Human Health and Industrial Pollution in Bangladesh

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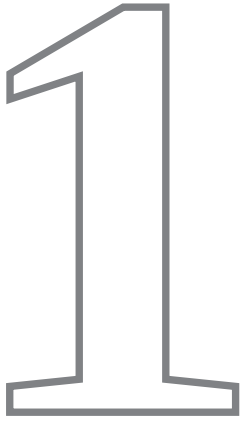
Acronyms and Abbreviations

ARI	Acute Respiratory Infection
BOD5	Biological Oxygen Demand
BRAC	Bangladesh Rural Advancement Committee
COD	Chemical Oxygen Demand
EPZ	Export Processing Zone
FCPS	Fellow College of Physicians and Surgeons
DFID	Department for International Development
DoE	Department of Environment
GDP	Gross domestic product
GNP	Gross national product
GOB	Government of Bangladesh
iPRSP	Interim Poverty Reduction Strategy Paper
MACH	Management of Aquatic Ecosystems through Community Husbandry
MBBS	Batchelor of Medicine and Surgery (MBBS)
PAH	Polyaromatic hydrocarbons
PCB	Polychlorinated biphenyls
PCP	polychlorinated phenols
PRA	Participatory rural appraisal
PHC	Primary health care
RMG	Ready-made garment
RRA	Rapid rural appraisal
SEHD	Society for Environment and Human Development
THC	Thana Health Complex
UHC	Upazila Health Complex
USAID	United States Agency for International Development

Beel	Shallow, seasonal lake
Khal	Canal
Imam	Islamic priest



Introduction

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Bangladesh is one of the most densely populated countries in the world with approximately 895 people per square kilometre, and a projected population of around 146 million by the year 2010. It is also one of the world's poorest countries, with a per capita Gross National Product (GNP) of $260, and in which approximately 60 percent of the population live below the poverty line (WB, 1993). The population remains largely rural with only around 20 percent living in urban areas. Rural livelihoods are dominated by agricultural production but people's livelihood systems are diverse with fishing either for purely subsistence use or small commercial sales being common. Fish accounts for approximately 63 percent of the animal protein in people's diet (BBS, 2004). Less than 40 percent of the rural population has access to modern primary health care (PHC) services beyond child immunisations and family planning (BBS, 2000; Abedin, 1997).

The high population growth rate and poverty levels have led Bangladesh to set a development target in the Interim Poverty Reduction Strategy Paper (iPRSP) of a seven percent growth in GDP to achieve its development goals by 2015. The iPRSP calls for a "focus on employment-intensive industrialisation with emphasis on small and medium enterprises and export oriented industries" (iPRSP, 2002, p.32).

The country still has a relatively small industrial sector contributing about 20 percent of the GDP between 1996 and 1997 but it is growing rapidly. The manufacturing sub-sector accounts for about half of this and grew at a rate of five percent between 1972 and 1992 (Bhattacharya et al., 1995). There are now over 24,000 registered small-scale industrial units in Bangladesh (SEHD, 1998) and it is generally accepted there are an equivalent number unregistered. The growth of small-scale industrial activities in Bangladesh has a positive development dynamic in macro-economic terms, for example, the ready-made garment (RMG) sector accounts for a little over 75 percent of national export earnings and 9.5 percent of GDP, providing US$ five billion in revenue and employing around 10 million people. However, industrialisation has also brought with it a range of problems. The industries tend to be clustered together and are highly polluting. As a consequence of their rapid and largely unregulated development, many aquatic ecosystems are now under threat and with them the livelihood systems of local people (Chadwick

and Clemett, 2002). Consequently, whilst Bangladesh is, in industrial terms, a relatively undeveloped country, "the problem of localised pollution is alarming" (SEHD, 1998); a situation that is compounded by the high population density of the country.

Kaliakoir Thana in Gazipur District to the north-east of Dhaka is one such industrial cluster where rapid, unplanned industrial expansion has led to serious local pollution. This area was historically an important rice growing area but its close proximity to Dhaka has gradually led to more industries locating there over the past 15 years. There are now several types of industry in the area including a tannery, poultry farms and pharmaceutical industries but it is dominated by textile manufacturers, including dyeing and printing units.

The Management of Aquatic Ecosystems through Community Husbandry (MACH) project, funded by the GOB and USAID, which aims to enhance community-based wetlands and water resource management, first reported water pollution5 problems in the Kaliakoir area in 1999 (MACH, 2001). The project undertook some initial pollution studies of the area, which identified the local industries as the main polluters.

Further water quality analysis was conducted under the Department for International Development (DFID) funded project "Managing Pollution from Small Scale Industries in Bangladesh". Samples were taken at various stages of the production process, at the outlets of factories, the khal (canal) that forms the main conduit for waste for the industries, and Mokesh Beel (shallow lake), into which the khal discharges. During the dry season the khal is the only source of water to the beel. The beel then links to the Turag-Bangshi River. The results of sampling from the production processes show that effluent from the factories generally have high biological oxygen demand (BOD), very high chemical oxygen demand (COD) levels, and also contain high levels of sodium sulphate, ethanoic acid, reactive dyes, and detergents (Chadwick et al., 2003). Sampling in the beel also shows high levels for the same pollutants,

[5] Water pollution is the degradation of water quality, as measured by biological, chemical, or physical criteria, that can make water unsuitable for desired uses such as bathing, drinking or fishing, and can have serious effects on the health of humans and animals through contact or ingestion (Mason, 2002)

though they are lower than at the factory outlets due to the addition of water from washing and rinsing processes which serves to dilute the levels of pollutants.

The projects also observed that the livelihoods of the people who live in Kaliakoir are seriously affected by the pollution. Discussions with community members revealed problems with agriculture and fish production, as well as health impacts. The discussions identified the need for a more systematic rapid health assessment.

2

Industrial Sector and Pollution in Bangladesh

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Industrialisation began at a very slow pace in Bangladesh in the 1950s with the primary focus on agro-based industries such as jute, cotton and sugar. After independence in 1971, interest grew but it was not until the late 1970s that industrialisation increased rapidly driven primarily by the RMG industry. Several government initiatives were also undertaken to promote industrial growth, including the establishment of industrial estates and export processing zones (EPZ). By late 1990, 60 industrial estates and two EPZs had been established. Growth was particularly marked in the RMG sector. The Bangladesh Garment Manufacturers and Exporters Association (BGMEA) reported a growth in the RMG industry from 30 enterprises in 1980 to 4107 in 2005 (BGMEA, 2005) although this only represents those who are members of BGMEA, and does not include members of the Bangladesh Textile Mills Association (BTMA) or the Bangladesh Knitwear Manufacturers Association (BKMA), or all the industries that have not registered with any of the trade associations. BGMEA (2005) also reported a 20 percent increase in RMG export over the past two decades.

From a pollution point of view, dyeing, leather, sugar, pulp and paper industries are the major contributors. Non-renewable local resource based industries include industries based on mineral resources such as limestone, hard rock, gravel, glass, sand and various types of clays. In this category, major polluters are the cement and fertilizer factories. Imported resource based industries includes textiles, pharmaceuticals, plastics, petroleum and metal works. Many of these are found to be highly polluting.

For many years policy planners have been under the impression that since Bangladesh is one of the less developed countries, pollution is yet to be an issue of concern (SEHD, 1998). However, several studies undertaken in the last decade have dispelled such beliefs. The Department of Environment (DoE) in the early 1990s carried out a survey of industries, principally tanneries. The report found that acidic emissions from effluents had the potential to cause serious respiratory disorders to the employees and residents of the area and damage to buildings (GOB, 1997). Similarly, the Society for Environment and Human Development (SEHD) published a report in 1998 which provided

an overview of the key environmental issues in Bangladesh. It showed that treatment of industrial waste was considered a low priority and that due to the absence of strong preventative measures and lack of awareness, the practice of discharging untreated industrial waste into water bodies was almost universal. The serious public health problems that this could create have so far been minimized as the waste was diluted and flushed from water bodies during the rainy season. However as industrial expansion has continued since the 1980s, acute localized pollution is now threatening the sustainability of the resource base and increasingly impacting on the health of the population.

To address rising concern the National Environmental Policy was approved in 1992 and the National Environmental Action Plan was developed. In 1995, the Bangladesh Environment Protection Ordinance was enacted. Environmental objectives were also contained in the government's Fourth Five Year Plan (1990-1995) and are present in the Perspective Plan (1996-2010). A plan of action for food safety and an inter-ministerial committee for coordinating and monitoring food safety are operational. Yet, despite these policy initiatives, little has changed in practice. One of the main difficulties is that environmental governance is limited with the principle institution, the Department of the Environment, having limited human and financial resources to tackle the problem.

3

Health Assessment Purpose and Objective

Health Assessment Purpose and Objectives

Based on the findings from the initial pollution analysis of the MACH project and continued concern of the local population over the health implications of the industrial water pollution in Kaliakoir, particularly in Ratanpur Khal and Mokesh Beel, a rapid assessment was conducted to try to determine whether any of the health problems currently occurring in the area could be attributed to the industrial pollution.

The overall objective of this study was to better understand the disease profile of the study population and determine if any of this profile could be attributed to the pollutants found in the local water bodies. The specific objectives were to:

- Assess the prevalent health conditions of the people living around Mokesh beel and prepare a health profile;
- Identify potential or evidence derived environmental factors associated with those prevalent health problems; and
- Identify potential pollution related health indicators.

3.1 Methodology

The research involved two key elements. The first involved a serious of focus group discussions (FGDs) and in-depth interviews with community members to identify their perceived current and historical health problems. The second involved the gathering of secondary data and the undertaking of interviews with health workers in the area to determine whether the perceived changes to health expressed by the local population matched the health trends observed by local health professionals, and what their opinion was as to the likely causes of the health problems that they currently observe in the area.

The field research was undertaken in four steps. The first involved capacity development. A two-day training workshop was held to explain and discuss with local staff the purpose and process envisaged for the work. This included the development of the research methodologies. Following the training and piloting of methodologies, the collection of secondary data in the form of reports and statistics of the local health

facilities, and the FGDs and in-depth interviews with the local communities and health care professionals, were undertaken. Following analysis of the data, a series of consultation workshops were held with local communities to present the findings.

3.1.1 Community Perceptions of Health Trends

The project identified 15 villages in the Kaliakoir area that are located within a few kilometres of the industries and whose residents are partly or wholly dependent, directly and indirectly, on Mokesh Beel, Kalidoho Beel and adjacent water sources. A total of 15 FGDs were conducted including one in each of the 15 villages (Table 1), of which three were with women in Shinaboho, Kaliadoho and Sholahati villages. Sixteen in-depth interviews were also conducted, one in each village and one with the Upazila Health and Family Planning Officer from the Kaliakoir Upazila Health Complex (UHC).

Table 1: Selected Villages and Population in 2001

Village	Total population	Male	Female
Harin Hati	3947	2246	1701
Ratanpur6	-	-	-
Purba Chandra	7454	4335	3119
Shafipur	10883	5883	5000
Mazukhan	1399	715	684
Karalsurichala	1495	817	678
Amdair	1196	601	595
Sholahati	520	263	257
Matikata	1279	686	593
Bagambor	665	340	325
Kaliadaho	460	240	220
Gobindapur/Gopinpur	919	486	433
Taltali	760	405	355
Kouchakuri	431	222	209
Sinaba/Sinaboho	1548	799	749

Source: Bangladesh Bureau of Statistics (BBS), 2001

[6] No data was available for Ratanpur

The participants of the FGDs and in-depth interviews were drawn from a wide range of villagers from a variety of primary professions. Most of them were involved in agriculture (47 percent) or small trade and other businesses (17 percent). About one-fifth of the respondents were teachers, other government employees or involved in the private sector. The vast majority of the female participants were housewives. Table 2 presents the range of occupations of the FGD participants.

Table 2: Occupation of the respondents in the FGDs and interviews

Occupation	Number (N=106)	Percent
Agriculture	50	47
Trade/Business	18	17
Teacher/Educationist/Imam	1312	
Fishermen	10	10
Service- Government or Private	10	10
Others	05	05

Focus Group Discussions

About 12 people were invited to attend each FGD. These people were selected on the basis of their key occupation and on the recommendation of staff involved in the MACH project who identified people from each village who they considered to be responsive and well informed in terms of what occurred in the village. Three additional FGDs were conducted specifically with women, to explore issues of maternal and child health.

In-Depth Interviews with Key Community Members

The purpose of the in-depth interviews was to rapidly gather information on specific issues that otherwise may have to be collected from the population using time consuming and costly questionnaires. The participants selected were either school teachers, village leaders, Imams, village elders, farmers, fishermen, traders, businessmen, teachers or factory workers.

3.1.2 Interviews with Health Care Professionals

A second phase of in-depth interviews was conducted with health workers in the area including: doctors, pharmacists, nurses and “local doctors”. These people were identified by asking the villagers whom they went to see when they had a health problem. In general people

visit the pharmacy or local doctor for minor complaints such as diarrhoea and skin problems, but travel to the UHC for more serious health problems. There are also two Thana Health Complexes (THCs) in the area but discussions with community members suggested that the villagers living around Mokesh Beel rarely visited these. Ten health professionals were interviewed in the study area and one from a nearby area where the local population do not use the water bodies impacted by the industrial waste.

The respondents were asked to identify the five most common health problems that they saw in the past year. They were then given 50 counters and were asked to make piles next to each disease according to its prevalence. For those health workers who had been in the area for several years, this process was repeated for five and 10 years ago so that the trend in diseases could be seen.

4

Analysis

Analysis

4.1 Community Perceptions of Health Profile

In an open question on predominant health problems in the community, the respondents mentioned that diarrhoea, skin diseases, gastric ulcers, gastroenteritis, respiratory illnesses (common cold, asthma), anaemia, high blood pressure and jaundice were the most common health problems amongst the population in the area. In addition, people also suffer from gout, rheumatism, conjunctivitis, pneumonia, malaria, tuberculosis and cancer. At least 70 percent of the people involved in the discussions reported that they were suffering from skin diseases, gastric ulcers or other gastric problems at the time that the research was taking place.

The respondents were then asked to list what are, in their opinion, the five most common diseases, putting the most common disease first and the least common fifth. Diarrhoea and dysentery7 were mentioned in 14 of the 15 FGDs. Skin diseases were also considered common, being cited in the list of five most common diseases in 13 villages (Figure 1). The in-depth interviews confirmed that diarrhoea, dysentery and skin disease were, in the opinion of the interviewees the most common health problems in the area.

Figure 2 shows the distribution ranks of the most commonly cited health problems. Colds and skin diseases were the health problems ranked as most frequently occurring in the area by over a quarter of the village FGDs. Diarrhoea and dysentery are considered the most frequent illness by one fifth of the FGDs and are considered the second most frequent by nearly half of the FGDs.

[7] These two health problems were often not differentiated by the respondents and therefore are kept as one category in the analysis.

Figure 1: Number of times a health problem was listed in the top five most common in the 15 FGDs

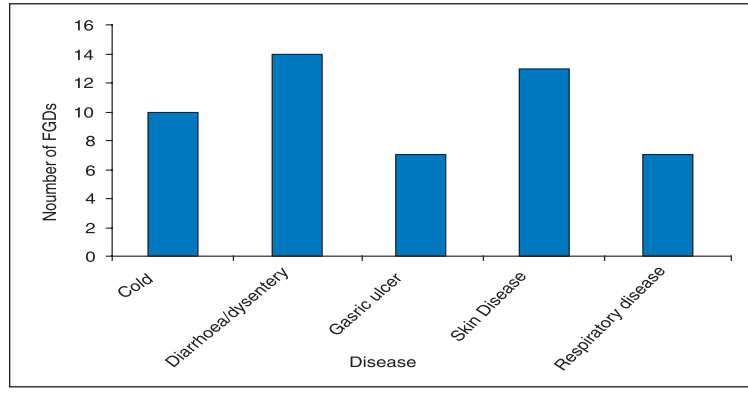
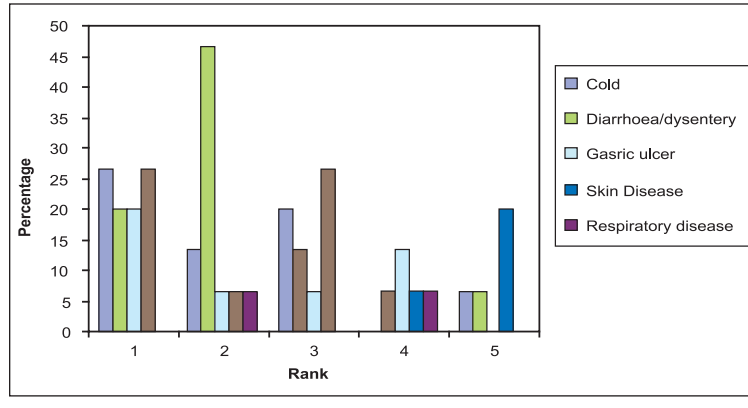


Figure 2: Percentage of villages ranking common health problems by perceived frequency



The disease pattern recorded in the UHC reflects the prevalence and trend of the diseases identified during interviews. Diarrhoea, acute respiratory infection (ARI), skin diseases and ulcers were amongst the health problems experienced by the most number of people who attend the health complex (Table 3). However, the total number of patients in the UHC does not reflect the magnitude of the problem, because the vast majority of the patients in the study area were found to be using local private doctors, traditional doctors or pharmacists as the first point

of contact and would tend to only attend the UHC for serious medical matters or if they were referred there. The UHC covers a much larger area that the Mokesh Beel system and therefore will also show broader health patterns that do not necessary reflect those specifically occurring in Kaliakoir. Nonetheless it provides a useful insight into the changing pattern of health issues in the area.

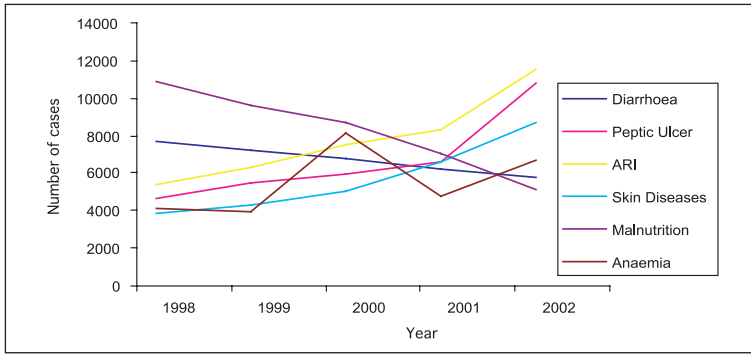
Table 3: Number of patients presenting symptoms of major diseases in Kaliakoir UHC

Year	Number of Patients						
	Diarrhoea	Peptic Ulcer	ARI	Skin Diseases	Malnutrition	Anaemia	Total
1998	7659	4670	5375	3840	10879	4072	36495
1999	7227	5480	6280	4280	9580	3890	36737
2000	6798	5990	7540	5060	8690	8180	42258
2001	6219	6578	8367	6611	7052	4743	39570
2002	5773	10821	11492	8723	5080	6666	48555

Source: UMIS, 2001, Draft Kaliakoir UHC Report, 2002/03

Figure 3 shows that malnutrition and diarrhoea appears to have declined relative to other diseases recorded at the UHC, whilst acute respiratory illness (ARI), peptic ulcers and skin diseases have increased.

Figure 3: Prevalence of six main health problems based on symptoms presented at the UHC[8]

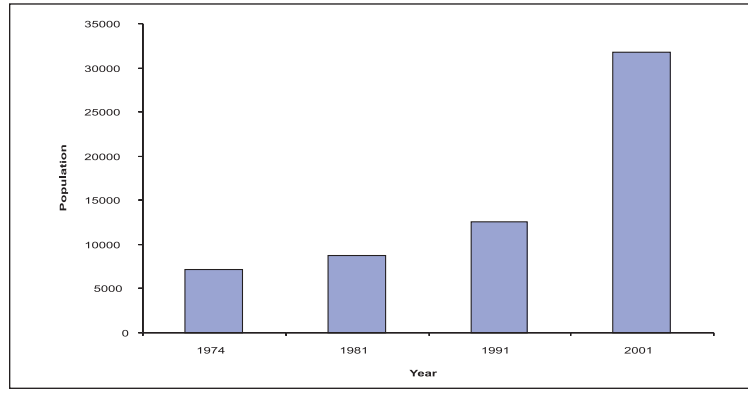


[8] Source: UMIS, 2001, Draft Kaliakoir UHC Report, 2002/03

The situation is of course also dependent on population growth, migration and levels of awareness, which makes it impossible to conclude there has been an actual increase in the frequency of these diseases amongst the population. National statistics do show a substantial increase in the population but unfortunately these statistics are not available for the same time periods - the UHC data being for the period 1998 to 2002 and the national census for 1991 and 2001 (Figure 4).

Calculation of a linear annual population increase between 1991 and 2001 however gives an annual increase of six percent. This translates into a population increase between 1998 and 2001 of approximately 19 percent. Over the same period there has been an overall decline in the number of reported cases of diarrhoea (down 19 percent) and of malnutrition (down by 35 percent) but an increase in the reported cases of anaemia (up 14 percent), peptic ulcers (up 29 percent) and skin diseases, which was up by 42 percent. This implies that the rate of increase in cases of peptic ulcer and anaemia may have been above the rate of population increase but that other health problems have declined in relative terms.

Figure 4: Trend of population in Kaliakoir between 1974-2001 based on 14 villages9



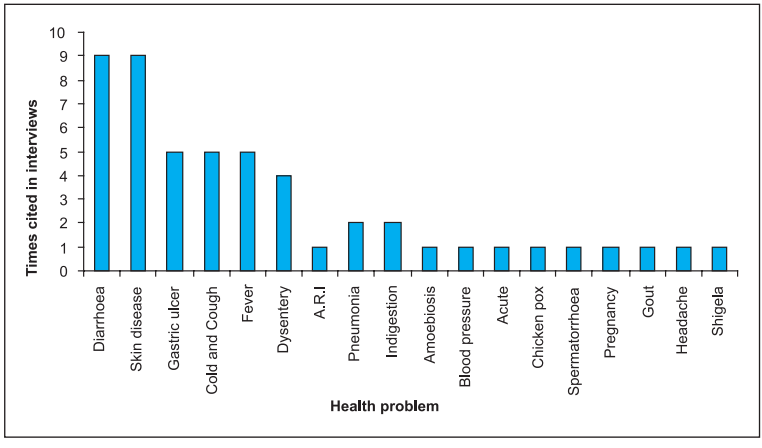
[9] See Annex A for the village data used to compile this figure. Source: Bangladesh Bureau of Statistics, 2001

Despite these figures, community-based discussions provide anecdotal evidence that the prevalence of diseases is increasing in general. For example, during both group and individual interviews respondents mentioned that "illness" had been a common phenomenon in their community for the past couple of years. Local villagers expressed concern at the increased frequency of "attacks of sickness" from one or more of the diseases. They referred to increasing morbidity over the last 10 years.

4.2 Health Workers' Views

The interviews conducted with health workers in the area provided similar results in terms of the five most prevalent health problems in the area to those given in community FGDs. The health workers identified a total of 20 health problems that were prevalent in the area at the time of the interview. Of these the five most frequently cited were diarrhoea, skin diseases, gastric ulcers, cough and cold, and fever, with the first two being mentioned in nine of the 10 interviews. The next most common health problem was dysentery10, which was mentioned four times; all others were only mentioned once or twice (Figure 5).

Figure 5: Number of times each health problem was cited among the five most common problems



[10] Unlike the village interviews the health workers were able to clearly distinguish between diarrhoea and dysentery and therefore these problems have been kept separate. Simple addition will however provide easy comparison with village FGD results.

The health workers then scored these, distributing a possible total score of 50 across the five health problems. The mean of these scores shows that skin disease, diarrhoea and gastric ulcer are not only cited the most number of times but also gain the highest mean score (Table 4), therefore being perceived as both frequent within villages and common across the area.

Table 4: Average score given by health workers for prevalence of health problems

Health problem	Sum of score	Mean score ± SDa	Rank
Skin disease	78	7.80± 3.52	1
Diarrhoea	76	7.60 ± 4.62	2
Gastric ulcer	75	7.50 ± 8.09	3
Fever	50	4.10± 5.67	4
Cold, cough	44	4.40± 5.82	5
Dysentery	40	4.00 ± 5.72	6
Cold cough and feverb	8	0.80 ± 2.53	7
A.R.I	16	1.60± 5.06	8
Pneumonia	15	1.50± 3.17	9
Indigestion	14	1.40± 2.95	10
Amoebiosis	12	1.20 ± 3.7	11
Chicken pox	10	1.00 ± 3.16	12
Hypertension	10	1.00± 3.16	12
Acute abdomen	10	1.00± 3.16	12
Spermatorrhoea	8	0.80± 2.53	13
Gout	8	0.80± 2.53	13
Pregnancy	8	0.80± 2.53	13
Dysentery and diarrhoea	6	0.60± 1.90	14
Head ache	5	0.50± 1.58	15
Shigela	5	0.50± 1.58	15

Notes:
n = 10 total number of interviews
SD- standard deviation
[a]Mean score and standard deviation was calculated using Minitab 12
[b]In this interview cold, cough and fever was treated as a single health problem as even after questioning the health worker was unable to separate them and considered them to be a problem that always occurred together.

4.3 Key Issues and Possible Association with Industrial Pollution

Qualitative information suggests that there may be a link between the pollution and health problems.

4.3.1 Skin Problems

Skin problems, allergic conditions, itching and other skin lesions are contact-type diseases. Research has shown that the khal and beel are generally alkali, which is likely to be attributable to the extensive use of the alkalis soda ash and caustic soda in the textile dyeing industry. This alkalinity is likely to be a key factor in the skin irritations reported by local communities as they reported that the symptoms manifest themselves when their skin has come into physical contact with beel water or sediment.

The research team observed that skin problems were very widespread in the study area. Almost all FGD participants claimed to have experienced skin problems because of their frequent contact with beel and khal water, and some participants were currently suffering from skin problems. They willingly showed the team the skin lesions in their bodies, particularly in hands and legs. While talking to the local doctors and village practitioners, it was found that the drugs for skin problems, both traditional and allopathic, were the highest selling drugs in the locality.

The majority of the respondents reported that children and factory workers suffer the most from skin diseases. Usha (1989) also reported that eczema and contact dermatitis among the workers of textile factories. Other respondents noted that, fishermen and those who have frequent contact with beel and khal water, also tended to suffer more from these problems. The symptoms of the skin conditions include a rash, boils and irritation. There are two main reasons given by the communities as to the source of the problem. The first is that it is spread by contact especially among children who are living in unhealthy environments. The second and more frequently reported cause is contact with the chemicals used in the factories. This cause was also cited by a community that is far from the factories (Barai bari) but it may be that the people here come into contact with the beel and river water whilst using it for agricultural purposes or when they come fishing.

“Skin disease has increased in this area. Farmers, children and

fishermen are mainly affected as they work in the water. The pollutants from industries are responsible for it. Pollutants from industries enter in the Turag River through the khal and beel and end up here. Local Health Complex and Department of Environment should take the initiative to stop the pollution" (Barai bari health worker).

4.3.2 Diarrhoea and Dysentery

The majority of the respondents also blamed the lack of proper sanitation systems, poultry farm waste and lack of knowledge about hygiene for diarrhoea and dysentery, which are frequent among children, slum dwellers and factory workers. Diarrhoea is one of the most prevalent health problems reported to be suffered by children, being ranked first in six of the FGDs.

Gastric ulcers have been identified as a common health problem for workers in the area, including factory workers. The doctors and health workers interviewed felt that this was due to irregular eating habits and the length of time between meals. Many studies confirm the occupational health problems associated with working in the textile dyeing industry in Sanganer, including that by Usha (1984) which notes the high incidences of not only skin problems but also asthma, chronic bronchitis, tuberculosis, bladder cancer and irritation of the eyes.

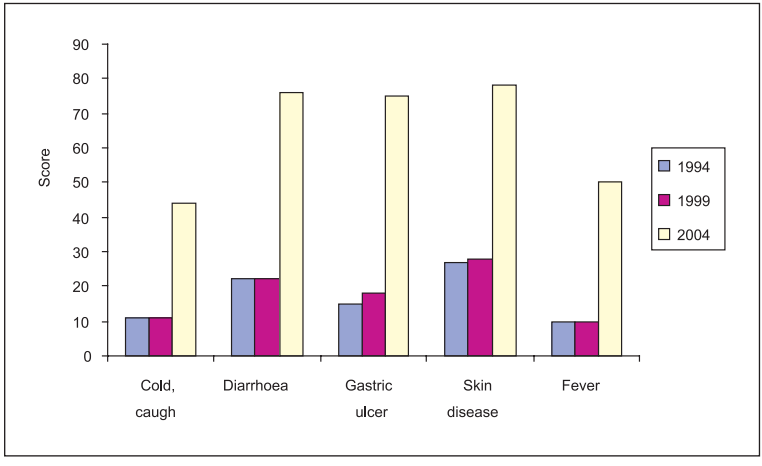
The trend of health problems over the past 10 years was also researched in the interviews and it appears that the five health problems cited as being the most prevalent now have increased in their relative prevalence over that period (Figure 6). Some of the health workers felt that in absolute terms there were fewer cases of health problems such as dysentery and diarrhoea simply because there were fewer people living in the area, as many people have migrated to work in the factories. However, in relative terms they felt that diseases have increased.

"I did not see many patients with skin diseases in the past, and dysentery and diarrhoea have increased a lot in the area... The lack of cleanliness and also eating fish from polluted water is the main cause of this disease...Polluted water from industry is responsible" (Sinaboho interview).

The disparity between this anecdotal evidence relating to diarrhoea and dysentery and the data collected from the UHC may be that the UHC covers an area much larger than the Mokesh Beel area and includes

villages that come into contact with less polluted water resources. It may also relate to the fact that only the most serious cases are referred to the UHC by these health workers and that large numbers of people suffering from less acute symptoms do not visit there.

Figure 6: Trend of health problems in the area between 1994 and 2004 according to local health workers



4.3.3 Respiratory Disorders

Respiratory disorder was highlighted as a major problem in 11 FGDs and participants in Bagambar village also mentioned the problem of asthma. Although this may be caused by a number of factors studies have shown that occasional high concentrations of hydrogen sulphide found in community air samples were consistent with complaints of headaches, eye irritation, and sore throats (Fielder et al., 2000). Bhambhani and Singh (1985) also reported that exposure of 42 individuals to 2.5 to 5 ppm (3.5 to 7 mg/m3) hydrogen sulphide caused coughing and throat irritation after 15 minutes. In addition there is a large body of evidence that shows that textile dyes can act as respiratory sensitizers and can lead to choughs, respiratory tract irritation and asthma (Ahmed et al., 2005).

4.3.4 Malnutrition

The majority of participants in the FGDs claimed that the diseases that occur most commonly in the area are either because of direct ingestion of contaminated water or because of reduced food intake, which some attribute to the pollution. Respondents said rice production had decreased in the area and fish catches in the beel had declined this is, in their opinion, due to water pollution and is causing a depletion of food and nutrition for the community.

"We were well-off because we used to supply fish to the whole region of Dhaka and Gazipur but now there is less fish in the Mokesh-Kalidoho beels. Moreover, if people know that these fish are from Mokesh Beel, they do not buy because the taste is not good. We are now suffering - both physically (due to illnesses and lack of fish) and financially" (Fisherman in Gupinpur).

The respondents generally agreed that the fish from Mokesh Beel do not taste good and smell of a "kerosene-like" substance. Participants said that this problem started about 10 to 15 years ago after the establishment of the industries.

Data collected by the MACH project on fish catch and consumption suggest that fish yields and consumption in the villages has in fact increased but this is not the perception of the local community members interviewed. One explanation may be that although fish production may now be increasing due to interventions by the MACH project, the market for fish from the area is facing difficulties. What is clear is over the last two dry seasons major fish kills have taken place in the project fish sanctuaries that are generally thought to be the consequence of industrial pollution (Daily Star, 6th April 2004).

Effects of malnutrition such as anaemia, protein deficiency syndrome and general weakness were reported in the interviews to be common amongst adults and children in the study area. Malnutrition can also aggravate the risks of other diseases caused by water pollution and may increase vulnerability to the effects of exposure.

4.3.5 Maternal and Child Health

Specific questions asked about maternal health care suggested that there has been an increase in complications during childbirth.

Respondents in all FGDs except one (where no children had been born in the past six months) stated that the number of pregnancy and childbirth complications had increased including: abdominal pain during pregnancy; labour pain but "delayed delivery" or births requiring caesarean, and sometimes still births. Swelling of the hands, feet and legs during pregnancy (oedema); abnormal bleeding, anaemia and malnutrition were also more common. There is medical evidence that suggest the view is at least plausible. For example, oedema, a condition when too much fluid, usually water, has accumulated in the body is linked with poor kidney function and lack of protein. Protein reduces the osmotic pressure of the blood and if blood protein levels drop significantly, there will be little or nothing to draw the water back into the blood from the tissue spaces through the capillary walls. The result is an accumulation of fluid in the tissue, called oedema. If fish production or sales are being affected by the pollution as suggested by the community this may be contributing to the problem as fish, on average, accounts for 63 percent of the animal protein and eight percent of the total protein intake in peoples' diets in Bangladesh (Department of Fisheries, 2004).

Health problems during pregnancy are common in Bangladesh and it is therefore difficult to determine whether or not there are statistically higher problems in the project area. National health statistics (2000) suggest that during pregnancy 25 percent of women suffer from abdominal pain which is followed by swelling of the legs or body. Of these over 23 percent reported swelling of the leg (oedema) and 20 percent anaemia. Other ailments included convulsions (two percent), haemorrhaging during pregnancy (four percent) and bleeding prior to delivery (three percent). Bleeding after delivery was reported by 22 percent, prolonged labour by 19 percent and injuries during delivery by 6 percent.

Although no direct link can be made between individual pollutants and these problems other studies have shown that hydrogen sulphide gas has had significant impacts on pregnancies. In a study in China of 106 women who reported occupational exposure to hydrogen sulphide in the first trimester of their pregnancy showed significant proportion reported spontaneous abortion Xu et al. (1998). In Kaliakoir hydrogen sulphide gas is almost certainly released to the atmosphere by the reduction of sodium sulphate, which is used in the textile industry.

Consequently in the research area the communities reported that there has been an increase in the number of mothers giving birth in hospital

due to the rise in the problems being faced by them. People in 11 of the 15 FGDs stated that the majority of births now took place at medical centres, with many respondents saying that approximately 80 percent of births take place there, whereas in the past they would have been delivered at home. The community members with whom discussions were held in the villages of Amdair, Harinhati and Sinabaha, specifically said that the reason for going to hospital was the rise in the number of caesareans that were required. However, discussions at the UHC revealed that caesareans have only taken place there since 2001.

There are cases of physically deformed children in the study area but with out comparison with statistics across Bangladesh it is difficult to determine whether these were above average. The participants of the female FGDs in Sinaboho said that there were three cases of deformed children in their village. In Taltoli village the FGD participants reported that there were at least three disabled babies (two were unable to stand, walk or speak) born in their village but they later died at the age of one, three and five years. In Amdair the participants mentioned that a child had been born one month before the interviews with only one leg and hand. There were several such cases report across the village but it is difficult to determine the cause or true extent of the problem. Evidence from empirical studies in India and elsewhere however demonstrate that textile waste does have mutagenic activity. Mathur et al. (2004) performed mutagenicity tests samples of ground water, surface water and effluent discharge from factories using the Salmonella/microsome reversion assay using the plate incorporation procedure. They found that both surface water and end of pipe samples had mutagencicity ratios higher than 2.0 and therefore indicate that they may have mutagenic effects. Similar finding were reported by McGeorge et al. (1984) for textile effluents and a study by Sanchez et al. (1988) showed that of various industrial categories tested, the textile industry contributed the highest percentage (67 percent) of mutagenic effects (Mathur et al., 2004).

4.4 Domestic Water-related Activities

Currently more than 95 percent of the villagers were found to be using tube well water for drinking and day-to-day household activities, and respondents said that there were no problems collecting water from a tubewell if they did not have their own. Only in Gupinpur was it found that the number of tube wells was less than adequate and people were using beel and river water for household activities including washing cloths

and utensils.

Culturally open water bodies have been the most common source of water for bathing. People generally bathe at least once a day. However, in the project area the communities complain that the local beel water is no longer of a quality in which people can bathe.

“I used to bathe and drink water from the ponds and beels when I was a young boy, but now I can not even think of doing that in these ponds and beels” (Local School Headmaster).

The beel was also used for cattle washing but people in the majority of the FGD’s reported that cattle now suffer from “sore mouths” when they drink the beel water and therefore many people are reluctant to use it even to wash livestock.

“In the past, ponds and beels were the main sources of water for this community and we used to use the water for all purposes, but now we can not do that. The quality of water has deteriorated so much that it has become absolutely black, oily, and it irritates when it comes in touch with our skin. Nobody would want to use that water. Now we have to depend on the tube wells - these tube wells cost us to install, more so, extra hassle to collect and store water” (Respondent, Harinhati village).

Although there has been a clear shift of water intake behaviour in the study area from beel water to tube-well water, the villagers have still been found to be suffering from the potential “intake-type” effects of water pollution. The incidence of problems including diarrhoea, gastric ulcers, respiratory illnesses, hepatitis and anaemia, are common amongst the study population although no comparison was made to a larger population size as national health datasets are limited. World wide epidemiological studies have conclusively shown that these diseases can potentially occur due to intake of water contaminated with toxic industrial chemicals, as well as human excreta and organic wastes.

The villages around Mokesh Beel are exposed to water pollution through both direct ingestion of toxicants through the intake of polluted water and via the food chain, including rice, vegetables and fish. In the dry season the wetland area of Mokesh - Kalidoho ecosystem is reduced from 4,500 ha to only 37 ha and the land is then used for agricultural production. Land is also irrigated with water from the beel

and in this way agricultural production is being impacted by the industrial pollution and may be accumulating pollutants. Several respondents involved in agriculture stated that the polluted sediment is responsible for their poor crop yields. Similarly in Jaipur, India it was found that drainage water and the dry bed of the drainage channel from industries, including textile industries, could not be used for agriculture or recreational purposes (Mathur et al., 2004).

4.5 Economic Migrants and Lack of Infrastructure

The population around Mokesh Beel ecosystem is about 300,000 with an average family size of 5.3. The inhabitants are mostly farmers or fishermen but there are an increasing number of economic migrants living in the villages. An important trend appears to be people embarking on new income generating activities. For example, some people are shifting away from agricultural production and instead are establishing, and renting out, semi-pucca "barrack-type" accommodation to factory workers on land that was previously cultivated. However, the accommodation is generally of poor quality and facilities such as sanitation are inadequate. As a result, the local environment is being polluted due to the waste and excreta created by the additional people in the village. It was observed by the field teams that certain areas around villages appear to be acting as areas for open defecation with large amounts of excreta visible.

"We had only 13 families with average 6 or 7 members per family in our village about 10 years ago, now we have more than 500 inhabitants, most of them are industry-related workers and traders who have come from outside. They are living in overcrowded, congested, rented accommodation with limited facilities. In some cases, around 50 people share only one tube-well and two or three latrines" (Elderly resident, Harinhati village).

Several respondents also referred to the problem of increasing promiscuity and an increase in sexually transmitted infections. The health workers also mentioned genitor-urinary problems but were more inclined to relate this to women sitting for too long in factories, not emptying their bladders regularly enough and not practicing adequate personal hygiene, due to lack of facilities.

4.6 Health Services Delivery and Awareness Raising Activities

Villagers usually consult a village doctor first for any minor illnesses. If they are not cured, they then go to registered qualified Batchelor of Medicine and Surgery (MBBS) and Fellow College of Physicians and Surgeons (FCPS) private practitioners, in the local village pharmacy or in the private clinics. Those who can afford the cost of treatment in the private sector usually go to the private clinics straightaway. Some villagers, often poorer patients, choose public facilities, such as the Kaliakoir UHC, for their more serious health care needs but the time and costs of travel discourage people from using the UHC immediately. Moreover, there is a general belief that the health care in private clinics is of better quality than in the Kaliakoir UHC.

In the study area, the villagers' receive limited health awareness messages from Bangladesh Rural Advancement Committee (BRAC), Proshika, Pollimangal and Grameen Bank who occasionally run campaigns and sanitation programmes. The respondents also mentioned that they do not see any activities from government health and family planning workers at the village level.

4.7 Community Responses to the Aquatic Pollution

It was revealed in both the FGDs and in-depth interviews that there had been several attempts at joint discussions between community leaders and the factory owners about how to minimise pollution. At these meetings apparently actions were agreed with the factory owners but no action was taken. The MACH project has taken various initiatives with both villagers and the factory owners to control pollution, and to mitigate the pollution related problems in the community. The respondents believed that only joint and collaborative efforts between the local community and the industry owners could bring a sustainable solution of this pollution problem.

5

Conclusions and Recommendations

Conclusions and Recommendations

The research undertaken with the community and health workers in Kaliakoir provides evidence that local communities are suffering from a variety of health problems that could be a direct or indirect result of the activities of local factories. These problems include skin diseases, diarrhoea, dysentery, respiratory illnesses, anaemia and complications in childbirth. Members of the community and health workers are of the view that the incidents of various health problems are relatively high in the area and are increasing. In some cases this is corroborated by statistical information.

Many community members believe that these problems are a result of an increase in the number of industrial units in the area. It is their opinion that effluent entering the surface water bodies in the area, including the khal and beel, is reducing the quality of water and as a result they are unable to use it for the purposes for which it was used in the past, such as bathing and washing cattle. When they do they (and their livestock) suffer direct health impacts such as skin rashes and sores.

Not only do community members feel that industrial pollution is affecting their health directly but also that it is impacting on the productivity of the beel and land, which is in turn affecting their health.

Whilst no direct linkages have been proven between industrial pollution and ill health there is evidence to suggest that they may be related. Skin problems may for example be related to the high pH of the water, which has been found to be as high as pH 10.9 in some places in the khal (Chadwick and Clemett, 2003). Such alkaline conditions could certainly irritate the skin and result in sores. The high pH levels are likely to be the result of the large quantities of caustic soda and soda ash used in the dyeing process to achieve a pH of between pH 10.5 and pH 11.5.

It is more difficult to attribute the stomach problems to industrial pollution as people in the area do not drink surface water. However gastric ulcers and other similar gastric problems may be related to diet and the impacts of the pollution on crops and fish consumed by people living around Mokesh Beel. It is also possible that groundwater is being polluted by infiltration of industrial effluent but similarly there has been no empirical research into this. The problems of diarrhoea and

dysentery are unlikely to be caused directly by the industrial effluent, as they are usually the result of microbial contamination. However, the high level of in-migration to the area is putting considerable pressure on poor sanitation infrastructure and may be increasing the risk of contracting communicable diseases.

None of these findings have been confirmed with rigorous epidemiological studies. Further research studies, including epidemiological studies, are necessary to determine better the impact that industry is having on the environment and the people who interact with it. Such evidence is crucial in if policy makers and industry owners are going to be influenced to control and mitigate for environmental pollution.

In order to improve the situation interventions both at the national and local levels are required. The implementation of legislation on safety precautions, banning toxic chemicals and pollutant concentrations in industrial discharges into water sources are all required. Currently, most dyeing units in the Kaliakoir area and across Bangladesh are in breach of the Environmental Conservation Act. However, the Department of Environmental due to financial, human and political reasons does not act.

An Information, Education and Communication campaign would be beneficial in providing an understanding in the community about risks and possible ways to minimise them, and to inform the Bangladesh public of the problems.

References

Abedin, M. N. (1997) Health and Population Sector: An Overview and Vision - Paper for the Logical Framework (Log-Frame) Workshop for the Fifth Health and Population Programme (HAPP-5) 23-25 February 1997. Government of Bangladesh, Dhaka, Bangladesh

Ahmed, S., Tapley, K., Clemett, A. and M. Chadwick (2005) Health and Safety in the Textile Dyeing Industry. Stockholm Environment Institute and Bangladesh Centre for Advanced Studies, Dhaka, Bangladesh.

Akhtaruzzaman, M., Clemett, A., Knapp, J., Mahmood, M.A., Ahmed, S. and M. Chadwick (2005) Choosing an Effluent Treatment Plant. Stockholm Environment Institute and Bangladesh Centre for Advanced Studies, Dhaka, Bangladesh.

Allan, J. D. and A. S. Flecker (1993) Biodiversity Conservation in Running Waters. BioScience, 43: pp 32-43.

Allan, J. D. (1995) Stream Ecology: Structure and Function of Running Waters. Chapman & Hall, London and New York.

Asante-Duah, K. (2002) Public Health Risk Assessment for Human Exposure of Chemicals: Environmental Pollution, Dordrecht. Kluwer Academic Publishers, Netherlands.

Bhambhani Y, and M. Singh (1985) Effects of hydrogen sulphide on selected metabolic and cardiorespiratory variables during rest and exercise. Report submitted to Alberta Worker's Health and Safety and Compensation.

ATSDR (1999a) Toxicological profile for total petroleum hydrocarbons (TPH). Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Department of Health and Human Services, Public Health Service, Atlanta, USA.

ATSDR (1999b) Public Health Assessment, A Report prepared by Illinois Department of Public Health, Illinois: Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Department of Health and Human Services, Public Health Service, USA.

Bangladesh Garment Manufacturers and Exporters Association (BGMEA) (2005) Bangladesh Apparel and Textile Exposition, 29 September to 1 October, 2005. Dhaka, Bangladesh.

BBS (2001) Health and Demographic Survey-2000. Bangladesh

Bureau of Statistics, Dhaka, Bangladesh.

BBS (2004) Fisheries Statistical Yearbook 2003-2004. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh.

Baxter, P. (1990) Review of major chemical incidents and their medical management. In: Murray V (Ed) Major Chemical Disasters- medical aspects of treatment. Royal Society of Medicine, 1990, pp 7-20, London, UK.

Berry, B. J. L. and F. E. Horton (1974) Urban Environmental Management. Prentice Hall International Inc., London, UK.

Bhattacharya, D., Kabir, B. N. and K. Ali (1995), Industrial Growth and Pollution in Bangladesh: A sectoral Analysis, Paper presented in the Symposium "Environment and Sustainable Development with Special Reference to Bangladesh". North-South University, Dhaka, Bangladesh.

Bhattacharya, R. N. (2001) Environmental Economics: An Indian Perspective (Eds). Oxford University Press, 2001 ISBN: 01956556-7, New Delhi, India.

Chadwick M. T. and A. E. V. Clemett (2002) Managing Pollution from Small- and Medium-Scale Industries in Bangladesh: Project Proposal. Stockholm Environment Institute, York, UK.

Chadwick M. T. and A. E. V. Clemett (2003) Managing Pollution from Small- and Medium-Scale Industries in Bangladesh: Inception Report. Stockholm Environment Institute, York, UK.

CPREEC (2001) Pollution and Health: A CPREEC Booklet Series. C.P.R Environmental Education Centre (CPREEC), 2001. Available at: http://cpreec.org, New Delhi, India.

Daily Star (6th April 2004) Turag Fish Die as Mills Dump Waste, Dhaka, Bangladesh.

Dasgupta, P. (1982) The Control of Resources. Harvard University Press, Cambridge, MA, USA.

Dasgupta, P. (1990) The Environment as a Commodity, Oxford Review of Economics, 6 (1), pp 51-67.

Dasgupta, P. (2001) Human well-being and the Natural Environment, Oxford University Press, Oxford, UK.

Department of Fisheries (2004) Fisheries Statistical Year Book 2003-2004. Dhaka, Bangladesh.

ECETOC (1988) Technical Report No. 27, Nitrate and Drinking Water; cited in Harrison, R. M. (Editor, 1992) Pollution Causes, Effects and Control. The Royal Society of Chemistry, Cambridge, UK.

Faisal, I., Shammin, R. and J. Junaid (2001) Industrial Pollution in Bangladesh. Available on-line at: www.worldbank.org/nipr/INfoPol/Industrial%20Pollution-003-full.htm

Fielder, H. M. P., and Poon-King, C. M., Palmer, S. R., Moss, N. and G. Coleman (2000) Assessment of impact on health of residents living near the Nant-y-Gwyddon landfill site: retrospective analysis. British Medical Journal, v320 (7226): 19-23

Harrison, P. (1992) The Third Revolution: Population, Environment and A Sustainable World, Penguin Books, London, UK.

Harrison, R. M. (1990) Pollution: Causes, effects and control (2nd Ed). Royal Society of Chemistry, London, UK.

Harrison, R. M. (1992) Understanding our environment: An introduction to environmental chemistry and pollution (2nd Ed). London: Royal Society of Chemistry.

Harrison, R. M. (Editor, 1992) Pollution: Causes, Effects and Control. Cambridge, United Kingdom: The Royal Society of Chemistry.

Holdgate, M. W. (1979) A perspective of environmental pollution. Cambridge University Press, Cambridge, UK.

Holdgate, M. W. (1979) A Perspective of Environmental Pollution. Cambridge University Press: in Mason, C. (2002) Biology of Freshwater Pollution, 4th Edition. Pearson Education Limited, Essex, UK.

Interim Poverty Reduction Strategy Paper (iPRSP) (April 2002) A National Strategy for Economic Growth and Poverty Reduction. Economic Relations Division, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

Mason, C. (2002) Biology of Freshwater Pollution, 4th Edition, Prentice Hall, Harlow, UK.

Ministry of Labour (2002) Guideline Lead on Construction Projects.

Ontario, Canada. http://www.gov.on.ca/lab/english/hs/pdf/lead_draft.pdf

Muthur, N., Bhatnagar, P., Nagar and Bijarnia, M. K. (2004) Mutagenicity Assessment of Effluents from Textile/Dyeing Industries of Sanganer, Jaipur (India): a case study. Ecotoxicology and Environmental Safety, 61, pp. 105-113.

OhioEPA (2002) Pollution Prevention Opportunities for PBT Chemicals: Chromium and Chromium Compounds. State of Ohio Environmental Protection Agency, Ohio, USA. http://www.epa.state.oh.us/opp/mercury_pbt/fact91.pdf

Okada, M. and S. A. Peterson (2000) Water Pollution Control Policy and Management: The Japanese Experience. Gyosei, (ISBN4-324-06240-4), Japan.

Penney, J. (1993) Report "Background Information on Cadmium Poisoning in Support of a Fact Sheet for Lay adjudicators" Prepared for the Occupational Disease Panel (Industrial Disease Standards Panel) Ministry of Labour, July 1993. Ontario, Canada. http://www.canoshweb.org/odp/html/cadmium.htm#p1

Revenga, C., Brunner, J., Henniger, N., Kassem, K., and R. Payne (2000) Pilot Analysis of Global Ecosystems: Freshwater Systems. World Resource Institute, Washington DC, USA.

SEHD (1998) Bangladesh Environment: Facing 21st Century, First Edition. Society for Environment and Human Development (SEHD) Publications, Dhaka, Bangladesh.

Sheridan, W. D. (1996) Reference Data Sheet for Aluminium. Meridian Engineering and Technology Inc., Glenview, IL, USA.

Shiklamanov, I. A. (1997) Comprehensive assessment of the Freshwater Resources of the World: Assessment of Water Resources and Water Availability in the World. World Meteorological Organisation and Stockholm Environment Institute (SEI) Stockholm, Sweden.

Smith, W. E. and Smith, A. M. (1975) Minamata. Holt, Rinehart and Winston. New York, USA.

Taylor, R. and Smith, I. (1997) State of New Zealand's Environment 1997. The Ministry for Environment. Wellington, New Zealand. http://www.mfe.gov.nz/about/publications/ser/front.pdf

The Environmental Pollution Control Ordinance, 1977, Ordinance no. XIII of 1977. Bangladesh.

The Bangladesh Environmental Conservation Act, 1995, Act No. 1 of 1995. Bangladesh.

The Environmental Court Act, 2000, Act No. 12 of 2000. Bangladesh.

The Environmental Conservation Rules, 1997. Bangladesh

UNEP/GEMS (1995) Water Quality of World River Basins. United Nations Environment Programme (UNEP)/Global Environment Monitoring System/Water, Nairobi, Kenya.

Usha (1989) Impact of Industries in Sanganer. P.G. Diploma Field Study Report, Indra Gandhi Centre for HEEPS, University of Rajistan, Jaipur, India.

WHO (2000) Hazardous chemicals in human and environmental health: a resource book for school, college and university students. WHO (IPCS), Geneva, Switzerland.

World Bank (The) (1993) World Development Report - 1993: Investing in Health. Oxford University Press, New York, USA.

WRI (2001) Dirty Water: Pollution Problems Persist, Earth Trends 2001. World Resource Institute (WRI), Washington DC, USA.

Xu X, Cho SI, Sammel M, You L, Cui S, Huang Y, et al. Association of petrochemical exposure with spontaneous abortion. Occup. Environ. Med. 1998;55(1):31-36.

Annex A: Population Census Data 1974 - 2001

	Total population				
Year	1974	1981	1991	2001	unpublished
Village : Harin Hati		Not available	203	330	3947
Union : Mouchak					
Thana : Kaliakair					
District : Gazipur					
Village : Ratanpur		Not available	Not available		Not available
Union : Mouchak					
Thana : Kaliakair					
District : Gazipur					
Village : Purba Chandra		Not available	538	1524	7454
Union : Mouchak					
Thana : Kaliakair					
District : Gazipur					
Village : Shafipur	615	2362	2788	10883	
Union : Mouchak					
Thana : Kaliakair					
District : Gazipur					
Village : Mazukhan		1139	587	1412	1399
Union : Mouchak					
Thana : Kaliakair					
District : Gazipur					
Village : Karalsurichala		501	678	967	1495
Union : Mouchak					

Thana : Kaliakair
District : Gazipur

Village : Amdair Not available 961 1179 1196
Union : Madhyapara
Thana : Kaliakair
District : Gazipur

Village : Sholahati Not available Not available Not available 520
Union : Mouchak
Thana : Kaliakair
District : Gazipur

Village : Matikata 104 121 235 1279
Union : 4 No. Muchak
Thana : Kaliakair
District : Gazipur

Village : Bagambor 305 399 525 665
Union : 4 No. Muchak
Thana : Kaliakair
District : Gazipur

Village : Kaliadaho 341 401 471 460
Union:Mouchak
Thana:Kaliakair
District: Gazipur

Village: Gobindapur/Gopinpur Not available 871 1147 919
Union:Madhyapara
Thana:Kaliakair
District: Gazipur

Village: Taltali Union: Mouchak Thana:Kaliakair District: Gazipur	416	528	684	760	
Village: Kouchakuri Union: Mouchak Thana:Kaliakair District: Gazipur	11	2958	210	350	431
Village: Sinaba/Sinaboho Union: Mouchak Thana:Kaliakair District: Gazipur		816	928	964	1548
TOTAL	7195	8787	12576	32956	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