.A	N A	N A	N.A	N.A	N.A	N.A	N.A
Well No.20	Kawnia	375	N A	N A	N A	N.A	N A	N.A	N.A	N.A
Well No 19	Hatem ali College	323	28.85	27 27	9.34	9.95	13.27	330	11	Moderate
Well No.22	Sadder Rd	303.95	28.83	72.27	9.27	7.09	15 01	480	10	Good
Well No.24	Gorostan Road	243 24	28.85	9 09	10 20	11.10	16 10	460	9	Moderate
Well No 23	Zilla School	279	28 85	54.54	9.50	12 10	20 01	380	16	Moderate

Note : N A or blank cells indicate not applicable or data were not available during survey. Table includes both working and non-working Tubewells

7.1.2 Pumping Facilities

From Table 6.5 it is observed that only pump no. 15, 22 and 14 are operating at satisfactory level. Rest 14 pumps are operating below the nominal capacity, pumps no. 5,17,19 and 24 should replace immediately. Pump N. 2,9, 11, 13,16 and 23 consuming more power against their discharges. There should also required to be replace for economical running.

7.1.3 Overhead Tanks

One overhead tank located at Gorostan Road still now unused due to lack of sufficient water of production wells. There should install one or two no of production well nearby to operate the tank. Overhead tank of Kazipara and Kawnia need some repair. Both the tanks require level indicators for assessment of production and supply through the tank. Rest four overhead tanks constructed in five districts project period still now running well.

7.1.4 Distribution Pipe Net Works

Barisal Pourashava water supply system distribution network consists of 140 km length of 12" dia to 4" dia pipelines of various materials. These pipelines were installed at different time during last 50 years without planning. The main problem is there is no any complete pipeline network map of Barisal Pourashava. There are some unplanned inter-connector which are causing unequal distribution of water. There are also 2 to 3 Nos of distribution pipelines in the same road installed in different time. As a result desire pressure cannot be maintained at supply time Without this there are some illegal motor

by which some consumer driving out of water form distribution pipeline. Though Authority is trying to check and control this illegal pumping.

7.1.5 Water Quality

Quality of water of Barisal Pourashava as produced from production well sources and supplied in general are found to be good quality: all the contents remaining within the limit of EPCB and WHO standard. Due to presence of occasional coliform only chlorination and no other treatment is required.

Table 7.2 Complain about the quality of supply water

Quality	Frequency	Percent
White/red Sediment	157	46.6
Turbid water	115	34.1
Bad taste/ bad smell/saline water	56	16.6
Soap foam dose not appear	6	1 8
Others (Specify)	3	0 9
Total	337	100.0

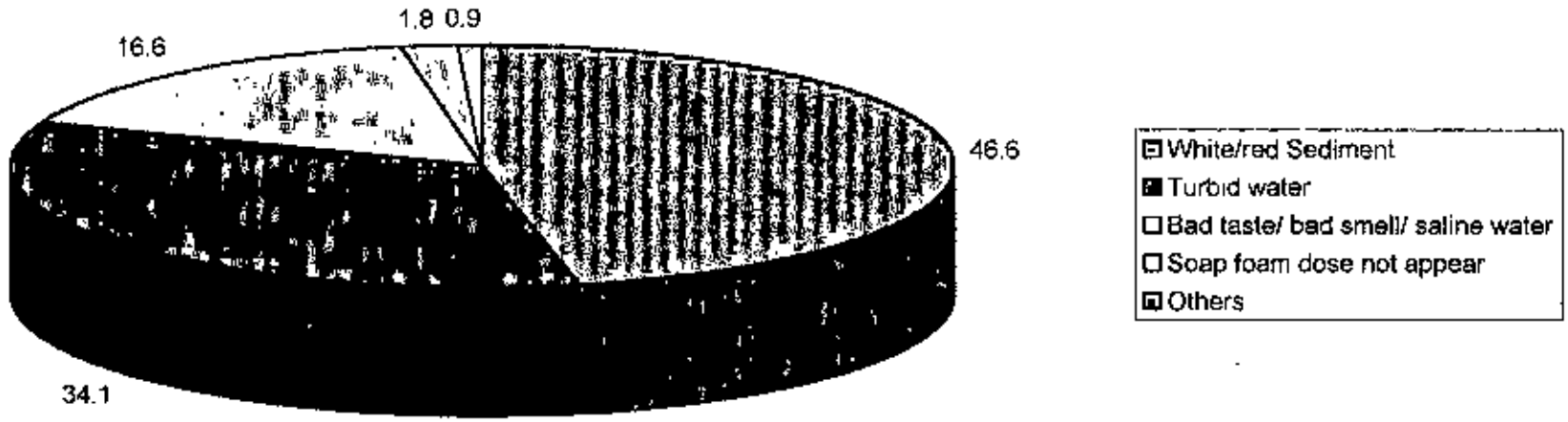
Source: Field Survey2001.

7.1.6 Leakage and Wastage

In Barisal Pourashava it was found that leakage and wastage in water supply system is about 27.33% It is very high. For an efficient and economic performance of the supply system, the leakage and wastage must be brought down to a tolerable limit, say up to 10-15%. Following measures may be taken to reduce the leakage and wastage amount.

(i) Replacement of old & defective pipes, pipe line joints and sluice valves.

Fig-8: Distirbution of households by Complaints about the quality of supply water



(ii) Proper and regular maintenance of the distribution network.

(iii) Frequent checking of household overhead tank over flow and defective faucets and imposing penalty on consumers for repeated wastage.

(iv) Using good quality taps in public street hydrant and should convert the street hydrant to community tap for giving responsibilities to the users.

(v) Need social motivation to bring awareness among people for preventing wastage of water.

(vi) Metering of all service connection.

(vii) Each road should have only one distribution line. Other will have to be closed and removed.

7.1.7 Operation and Maintenance

Weekly or monthly maintenance schedule for each component of the system to be prepared and followed accordingly.

Measuring equipment for discharge, draw down and water table of wells, pressure records, bulk meters, both at production and major distribution points to assess the amount of system loss should be installed. Sufficient supply to all the areas can be ensured by sequential control of valves at different points of distribution lines. If required new valves to be installed. Surplus inexperienced staffs are in Barisal Pourashava water supply system. So training is necessary for the staff and technicians.

7.1.8 Financial Management

Financial management of Barisal Pourashava water supply system is very poor. At first 20-30% water bill remain uncollected. It is increasing day by day because people are not interested to pay bill as they are not getting sufficient water. Peoples are sinking Tubewell personally and would like to close the connection. Ward Commissioner's are recommending for disconnect the connection of the applicant. They do not like to think the future of the water supply section. So revenue earning is decreasing day by day The Consumer's are sinking own hand tubewell for sufficient and pure water supply.

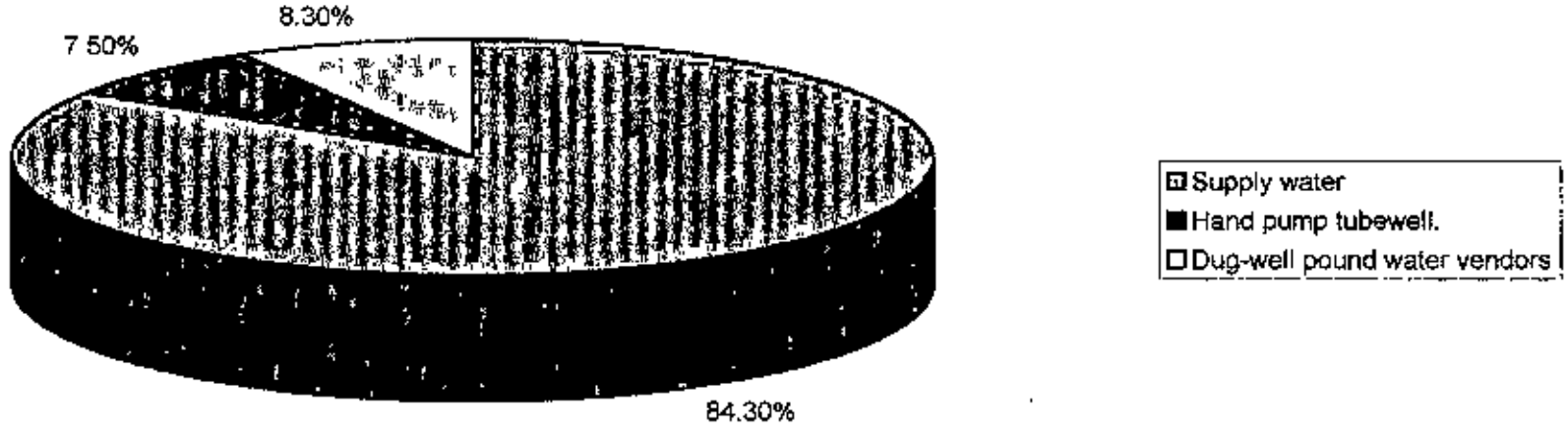
Table 7.3 Source of water for household use

Source of water	Frequency	Percent
Supply water by municipality	337	84.3
Own hand tubewell	30	7.5
Street hydrant	33	8.3
Total	400	100.00

Source: Field survey,2001.

On the other hand the expenditure is on the increase every year due to increase of electricity rate, employee's salaries, maintenance and occasional development work. As it is a good running account chairman transferring this fund to some other important work which is not related to water supply system. As a result now emergency maintenance work of water supply system is difficult to perform due to lack of money. So the crying need for Barisal Pourashava water supply system is to improve the financial management.

Fig-9: Distribution of households according to source of drinking water



Water Rates

The present water rates of Barisal Pourashava were fixed up in June 1990, After that it was not updated for last 12 years.

The appropriate fixation of water rate is a very important factor for a sustainable water supply system as well as for giving quality services to the consumers. Survey report shows that 62.7% people of Barisal Pourashava are interested to pay 25% more tariff for better quality and sufficient water supply. But Chairman and the committee of Barisal Pourashava, do not like to increase tariff.

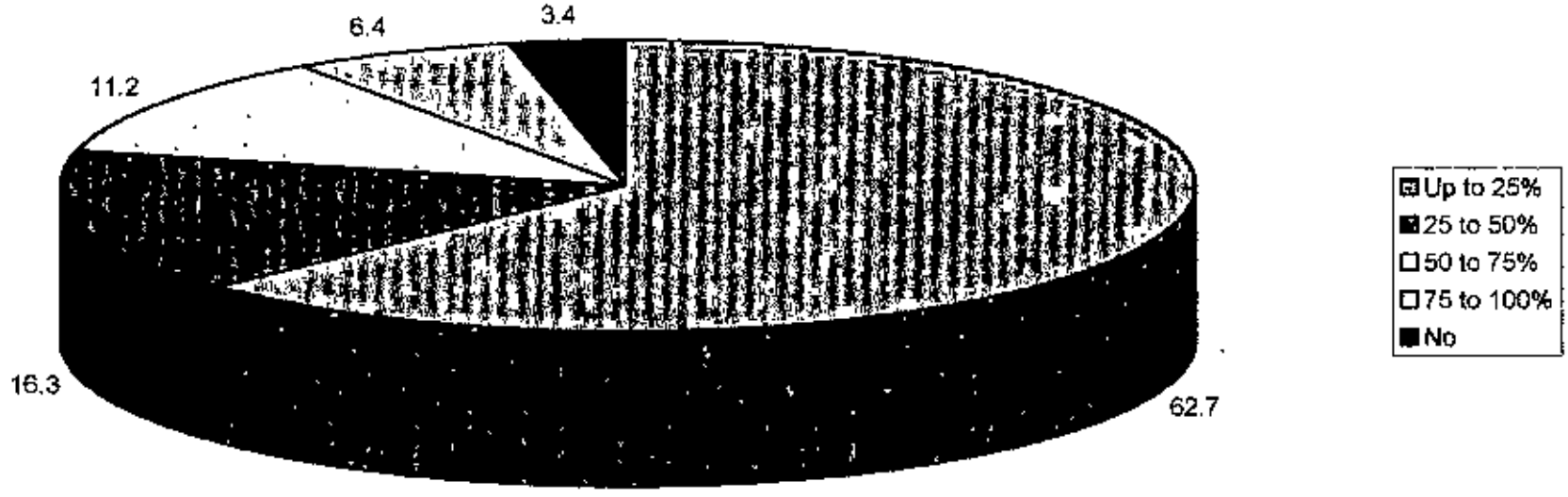
Table 7.4 Opinions about agree to pay on increase in water rate.

Increase in tariff	Frequency	Valid percent
Up to 25%	185	62.7
25 to 50%	48	16 3
50 to 75%	33	11.2
75 to 100%	19	6.4
No	10	3 4
Total	295	100.0

Source: Field survey,2001.

Analysis on different income groups ability to pay shows that 25% increase of tariff if levied will be acceptable by the consumer of Barisal Pourashava.

Fig-10: Distribution of households by willingness to pay increased water rates



7.2 Water Sources

The main source of water supply for Barisal town is from the underground. The ground water has been used as the source for the water supply in the town. After introducing the piped water supply in 1960, a second major expansion of the system was done by installing 12 more tubewells during 1985-90 both under ADB assistance & afterward. There is a surface water sources, But as the ground water quality & resource till now is in good condition, the surface water has not been considered as a source for water supply.

7.3 Hydrology

The hydro geological condition of Barisal town varies from place to place. The test drilling done by water jet method almost indicate many water bearing strata separated by imperious or semi imperious layers. The sweet water aquifer normally exists from 700 ft to 1000 ft in between which the separating layers also exit. The medium depth layers is normally saline & also have limited thickness. The production wells are normally installed within the sweet water aquifer. The transmissivity coefficient of the aquifer are estimated to be good (as no pumping test data was found available) as the present aquifer is surviving the need of the water. However, the deeper aquifer over 1000 ft did not give promising output as seen from the experience of the five districts town project.

7.4 Future Ground Water Abstraction

The performance of a well is often observed to decline with time. The water quality is not only the controlling factor but heavy pumping accelerate the clogging phenomenon in the screen by accumulating fine grains. From the radial flow concept, it is apparent that as ground water converges towards a well, its velocity increases. If the velocity exceeds the critical limit, finer particles will be transported from the aquifer into the gravel pack. The filter subsequently clogg resulting in a loss of head. Moreover, this increasing head loss

will strengthen the potential for incrustation & further plugging of the screen area. The approach velocity of the water to the screen should, therefore, be restricted. Husman (1972) suggested to modify Sicharde's relationship to

$Va < 1/30\sqrt{k}$

Where,

Va = approach velocity (m/s)

K = Hydraulic Conductivity (m/s)

This should also be noted that when some portion of the screen clogges, the entrance velocity in the other portion of the screen clogges, the entrance velocity in the other portion of the screen become unacceptably high & consequently the above mentioned relation ship is no longer valid. Therefore, the well should be monitored on regular basis & the screen should always be kept clean as practicable considering the average aquifer formation (medium to fine sand). The recommended abstraction rate from each well is 68 m^3 /h for Barisal town. However, this rate may required to be lower down, if pumping tests indicate to do so.

7.5 Present Coverage

There are 14 (fourteen) Production wells which are pumping ground water for the water supply system of the town. The daily production of water is 27 LG. Regarding water Consumption only about 69% of the total supply is used by the consumers. The average present per capita consumption is 60 lpcd. However, in comparison to present estimated population of the town (Pourashava) the coverage is 77.8%. The rest population are covered with hand pump & other sources of water.

7.6 Management Of The Water Supply System

The water supply system managed by the Pourashava. One Assistant Engineer is in charge of the poura water supply system & is directly controlled by the Chairman. The Pumps are operating by the pump drivers. The new development work is done by DPHE. The monthly water tariff collected by Pourashava. Pourashava is responsible for operation and maintenance work of water supply system.

CHAPTER VIII

WATER DEMAND PROJECTION

The water demands for Barisal Pourashava are developed on the basis of data on present consumption obtained for each group of domestic and non-domestic consumers during the field investigations.

8.1 Area and population served

According to the Pourashava ordinance, 1977 under its compulsory function the Pourashava is supposed to provide or cause to be provided to its inhabitants an supply of wholesome water sufficient for public and private purpose with in the limits of the funds at its disposal. So, in principle, all the populated areas and the population therein are to be supplied with water by any means or system like hand pump tubewell, mobile supply or piped water supply. In the following sections (8.1.1 and 8.1.2) the area and population to be served for the plan period through piped water supply are discussed. The rest of the areas and population will be provided with hand pumps or other suitable sources of supply.

8.1.1 Area Served

For preparation of the water supply system master plan shown in Appendix-II up to year 2020 the areas to be served in future are carefully considered on the basis of the following basic approach.

(i) Basic Approach for selection of area served:

Population density, geographical and spatial conditions and the land use plan are considered for selection of the area served.

(ii) Population Density:

Barisal pourashava has been declared as divisional head quarters on 1st January, 1993. People of its surrounding are gathering in this town day by day for better urban life. So expansion of area taking place in the outward directions from the inner area of the pourashava. Density alone cannot be the criteria for selection of the area to be served. For certain areas having comparatively higher population density or where some public institutions or private establishments (if any) are planned by the land use plan will not be included in the area served if such areas are isolated or situated at far distance. On the other hand areas having lower densities but located within or close to the area served under existing water supply system will also be included in the future plan. At present area served is about 15.38 sq Km of the study area. The area planned to be serve up to year 2020 can be seen by the following table:

Table 8.1 Ward basis served area up to 2020

Ward No	Name of Ward	Gross area (sq. km)	Area served (sq. km.)	
			1999	2010
01	Kawnia	2.13	2.10	2.13
02	Amanatganj	1.69	1.62	1.69
03	Bazar Road	0.40	0.40	0.40
04	Mashjid Bari	1.21	1.11	1.21
05	Alekanda	2.83	2.50	2.83
06	Sagardi	4.23	3.89	4.23
07	Kalibari	1.17	1.17	1.17
08	Fakirbari	0.40	0.40	0.40
09	Zila School	0.40	0.40	0.40
10	Barisal Union	1.89	1.79	1.89
TOTAL			15.38	16.35

This ten wards of Barisal Pourashava covered under the existing water supply system and the adjacent area which will attain required densities has been included into the area served.

The area to be served thus selected covers an area of approximately 39.60 sq. km, Which is about 80% of the study area. The total population in the served area will be about 302588 by the year 2020.

8.1.2 Demography & Population Projection

In order to asses present & future demand of water for the planning period of 2020 correct projection of population among others is essential For estimating future population the following relation was used.

$$P_p = P_b (1 + r)^n$$

Where

P_p = Projected population in year n.

P_b = Base population.

r = Rate of natural increase per year.

8.2 Existing Mouza wise population projection and net residential density of the study area

Barisal municipality is the only urban area of the thana. It consists of ten wards 38 mahallas and seven adjoining mouzas as other urban area and occupying an area 39.60 sq. km. of which 16.35 sq. Km. is municipal area.

Tabel 8.2 Mouza wise Population Density of Barisal Pourashava:

Mouza Name with Geo-code	Area sq.km	H/H	Population			Sex Ratio	Density
			Total	Male	Female		
Barisal Municipality	16.35	30,504	170232	92982	77250	12	10 412
Ward No 01	2.13	5676	29144	15228	13916	109	13 683
806-Paschim Kawnia		761	3966	2046	1920	107	

33-Purba Kawnia		4915	25178	13182	11996	110	
Ward No.02	1.69	4.461	24809	13227	11582	114	14680
053-Amanatganj		1738	9783	5252	4531	116	
295-Charupan		1660	8361	4378	3983	110	
968-Town School		435	2584	1405	1179	119	
972-N.Amanatganj		628	4081	2192	1889	116	
Ward No.03	0 40	3127	15978	10140	5838	174	39945
188-Bazar Road		392	1651	1055	596	197	
242-Chack Bazar		224	931	702	229	307	
268-Char Hatkhola		987	4022	2413	1609	150	
386-Forrya patty		135	1124	956	168	569	
403-Hatkhola		1289	6955	3919	3036	129	
430-Jailkhana		120	1295	1095	200	548	
Ward No 04	1.21	2200	17277	10964	6313	174	14,279
376-Girza Mahalla		554	3000	1869	1131	165	
510-Katpatty		830	4550	2867	1683	170	
537-Maszidbari		816	9727	6228	3499	178	
Ward No 05	2.83	4082	23588	12131	11457	106	8335
287-S. Alekanda		2591	15376	8054	7322	110	
645-N. Alekanda		1491	8212	4077	4135	99	
Ward No.06	4.23	3766	20247	10959	9652	110	4707
080-S.M. College		165	1067	716	351	204	
107-Baiddapara		260	1445	732	713	103	
134-Bagura		952	5340	2792	2548	110	
314-S. Sagardi		378	3915	2021	1894	107	
779-W Bagura		507	2539	1313	1226	107	
860-W.Sagardi		479	2507	1308	1199	109	
190-N. Sagardi		665	3434	1713	1721	100	
Ward No.07	1.17	2488	13390	7083	6307	112	11444
457-Jhautala		234	1365	751	614	112	
484-Kalibari		733	3785	2038	1747	117	
591-Natun Bazar		141	776	383	393	97	
618-Nazir Mahallah		522	2942	1535	1407	109	
980-E.B.M.College		598	3092	1679	1413	119	
995-Professor para		260	1430	697	733	95	
Ward No.08	0.40	1110	5793	3119	2674	117	14483
322-Fakirbari		1110	5793	3119	2674	117	14483
Ward No.09	0 40	929	5388	3000	2388	126	13470
241-S. Zila School		350	2232	1269	963	132	
726-N.Zila School		579	3156	1731	1425	121	
Ward No.10	1.89	2665	14618	7495	7123	105	7734
026-Bagura Road		1128	6255	3232	3023	107	
053-Battala		231	998	532	466	114	
161-Barisal		560	3119	1590	1529	104	
564-Mu. Graveyard		225	1378	697	682	102	

752-Oxford mission		521	2868	1444	1424	101	
Adjoining Urban Area	23.25	5902	32514	17187	15327	112	1398
058-Baghia	0.90	286	1584	860	724	119	1760
277-Char Ulanghai	0.46	90	462	231	231	100	1004
285-Char Baria	4.08	648	3518	1767	1751	101	862
555-Kashipur	1.80	663	3515	1797	1718	105	1953
578-Khur Char	6.60	1360	7073	3761	3312	114	1073
848-Rua	0.96	217	1273	672	601	112	1326
856-Ruptali	8.45	2638	15089	8099	6990	116	1786
Total	39.60	36408	202746	110169	92577	119	5120

Source: Bangladesh population Census, 1991.

8.3 Water Demand

Water demand projection usually based on historic consumption level, population projections, settlement pattern, land use & service level. For assessing demand, both residential & non residential demand have been considered separately.

8.4 Assessment Of Water Demand For The Year 2020

For 2020, the domestic demand for Barisal town was considered 110 lpcd (from field survey) and for other demand 20% of domestic demand including loss was considered. So the per capita consumption rate is 132 lpcd. Total supply hour is considered 12 hours. Considering 2.5% population growth rate, the demand for the total population of 302588 nos is calculated to be 47966.50 m^3/day.

8.5 Water Source For The Year 2020

In Barisal town the potential surface water source is not considered as the source. The only source of water supply has been considered to be the ground water. The present

discharge from the production well is showing a declining trend. So for future the discharge from a production well is considered to be 68 m^3/h. For excessive use of ground water there might be mining effect on the ground water. Therefore during 2005 to 2008 a situation analysis of the ground water potential study will have to conduct. If ground water is not found feasible, surface water treatment plants could be constructed If surface water treatment plant is needed to be constructed, then the present system to be redesigned for the year 2015.

CHAPTER IX

WATER SUPPLY SYSTEM MASTER PLAN

GENERAL

To design a sustainable water supply system master plan for Barisal Pourashava at first wards no 6,7 & 10 have been taken on an experimental basis. Steps for the preparation of a master plan of water supply system with reference to these three wards up to the year 2020 has been described in this chapter. The plan has been developed based on projected population & considering the income levels of people in the area.

9.1 Water Supply Plan For Ward no 6,7 & 10

For planning a sustainable water supply system for Barisal Pourashava it was observed that urban growth tendency directed towards flood free land in areas where there are not only opportunities for job creation but also sufficient adjacent land for extensive residential development. The northern corridor in the Kashipur area & Rupatoli the southern along Patuakhali & Jhalakati road become the principal channel for urban growth in the long term. Now there are 10 wards in Barisal Pourashava with 5727 acres of lands among which ward no 6 (Sagardi) is the largest in size covering 1476 acres of lands. But population density & development work of this ward is very poor comparative to other wards On the other hand, ward no 7 (Kalibari) is smaller in size with 169 acres only. Its population density & development work is overwhelmingly higher than rest of the wards It is also important to mention that ward no 10 (Barisal) is the heart of the town & medium in size with 369 acres. Though its population density is high but development work is increasing minimally because in this ward scope for development is low. Now there are about 50,000 people in these three wards. Existing population, population projection for 2020 & income levels for these wards are given in Table 9.1

Table 9.1 Population Projection & Income Levels For three wards (Ward No. 6 , 7 & 10)

Ward No. & Name	Population 1991	Projected Population 2020	Income groups		
			Lower Income Group	Medium Income Group	Higher Income Group
Ward No. 6 Sagordi	20247	42469	3525	29176	9895
Ward No. 7 Kalibari	13390	28086	2331	19295	6544
Ward No. 10 Barisal.	14618	30662	2545	21064	7149

9.2 Assessment Of Water Demand Of Different Income Groups For 2020 In Ward 6, 7 &10

Now there are about 50,000 people in these wards. In 2020 total population will be about 10000 (considering incremental rate 2.5 %) & their water requirements will be about 30 laks gallon per day.(considering 110 Lpcd) Though water demand projection are usually based on historic consumption levels, population projections , settlement patterns ,& income levels respectively . But in this study from field survey 2001 it was observed that demand of water for upper income levels is about 148 LPCD, 100 LPCD for Medium income groups , & 60 LPCD for Lower income groups . Accordingly demand of water for different income groups for 2020 is given in Table 9.2 in those wards.

Table 9.2 Demand of water for different income groups in 2020

Ward No. & Name	Demand of water in the year 2020		
	Lower Income Group	Medium Income Group	Higher Income Group
Ward No. 6 Sagordi	211500	2917600	1464460
Ward No. 7 Kalibari	139860	1929500	968512
Ward No 10 Barisal.	152700	2106400	1058052

So total demand of water will be about 10948584 Lpcd, or 29 laks gallon per day. At present only 5 laks gallons of water can be produced & supplied in these three wards.

9.3 Existing Water Supply Facilities In Ward 6, 7 & 10

There are about 50,000 people in these wards To serve them there are 7 nos. of production wells & 2 nos. of O/H tank. Among the production wells discharge of Kazipara & Nazirmahalla production wells are very poor. These wells will have to be replaced. Rest of the wells are not in good condition. Those will have to be moderated also subject to their problems (like mechanical & electrical). At present only 5 laks gallons of water can be produced by these wells. Performance of existing wells & aquifer condition are given in Table 9.3.

Table 9.3 Existing water sources & their aquifer condition of ward 6,7 & 10

Ward No & Name	Production Well No. & Location	Depth (m)	Screen length (m)	Discharge "Q" (m3/h)	Remarks
VI Sagordi	Kazipara No-6	287.60	24.36	--	Replace
	Madrasha No-17	300196	28 85	13.68	Moderate
	Zero Point No-16	302.15	28.85	50.04	Moderate
VII Kalibari	Nazir Mahalla No-10	297.92	28.85	--	Replace
X Barisal.	Homio college No-13	298.05	28.85	90.90	Moderate
	Hatem ali College No-19	323	28.85	27.27	Moderate
	Gorostan Road No - 24	243.24	28.85	9.09	Moderate

Source : Field survey 2001.

9.4 Future Water Source Selection For Ward 6,7 & 10

In 2020, population of ward no 6, 7 and 10 will be about 101217 & to fulfill their water demand total water requirements will be about 10948584 liter per day or about 30 laks gallons per day for different income groups. So average per capita consumption will be about 108.17 lit/day. So for 2020, per capita water demand for Barisal Pourashava master plan design we may consider 110 liter/day, 20% of loss will have to considered. So the per capita demand rate is 132 lpcd. Total supply hour is considered 12 hours. To produce 30 laks gallons of water 5 nos of new production wells will have to be installed in these wards & 2 production wells at Kazipara & Nazirmahalla will have to be replaced.

Production hour will be 16-18 hours with an average discharge of 63 m3/h from each production well. Future water sources & amount of production are given in Table 9.4 for ward 6,7 & 10. Locations of these are shown in appendix i.

Table 9.4 Existing water sources, deficiency of water and future water sources selection for ward 6,7 & 10 in 2010 and 2020

Present Population	Present requirements of water	Present water available	Deficiency of water per day	Present no of production wells	Extension work requirements
48255	14 lak gallons per day	5 lak gallons per day	9 lak gallons per day	5	2 new production wells and 2 production wells replace

In 2010 water requirements and no of production wells for these wards will be

Present population	Population in 2010	Requirements of water in 2010	Requirements of Production wells in 2010
48255	74736	22 lak gallons per day	9 no

In 2020 water requirements and no of production wells for these wards will be

Present population	Population in 2020	Requirements of water in 2020	Requirements of Production wells in 2020
48255	101217	29 lakh gallons per day	12 nos

9.5 Planning for Water Supply system of Barisal Pourashava as a whole

So to fulfil the total water demand of 10 wards of Barisal Pourashava in 2020 it will be required to install an additional 20 new production wells. These for the year 2020 about 37 nos of production wells will be required to meet the demand including the existing ones. The design criterion used for planning the master plan network of Barisal Pourashava is given in Table 9.5

Table 9.5 Planning criterion for Barisal Pourashava:

Sl No	Item	Unit	Value
1	Population growth rate	%	2.5
2	Per capita consumption per day (2020)	Lpcd	110
3	Losses & wastage	%	20
4	Supply hour	Hour	12
5	Minimum pressure	M	3
6	Minimum peak factor	No	2.0

9.6 Planning Data For The Year 2020

To plan a sustainable water supply system for Barisal Pourashava the calculated design data based on planning criteria of table 9.5 is shown in Table 9.6

Table 9.6 Design data for the year 2020

Sl No	Item	Unit	Year		
			2001	2010	2020
1	Per capita demand	Lpcd		100	110
2	Loss 20%	Lpcd		20	22
3	Total per capita demand	Lpcd		120	132
4	Supply period	Hrs	4	12	12
5	Total population	Nos		236382	302588
6	Nos of production wells	Nos	17	37	37
7	Pipe lines	Km	140	210	210
8	Total demand	m3/day		34542	47966

Though in this plan for Barisal Pourashava it is assumed total that all the people within the pipe line coverage area would be dependent only on piped water, but practically many users have alternative sources of water like pond, HTWS etc to cope with their demand.

In the light of above considerations & to make the system sustainable by completing loops & by reducing number of dead ends, a pipeline network has been designed & presented in the following section. This design is based on the projected population of 2020. A growth rate of 2.5% has been considered for making the projection. The population of Barisal Pourashava grew at a rate of 4.23% between 1974-81 period and 2.07% between 1981-91 period. Growth rate during earlier period was a little bit higher while the growth rate during the latter period was a little bit lower. We thought it wise to consider a growth rate that reflects both the periods and thus arrived at a growth rate of 2.5% considering the whole period from 1974 to 1991.

9.7 Service Water Pressure

In the five district town water supply project DPHE'S practice was to key this pressure to 15m on 49ft, in order to allow the water to reach the roof tank of the consumers upto four story house. But actually in Barisal town now the pressure is so low that it even does not reach to consumer's ground floor level reservoir.

The Pourashava is supposed to supply water at least to the ground floor level of the houses, which requires minimum residual pressure (about 3m as for street hydrant), at the dead end of primary distribution mains. Here another major issue is pure water supply. It was observed that if consumers get water in their ground level or upper level tank they never wash their tank regularly so during non-supply hour dirty water of consumer's tank come back to the distribution mains due to back pressure. So for pure water supply it is preferable to keep the pressure up to maximum 3m or 10 ft.

9.8 Supply Hours

At present Barisal Pourashava is capable to supply a 4-6 hours water supply to its consumer daily. In the proposed master plant if 24 hours supply is practiced, the operational cost will be too high. A 12 hours supply period is assumed for planning of the system which will optimize the number of wells required, minimize operational cost and reduce the dia. of pipelines. Moreover, the 12 hours supply practice will allow the system to meet the demand level even beyond the designed demand level by supplying for more hours.

9.9 Redesign Of Distribution Network For The Year 2020

Presently the distribution pipelines in Barisal town is unplanned. So desired water pressure cannot be maintained. Water distribution system is now designed to meet the demand of the service area over a planning horizon. The design is based mainly on a specified level of service, which may be expressed technically in terms of minimum pressure in the system during peak demand. Pressure should be high enough to fulfill the demand of the consumers. But high pressure causes more leakage &loss of water.

In water distribution system, looped network is generally preferred due to its relative advantages as compared with branched network. A looped system is more dependable for the supply of water, as well as more suitable for hydraulic properties of the system. But in towns like Barisal, there are many roads where dead ends exist. In fact now there is no way of making loop. Therefore, the branch network cannot be totally avoided in Bangladesh. Similarly, the supply of water in most parts of the town is intermittent. For this, there is no scope of considering the average daily demand of the peak hour. However, as the system will work for the year 2020, it might be possible to bring the system under 12 hour supply system. For system redesign a peak factor 2 is considered.

The hydraulic analysis of network has been carried out using loop program (version 40) developed by the World Bank. The program is widely used for looped network simulation and least cost branched network design. The input data is organized by numbering each pipe and each node in the system & where necessary introducing pseudo nodes with zero flow. The input nodes (i,e wells , reservoirs) are marked with (+) flow while the demand nodes are marked with (-) flows. Then the length, diameter & Hagen - William co-efficient of each pipe & also the flow & elevation of each node are determined with several trials for balancing the Unbalanced flow. The capacity of the pipe lines are computed by using standard Hagen - William's formula. Upon completion of simulation, the output of the program provide length of pipe lines connection node numbers, flow velocity & head loss, hydraulic grade line (HGL) & residual pressure.

The detailed design of network includes pipe length, pipe diameter, pressure in the pipes, flow, head loss, pipe type used for the year 2020.

9.10 Street Hydrants

There are 756 Nos. of street hydrants in Barisal Pourashava. Wastage of water and impurification of water are occurring due to these street hydrants which are excessive in number. It is suggested that these should be transformed into community street hydrant for proper maintenance. People also support this view as shown in the table below:

Table 9.7 Willingness to pay Community S/H

	Frequency	Percent
Yes	28	84 8
No	5	15 2
Total	33	100 0

Source: Field Survey 2001

Table 9.8 Amount of Payment

Taka	Frequency	Valid Percent
5.00	19	67.9
10 00	6	21 4
15 00	3	10 7
Total	28	100.0

Source. Field Survey 2001.

From survey reports it was observed that 84.8% consumer agree to pay for community S/H and 67.9% consumers agree to pay Tk. 5/- per month for better and sufficient water supply. So for better and sustainable water supply system Number of existing street hydrants should be reduced and converted them as community street hydrants.

9.11 Metering

Barisal Pourashava existing water supply system is equipped with no measuring instrument. This allows abnormal volume of wastage, especially through consumer's household faucets since they would hardly care about the amount of consumption because of the lack of service water meters Moreover, any improvement of the water supply facilities including increment of the water supply capacity does not necessarily generate the increment of water revenues to the water supply agency, because water charge is levied on flat rate basis without relation to the amount of water consumption. To accomplish a sound management of the water supply, this situation must be corrected by metering. The installation is firstly planned for higher income domestic users, all non-domestic users and community street hydrants. Bulk meters are also recommended to be installed in secondary distribution pipelines for monitoring non-metered areas.

9.12 Minimize Loss & Wastage

The present water production capacity of Barisal Pourashava is about 27 laks gallons per day. Of this amount 27.33% of water is lost through wastage & leakage & about 3.67% of water remains unknown or unaccounted for. To plan a sustainable water supply system this loss will have to be minimized & be within 10-15%. To minimize loss & wastage the following steps will have to be implemented:

*Replacement of old & defective pipes, pipeline joints and sluice valves.
*Proper and regular maintenance of distribution network.
*Frequent checking of household overhead tank overflow and defective faucets and imposing penalty on consumers for repeated wastage.
*Using good quality taps in public street hydrant and should convert the street hydrant to community tap for giving responsibilities to the users.
*Need social motivation to bring awareness among people for preventing wastage of water
*Metering of all service connection.
*Each road should have only one distribution line. Other will have to be close and remove.
*Illegal connections will have to find out & legalize.

CHAPTER X

PROJECT COST & BENEFITS

10.1 Project Cost

The proposed sustainable water supply system plan attempts to provide water to all the inhabitants of Barisal Pourashava in manner as found suitable from the aforesaid analysis The study area covers 39 06 sq km of land to be occupied by 302588 nos of people by the year 2020. Incorporating the existing 14 nos of production wells & 140 km pipelines into the system, 20 nos of additional wells & 70 km of pipeline are proposed on a 12 hours supply system in suitable location to feed the distribution network designed to serve the estimated population. The salient features of the plan & major facilities to be constructed with their estimated costs are shown in the table 10.1

Table 10.1 Cost estimate for the implementation of the water supply system plan up to year 2020

Sl. No.	Items	Unit	Quantity	Unit rate Tk.	Tot in Tk.
	HAND PUMP TUBEWELL SYSTEM				
1	1½" dia hand tubewell	No	100	38,924.40	3892440
	SUB TOTAL (A)				3892440
	PIPED WATER SUPPLY SYSTEM				
1.	Land Acquisition	Acres	0.826	6 laks	9912000
2	CIVIL WORK				
	(a) Deep well	No.	20	1591304 0	31826088
	(b) Pump House	No.	20	1,80,000	3600000
	(c) Pump facilities power line Installation	No.	20	3,50,000	7000000
3	Distribution system				
	(d) Distribution pipe line				

	(Primary) 8" dia 6" dia	 Km Km	 10 20	 527000 336000	 5270000 6720000
	Distribution pipe line (Secondary) 4" dia	Km	30	164000	4920000
	(e) Replacement of 4" dia pipeline	Km	10	221000	2210000
4	Treatment Chlorination plant	No	37	2.25	83.25 laks.
5	Service system (f) House connection (g) Group tap connection (h) Convert street hydrant to Community street hydrant	 - No No -	 50 756	 3000 1000	 150000 756000
6.	Establishment Cost (i) Administrative building	 No	 1 two storied building of 3000 sft.	 800	 2400,000
	MATERIALS PLANT AND EQUIPMENT				
1	Flow meters	No	40	10,000	400,000
2.	Service water meter	No	12466	1500	18699000
3.	Meter testing Apparatus Leakage Control equipment and Misc. equipment	Per set	1	2 laks	2,00000
4	VEHICLE i. Jeep ii Pick-up iii. Water Lorry iv. Motor Cycle	 No No No No	 1 1 1 4	 1800000 600000 1900000 90000	 1800000 600000 1900000 360000
	CONSULTENCY SERVICE	e s	4%		4593318.72
	TOTAL				1194262867

Total Project Cost: 11.94 crore Tk.

Project costs are presented in table 10.1, all the costs are calculated in 2001 current price & unit rate of cost is obtained from DPHE, Pourashava & from present market price. Total capital cost for the project is Tk 119426286.7. This cost will be spread over a period of three years starting from 2003. Accordingly capital cost will be 2,00,00000, 6,00,00000 and 3,94,00000 for the year 2003, 2004 and 2005 respectively.

10.2 Operational Expenditure

The major operational expenditure of the existing system is on electricity consumption by the pumps & the establishment cost (Salaries & wages of employees). Maintenance & operation expenditure are very low compared to these two costs. The average expenditure on establishment per personnel was Tk 25854-/ per year in 1999-2000. The establishment cost is recommended to be within an average limit of 2% increase per year. Electricity bill to be kept an increase of 5% per year.

The expenditure made on maintenance & repair in 1998-1999 was 7.11% the total annual expenditure while in 1999-2000 it was 7.00%. The repair & maintenance cost is recommended to be kept within 10% of the total expenditure (Five district town project, DPHE)

Depriciation out of electrical equipment's like pumps & service meters etc. may be considered as 6 % annually. (Five district town project, DPHE).After the implementation of the project maintenance and operation cost would significantly increase. Project life is assessed to be 22 years from 2003 to 2025. Capital and operation and maintenance cost during this period are shown in table 10.2.

Table 10.2 Operational expenditure

Year	Capital Cost	Operating Cost
2003	20000000	11980680
2004	60000000	18880630
2005	39400000	20600000
2006		20800000
2007		21000000

2008		21200000
2009		21400000
2010		21600000
2011		21800000
2012		22000000
2013		22200000
2014		22400000
2015		22600000
2016		22800000
2017		23000000
2018		23200000
2019		23400000
2020		23600000
2021		23800000
2022		24000000
2023		24200000
2024		24400000
2025		24600000

10.3 Return From The Project

By keeping existing water tariff a sustainable system plan cannot be designed for Barisal Pourashava. The minimum water rate should be such that it covers up all the operational expenditure. Again for repayment of loans and generation of fund for future development work if required, the rates are to be increased accordingly but at the same time it should remain within the paying capacity of the consumers Existing water rate of Barisal Pourashava is very poor because it was introduced in 1990.Tariff rate must be increased if the project is to be made sustainable. We are not sure, however, by what percentage the tariff rate has to be increased. Three sceneries are considered based on the increase of tariff rate by 100%, 200% and 300%.Table 10.3 shows the returns based on increased tariff rates as mentioned.

Table 10.3 Expected Return From The Project

Year	Return Based On 100% Increase	Return Based On 200% Increase	Return Based On 300% Increase
2003	7438560	7438360	7438360
2004	8107380	8107380	8107380
2005	10265690	10265690	10265690
2006	20531380	35929915	41062760
2007	21057864	36851263	42115729
2008	21584311	37772545	43168620
2009	22123910	38716843	44247816
2010	22677007	39684763	45354008
2011	23243938	40676892	46487867
2012	23825038	41693817	47650064
2013	24420663	42736160	48841310
2014	25031176	43804558	50062334
2015	25656962	44899684	51313903
2015	26298386	46022175	52596747
2016	26955840	47172719	53911651
2017	27629737	48352039	55259442
2018	28320479	49560839	56640924
2019	29028498	50799872	58056957
2020	29754173	52069802	59508302
2021	30498044	53371576	60996040
2022	31260430	54705752	62520808
2023	32042003	56073505	64083950
2024	32843051	57475339	65686040
2025	33102035	58062354	67236840

10.4 Economic Viability Of The Project

A conventional cost benefit analysis has been made for assessing the viability of the project. The assessment has involved mainly financial analysis. This is alternatively referred to as Discounted cash flow method (DCF) or Benefit Cost Ratio (BCR) analysis method. In this project net present value (NPV), Benefit Cost Ratio (BCR) & Internal Rate of Return have been calculated for the three sceneries, that is, increase of Tariff rate by 100%,200% and 300%.This are shown in the table below .In such calculation discount (or interest) rate has been considered as 13%.It is obvious that the project becomes viable only when tariff rate increase by 300%, that is, three times .In that case project can be sustained even by borrowing from financial market. Otherwise the project cannot be sustained. For example, if we choose alternative 1,that is , increase of tariff rate by 100%, then we have negative NPV and negative IRR. In case of alternative 2 (200% increase) the situation is better because IRR is 11% and Benefit Cost Ratio is close to 1. But the NPV is negative meaning that at 13% interest rate cost cannot be recovered fully.

Table 10.4 Single-Value Measures Of Economic Viability Of Project

Alternative	Values in Taka					
	Project Life (years)	Discounted Cost	Discounted Benefit	NPV	BCR	IRR (in percent)
1.Increase of Tariff Rate by 100%	22	239,883,902	138,148,185	-101735717	0 576	- 4%
2. Increase of Tariff Rate by 200%	22	238,563,917	223,590,779	-14973138	0.937	11%
3. Increase of Tariff Rate by 300%	22	239,883,902	256,247,157	16363255	1.068	15%

10.5 Implementation Schedule, Phasing

Implementation authority of the Planing will be the Barisal pourashava, Barisal. They will have to take all the necessary factors of the plan viz. detailed design, tendering, procurement of component of auxiliary equipment, developing, testing and commissioning with the technical help of DPHE (if necessary).

The plan is phased into two main phases i.e. first phase (design) and 2nd phase programs (construction phase).

The first phase program is scheduled to commence in July December 2000 with Engineering services and detailed design of the project, followed by tendering and awarding of contract. The phase will end December 2001.

The second phase program is proposed to commence in January 2001 with the procurement of materials and equipment, construction of all civil works, and test operation and to be completed by December 2006.

Appraisal of feasibility of the project, funding arrangement and approval are scheduled in third and fourth quarters of 2000, which is followed by the engagement of engineering consultants for detailed design and tender. For design and tender stage 1.5 years is allowed. For procurement of materials and equipment and construction work, a total of five years is allotted.

Interim measures which shall be undertaken by the government on its own account are scheduled in 2000-2001.

10.6 Management and Development Control

On implementation of the plan, the water supply system to the Pourashava as usual for its operation and maintenance.

An efficient management system in all respect viz. technical, financial and administrative are to be development for smooth running of the system. The organizational structure of the existing water works system is to be reviewed and if

required rearranged on the basis of the evaluation of the capabilities of water works personnel. Gradual recruitment of new staff in accordance with projected expansion of services should be included in the staffing schedule.

A reliable and fairly efficient recording and reporting system is required for effective management. Management systems specifically geared to water works operations should therefore, be designed and implemented.

The Pourashava authority should execute its power in development control as regard to unauthorized land uses violating the land use plan which may turn the projected water consumption to be either under or over estimated. Any unauthorized new well, deep tubewell, water pump or any other source of water for drinking purpose must be controlled by the Pourashava in accordance with the Pourashava Ordinance, 1977 for a balanced utilization of the system planned.

10.7 Monitoring, Review

The plan, during both phases of implementation should be monitored as regard to any change or variation in the planning standard and criteria as was adopted for the plan. The unavoidable changes are to be adjusted and accommodated in the plan accordingly. The plan shall also to be reviewed at the interval of maximum two years with respect to its achievements on the targeted objectives and providing with necessary alternatives as required for the timely and economic implementation of the plan.

CHAPTER XI

SUMMARY AND RECOMMENDATION

11.1 Summary

At present water supply system of Barisal Pourashava is entirely by under ground water. There were 24 nos of production wells among which 14 nos of production wells are running to supply about 270000 people of Barisal Pourashava in 10 wards and 38 Mahallas by 140 km of pipeline & 6 nos of overhead tanks. The total service facilities of the Pourashava are mainly concentrated in the core area and are mostly dispersed in the peripheral zones. At present only 27 to 30 lakh gallons of water can be produced & supplied to the city dwellers. It was also surmised following extensive discussion, that about 77.8% of the total Population are receiving water from the 14 production wells connected to the present distribution network.Thus at present the total estimated deficit is about 40 lakh gallons per day. So to fulfill the total water demand of 10 wards of Barisal Pourashava in 2020 it will be required to install an additional 20 new production wells.

For the year 2020 about 37 nos of production wells will be required including the existing wells to meet the demand. Financial management of Barisal Pourashava water supply system is very poor. Initially 20-30% water bill remained uncollected. It is increasing day by day because people are not interested to pay bill as they are not getting sufficient water. People are sinking tubewells personally and would like to close the connection. On the other hand present water rates of Barisal Pourashava were fixed up in june1990. After that it was not updated for the last 12 years. The appropriate fixation of water rate is a very important factor for a sustainable water supply system as well as for giving quality services to the consumers. Survey report shows that 62.7% of the consumers of Barisal Pourashava are interested to pay 25% more tariff for better quality & sufficient water supply. On the other hand there are about 756 nos of street hydrants. Wastage of water & impurification of water are occurring due to these excessive number of street hydrants.

11.2 Recommendation

On the basis of the present study it can be said that the water supply system of Barisal Pourashava has serious deficiencies in terms of all aspects such as types of facilities, provision standard, performance standard, maintenance & management system, cost recovery system, etc.

Existing water tariff of Barisal Pourashava is very poor. Now water selling rate per 1000 gallon of water is Tk 7.04 and its operating cost is Tk 8.31(without considering capital cost).Tariff rate must be increased on order to improve the performance of the system. On the other hand quantity & quality of water supply also will have to be increased for the consumers. Total number of water supply sources should be increased by Barisal Pourashava. Moderation is also needed for existing water sources, especially which are not working properly. Tariff should increase after installation of some new wells & by providing sufficient pure water supply to the city dwellers

There are 756 Nos. of street hydrant in Barisal Pourashava Wastage of water and impurification of water are occurring due to these over nos. of street hydrants. Now most of these should be converted into community street hydrant for proper maintenance.

From survey reports it was observed that 84.8% consumer agreed to pay for community S/H and 67.9% consumers agreed to pay Tk. 5/- per month for better and sufficient water supply. So for better and sustainable water supply system number of existing street hydrants should be reduced and the remaining ones changed as community street hydrants. By this way, so called system loss & pollution in water supply can be decreased gradually.

Metering system will have to be introduced. Any improvement of the water supply facilities including increment of the water supply capacity does not necessarily generate the increment of water revenues to the water supply agency, because water charge is levied on the flat rate basis without relation to the amount of water consumption. To

accomplish a sound management of the water supply, this situation must be corrected by metering.

Maintenance & management systems need to be improved to make it efficient, & regular. Concerned officials who are engaged in management & maintenance systems should be more responsible.

In the year 2020, 80% of the total population of Barisal Pourashava are expected to have house or community tap connection. They will also have the ability to pay Taka 200 per month as water bill. At present the water rate is very low and the system is not self-sustainable. To meet the water demand by 2020 further investments will have to be made. But to make the system financially sustainable water rate will have to be increased by nearly 300%. Even after such an increase water rate will remain lower than the water rate (Per 1000 gallons) in Dhaka city.

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ATTITUDE SURVEY QUESTIONNAIRES
(QUESTIONNAIRE -1)

DEPARTMENT OF URBAN AND REGIONAL PLANNING
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA.

Questionnaire for survey of water Supply System for Different Income Groups of Barisal Pourashava.

(collected information shall be used for academic research only)

Name of the interviewer	Date	Time	Signature

1. Name of the respondent/ Head of the household:

2. Name of Road/Address:

3. Name of ward /Mouza:

4. General information of the respondents.

Age	Sex	Education Level	Occupation
Yrs Old	☐ Male ☐ Female	☐ Illiterate ☐ Primary ☐ Secondary ☐ SSC/HSC ☐ Degree & above ☐ Technical education	☐ Govt. Service ☐ Semi govt. Service ☐ Private service ☐ Business ☐ Student ☐ Public representatives ☐ Daily labour ☐ Unemployed ☐ House wife ☐ Others

5. You are owner of the house ☐ Tenant ☐

6. What is the monthly average income of respondent/ the family?

Ans:. Tk./Month.

7. What s the monthly average expenditure of the respondent/ the family?

Ans:. . Tk./Month.

8. Your monthly expenditure breakdown.

Expenditure per month	Taka
Food	
Houserent	
Education	
Clothing	
Transportation	
Medical	
Electricity	
Water	
Telephone	
Others	

9. Type & no. of houses of respondent/the family

Nature	Number of houses
Pucca	
Semi pucca	
Kutcha	
Mud	

10. How many persons live in this house of respondent / the house hold

Ans' persons

11. Where do you get water for household use ?

Supply water by Municipality ☐ Own Hand tubewell ☐

Street Hydrant ☐ Other than above ☐ (Pond/River/Khal)

12. Where do you get water for drinking?

Supply water by Municipality ☐ Own hand tubewell ☐ Street Hydrant other than above ☐ (Pond/River/Khal)

13. If the respondent / household use -

i) Municipal water by house connection then go to part A

ii) Water by owned hand tubewell then go to part B.

iii) Water by Municipal S/H then go to part C.

iv) Water from other than above them go to part D.

Part A. for Municipal house connection

a) What size of municipal connection do you have?

Ans: i) 1/2" dia ii) 3/4" dia iii) 1" dia iv) 1 1/2" dia

b) Is the water connection from the municipality of the household using legal / Illegal.

Ans: i) Legal ☐ ii) Illegal ☐

c) If the connection is illegal. Do you agree to legalize the connection?

Ans. - i) Yes ii) No.

d) What is your present water account no.?

Ans:

e) How much water is required for your house in gallons?

Ans: . . . .gallon/day.

f) Is the amount of supply water you are getting by municipality adequate for your family members?

11. Where do you get water for household use ?

Supply water by Municipality ☐ Own Hand tubewell ☐

Street Hydrant ☐ Other than above ☐ (Pond/River/Khal)

12. Where do you get water for drinking?

Supply water by Municipality ☐ Own hand tubewell ☐ Street Hydrant other than above ☐ (Pond/River/Khal)

13. If the respondent / household use -

i) Municipal water by house connection then go to part A.

ii) Water by owned hand tubewell then go to part B

iii) Water by Municipal S/H then go to part C.

iv) Water from other than above them go to part D.

Part A. for Municipal house connection

a) What size of municipal connection do you have?

Ans: i) 1/2" dia ii) 3/4" dia iii) 1" dia iv) 1 1/2" dia

b) Is the water connection from the municipality of the household using legal / Illegal.

Ans: i) Legal ☐ ii) Illegal ☐

c) If the connection is illegal. Do you agree to legalize the connection?

Ans. i) Yes ii) No.

d) What is your present water account no.?

Ans:

e) How much water is required for your house in gallons?

Ans: . . . .gallon/day.

f) Is the amount of supply water you are getting by municipality adequate for your family members?

l) (If yes) Regular and sufficient supply of water would depend on how much increase in water rate you can afford to pay. You can pay

a) Up to 25% increase
b) 25 to 50% "
c) 50 to 75% "
d) 75 to 100% "
e) above 100% "
f) No "

m) Do you have any complain about the existing billing system?

Ans: Yes No

n) If yes, What ?

a) Irregular billing system
b) False billing
c) Others (specify)

o) What measures do you think necessary for the improvement of the existing water supply system of Barisal pourashava.

a)

b)

Part 'B' for water by owned hand tubewell.

a) Was the tubewell sink by you/by municipality /by D.P.H.E./NGO/others ?

Ans:

b) Why you like to get water by tubewell?

i) For sufficient water.
ii) For pure water
iii) Municipal water tariff high
iv) Irregular water supply by municipality.
v) Other reason (Specify)

c) What kind of problem you face with the existing Hand tubewell system by which you get water?

i) Water does not comeout during dry reason.

ii) Little quantity of water discharge.

iii) Much manual labour.

iv) Head of the HTW not good.

v) Water quality not good.

vi) Others (specify)

d) Now using water by TW is municipal Tax free. If Municipality levy tax on HTW owned consumer then which one you will prefer :

i) Will pay tax & continue this system for sufficient water.

ii) Stop this system & will take connection from municipality?

iii) Will pay Tax & use water from both sources (tubewell and municipal connection).

iv) Others (specify)

Part C For water by Street Hydrant

a) Is the street Hydrant established

☑ by Municipal authority as free of cost.

☐ by users as community tap.

☐ by land owner as personal donation.

☐ others (specify).

b) Why you take water by S/H?

i) Water is pure and free of cost

ii) Cann't afford Municipal house connection personally.

iii) Cann't afford Hand T/W personally.

iv) Others (specify)

c) What kind of problem you face with the existing supply water?

i) In adequate of supply water

ii) Too many people sharing this water.

iii) No bib cork.

iv) No caretaker for maintenance.

v) Others (specify).

d) If this free S/H is converted to Community S/H for better service would you agree to pay some taka as bill to the municipal authority?

i) Yes ii) No.

e) If yes. then how much you will be able to pay?

Ans:. . Tk./month.

f) Do you think the location of the street hydrant / community tap is suitable?

i) Yes ii) No.

g) If no. why?

Ans:

h) How many number of families are using the water of this S/H or community tap?

Ans: . . . . . nos.

i) Do you think this number is very high ?

i) yes ii) No.

j) If yes. what should be the maximum number of families to use this S/H / community tap?

Ans: . . . . . nos.

<u>Part D. water for other sources like ponds, canals, khals etc.</u>

a) Do you use this water for ?

i) Household use only ☐

ii) Drinking purpose ☐

b) Why you use this water for drinking purpose?

i) No TW nearby ☐

ii) No Municipal pipe line ☐

iii) Others (specify)

c) Do you know if you use this water for drinking purpose that may hagerdous for your life?

i) Yes ii) No.

d) If yes, do you like to get water from ITW of municipality by some contribution money?

i) yes ii) No.

e) If yes, then how much you will be able to pay.

Ans:. . . Tk. per month

APPENDIX - 'F'

KIRTANKHOLA RIVER

WARD No-6 (SADAR)

LEGEND

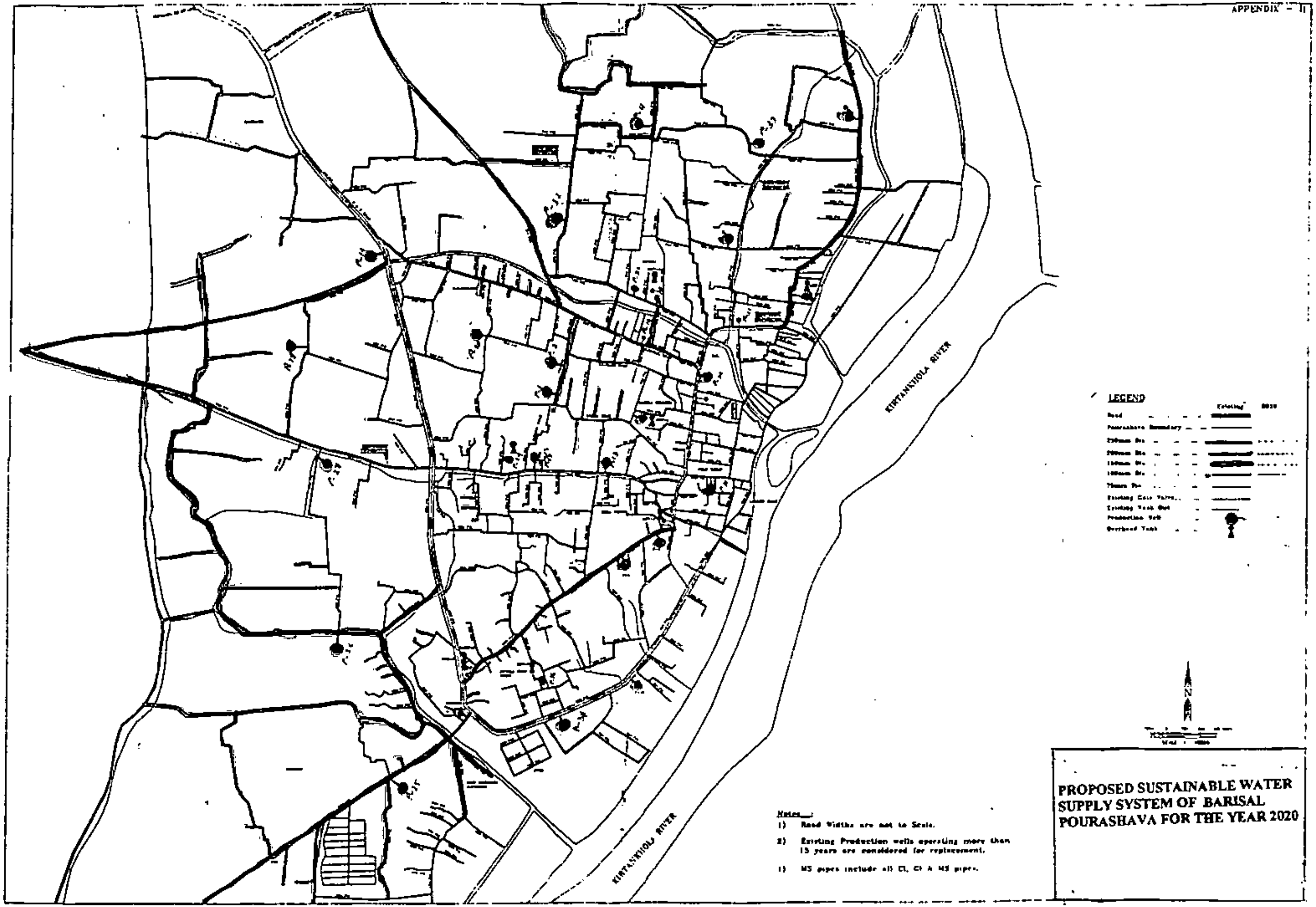
Notes :-

1) Road Widths are not to Scale.

2) Existing Production wells operating more than 15 years are considered for replacement.

3) MS pipes include all CI, GI & MS pipes.

PROPOSED PRODUCTION WELL AND PIPELINE LOCATION OF WARD NO 6,7 AND 10 OF BARISAL POURASHAVA FOR THE YEAR 2020



PROPOSED SUSTAINABLE WATER SUPPLY SYSTEM OF BARISAL POURASHAVA FOR THE YEAR 2020