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Causes, effects and recommendations to combat marine pollution in the river Karnaphuli and the estuarine water

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The Causes, Effects and Recommendations to Combat Marine Pollution in the River Karnaphuli and the Estuarine Water.

By

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BANGLADESH

A paper submitted to the faculty of the WORLD MARITIME UNIVERSITY in partial satisfaction of the requirements of the MARITIME EDUCATION (ENGINEERING) COURSE.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the UNIVERSITY.

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Ziauddin
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1983

Dedicated To My

Beloved Parents.

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Preface:

The widening interest in Maritime activities has led to the establishment of the World Maritime University.When in 1983,I joined World Maritime University,I was very much enthusiastic about the problems of Marine Pollution.I was also greately impressed by the activities of International Maritime Organisation (IMO) to stop Marine Pollution at sea.

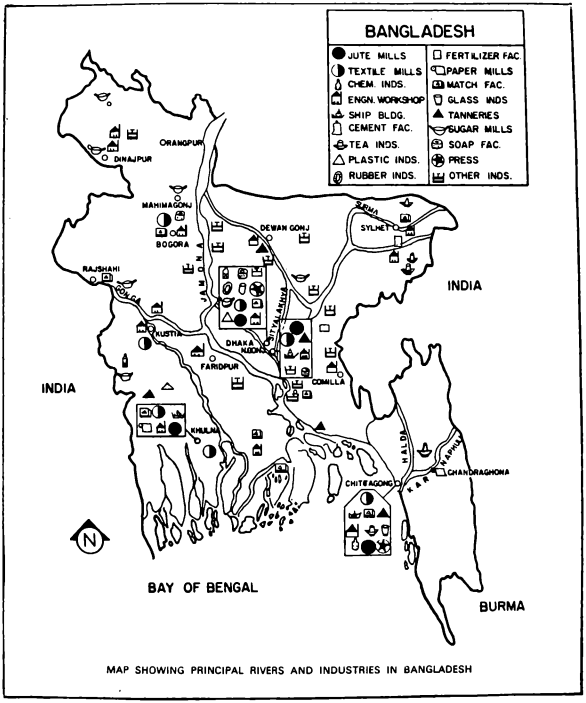
In my formative years as a Marine Engineer at sea,I spent a good deal of time seeking informations on Marine Pollution.

The present investigation was undertaken to evaluate pollution caused by various sources and those long term effects and dangerous materials which could produce a threat. Research on problem of Marine Pollution is a social obligation as it effects the living resources.It is understood if the pollution is not stopped,the species of fish-eating feathered creatures will be condemned to extinction along with other Marine life.We can hope that the obvious dangers to Marine life and the health problems for man,eating sea food and swimming in the sea,have been identified.These problems could be solved with existing technology.My prognosis is,-however only valid under the condition that reasonable measures taken.I have tried to present the soientific evidence in a way that can be checked and criticized.

I am greately indebted to those who over many years have generated the body of knowledge that I have attempted to bring in my paper.I especially wish to express my gratitude to prof.C.E. Mathieu,course professor,Maritime Education (Engineering),WMU,for

his encouragement,guidance and helpful comments on the manuscripts.Lastly,I also like to thank my wife,Mrs.Yasmin Zia for her constant encouragement,for her assistance in preparing the manuscript and for her patience throughout the papers development.

Malmo,April 1985. Mohammed A.M.Ziauddin



MAP SHOWING PRINCIPAL RIVERS AND INDUSTRIES IN BANGLADESH

Abstract:

This document deals with the aquatic pollution in the river Karnaphuly and its estuarine water.It summarizes some of the problems that now exists concerning agricultural,industrial and domestic pollution.The water pollution in the river karnaphuly is reviewed using published papers,reports and books.The port city of chittagong,principal source of domestic and industrial pollution situated on the right bank of the Karnaphuly river.The nature and sources of pollutants with their possible effects on this river water and qn aquatic organisms are covered and recommendations are made for the control of pollution.

1.Introduction:

Bangladesh a small and densely populated country of 55,598 square miles lies in the north-eastern part of the sub-continent.The Karnaphuly river,one of the major rivers of Bangladesh,originates from Lushai Hills of Mizoram union territory, India.After covering a distance of about 170 miles in south and south western direction through Chittagong Hill Tracts and Chittagong district,it empties into the Bay of Bengal about 9 miles below the Chittagong city.The port city of Chittagong is situated Latitude:$22^{0}18'45''$N,Longitude:$91^{0}46'30''$E in the north,and Latitude: $22^{0}03'13''$N,Longitude:$91^{0}50'00''$E in the south.The Karnaphuly river receives on its right bank the important Halda river.

Bangladesh is a low land having innumerable numbers of rivers,canals,lakes,ponds etc. with a coastline of about 430 miles around the Bay of Bengal.It is a village oriented country.About 75% of the people are engaged in agricultural activities.The main agricultural crops of Bangladesh are jute, paddy,sugarcane and tea.The fish industry is also being developed with considerable significance to the economy.

Quality of water is essential for the production of crops,fisheries,aqua-marine plant and safe environment for the human health condition,but to protect the water free from pollution is not receiving much attention in Bangladesh.The use of agro-chemicals,such as fertilisers,insecticides and fungicides in the crop-field,a common practice,has adverse effects on the aquatic fauna.Morever sewage and industrial wastes have been dumped without treatment,which also effects the water quality and finally the

aquatic ecosystem.

The marine environment and the living organisms which it supports,are of vital importance to humanity and all people should have an interest in assuring that it is so managed that its quality and resources are not impaired.Morever,the capacity of the river and sea to assimilate wastes,oils etc. and render them harmless and its ability to regenerate natural resources,is not unlimited.All people should pledge themselves to take take all possible steps to prevent the marine pollution of the water by substances that are liable to create hazards to human health,to harm living resources and marine life,to damage amenities or to interfere with other legitimate users of the river and sea. We are not merely live for ourselves,but also for the future generations.Hence we meet as trustees for all life on this planet and for the life in the future.

Pollution of wastes has been going on in Bangladesh for quite a long time as no law enforcing agencies pay much attention to this.In the recent years,due to the population grouth and industrial activities,the pollution has become wide spread. The major rivers including Karnaphuly,Buriganga,Sitalakhya,Meghna, Rupsa and Surma rivers,are very badly polluted.As most of these rivers originate from the neighbouring country,India,co-operation between India and Bangladesh to combat marine pollution is of utmost important. Information regarding the nature of pollutants, self-purification capacity of the river,extent of damage etc.are very scanty.Environmental pollution control experts (WPCP 1975) (EPC 1980) undertook extensive studies on the water bodies chemistry.

An extensive survey was made of the industrial areas and the chemicals used by different industries (EPC 1980a). Qader (1976), Kabir and Begum (1978),Mohsin (1979),Rahman et al (1980),Paul (1981),Bhouyain (1979) and Kabir and Ahmed in 1979 worked on the subjects.Bhouyain also published a fishing information bulletin in 1983.this paper is mainly based on the aforesaid papers plus some other reports and seminers.

2.Sources of pollution and thier possible effects:

Marine pollution is the introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuarine) resulting in such deleterious effects as:harm to living resources, hazards to human health, hindrance to marine activities, including fishing, impairing the quality for use of water and reduction of amenities. It may also be defined as anything we do not want in the water if it harms us or the plants, fish or animals we care for, if it offends our senses of sight or smell and if it interferes with our activities.

The principal sources of pollution in Karnaphuly river may be classified as follows:

2.1 Atmosphere.

2.2 Industrial Effluents.

2.3 Sewage (Domestic Effluents).

2.4 Agricultural wastes.

2.5 Natural Pollution.

2.6 Oil pollution.

2.7 Problem due to Environmental Alteration.

2.1 Pollution from atmosphere:

The atmosphere is a transporting agent for harmful substances.Atmosphere is being continuously polluted by the industrial,by automobiles and by ships exhaust gases.The principal gases are carbon monoxide,carbon dioxide,hydrochloric acid,sulphur dioxide and nitrogen oxide.The chemical industry produces,from chlorine,simple volatile chlorinated hydrocarbons.During the rainy season,the gases dissolves in rain water and run off to the Karnaphuly river.

A report recently published by a house of lords select committee has called for Britain to take "immediate steps" to cut acid rain. The air pollution report is the result of evidence from large industrial plants, such as power stations.On EEC proposal sets out to reduce sulphur dioxide emissions from power stations by 60%.But the central electricity generating board (CEGB) says that to do this would mean fitting desulphurization equipments to her plants.This will reduce the sulphur dioxide emission by 30% by the year 2000.

The report-the strongest internal pressure yet on the British Government to act on acid rain-favours the installation of pressurised fluid bed combusters. This method would tackle the promlem of Nitrogen oxides emissions. and would create fewer problems with the disposal of waste sludges.

New York state in the U.S.A has gone it alone in a legal bid to combat acid rain.The state has become the first in America to introduce specific legislation aimed at cutting down the

acid rain problem by controlling levels of industrial sulphur emissions.As a result,by the end of this year,scientists must identify with sections of the state,one of the most heavily forested in the country, are sensitive to acid rain.They also have to decide what level of sulphur deposition can be tolerated in water and vegetation at these sites.Sulphur dioxide,is thought to be the primary cause of acid rain.The state's new rules also lay down that by 1986, New York must have a set of regulations governing oil and coal burning power plants and factories which will take effect two years later.

Scientists have calculated that 499 mountain lakes in the state are suffering from acidification at varying levels and forests in the region are not growing as fast as they used to, as acid rain leaches nutrients from the soil.

To control such harmful gases escaping into the atmosphere is practically nil in Bangladesh.These dissolved gases obviously effect marine environment.Not much research has so far been made to determine the extent of pollution from this source.

2.2 Industrial Effluents:

Bangladesh has more than 8000 small and large industries in different areas.Among these,the major wastes producing industries are paper and pulp mills,Rayon mills,Tanneries fertiliser factories,pharmaceutical industries,jute mills,rubber processing industries,chemical industries,oil refineries,machine tools factories,ship building industries,soap factories slaughter houses etc.Most of these industries demand clean water for thier

manufacturing purposes and so have been established on the banks of the rivers where the water is easily available.This location pattern also facilities the transport of incoming raw materials and outgoing finished products.

The port city,Chittagong,which is situated at the bank of the river Karnaphuly,has four large industrial areas, Foujdarhat,Sholashahar,Nasirabad and Kalurghat with approximately 80 industrial units representing 12 textiles mills,12 tanneries, 3 oil mills,4 rubber plants,2 bone cutting factories,4 soap factories,10 tin and aluminium factories,1 refinery,1 steel mill and various other kinds of small factories.Most of these industries use bleaching powder,lisapol,hydrogen peroxide,different acids,alkali salts,linse dyes,pigments,aluminium sulphate etc. for thier manufacturing process.EPC 1980a stated that these industries discharges large quantities of organic wastes containg wood chips,pulp and waste row hides with inorganic chemicals without any treatment into the surrounding water,which ultimately find its way to the Karnaphuly river. Most of these industries do not have any waste water trestment plant and a few have non-functional treatment plant or facilities which are not at all effecting in the removal of pollutants.These are volumes of organic wastes undergo rapid decomposition and change the chemical characteristics of the river water by producing large quantities of toxic substances and other products of decomposition and also by reducing the quality of dissolved oxygen.The national technical advisory committes stated that under extreme conditions the dissolved oxygen concentration may be as low as 4 to 5 mg/l for short period./Reduced dissolved oxygen (DO) below 3 mg/l delays hatching of fish eggs,interfere with growth rate and also decreases tolerance to certain toxicants.

Additionally there are many industries outside of the city area.Some industries are also established on the right bank at Chandraghona (KPM ,KRC),Kowkhali (Jute mill) etc. Bhouyain (1979) worked on the effect of Karnaphuly paper mills (KPM) and Karnaphuly rayon mills (KRC) wastes on the biology of the river. These industries discharges more than 10/12 million gallons of untreated waste water daily into the same river,resulting in mortality among fish in a five mile stretch down stream and one mile upstream from the mill (EPC,1980a).As per Bhouyain 1979, the manufacturing process of KPM is "sulphate process" and KRC is "xanthation process" where the principal chemicals used are (a) sodium sulphate (b)sodium hydroxide (c) sodium hypochloride (d) chlorine dioxide (e) sodium sulphide (f) chlorine (g) sulphuric acid (h) hydrochloric acid (i) mercury (j) sodium carbonate (k) calcium carbonate (l) calcium hydroxide and (m) china clay.

At Chandraghona,the Karnaphuly river receives a large volume of paper mill wastes (0.35 tons of china clay and 1 ton of cellulose fibres) daily along with effluents which contains toxic chemicals.Bhouyain (1979) while studying noted a foul smell of mercaplanes with approximately 3.5 inches thick soapy froth which was floating and covering a large area of the water surface around the discharge drains.It has also been found that the cellulose fiber formed a thick layer like blanket on the bottom bed of the river which peeled off and again get mixed up with the river water.The water colour of the river also changes from time to time according to the colour of the effluent discharged by the paper mill.

Near Kalurghat,the river water recoeives effluents from tanneries,food processing industries,packaging factories etc.

This river receives huge quantities of untreated sewage,industrial wastes and domestic wastes from the industrial city of Chittagong (Mohsin1979, WPC 1975, EPC 1980a).The deleterious effect of these wastes call for immediate measures to solve this river for future use.Bhouyain (1979) observed drastic changes of the bottom bed fauna at the polluted area,composed of mainly oligochaete organisms along with few polychaetes,mollusces and chironomid larvae.The pollution sensitive species were totally eliminated from the vicinity of the effluents drains.He also noted characteristic changes of the water quality at the polluted areas as compared with the controlled region.It should be noted that the paper mills authority use mercury in their process,which also present in the paper mills effluents.

Industrial effluents are as diverse as industrial products.Many of the above mentioned industries discharges mercury with their effluents.Paper and cellulose plants used to protect their products against fungi with mercury phenylacetate or other organic mercury compound (garlack 1981).Liquid wastes from such a plants contain mercury.The chlorine and alkaline electrolysis plants discharges mercury with their effluents (for the production of diaretics anti septics etc.),paint industries (mainly for the production of anticorrosive)contains mercury.Some organo-mercurial fungicides at 0.1 PPB may reduce the photo-synthesis and plankton growth.In japan,between 1952-1960,many people died due to Minimata desease caused by the intake of fish which had accumulated mercury at danger level.In Bangladesh no report is available regarding the concentration of mercury in the fish.FAO/WHO limit 300/ug of mercury per week of which 60% must be methyl mercury for human consumption.It is evident that over a period of many years mercury has

been released into the marine environment,it accumulates not only in organisms but also in the sediments.

Since 1977,the European community has been directing its efforts to prevent the release of more than 0.5 g of mercury per ton of chlorine from new plant, 0.1 g from plants already in production,into the environment via waste water.

This seems to be technically possible and economically feasible and will result in minimal mercury concentration from industrial plant in coastal areas.The mercury contents in The Thames was reduced by 75% ín 6 years.To free coastal areas completely from contamination by mercury, additional means would have to employed because mercury is even introduced into estuaries by domestic effluents (Gerlack 1981).

The Karnaphuly river exposed to serios pollution from some other heavy metal industries.They are stable compound not readily removed by oxidation,precipitation or any other natural proocesses.In upwelling regions,sea water from deep sea comes in contact with the surface layer of the sea,and a good supply with nutrients and energy from the sun stimulate blooms of planktic algae.However,sensitive dinoflagellate algae cannot develop before more resistant diatom algae have conditioned the sea water by excreting organic compounds.It is a hypothesis that such organic compounds have a chelating effect on ions of heavy metals and decrease their toxicity.If this hypothesis is correct,the natural concentration of some heavy metals in clean,unpolluted sea water are toxic to marine life and certainly double concentration would be more toxic.However upto date it is not olear which of the dif-

ferent highly toxic element in sea water could be responsible for the toxic effect of fresh upwelling water:besides mercury it could be copper,cadmium,lead or some other heavy metals.

A commission of experts of world food and agriculture organisation (FAO) and world health organisation (WHO) came to the temporary conclusion in 1972 that the tolerable amount of cadmium for human is not more than 0.0075 mg/kg body weight or 0,5mg per person per week.Agricultural products contaminated by fertilisers which contain up to 30 mg/kg cadmium are very much controversial subject.

Lead is not as toxic for marine organisms as mercury or cadmium.Usuaally values of around 0.1 mg/l are indicated as threshold at which adverse effects become apperant.Lead can find its way into estuarine from road run off, from lead mine dust, from paints and from weathering of lead surfaces mostly via rivers.But in Bangladesh hardly any research has been done to find out the contents of cadmium or lead in the estuarine water.

/ Perhaps the most serious form of pollution in the estuarines is that is a decrease in the oxygen contents of the water. This condition can be achieved in three somewhat distinct ways.Some pollutants are discharged in a reduced state and are then oxidised by contact with a medium containing oxygen.Others are capable of being oxidizing by bacterial action.The third Category is That due to Eutro-phication.

Effluent from pesticides plants is a another cause of severe water pollution.The chemical factory of Barabkunda manu-

factures DDT and CIB on a commercial scale and they minimise their waste problem by discharging into the near by canal without any treatment.These pesticides plants effluents such as DDT and BHC are poisonous and are responsible for the mortality of many fish and other aquatic organism.The lethal dose is the concentration of 0.004 mg/l.

Continuous discharge of residuel heat from large industries also effect the marine life.Marine life is found in temperatures range from -2^{0}c in the Antarctic and in deep sea regions to 40^{0} - 50^{0}c in topical shallow areas with strong exposure to the sun's rays.However,temperatures between 32^{0}c and 34^{0}c have a fatal effect on most tropical marine life.Basically,it cannot be said that marine life flourishes better at low temperature than say, at 28^{0} c.On the contrary,metabolism, growth and reproduction are more intensive at higher temperatures.

Every increase in temperature causes an increase of the flow of energy in the ecosystem similar to the increases that occur in chemical process at elevated temperatures. Primary production -that is photosynthesis- is increased modestly. But the consumption of plant food by animals and rate of degradation of deadorganic matter by bacteria is increased even more. The result of this activity is increased respiration,in other words,increased consumption of oxigen.One could estimate how an increase in temperature effects the various components of an ecosystem,because one can apply the reaction rate role (Reactoin time,approximately doubled at a 10^{0}o increase in temperature)to the activity-temperature correlations as one does in chemical process.Gerlack in 1981 mentioned that in the Gulf of Mexico a study was done and it was found

that the phytoplankton biomass turnover rate was 5 days,24h faster than it was in the unwarmed area. The zooplankton was somewhat more numerous in the heated lagoon,the Benthos somewhat less than in the comparison area .

Under the restricted conditions in estuarines,the oxygen level assumes a key position.Increased temperatures work in the same direction as an increased organic stress.At higher temperatures,the metabolism of bacteria accelerates and thier oxygen consumption inoreases. At the same time, the physical dissolubility of oxygen in warm water is less than in cold water.If warm water is going to be introduced,without additional damage to the ecosystem, care must be taken through treatment plants that the organic load is lessened in domestic effluent.

There is, by the way,a harmful side effect on cooling water passing through a power plant. High flow-through speeds require effective pumps.Plankton is partially destroyed by these pumps.Supposedly,it is best to use larger quantities of water for cooling so that they can flow more slowly through these cooling system,because many estuary organisms can tolerate a brief period in water up to 10^{o}c warmer that ambient water.

2.3 Domestic Effluents or sewage:

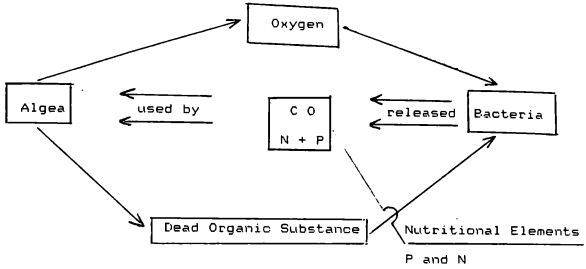
The domestic effluents or sewage is a complex mixture of inorganic or organic matters.It consists of spent water from bath rooms (detergents or soapy water ,kitchen ,food materials, dirty water),lavaratories (urine and faces) and sometimes may contain harmful matters (bacteria,viruses and pathogenic pro-

tozoa).

Man like all animals,consumes organic food stuff and leaves undigested organic remains in his faces. In the preparation of his food organic substances are also left over as garbage, whether in the commercial processing foodstaffs or as house-hold waste. In natural envirinments,decomposes exist:organisms which specialize in the breaking -down of a dead organic substances.More precisely,they are organisms which satisfy their energy needs from dead organic substance.For the most part they are bacteria and micro-fungi.

Under ideal conditions,the cycle of carbon and oxygen is balanced in nature (as per diagram) .When effluents from a city are introduced into a body of water,this means an additional supply of dead organic substances and the quetion is whether or not it can be absorbed by nature.The number of bacteria in bodies of water can respond to the amount of available organic substances (to thier food).However ,bacteria consumes oxygen in thier respiration process. One unit represents the amount of oxygen that is consumed to break down during a 5 days'experiment the readily degradable fraction of the faces and the garbage produced by 1 person per day.

This figure is called Biochemical oxygen demand (BOD) Under ideal condition,the cycle of carbon and oxygen is balanced in nature, when additional effluents are discharged in the water, the balance is disturbed due to Bio-degradable organic substances and Bio-chenical oxygen demand (BOD) increases.On the other hand,it reduces the level of free oxygen creating a hazard for marine life.



The above diagram simplified schematic of the circulation of oxygen and of Nutrients. The rate of animals in the circulation of substances has been omitted . Attention is focused on the contribution of dead organic material and nutrients which domestic effluents may support.

When the domestic effluents are biodegraded by bacteria,not only carbon dioxide and water,but also nitrigen and phosphorus are released as inoganic compounds which were originally contained in the protein component of plants and animals.Nitrates ,Phosphates. and other salts are nutrients essential for the growth of plants.The circulation of matter in nature functions only when these nutrient salts are continuously released.Without them,no plant growth could take place.However ,it is too much of a good thing when more nutrients are introduced into bodies of water than are used for good plant growth.As a result,these bodies of water are genuinely over fertilised,not eutrophized but hypertrophized, with the result that too much a plant growth results.If a farmer fertilized without farming ,nothing but weeds would be the

result.In the sea ,weeds cannot be pulled up. As a result of over--fertilization ,a flora results which is not always desirable because it displaces the normal algae flora.

The purification of effluents by waste water treat-ment plants has only a limited effect on this transportation of nutrients.Biological treatment plants hold back only around a third of the phosphorus ,because waste water bacteria set phosphorus compounds free in dissolved form.Only by special chemical methods of waste water purification,by precipitation with ferrous or aluminium sulphate, can nutrients effectively be removed from effluents.

Detergents or tensides are defined as substances which reduce the surface tension of water.They are effective in wash powder.For several decades they have played a large role in households and industries As a result of bad experiences with persistent compounds, law now exist specifying that wash powders must be to a great extent biologically degradable. It is however, a fact that various compounds of tenside are poisonous in concentration over 0.1 mg /l (garlack 1981).This is, among other effects, because the change in the surface tension of water also influences the transfer of substances in and out of organisms.

The city area of chittagong has no sewage treatment system.Generally,the sewages or domestic effluents are stored in large septic tanks after collecting the sewage from service latrines nearby.The chaktai khal originates from Baizid bostami and chittagong cantonment area and travels most of the areas of the city and finally falls into the Karnaphuly river. It receives all types of waste materials from small industries, factories,domestic

and municipal users and markets. Service latrines outlet are directly connected with this canal in most of the areas.It also receives wastes from the medical college clinic, hospital and slaughter houses.Morever ,all the solid wastes collected by the chittagong municipal workers used to be dumped into a populated area near chittagong medical college.No measure used to be taken to destroy the infections organism before the dumping.During the rainy season,the water washes the wastes from the dumping area and carries the infections deseases throughout the whole area.Recently, the dumping site has been changed to some other place.

Any way,all these wastes ultimately find thier way to the Karnaphuly river.Four drains from different areas of the city are connected with this canal at Chaktai, Anderkilla, Chandanpura and Kapashgola areas. The Chaktai khal receives large quantities of sewages of complex nature,waste water, market wastes etc. from different part of the city through these four drains. Mohsin (1979) reported large quantities of E. Coli from water bodies. The Condition of rural areas are more grave.Generally the facel matter left on the ground near canals or ponds that finally is washed by rain water to the river during the monsoon period. Ahmed (1979) stated that the rate of facelly transmitted deseases in Bangladesh is the highest in the world. A UNICEF / WHO counrty wide random sample survey in december 1976 reported that the overall incidence of reported diarhoes was 4.7 %. Nearly 20 % of the deaths among infants is accounted by diarrhoeas desease.

2.4. Agricultural wastes:

Due to the technological development in the agri-

cultural sector, a remarkable quantities of pesticides, insecticides and fertilisers are being used to obtain higher crop production. The residue of these chemicals come in contact with the rainy water every monsoon and finaly the solution finds its way into the river and ultimately to the sea.

As Bangladesh is an agricultural dependent country of more than 0.12 million acres of agricultural land crisscrossed by innumerable canals and rivers. For cultivation of crops, irrigation is a positive necessity in our country.Agriculture in general effects inland water in three different ways.Firstly, cultivation leads to loss of soil and so increasing silting. Secondly ,fertilisers are leached out into the streams and then,thirdly,they increase the rate of Eutrophy and insecticides effect the aquatic fanna.

According to the directorate of plant 5,577.29 tons of different chemicals were used in the year 1981 -82. DDT ,a most effective insecticides, has been banned in many countries due to its deleterious effects on other animals. While in Bangladesh DDT and CIB are being used exensively. These insecticides or pesticides are sold in the open market and the farmers using them have no knowledge of proper handling and care.

Many authors like Yonus & soon (1970), Kabir & begum (1978), Henderson & pickering (1957). well established the toxilogical effect of these insecticides on the aquqtic environment. Kabir and Ahmed (1979) observed that Padan, even within the recommended field dose effects the fish Anabas Testudineus and concluded that Furadan and Basudin (insecticides commonly used in

Bangladesh),although found to be apparently harmless at thier recommended doses,can effect the fish if the doses is exceeded. Klein (1962) stated that some agricultural chemicals are extremely toxic to birds, mammals and fish. And thier wide spread use can cause pollution of the rivers and fish mortality especially after rain. Hynes (1960) points out that both sprayed and dusted insecticides inevitably reach the rivers where some of them caused deaths of fish and thier food source.

In 1976 (Garlack 1981) all sea gulls and cormorants of Los Angeles zoo died from DDT poisoning ;sea gulls had 430 mg /kg DDT in thier brain, cormorants 220 mg / kg. Mullets (Mugil) off the pacific coast of Guatemala had amounts of DDT up to 36mg / kg. After shrimp had first died off, dead mullets were observed . The cotton fields which were located directly on the coast had been intensively treated with DDT (Keiser at el 1974). DDT was used in large quantities as a pesticides in the orchards all around the Sogne Fjord in Norway up untill 1970. As a consequence,the liver of cod from the Sogne Fjord may not be used for human consumption. In Bangladesh very scanty reports are available regarding the contents of DDT or other pesticides in the fish.

The washed fertilisers sometimes increase the total nutrients contents of the adjacent khal,lake or river. This cause unwanted troublesome growth of some plants. Mackenthun (1969) states that as nutrients concentration increases,the number of algae cell also increases, which may create a nuisance. It has been shown that the presence of even small quantities of phosphorous compounds is important in causing development of algae blooms, which under go decomposition and so can cause damage to fisheries.

According to BADC (1982) reports a total of 7,27,000 tons of fertiliser, comprising Urea 4,38,823 tons: Tsp (g) 1,39,220 tons:HP 329 tons : NPK 7,506 tons : PS /GYP 11 tons:and Zinc 726 tons were used from July 81 to april 1982. The highest quantity, 49,015 tons was used in April.

In Bangladesh the monsoon starts from April and the first rain starts during the last week of April or the first week of May and continues up to semptember.So, it is obvious that a portion of the fertiliser used must enter into the river or pond or lake through run off.Bhouyain (1979) recorded higher concentration of nutrients during rainy months.Haque (1982) stated that use of agro-chemicals as fertilisers,insecticides and fungicides has a deleterios effact on the biotic and abiotic environment and he suggested that the Bangladesh Government should consult with the relevant scientific personnel before import, production and use of these chemicals.

2.5. Natural Pollution:

Pollution of our water bodies also takes place as a result of natural causes, not necessarily associated with the activities of man.During rainy season natural pollution predominates. Cyclones and floods are the most common disasters in every year in Bangladesh. The rain water carries silt, vegetable wastes, manure, faces,garbage etc. into the canal or streams. It increases the turbidity of the receiving water and causes the lowering of light penetration (Hoak 1959) having many adverse effects on the aquatic ecosystem (Cairns 1968) ultimately causing poor fishery (EIFAC 1965). Heavy rainfall sometimes causes erosion, which results in

serious pollution problem in our rivers. Moreover,dams have been constructed in some areas for the protection from floods or for irrigation purposes. These dams sometimes are eroded due to continuous heavy rainfalls which leads to considerable natural pollution.Ellis (1931, 1936) makes general statements on the deleterious effect of erosion silt in different river basins in America. Hynes (1960) pointed out that during erosion the leaching out of nutrients from the soil also increases the fertility of lakes or streams which may cause pollution.

A second type of natural pollution may result by sudden exessive growth of phytoplankton bloom or by excessive growth of weeds, particularly water Hyacinth. Algae bloom is a common phenomenon in our water bodies and it may be due to the presence of high concentration of nutrients, which is the result of decomposition of organic matters, sewage, garbage etc. This algae-bloom-pollution occurs during the dry season, and dies within a short period due to lack of photosynthesis and undergoes decompisition causing total deoxigenation (Klein 1962) and formation of substances toxic to fish (prescott 1948). Mackenthun (1969) reported the deaths of fish caused by the decay of algal blooms from Yahara river. Water hyacinth, a common aquatic weed of Bangladesh , is present in most of the water bodies.This hyacinth is also hampers the growth of many aquatic plants.

2.6. Oil Pollution:

The world wide demand for oils of all kinds is continuously increasing with crude oil production rising every year.Increased crude oil production will result in a continual

increase in the total amounts of crude and oil products that are processed and transported each year. Most of this material is transported and stored several times between the production well and the point at which it is consumed,while incidents involving the massive discharge of oil into the sea are fortunately rare, smaller quantities of crude oil and also oil products enters sea, estuaries,harbours and rivers as a result of accidents to vessel, tank,-pipeline etc.

Over the years there hsa been a greater concern by all on questions of pollutions and this has been reflected in many improvements in the handling and transportation of petroleum and its products. Nevertheless, the increasing involvement of the petroleum industry in activities of production and transportation in the marine environment result in a continuing need for reliable analytical procedures that can be used for helping in the identification of the sources of pollutants.

Main sources of oil pollution of the river Karnaphuly and her estuaries are from, (a) Refineries (b) Handling loss (c) Garbages (d) Discharge from tankers, Merchants ships and (e) Naval propagation. Information regarding oil pollution in our water bodies is very scanty.Sometimes oil can be seen floating around ships and refineries discharge areas. About a year before,a large oil tank of Eastern refineries,which was full of crude oil,burst and caused serious oil pollution problem in the estuarine region of the Karnaphuly river.

Oil may cause serious damage by different ways. Such as (A) Coating and Asphyxiation : (a) Reduction of light

intensity underneath an oil spill which inhibits photosynthesis (b) Oil film on water reduce the exchange of oxygen and (c) smothering particularly in the intertidal areas where shellfish, algae and lichens may be coated and destroyed and (d) damage to bird population coating the feathers by oil which causes buoyancy and insulation losses. (B) Acute toxicity: Sometimes spillage may cause widespread mortality amongst populations of fish,worm,crabs etc.

A case study on oil pollution in the river Karnaphuly was done by the department of marine biology and a paper was presented to the first National workshop on marine pollution,prevention,control and response. It was reported that extraction of oil was made only from the water samples of polluted areas and average value was found 10.62gm /l. Higher was 32.08 gm/l in January and lowest was 2.0 gm /l in the month of August.

Concentration of oil in the surface water of Karnaphuly estuaries during December '79 to November '80,

Months	oil (gm/l)
December	9.26
January	32.08
February	22.70
March	10.56
April	10.50
May	3.90
June	10.34
July	7.10
August	2.00
September	5.46
October	6.82
November	6.75

Amount of dissolved oxygen in polluted area was found to be minimum throughout the period of investigation.It was also observed that the Biochemical oxygen demand increased with the subsequent increase in oil concentration in the polluted areas and high BOD was recorded in water of the polluted areas. The oil concencentrations observed in this estuarine water was high enough to cause pollution. According to Prouse et al (1976),the range normally enccountered in sea water to cause oil pollution in less than 1 mg/l.

During the investigation in the Karnaphuly river and her estuaries,plankton did not appear to be much effected by oil pollution. It may be due to the fact that the water in this estuaru does not remain stagnent as the oily upper layer is driven off quickly upon generation by strong tidal currents.

Planktons are very sensitive and effected by oil while it is still in toxic condition ,a 5 minutes contact between Ditylum Brightwellii and sea water containing 1.0ml/l Mazout caused a statistically significant delay in development upon being returned to clean water. If contact time was increased to one hour death followed 3-day after return to clean water (Mirnov 1972).

Water soluable extracts from toxic fuel oils such as Baytown and New Jersey have high potential for environmental damage, either through selective or enrichment effects on natural populations or through a lowering of total primary production (winters et al,1976)

The effects on marine life and particularly on lit-

toral communities,of both oil spillage and clean-up methods have been the subjects of worldwide concern and study,once again,the year of the Torrey Canyon, 1967, was a turning point in these matters because it focused the attention of the world on the problems with which all the maritime nations could be faced. But although there has been a common concern about the effect of oil and of oil spill dispersants,for example,there has been little agreement regarding how such effects should be measured,predicted and combated. Oil is a simple term but covers a vast number of variables and there is also a wide variation between the properties of the many dispersants which are now commercially available for dealing with oil spills.

The toxicity of alone is a matter which is attended by some degree of ambiguity on account of the diffeculty of defining the nature of the oil. While crude oil containing molecular species ranging from say C-4 to C-40+ may well be toxic to marine organisms,the likelyhood of this unweathered material coming into contact with marine life is dubious in view of the rapid loss of the volatile constituents on exposure to the air.

Oil coming ashore from spillages such as that from Torrey canyon showed little evidence of harming marine life when free from dispersants and this can undoutedly be associated with the fact that this oil had weathered for several days on passage to the coast and lost a proportion of its more volatile constitutes.

Where oil contamination is very heavy,there will of course always be the possibility of shellfish,for example,becoming smoothered,with consequent interferance with respiration and brow-

sings activity.The deleterious effect of oil on marine life would appear to be physical rather than chemical. For example it has been found that oil contamination of the gill filaments of fish prevents the exchange of gases and so causes anoxia. The solubility of hydrocarbons in water is not very much.The oil contents measured ranged from 31 ppm 15 minutes to 4.6 ppm after 1 day, 2.7 ppm after 2 days and 0.6 ppm after 147 days.

Factors affecting extent of biological damage:

After much investigation it has been found that the effects of oil spills, cleaning treatments,and refinery effluents range from localised annihilation to actual growth stimulation of certain salt-marsh plants. Some knowledge has been gained of the factors that can determine the extent of damage, these are described below:

Types of discharge are "one off" oil spills, successive small spillages (the usual situation in a port),or continuous oily effluents such as refinery effluents. The literature is full of accounts of the biological effects of "one off" oil spills and as a general observation,recovery of most shores appears to be good if not complete in periods ranging from 2 to 10 years. Some species on the shore may survive the oil, like common brown seaweeds that have protected mucilaginous covering. Others such as Limpets and Barnacles, may die but are replaced during the shore recovery period by settlement from the young planktonic stages of these animals.

Estuaries used as oil ports suffer from comperati-

vely large numbers of small spillages. Promlem arises where many such spillages effect the same area of estuary, because in such a case the shore biota may never have a chance to recover properly. Thus many small successive spillages in the same place likely to be more damaging than one larger spillages. The experimental work of "Baker" has shown that many salt-marsh plants,including the wide-spread grass spartina anglica,can withstand four successive monthly oilings with fresh Kuwait crude oil, but decline with further oiling. Death can result in bare mud liable to erosion.

The greatest frequency of oiling may be found near continuous discharges,in particular refinery effluents that commonly have oil contents of up to 25 mg / l. In calm conditions an effluent of this quality can produce thin oil films that may be deposited on the shore as tide goes down. If the effluent is discharged into a salt-marsh area,the marsh plant to which the oil sticks firmly may die following repeated exposure to oil. Effects associated with refinery effluents may fall into the following categories:

Category 1: Offshore effluent discharge: Although there is evidence to show that the undiluted effluent is toxic, in general the biological effects of this type of discharge seem to be small, presumably owing to rapid dispersion and dilution.

Category 2: Shore discharges with good dispersion: Discharge from a headland into an area of strong tidal flow may achieve the same good dispersion as category 1.

Category 3: Shore discharges with poor dispersion:

Typically,poor dispersion of effluents leads to accumulation of only sediments and subsequent improverishment of bottom fauna. Oil from effluent is easily trapped on the marsh vegetation that often grows under the sheltered conditions and eventually kills it. This applies both to salt-marsh areas and fresh water marsh land but in the former the area of damage is likely to be greater owing to spreading of oil films at high tide.

There are of course "point source" discharges other than refinery effluents,for example ballast water discharges from oil terminals or offshore oil storage tank.

Type of pollutants Encountered:

Pollution by oil may be encountered anywhere in the marine environment or in inland water. It may arise,either accidently or operationally,wherever oil is produced,transported,stored,processed or used at sea or lands.Thus any list of the type of pollutant that may be encountered must inevitably cover the complete range of oils (including those of other than petrolium origin) and thier products).Innearly all cases,the pollutant has undergone some degree of weathering.Although it is impossible to be dogmatic about the absence of any one type of pollutant in any particular part of the environments,certain types are observed more frequently in certain areas eg,petroleum distllate on inland waters. The pollutants and the areas in which they are most frequently obserbed are summarized in the table. The pollutant may contain more than one type of oil.

Most frequent distribution of pollutants may be

found as follows:

Sea,Beaches Coastlines	Estuaries,Harbour Docks	Rivers,Canals Inland waters
Bilges	Bilges	Fuel oil
Crude oil *	Crude oil	Lubricating oil
Dirty Ballast	Fuel oil	Refined Distillates
Fuel oil	Lubricating oil	
Tank washing	Coal tars and products	

Oils of animals and vegetable origin

*Unusual,unless there has been a wreck or collision.

A given volume of oil may have different effects according to whether it reaches living organisms as thin oil films, thick oil films, water in oil emulsions,in oil in water emulsions, oil films or water in oil emulsions (mousses),as already described may coat organism on shore and have a directly toxic effect or a physical smothering effect.Oil in water emulsions may formed from oil sticks naturally or following the use of dispersants and may be present in a variety of industrial and other effluents from land-based discharges.Such emulsions,which may disperse through large volumes of water, are more readily available to bacteria for degradation but oil in this state is also more likely to be ingested by plankton (including planktonic larval stages of some shore orga-

nisms) and a variety of animals which feed by extracting particles from the water.Shore animals of this type include barnacles and mussels.

Interactions affecting oil toxicity:

The toxicity of oil may be altered through interactions with other compounds and this is of particular importance when considering mixed discharges such as refinery effluents. Factors which may cause variations in toxicity of the oil by increasing or reducing the stress to particular organisms including salinity,PH,sulphides,phenols,ammonium compounds,suspended materials,-dispersants, and temperature.A great range of interactions are obviously possible and are currently being studied.

Cleaning methods:

In practice, three approaches are commonly used for cleaning oil polluted areas.These are as follows:

(1) physical removal: Burning is a initially attractive course of action but most stranded oils do not burn easily because of evaporative losses and absorption of water.If they could be burnt in some way,there would probably be severe immediate effects on population of shore organisms.Physical removal of oil and oily substrates either on a large scale using bulldozers or on a small scale using buckets and spades,is commonly used on aminity sands and shingle areas. Such areas are not usually the richest of shores biologically or physically removal appears to be acceptable from both the biological and amenity point of view. This

method is not usually suitable,however on rugged rocky shores or soft mud or salt-marsh substrates.In the first case,appropriate machinery cannot easily be maneuvered along rocky areas and in the second,removal of the surface layers of sediment would probably mean removal of many animals such as polychaete worms,and root systems of plants.This may be justified in cases of thick smothering when deposits are likely to be long lived and prevent recolonization,but on soft mud it would be difficult from the practical point of view.

(2) Cutting of oily vegetation: Oiled salt-marsh plants are sometimes cut and removed and provided heavy trampling damage to the marsh can be avoided.This seems to be an acceptable treatment.Experiments on the cord-grass spartina,oiled with Kuwait crude oil showed that cutting neither significantly decreased mortality nor had a significant harmful effect.

(3) Using dispersant: Oil spill dispersants usually consists of a surface active agent (surfactant) mixed with a hydrocarbon solvent and sometimes a stabiliser. Majority of dispersants documented appear to be based on petrolium solvent,some consists of surfactant and a water miscible solvent such as iso-propyl alcohol.

As is well known ,surfactants can be devided into three groups; (a) Anionic (b) Cationic and (c) Non-ionic.The Anionic types form the largest group,being largely used in house hold detergents and mostly consists of alkali salts of organic sulphates or sulphonates in which the Anion is surface active.Cationic types in which the cation is surface active are mainly used based on Alkylamines or Pyridine structures and form the smallest group.The

oxide.

The relationship between the toxicity and chemical structure of the surfactants based on ethylene oxide condensation has been attributed to the degree of polymerization of the polyoxyethylenic chain.The toxicity characteristics of the surfactants alone are important. So, it is of greater relevance to consider these of the formulated dispersant.

In 1962 the warren spring laboratory of the department of trade and industry reported that the use of solvent emulsifiers was an effective method of dispersing oil spill and that if applied correctly they were unlikely to present any risk to fishery interests. This was largely borne out by events following the exensive use of solvent emulsifiers (dispersants) to clean up the oil from the Torrey-Canyon.Local fish stocks were not effected directly to any great extent and they have shown no subsequent changes that can be attributed to the use of dispersants.

Misuse of dispersants can give to many problems and sometimes long lasting effects of products used to clear the oil.-Lattoral plants and animals recieved heavy treatment of oil and dispersants and suffered heavy mortality.Laboratory investigations into the effects of dispersants demonstrated only that short exposures to low concentrations were acutely toxic to a wide variety of marine species,but also that they could induce detrimental effects which were not apparent untill several months after exposure.As a result of these and similar studies,efforts to develop less toxic

dispersants were intensified. Since 1967,the fisheries laboratories at Burnham-on-crouch has co-operated with warren spring laboratory in assessing new dispersant formulations for thier efficiency in dispersing oil at sea and rivers,on beaches and for thier toxicity to-wards marine life.However,whatever the toxicity of a dispersant, its use on mud and salt-marsh areas is likely to cause problems.- This is because the dispersed oil sinks much more readily into soft sediments where it may remain for a very long time with unknown effects.Oil from a 1967 spill is still present in a small area of salt-marsh mud in Milford Haven in U.K.It was carried to depth of up to 500 mm by dispersants use.

Care must be taken to observe whether an animals behaviour is such that factors other than the oil or dispersant toxicity will affect its survival in the field.An obvious example of this is the behavior of the littoral snails studied by Crapp'30. These retract into the shell on encountering even low concentratio- not dispersants.The retracted snails may roll about or be swept away from the shore ,and the numbers that recover will depend ,among other things,upon the intensity and duration of dispersant use. Animals which survive dispersant treatment may suffer an impaired vitality reflected in reduced rates of feeding and growth.Again this has been shown in experimental work;for instance ,Perkins'21 found depressed growth rates in Littorina Saxatilis,L.- Littorea and Nucella Lapillus,and Crapp'22 found a reduced rate of feeding in Nucella after exposure to BP 1002.

The national oceanic and atmospheric administration (NOAA) of United States has initiated a new scheme to monitor and assess coastal and estuarine environmental quality. The national

status and trends (NS & T) programm as documented in a paper delivered at the oceans '84 conference in Washington D.C and long term,temporal and spatial trends of key contaminant concentrations,water quality parameters,and biological indications of adverse effects in the United States' coastal and estuarine environments.Furthermore,The NS & T programme will use a nationally uniform set of measurement techniques to determine marine environmental quality parameters on a national scale.

Structurally, the programme has four major components ; (1) Benthic Surveillance (2) Mussel Watch (3) Water quality and complilation of data base from relevant existing programmes.

The Benthic surveillance component will measure toxic chemicals in the surface sediments and bottom fish taken from the same area, reports the paper . Forty to fifty locations along the coast are set up.for the mussel watch collection 150 sites nation wide are chosen. The water quality component was introduced in 1980 as the Northwest Monitoring programme.This will measure dissolved oxygen concentration.

The identification of extramural monitoring data useful for assessment of the status and trends of the coastal and estuarine environment has been prepared by Battelle New England Marine Research Laboratory. There are at least 36 international and regional agreements which include questions of marine pollution;of these 2 deal with the dumping of garbage originating from ships,10 with the problems of contamination caused by oil, and 12 with the oceans exposure to radiactivity.

Regulations concerning marine pollution from land are inadequate,at least on the intrnational level.They are difficult to enforce because important national economic intersts are ooncerned (Waldickak 1978).Absolutely no regulations,apart from for incineration at sea ,exist concerning harmful substances which enter the world-wide pollution of the oceans with chlorinated hydrocarbons has its source in atmospheric contamination.But if one wants to reduce the concentration of pollution in the marine atmosphere, one has to regulate the fabrication and the use of such harmful substances inland.Effects upon industry ,agriculture and health standards would be manifold, and the argument from the marine is just one among many conflicting argument.However,the health of the biosphere,of all life on the globe ,is well reflected in the oceans and in marine life.Therefore,marine science has an important task at least to monitor trends in the future,and to give warnings if pollution should increase or should not decrease with time.The international -national maritime organisation is acting to achieve the goal to keep world environment free from pollution.

2.7 Environmental alteration:

Bangladesh is a tiny land in the world.But its population has reached its maximum limit.Therefore,the small country is now faced with enormous promlems to be dealth with.To face the gigantic problems successfully ,the country needs urgently heavy exploitation of all its major natural environmental resources.To make maximum utilisation of her environmental resources,the modern scientific technology will play a great role. But the scientific technology created major problems beyond those of exploitation.A-

gricultural wastes,industrial wastes,deforestation ,dams,reclamation of fishing ground etc.have now become the means of pollution,-modifying the ecosystem.With the rapid industrialisation and agricultural development,dams ,sluice gates and barrages across the karnaphuly river and her branches have been constructed for the purposes of irrigation flood control,and generation of power etc. Most of the tidal areas of chittagong have been reclaimed for agricultural production by constructing coastal embankments.With the times more and more of such structures will come into existances.-These modifications of the aquatic environment may cause serious complications to the ecosystem depending on the particular situation.

To-day an increasingly intensive and use is made of water.More water is utilised for economic and domestic purposes in cities and for industrial needs.For example,2500 tons of water is needed to produce a ton of rubber and 5000 tons to produce a ton of copper.More of the river water is used on irrigation.And demand for water,far from decreasing ,is growing all the time.

Many countries to-day suffer from a "water crises".(the USA,Japan,Brazil,France,Denmark,the Netherlands,West Germany etc.).Even though only some one hundred years ago they had no such problem.Each country seeks for its own way out of the situation in accordance with its possibilities and resources.

The same need forces western scientists to elaborate such projects as, say, the use of Arctic or Antarctic ice to supply water to Brazil,North America and Africa.A middlesized iceberge consists of hundreds of millions of tons of water.To haul

such a hunk of ice to the shores of California ,for example,is also a complicated and costly affair.But it is sure if such a project is undertaken and they are prepared while performing it,to take upon themselves responsibility for the possible risk involved.

The main sources of water is the river.Now the question arises what will happen to the rivers when the land reclamation is implemented,what ecological results may be expected in this connections.

There are examples from different countries, including the most industrialized ones.It is sufficient to recollect that to begin with,irrigation in the USA had caused the so-called secondary salination of the soil,which resulted in the huge areas of agricultural land becoming infertile.The desalinization of this land required colossal spending which had not been thought of beforehand.

Mankind while improving the land for the sake of its most urgent needs, has gained quite a lot of know-how and sometimes bitter know-how.

Mistakes have been made and on one can guarantee that new ones won't be made.More than that,we have to be reconciled to some inevitable losses.The matter is not to inflict upon nature irreplaceable,irreversible damage,which is unjustified even by the most urgent need.

In USSR,the gigantic project,to divert the part of the flow of the northern and then the Siberian rivers southwards is

undertaken.The problem of redistribution of water resources is being studied.More than 150 research and design institutes are involved.Experts have to go into literally every aspects of the socio-economic,natural climatic and sanitary -epidemiological conditions attaching to,as well as the consequences of,the transfer of water.The comments and wishes experssed by ecologists,geographers, economists,workers in industry and transport,public personalities and statesman are taken into account.

Although a large areas of coastal regions has been reclaimed for agricultural production by constructing embankments, very little success has been gained.The farmers face so many new problems that cannot be solved by them(salinity,acidity,toxicity etc).On peninsular Malaysia,rice cultivation on reclaimed mangrove land has been unsuccessful due to the development of acid sulphate in soil.Sasekumer (1978) states that Pyrites (FeS) are formed in the soil where the amount of carbonate is too little to neutralise the acidity that is released upon oxidation of pyrites during reclamation.So,the reclamation of mangrove land for agriculture is not recommended by several workers (Moormann and Pons 1974;Saekumar 1978).

Rivers are the creation of nature.Any artificial dams,sluice gates or barrages will disturb the natural balance of ecosystem.The dams,sluice gates and barrages act as physical barriers to migrations tending to prevent access of the fish to their usual breeding,rearing and feeding grounds.The Kaptai dam is an example in the river Kharnaphuly.The downstream of the river has shown a remarkable reduction of fish stock.Jhingran (1975) states that the restriction of migration may result in permanent and irre-

pairable damage to fishing industries from lowering the levels of abundance to extermination.He also states that due to the dam construction and reservoir formation,substantial morpho-ecological changes occur above and below the dam-site which include conversion of the running water into a water body of slow discharge characteristics and thus hamper the spawning of many important fish.

Collier et al 1973,mentioned that the Aswan dam in Egupt on the river Nile was dammed to produce electricity,to increase the agricultural production and also to reclaim the agricultural land.It is now found that the dam created much more ecological unbalance than expected.The dam on the river Nile has seriously disturbed basic ecological relationships throughout not only on the lower Nile valley but much of the eastern Mediterraean sea as well.It was concluded that although this has significantly increased agricultural production,some serious problems have developed and these are (1) in canal irrigated areas,there is no longer any silt deposition during the flood period.Silt is now deposited on the bottom of the lake Nasser.So,a major requirement for use of artificial fertiliser is being noticed. (2) as the "flushing "action no longer occurs,large areas of irrigated land are experiencing increases salinity.It has been estimated that unless preventive measures at a minimum cost of one billion dollars are undertaken,much of this land will quickly become useless (sterling 1971) and thirdly (3) the silt free water below the dam flows faster and tends to re-acquire a normal silt load.On the other hand,the fish harvest,following closure of the Aswan dam was reduced from the proceeding years to a remarkable quantity i.e 135000 tons in 1974 to 500 tons in 1968 (Collier et al 1973).

3. Conclusion and Recommendations:

Pollution of environment is a direct threat to human health today.Pollutants reach us through the water we drink, the air we breathe,and the food we eat.Overpopulation and consequent industrialization have contributed in various ways to the pollution of the environment.Pollution in the past resulted mainly from the animal body wastes,but today it is affected by a host of some new means,such as trade-wastes,agricultural wastes and oils from different sources.

Water is the most essential natural resources on the earth,economically,biologically and culturally.Without water life cannot survive.Bangladesh is a riverine country.Ironically enough,the industries dischargeslarge quantities of thier liquid and solid trade wastes,as well as crude sewage into the river.This continuous addition of different types of wastes changes the water qualities substancially and creates pollution problem.However, protection of our rivers from such a human interferances has not, as yet recieved suffecient attention.The river Karnaphuly is one of the many rivers in Bangladesh.For centuries this river has controlled and shaped the lives of the human population on its banks.They use it for various household purposes such as washing,drinking as well as for agriculture.It is obvious that if allowed to continue unchecked,the present trend of polluting the water quality will certainly cause tremendous problems in water pollution ,which will surely seriously affect the economy of the country.

To prevent pollutions, the following recommendations are being made by the author.

(1) The causes of pollutions and its effects should be publicised at all levels.Until the people are aware of the consequences,no effective solution can be achieved regarding the pollution.

(2) to combat industrial pollution,it is of utmost importance to use proper treatment plants so that harmful substances are not discharged into the river.Special attention should be given to the following points: (a) Mercury effluents from industries are to be forbidden.More research is necessary to evaluate the effect of small traces of mercury in sewage upon the marine system.(b) Before well founded conclusions can be drawn,more studies on thermal pollution should be published.(c) Chlorinated hydrocarbons and other toxic organics in effluents from industry have to be forbidden.

(3) Sanitary and domestic effluents must be treated before the discharge. Present sanitary system should be abolished and modern sewage system should be introduced.Waste water treatment plants reduce the contents of biodegradable organic substances in waste water.It also reduces the contents of pathogens in the effluents.More research on the fate of dangerous pathogens,bacteria and viruses and their fate in the marine environment is necessary. To remove nutrients from sewage special treatment plants should be established.More research is necessary at what point costly measures against eutrophication are really necessary.Detergents with less toxicity can be developed.

(4) The farmers must be informed about the delete-

rious effects of the excessive use of fertilizers,so that they do not use the fertilizers, insecticides etc unnecessarily. Intensive programme to educate the farmers must be undertaken throughout the country.

(5) Scientific research on oil is hampered by different types of oil and the different properties oil acquire in the course of weathering.A standard oil quality for experiments would render results better comparable.Careful considerations are necessary whether or not to fight oil spills.When oil spill fighting is necessary,efficient equipments must be available.More pilot projects should be done in mechanical cleaning up devices and efficient oil booms.Above all,all the national and international laws regarding oil pollution must be stricktly followed.

(6) To reduce the pollution via the atmosphere,a better scientific monitoring system is necessary and more research on the fate and effects of such pollutants.Atmospheric pollution by toxic and persistent organics must be reduced.

(7) A research institute may be established to study the different aspects of pollution.

4. Summary:

Fresh water is most essential in Bangladesh for agriculture,fishery and for domestic purposes.It is an agricultural dependent country.Presently the fisheries is also developing significantly.But as the pollution of water is continuing,it is going to effect the economy of the country in the future.The present paper details how the river karnaphuly,is continuously receiving a large volume of untreated industrial wastes,sewage,agricultural wastes and domestic wastes etc.

Karnaphuly paper mill (KPM),Karnaphuly Rayon mill (KRC),tanneries,textile mills, chemical industries including DDT plant,fish processing industries and refinery are the worst source of industrial pollutants.They are discharging remarkable volume of untreated wastes including toxic chemicals.

The domestic wastes or sewages are being dumped into river without purification or treatment plants.The human wastes are being dumped into the river karnaphuly from the service latrine.As a result 70% of the total population living on its bank are suffering from water borne deseases and the water of the river karnaphuly and its estuary are becoming unsuitable for the human consumption and for the survival of fish.

Pollution of the river karnaphuly is also going on as a result of natural causes,like excess rainfall,excessive growth of weeds etc.Algae bloom is a common phenomenon in our water and water-hyacinth is a most familiar aquatic weeds of Bangladesh causing serious damage to our fisheries resources and the crops.

The coastal embankment,dams,sluice gates and barrages, which are built for the purposes of irrigation,flood control and generation of power will certainly bring many other problems in near future.All these are creating natural unbalance. Oil pollution is also creating alarming situation. The law regarding oily water discharge by ships should be stricktly observed as per Intrnational Maritime organisation's conventions.

However, protection of the water of the river karnaphuly and its estuarine from human interferances has not yet received sufficient attention.A systematic study is required to determine the effect of pollution on its physical,chemical and biological aspects.

Hence it is recommended that by anticipating the future dangerous condition of the water of the river karnaphuly, strong measures may be taken to control the pollution problems.

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