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ANALYSIS OF MAJOR HAZARDS ON HUMAN HEALTH IN KHULNA CITY

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Abstract: Being a developing country of the world, Bangladesh is overwhelmed with various environmental problems. The rapid increase in urban population has made a tremendous claim on the already over utilized civic facilities and created a state of disequilibrium in the urban environment. The overall environmental condition and human health condition in urban areas were miserable because of the absence of proper planning and lack of different basic services necessary for decent living in the urban area. This research identifies the major hazards that affect human health of Khulna City and find out the information about major hazards such as high population density, unhealthy housing condition, fire, bad sanitation system, improper water supply, improper solid waste management, unhygienic food, industry, insufficient health facility, water logging, noise and odour condition of the city. This study also finds out most stress areas of the city which affect human health. This research also finds out that only 33.77% people live in low and moderate stress areas. The city dwellers often suffer from several diseases like diarrhoea, dysentery and skin diseases.

Key words: Hazards, human health, stress and KDA

Introduction

The overall environmental condition of larger urban centres of Bangladesh is deteriorate rapidly and these urban centres are going to be the major focal points of population concentration in the next century. This trend is already being exhibited by the increasing level of urbanization in Bangladesh, which is about 25% of the total population of the country. The ever-increasing urban population, because of in-migration and high natural growth rate, will have far reaching negative impacts on the environment in places of those high population concentrations (Ahmad, 2005). A good environmental management system supported by effective monitoring, evaluation and problem oriented actions accompanied by people's participation can only ensure a sustainable urban living environment for future generations. Khulna has been experiencing a number of environmental problems due to some inherent reasons. In recent years, a good number of investment programmes by GoB, donors and NGOs have been undertaken, or are in the pipeline, for improving the overall environmental conditions of the city area. It is pertinent here to identify the major environmental problems in the city area, among them and help both the KCC authority to be able to most effectively channelise the limited development funds for the highest priority need and also the fund giving agencies to be able to find out the area where funding would be most vitally useful for the well-being of the dwellers of the city. Khulna, located in the

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southwestern region, is the third largest metropolitan as well as an important industrial city of Bangladesh. It is also the divisional headquarters of Khulna Division comprising 10 districts. Due to both push and pull factors, the population of the city has been increasing tremendously in the recent years. A vast majority of the population of Khulna is living below poverty level and most of them are engaged either in various informal sector jobs or small, medium and large sized industries as workers. As a result, they are compelled to live in slums and squatter areas without having least access to basic urban services and facilities. The overall environmental conditions of the slum areas are worse and unhealthy from any consideration. The existing services and facilities provided by different agencies (viz. Khulna Development Authority (KDA), Khulna City Corporation (KCC), Local Government Engineering Department (LGED), Department Public Health Engineering (DPHE), etc.) are not adequate to cope with the ever increasing demans for these services and facilities by the burgeoning city dwellers. Consequently, the quality of delivery system of these services is deteriorating gradually and thus the quality of living condition of the people is at stake. Apart from these, wastes generated from various sources are not scientifically disposed off. Notably, wastes generated from informal sector industries such as welding workshop, motor repair garage, saw mills, spice crushing' mills, soap factories, etc. are not treated scientifically. On the other hand, the large scale industries such as Khulna Hardboard Mills, different Jute Mills, Match Factories, Khulna Ship Yard, Khulna Power Station, etc. generate a lot of wastes which are discharged either in the nearby rivers or elsewhere without adequate treatment. Due to excessive dependence on the ground water for water supply for the purposes of both drinking and other household activities, there are some evidences of arsenic contamination in water in some wards of the city areas. The drains are not regularly cleaned and their channels and outlets are not also properly designed as per the natural physical configuration of the city area and the surrounding areas. The excessive use of polythene and its unscrupulous disposal have resulted in the blockage in the drainage system of the city. The low-lying areas in and around the city are the places of breeding ground of mosquitoes and other insects. Solid wastes are sometimes used for land filling purposes within the city corporation area, which cause wide spread of odor which are very injurious to people living in the surrounding areas. Actually Khulna city is located on the levee formation of the river partly and other sides are plain. As a result, there is stagnation of rainwater in the city area. In addition to this, there is flush back of saline water in the city area during the high tide. Consequently, some of the city areas remain wet (Murtaza, 2001). Presently no single agency is responsible to address all these environmental problems. Some of the service providing agencies encompasse the environmental aspects with their own plans and programs as peripheral issues. The existing institutional and regulatory arrangements of the service providing agencies are not in conformity with addressing the emerging issues concerning the environment of the city. Historically, Khulna has been established as a regional centre for trade and commerce. Khulna has achieved tremendous industrial growth during the early and mid sixties. Over the years, it has become the regional centre for higher education, industry and commerce. Recently, the export of shrimp has caused the growth of ancillary activities such as banking, insurance, transport, storage, and the alike. It can be rightly said that as a regional centre Khulna will continue to attract a lot of investments for its development of infrastructure, industries and associated functions. Khulna, like other cities in Bangladesh, has been experiencing a gradual increase in its population because of migration of peoples from various parts of the country, particularly from the rural areas in quest of job or provision for work for a decent living. With ever increasing population pressure, progressive development of various industries of different sizes, increase in the transportation, build up of a large area of slums and unplanned housing for providing residential accommodation of the city dwellers, development of various informal and small industries in residential areas, absence of any sewerage system, lack of adequate roads and drains, inadequate provision for water supply and solid waste disposal system etc. have led to the development of various environmental problems in Khulna City. The major objectives are (i) to

identify and mapping of environmental by stressed areas ; (ii) to find out the relationship between environmentally stressed areas and general level of health; and (iii) to identify the most important hazards for human health in Khulna City Corporation which are not being managed properly.

Materials and Methods

Several things which are relevant to the present study have played an incremental role for developing the concept of the study. Discrete selections of the study area are very much momentous for any study. It is remarkable that the ultimate success of any research fully depends on the selection of the study area. Since Khulna city is the third largest city of Bangladesh, and it is rapidly being urbanized. 69.5% of city population consists of low income group, 29.7% belongs to middle income and only 1.8% is of upper-income group. Management of human health and related environmental parameter in the municipal area is the responsibility of KCC. Present area under its jurisdiction is 44.78 sq. km divided into 31 wards with a population of 888792 (Anon, 2006). The criteria of this selection include: Khulna is one of the most unique dense regions of Bangladesh and is, therefore, subject to pollution; the city is the ideal unplanned residential area in the context of its dense population and defective environmental management system towards human health. A Simple random sampling technique has been applied as sampling procedure. A complete list of households in the KCC was used for the determination of sample size. Field survey direct interview the relevant persons of Local Government and Engineering Department (LGED), Water Development Board (WDB), Conservancy Department of KCC, Khulna Development Authority (KDA) and Bangladesh Statistical Bureau (BBS) Khulna Center, Public Works Department (PWD) Khulna etc. After the questionnaire survey a field survey was conducted for data collection during 2007. The people of city were suffering from many health hazards. According to household survey of the study the major hazards for health of city dwellers are related to water supply; drainage; water logging and sanitation; solid waste; housing and density; industry; food; health facilities; odour; noise; traffic, transportation and road ; air pollution and fire and dairy & poultry and cattle.

Results

Drainage condition: In the household survey it has been found that, of the respondents 19.8% said drainage condition is good, 38.2% said Fair, 30% said bad and 12% said they have no drainage facility. Ward no. 3, 5, 7, 10, 11, 12 and 13 do not follow the natural slope of the land. This results in inadequate flow of waste water. Due to construction of embankment the outlet of 26 into the Hatiya river is also problematic. Ward No 23 and 29 on the bank of Rupsha river are relatively in the flat land.

Population distribution: The present average density of population of Khulna city stands at 17,735 persons per sq. km. The highest density of ward no 10, 11, 12 and 20 density varied between 45,152 and 53,335 persons per sq. km. (Anon 2001). Ward no. 10, 11 and 12 are the high-density wards of the city all of which are in Khalishpur planned residential area close to the industrial area. Ward No. 20 is situated in the old part of the city and is a spontaneously grown area. The lowest density wards fall in the northwestern fringe where the structures are sparsely built and dominated by huge vacant and agricultural land.

Health situation: Three diseases were dominant among the respondents in city area such as diarrhoea, dysentery and skin diseases. The percentages are as follows (for last 1 year): Diarrhoea: 38.2%, Dysentery: 19.7%, Skin Diseases: 17.2%. The household survey found relative frequency of the three main diseases among the 165 cases are as follows (for six months) Diarrhoea 42.3 %, Dysentery 18.8 % and Fungal and Skin diseases 19.9 %. Thus three diseases comprised more than 80% of the cases of disease. It is worth mentioning here that the household survey of city area in

2007, also found the dominance of diarrhoea and dysentery, both of which are water borne diseases. Thus, health situation has not improved much though water supply system has improved significantly. In the household survey it is found that many respondents are not pleased with existing health facilities because of high fees of Doctors, improper private clinics (which building it use, not made for clinics), unhealthy condition of some clinics & hospitals.

Traffic transportation and road condition: City area is served by a network of pucca (metalled), semi-pucca and kutcha (unmetalled) roads. The city area includes about 327.21 kms of roads of which 168.88 kms are pucca, 101.52 kms are semi-pucca and the remaining 56.81kms are kutcha. Most of the KCC roads are in good condition except those which are kutcha and semi-pucca. The single lane pucca roads are narrow, often 3.6 metres in width, with un-surfaced kutcha shoulders and insufficient or no space for parking and pedestrian movement. In the field survey it is found that open roadside drain creates environmental problems for pedestrians, blockage of footpath and road junctions of 'Y' & 'T' types cause road accidents the road network of city and various road accident points (according to various vehicle driver).

Noise condition: The results of household survey conducted by the study illustrate that 16% respondents do not feel disturbed due to noise while 84% are disturbed. 24% people are exposed to the hydraulic horn of vehicle, which is followed by noise from industries (20%), loud speakers (17%) and workshops of various categories (13%). Study found that in industrial zone sound pollution disturbed people so in ward no 10, 13, 29 & 30 peoples suffer for noise than the people of ward no 4, 9, and 22.

Odour condition: In the household survey it has been found that in a year, at least for the time being, about 79% of the respondent felt discomfort due to odour pollution. While only 21% did not experience odour from any source. About 33% respondent suffer odour pollution for unclean open drains in their locality. About 29% and 39% of the households respectively suffer for the poorly managed decomposed wastes of nearby dustbins and sewer overflow for spread of obnoxious odour in their community and 7% respond for other reason.

Water supply situation: According to Water Works department, KCC ward No. 9, 10 and 12 each having over 14,000 meter length of pipelines, are the highest pipe line wards. The most disadvantaged wards are 4 and 8. These Wards have less than 500 meter pipes. Other low served wards are 17, 18 and 13. Except Ward No. 8 and 13 all other wards are fringe area wards where density is still low Ward No. 8 and 13 are industrial area wards where there are limited number of residential dwellings. The different sources of supply of drinking, cooking, washing and bathing water are summarized in Table 1.

Table 1. Supply of different purposes of water from various sources in Khulna City.

Type of water	Per cent of different sources of water				
	Pipe	Hand tube well (deep)	Hand tube well (shallow)	Pond	River
Drinking	4	59	37	0	0
Cooking	32	24	40	4	0
Washing	41	10	37	11	1
Bathing,	42	9	35	13	1

People are reluctant to use piped water for drinking purpose as it is often found contaminated. But large portion of the city dwellers are depended on pipe water supply for their bathing purposes. Ward no 31, 4, 6, 9 and 2 respectively are under threat of burgeoning arsenic contamination. (DPHE, 2006)

Water logging and sanitation: In the household survey it has been found that among the respondents of Khulna City Corporation area, the types of toilets are: 2.3% of the households have no toilets (they share toilet); 3.2% of the house holds have hanging latrines; 77.5% of the households have the toilets with septic tanks; and 17% households have toilets with ring and slabs.

In ward, no 10, 31, 2, 4, 11, 20 &18 toilet condition is relatively bad than other ward. Most of the waterlogged areas are located in KCC Ward No. 30, 10, 14, 20, 22, 27, and 31. In Khulna City Corporation 38% of the respondents regularly experience the water logging of short duration.

Industries: Industrialization in Khulna started in the late 60s but progress had been very slow. Major industrial concentration in Khulna is observed in the Atra and the Shiromoni Industrial Estates (S1E), located at the very outskirts of the Khulna city. A good number of large and medium industries, to avail the advantage of bulk transport, were also developed at two local points namely, Khalishpur and Rupsha within the city limit. Apart from these, with the growth of population and search for profitable vocations coupled with other factors, a number of small scale industries, both of formal and informal categories, and engineering workshops were developed scatteredly all over the city. Many of these industries have been located near the residential areas.

Solid waste: The solid waste management system is not satisfactory in the city area. Many of them are about to vanished (they are broken). In the field survey it has been found that most of the dustbins are causing odour pollution because of irregular and improper cleaning, traffic movement problem because of unplanned (over the road) locations. In many place it has found that although a dustbin present near but people threw their waste in the drain. As a result drains become block. Moreover the transportation of waste at day time by open vehicle causes odour problem to passerby.

Table 2. Weightage value and indicator of stress area.

Indicators	Weightage value
Water and sanitary related indicators	4
Related to water logging	2
Industry related	1
Overcrowding housing conditions	3
Related to obnoxious smell	4
Related to fire prone areas	3
Related to refuse	2
Related to intolerable noise	3
Related to drainage problem	3

Preparation of stress map: All the indicators discussed above were combined and weighted to get a stress map of Khulna City Corporation in GIS system. The weightages were given in the following way (Table 2). The higher the stress, the poorer the area is in terms of hygiene.

Discussion

***Water supply and health*:** Gastrointestinal and other communicable diseases are currently responsible for 45% of all deaths in children under four years of age, and the major cause of death is diarrhea disease (Sinha et al., 1998). Many health problems are linked to water quality, the quantity of water available, the cost and time needed to obtain it and the provision made for its removal, once used. Hundreds of millions of urban dwellers have no alternative but to use contaminated water-or water the quality of which is not guaranteed. A small minority have water piped into their homes while many more have water piped to a stand-pipe nearby. The quantity of water available to a household and the price which has to be paid can be as important to a family's health as its quality. Limited quantities of water mean inadequate supplies for washing and personal hygiene and for washing food, cooking utensils and clothes, Eye and ear infections, skin diseases, scabies, lice and fleas are difficult to control without sufficient water supplies. KCC water supply system is overwhelmingly dependent on ground water. Rockless withdrawal of ground water may have adverse affect on future water supply. The quality of pipe water is not safe for drinking purpose. So people have to depend directly on ground water reserve, which is alarming. At many places arsenic and salinity contamination have been reported at shallow acquifers. Intolerable level of salinity in the river water does not permit extraction of river water for drinking purpose within close vicinity. Surface water reserves can substantially reduce

dependency on ground water for washing purpose. But there is no foreseeable way/approach to preserve surface water bodies.

Solid waste, sanitation and health: The problem of solid waste in developing countries grows with population density and wealth. In areas with low per capita income all articles are recycled until they are of no use. In these societies little waste accumulates. Grave medical and hygiene problems, however, arise where rich and poor have to live in close vicinity. Though domestic solid wastes are rarely toxic, they are capable of providing sites for the breeding of disease vectors as well as presenting an aesthetic and olfactory nuisance. Disease vectors such as rats, mosquitoes and flies proliferate on garbage; where human excreta are added, the health risks are considerable. The majority of vector borne diseases could also be reduced by reducing the number of breeding sites through proper waste management - entailing waste collection, transport and treatment. Other fast-growing health threats presented by inadequate solid waste management are those associated with the release of harmful gases during burning and the illegal and careless disposal of toxic and radioactive materials (Shokhi, 2002). The groups with the highest exposure to these waste-related health threats are those which rely on collecting and sorting waste for a living, and often, as in the case of a whole suburb in one city, have to store the collected waste in their living-quarters until bulk sale is possible. Human health is being affected when solid waste is not collected from living and working environments.

Housing, population density and health: Healthy housing is usually thought to protect against health hazards, but too often the house itself becomes a threat to health. Simple interventions aimed at housing-design and building improvement could reduce the health risk (Sokhi, 2002). In many low-income settlements the available living space may range between 2 and 10 Sq.m. perhaps, leaving seven or more person to share one room. This cramped situation poses a high risk of exposure to communicable diseases (such as meningitis, tuberculosis) and is closely associated with high blood lead levels for children, high stress levels, frequent accidents, bums and poisoning. Building construction rules have been framed and operated to create a congenial and healthy living environment. Violation of setback rules results in a living environment without sufficient light and ventilation, which is detrimental to healthy living. Construction of building without sufficient back and side space not only causes inconvenience the building owner himself but also deprives his neighbors of sufficient air and light. Violation of height rules leads to increase in local population density, which creates pressure on local services and traffic stream thus deteriorating quality of urban services.

Industry and health: Toxic chemicals and their potential health impacts are growing in importance in many low-income settlements. Informal-sector manufacturing is often located within the living quarters or in the backyard. Not abiding by any environmental safety standards, such enterprises are a major source of air, noise, soil and water pollution in and around the immediate vicinity of the house. The multiple pollutants cause a severe health threat due to the exacerbating effect of multiple exposures. Various studies at intra-urban levels reveals that these highly exposed areas are characterized by high cancer mortalities. Green buffer zones, for example, could be used to separate large, polluting industries from residential areas. Traffic accidents, especially among children, are a serious hazard, while close proximity to industrial complexes exposes inhabitants to both subliminal and accidental poisoning and scalding.

***Effect of vibration on health*:** In some parts of the production processes of the iron and steel industry, for example where compressed air operated tools is used, vibration can be a problem in the working environment and there is a limited amount of documentation available concerning health effects.

Steel, engineering works, welding factories and health: In most of such engineering workshops workers do not use appropriate globes and eye protectors, for which many of the workers face metallic particles or dust injury on their body, particularly on hands and eyes. One of the most surprising aspects of the engineering workshops is that they use oxyacetylene flame for metallic welding. This is a very powerful light which definitely affect human eyes causing redeye, inflammation, welding burn, cornea striation, heavy hyperemic conjunctivitis, keratitis, corneal ulcer, rarely macula burn etc. But instead of using this welding at the rear side of the workshop they always carryout the welding job near the roadside where a large number of passersby are often exposed to this high radiation light on their eyes every day. Besides, some workshops which are located in the residential areas or close proximity to hospital or clinic producing noise ranging from 70-120 or more dB (Sinha et al., 1998), often causes mental distress, loss of hearing and personal discomfort of nearly residents and patients of clinics.

Oil depots, petrol pumps and health: The toxic and allergic effects of oil compounds on the skin are well known. There is also reference to the possibility of cutting and other oils containing some pathogenic microbes, which may give rise to some skin infection. Oil and oily substances contained in petroleum hydrocarbons have aromatic part, which is carcinogenic in nature and can enter into human body through contaminated food chain (Khandakcr, 1992).

Food related hazard and health: The process of urbanization for the middle and upper classes is usually related to a change in dietary intake-a higher consumption of sugar and fat and lower intake of crude fibre which results in a higher cholesterol level, obesity and less physical activity, all of which increase the risk of endemic heart disease. However, in poverty-stricken urban settlements the change in diet is accompanied by consumption levels that are substantially below minimum requirements, causing severe malnutrition. Access to food poses a severe problem for the poor. Land for urban cropping is scarce and the areas where they can grow their own food are often located on the least desirable spots, such as on former waste dumps or adjoining polluting industrial sites. It is important to note that rural mother generally breastfeed longer than others. This is probably related to higher employment rates in the urban and peri-urban areas, where mothers have to rely on artificial feeding provided by surrogate mothers or child minders-a high risk factor for malnutrition and infant mortality in the first six months of life. Apart from nutritional consideration, food is a medium for the intake of toxic chemicals and micro-biological agents; infections of the latter are most common type of food-related diseases. The dwellings of people in low-income groups often have few or no facilities for storing food to protect it against spoilage and contamination. Moreover, inadequate water supplies and washing facilities make the hygienic cleaning and storage of cooking utensils very difficult.

Road related hazard and health: Traffic accidents often turn out to be injurious and sometimes fatal. For low-income people accidents not only cause physical damage but also impose unbearable financial burden. Obstacles on roads and footpaths create hindrances to normal movement of pedestrians and vehicular traffic. Piling of garbage creates nuisance and odor and makes difficult for pedestrians to walk on roads. Extension of kitchen and food processing on footpaths has two adverse consequences: open air cooking may cause food contamination leading to health hazards; blocking of footpath forces pedestrians to walk on vehicular roads which may be dangerous; Illegal parking constraints normal traffic flow causing congestion and consequent time lose which has economic costs. Economic costs may also arise due to blockage roads due to political party meetings and temporary bazars.

***Air Pollution from industries, automobiles and their effect on human health*:** Air pollution is generally detrimental to health, especially to the respiratory system. Air pollution may not only cause the abrupt onset of symptoms, producing severe ill-effects and sometimes even death (acute effects), but it might also have longer-term chronic effects. Difficulties in assessing the hazard

posed to health are compounded by a variety of factors, which need to be taken into account as far as possible. Air pollution can be thought of as an additional stress factor, and the effects on health seem to vary in direct proportion to the ambient concentration. Naturally the effects will depend on which components or combination of components, are present and their relative concentrations. Young children are believed to be particularly susceptible to air pollution and exposure to serious pollution episodes during childhood can, in some cases, lead to a lifetime of respiratory complaint. It may be noted that while there are few ailments known to be solely and directly caused by air pollution, air pollutants may exacerbate existing disease and can be significant contributory causes of disease. Obviously air pollution can be lethal in sufficient concentrations, at lower concentrations; it is probably one of the contributory causes of chronic bronchitis and emphysema, and of lung cancer. By far the most important source of air pollution is industries. Various industries pollute air environment differently.

***Effect of carbon monoxide (CO) on health*:** Carbon monoxide (CO) is an odourless, tasteless, and colourless gas. It is produced by the inefficient combustion of carbon fuels. In combustion carbon dioxide and water vapour are formed. But when combustion is incomplete, carbon does not have enough oxygen to combine with and forms carbon monoxide. Although motor vehicles are the principal sources of carbon monoxide emissions, mines and blast furnaces also emit carbon monoxide (Karpagam, 1991). It is a major air pollutant, the main man-made source being the exhaust of petrol engines. Other sources include industrial furnaces and power stations, refuse incineration and faulty domestic cooking and heating appliances. Upon entering the respiratory system it combines in the lungs with the hemoglobin in the bloodstream to form carboxyhaemoglobin (COHb). This reduces the ability of the hemoglobin to carry oxygen to the body tissues. It may be noteworthy to mention here that CO has about 200 times greater affinity to attach itself to hemoglobin as compared to that of oxygen. Thus even low levels of CO can still result in high levels of COHb. At COHb levels of 2-5% are found to affect the central nervous system such as impairment of time interval discrimination and visual acuity. At levels greater than 5% there are cardiac and pulmonary function changes. Evidence has also been presented that a relationship exists between ambient CO levels and myocardial infraction (heart attacks) the effect of carbon monoxide is quite severe. As increasing concentrations of carbon monoxide are inhaled, the quality of life-sustaining oxygen that the blood stream transports from lungs decrease Several hours of exposure to carbon monoxide of 100 ppm (parts per million) results in headache and impaired perception. With concentrations of 300-400 ppm vision problems, nausea and abdominal pain may develop and 750 ppm can be fatal. Heart patients appear to be particularly susceptible to the adverse effects of carbon monoxide. Further effects of carbon monoxide with increasing COHb levels manifest as: with reduced mental activity- throbbing, vomiting and collapse, coma and death The diseases manifested by CO are many and range from simple drowsiness to severe lethargy, cough, bronchitis and arterial hardening resulting in hypertension, heart attack and brain hemorrhage (Rahman, 1992 and Karpagam, 1991). Senthd and Inderjct (1991) note that after exposure, CO is slowly released from the blood with a clearance half-life of 3 - 4 hours. Cigarette smokers commonly have COHb levels of about 5% with heavy smokers reaching values of 10% in the blood. This is due to the high CO concentration of about 400-ppm in cigarette smoke.

Effect of sulphur dioxide (SO_2) on health: Sulphur dioxide (SO_2) is a colorless gas with a choking taste, which is a harmful air contaminant and constituent of smog. The burning of sulphur compounds, which occur as a natural constituent of both coal and oil, produces it. At high levels SO_2 is a strong irritant to eyes and mucus membranes. Concentrations down to a few parts per million (ppm) arc liable to produce bronchio constriction (a narrowing of the airways such as occurs in asthma), and may stimulate coughing. While such effects are generally transient and easily reversible in healthy people, in patients whose cardio-respiratory system is already seriously impaired they can have serious consequences. International standard allows a maximum of 60

microgram per cubic meter of air. Sulphur oxides, primarily SO_2, have been found in the emissions from sintering, open-hearth furnaces, blast furnaces, electric furnaces and basic oxygen furnaces. The iron and steel industry also contributes to the community sulphur oxides pollution.

Effect of nitrogen oxides (NO_X): Recent increases in atmospheric levels of nitrous oxide (N_2O) have caused concern in view of its greenhouse properties and its contribution to stratospheric ozone (O_3) depletion Destruction of N_2O in the stratosphere by photolysis and reaction with oxygen atoms (O^1D) produces nitrogen monoxide (NO) which in turn plays a major role in regulating stratospheric O^3 concentrations. Production of gaseous N_2O occurs primarily as a result of microbial processes in soils and water and forms an important component of the nitrogen cycle. A number of anthropogenic sources of N_2O have also been identified. These include fossil fuel combustion and biomass burning. Data presented by (Rasmussen, 1988) indicate that levels of atmospheric N_2O have increased by around 4 % over the 14-year time span from 1975-1988. Of all the oxides of nitrogen, the significant ones in the context of air pollution are nitric oxide (NO) and nitrogen dioxide (NO_2). The major man made sources of nitrogen oxides are the combustion of fossil fuel (in power generation, heating plants and road vehicles); certain industrial non-combustion processes are significant local sources (nitric acid plants, electroplating and explosive works). Indoor sources include cigarette smoking, gas fired appliances and oil stoves. Oxides of nitrogen may affect human health directly. Nitric oxide is relatively harmless but nitrogen dioxide is highly toxic. In presence of sun light oxides of nitrogen react with certain hydrocarbons to produce ozone and other secondary air pollutants, referred to collectively as photochemical smog. The common effect of photochemical smog is lachrymation. Some respiratory effects have been reported. Within the working environment nitrogen oxides do not constitute a major problem in the iron and steel industry. They may, however, present a hazard during certain operations such as plasma arc welding, particularly if carried out in unventilated confined space. Toxicological information on nitrogen oxides is well documented and some criteria documents on the toxicity of nitrogen oxides are available (Anon, 1997). The proven effects of NO_2 on humans and animals are confined almost entirely to the respiratory tract and occur only with NO_2 levels higher than those now prevailing in the atmosphere. A higher NO_2 dose results in the following effect sequence: nasal irritation, breathing discomfort, acute respiration distress, pulmonary oedema and finally death. Even the mildest effects, such as mucous membrane irritation, do not occur at the prevailing atmospheric N02 concentrations. The odour threshold range of NO_2 in human is reported to be 1-3 ppm. Concentration above 12 ppm result in eye and nasal irritation, nasal irritation being more intense than that of the eyes. Concentrations of NO_2 greater than 100 ppm are lethal to most animal species, and 90 % of the resulting deaths are due to pulmonary oedema (Senthd and Inderjcct, 1991).

Effect of ozone (O_3) on health: Ozone is an extremely toxic and colorless gas. It's odor threshold is 0.02-0.05 ppm. Irritation of nose and throat occurs at 0.05 ppm. Headache (in 30 minutes) starts at 1 pp Industrial limit set by WHO for 8 hour working day at 100-200μg/m^3 Rats exposed to 1 ppm for an 8 hour day develop bronchitis, fibrosis (formation of fibrous tissue) and bronchiolitis. A concentration of 1.25 ppm for 1 hour causes an increase in the residual lung volume (reduced expiration) and a decrease in the breathing capacity. Higher levels cause pulmonary edema (accumulation of fluid in the lungs), hemorrhaging, and impairment of gas exchange through the alveolar membrane. The maximum allowable concentration of ozone for occupational exposure for an 8-hour workday has been set at 0.1 ppm (Senthd and Inderjeet, 1991).

Effect of lead (Pb) on health: Tetra-ethyl lead is used for blending with petrol oil to act as an anti-knocking agent in the petrol engine. Lead comes out in the environment with the a) exhaust of petrol engine; b) effluent of paint industries, steel and engineering mills, dyeing industries, and battery manufacturing industries; c) lead may also come from the pesticides (Khandaker, 1992).

Lead is toxic to human being at or above 80 ng/100 ml of blood (Lee and Lehmden, 1973). Lead is a dangerous air pollutant. It may exist in the air as dust or fume and it is perhaps the most ubiquitous of the heavy metals.

Suspended particulate matter (SPM) on health: Particulate matter suspended in the air is one of the most noticeable of air pollutants and consists of chemically stable substances such as dust, soot, ash and smoke. These pollutants are classified as primary pollutants, because they do not change their form after entering the atmosphere. Primary pollutants are dispersed and diffused by natural air environments but their structure or composition remains unaltered. Extensive industrial use of coal in the steel and electrical power industries, are the major sources of particulate. Besides, industrial fuels, automobiles, building materials, smelters also disperse particulate into the atmosphere. These tiny particles reduce visibility, damage property and carry poisonous materials into the lungs (Karpagam, 1991). It is, of course, the type of source, which determines the composition of this material; but the broad definition is in terms of the settling velocity of the particles and so is related to their size. Smaller particles (less than 3 micrometer) arc significantly more hazardous, especially in high concentrations. Low concentrations of small particles will pass into the deeper parts of the lungs to be deposited peripherally or filtered out to lymph nodes. Inert matter deposited in this way will discolor the lung tissue and nodes (e.g. anthracosis). Other matters may cause disturbance to the tissue (e.g. fibrosis or granulomatosis from beryllium; pneumoconiosis from dust in general; silicosis from silica; asbestosis from asbestos). The most familiar example of particulate matter in urban air is smoke, which is produced by the incomplete combustion of carbon based fuel. The term particulate covers a wide range of substances from smoke (grit, dust and fumes) to heavy metals, and asbestos Sometimes the particles itself are not harmful, but they act as vehicle for viral and bacterial pathogens like influenza, tuberculosis or conjunctivitis, all of these are common phenomena in Bangladesh (Rahman, 1992). Iron and steel production generates various types of particulate matter contributing to community air pollution.

Noise pollution and health: Hearing loss is the main health impact caused by the damage to the hearing mechanism in human body. The ear can be damaged in a number of ways such as physical poking of objects into the outer canal, physical break the bones of the middle ear, deterioration of nerve cells (Chhatw, et al., 2000).

Non-auditory physiological effect: In addition to its effects on hearing, noise has also been implicated as having other physiological effects. Non-auditory physiological effects of noise pollution that have been identified thus far include cardiovascular, autonomic, and gastric effects. The cardiovascular effects of noise have been the most abundantly researched non-auditory noise effects. Loud noise is purported to cause vasoconstriction with a consequent increase in blood pressure (Abel, 1990).

Annoyance: Annoyance is one of the most salient effects of noise on human. A noise is said to be annoying if an exposed individual or a group of individuals would reduce the noise, avoid, or leave the noisy area if possible (Molino, 1979). For example, louder noises are generally more annoying than quieter noises. Two sounds with equal intensity (i.e. loudness) may still result in different levels of annoyance.

Communication interference: Noise pollution can have a considerable effect on communication. Many factors contribute to the effect of noise on communication interference. For example, according to Berglund and Hassmen (1996), noise that has a similar frequency to speech will mask it better than noise at other frequencies.

Status of different ward: In ward wise the summary of major environmental problems in city area has been shown in table 4.

Table 4. Types of major health hazards in different wards of Khulna city in 2007.

W. N.	Major health Hazards										
	Industries	Drainage	Health facility	Water Logging	Odour	Noise	Population Density	Water Supply	Food	Fire	Sanitation
1					√				√		
2	√		√					√	√		
3	√		√						√	√	
4								√	√		√
5	√	√							√	√	
6			√		√				√		
7	√	√							√		
8	√							√	√		
9								√	√		
10		√		√			√		√		√
11		√					√		√		√
12		√					√		√		
13	√	√				√		√	√		
14	√			√					√		
15	√								√	√	
16									√		
17					√			√	√		
18								√	√	√	√
19							√		√		
20				√			√		√		√
21	√		√						√		
22				√					√		
23			√		√				√		
24									√		
25									√		
26		√							√		
27				√					√		
28									√		
29	√	√				√	√		√		
30	√			√		√			√		
31	√		√	√				√	√	√	

Table 6. Disease-stress Matrix.

Stress Area Disease	Extremely High Stress	Very Stress	High Stress	Moderate Stress	Low Stress
Enteric Fever	X	X	X		
Gastroenteritis	X	X	X	X	X
Insectial Parasites	X	X	X	X	
Jaundice	X	X	X		
Bronchitis	X	X	X		
Tuberculosis	X	X	X		

Table 5. Stress area of Khulna City 2007.

	Nature of area	Population	%
1	Low stress	113798	12.80
2	Moderate stress	186340	20.97
3	High stress	252729	28.44
4	Very high stress	207020	23.29
5	Extremely high stress	128905	14.50
	Total	888792	100

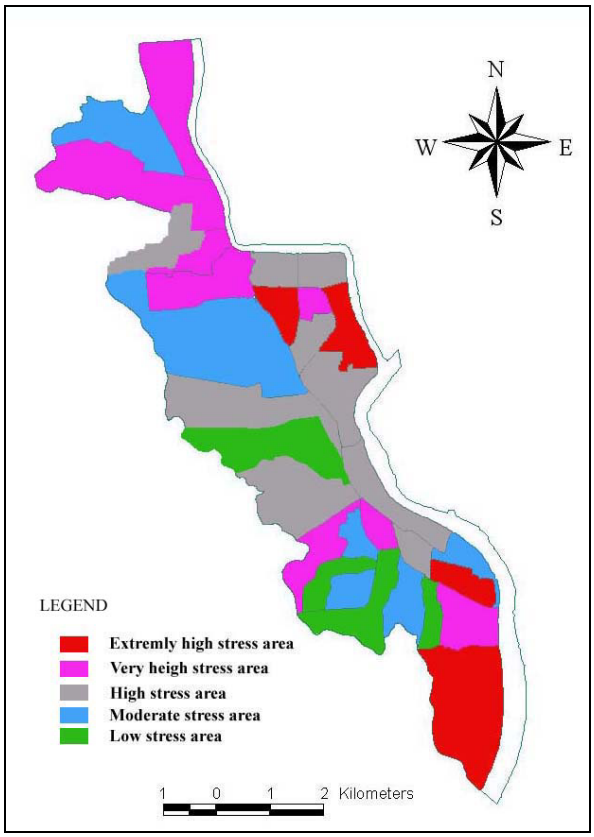
The study was conducted for identification of environmentally problematic area for human health considering environmentally pollution factor like drainage system, solid waste, housing condition, water logging, industry etc. To gain the prime objectives of this research work the stress areas were classified in five categories from low stress to high stress on the basis of different criteria and population living in such areas was calculated as given in Table-5. Thus, it has been seen that only 33.77% of the total population of Khulna City Corporation live in low & moderate stress condition. Rests are living in highly degraded environmental conditions.

***Relationship between general level of health and stress areas*:** Data collected by primary survey among doctors of the (Nogor sastho vabon) city and secondary information collected from DPHE

of Khulna, the health department of KCC and civil surgeon office revealed a very positive correlation between the incidence rate of diseases and the level of stress as analyzed in Table 6.

Conclusion

The overall environmental condition of city is not so good only 33.77% of the total population of city live in low & moderate stress condition. Various diseases like diarrhoea, dysentery & skin diseases are common in other stress areas. Health hazard problems are the common phenomenon not only in Khulna City but also in other urban areas of Bangladesh. For the last few decades the growth of urban population is extremely high. This is due to high migration rate of rural to urban areas as well as the natural increase of population. The major cities of the country contain large number of poor people living in slums and squatter settlements and they are the first sufferer of those hazards. KCC and KDA are the authorities responsible for the controlling and improving overall living condition of city dwellers. KCC provides services to all the people within their jurisdiction. Though, KCC and KDA have resource constraints but the maintenance of the services that they render and distribute and facilities are proportionately insufficient also in negligible condition. For getting vast and accurate knowledge about the hazards that are present in the KCC, it needs further in depth investigation. To reduce health related problem participatory approach should be grown among GOs, NGOs and Private sectors. All organizations have to work in equitable manner for development. Every development program should be free from political violence and political parties should have to work combinedly. Proper environmental settings are preconditions for any development initiative. Improper environmental condition has been shown to upset the productive potential of any sector. It may be mentioned here that environmental conditions include physical, biological (human being, animals and plants) and social environment. Therefore, maintaining a sustainable balance of physical, biological and social environment is necessary for effective and successful use of any environment for promoting the development for the benefit of mankind.



Map 1. Different stress areas of Khulna city 2007.

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