



Single Use Plastic: Hidden Costs of Health & Environment in Bangladesh!

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"Bangladeshies throw away about 87,000 tonnes of single-use plastic every year, about 96% of which is from food and personal care products packaging. About 33% of the total of these wastes are sachets, which are completely non-recyclable. Most single-use plastics used in Bangladesh are not disposed of properly, and so they end up in the landfills, lakes, rivers, or in the ocean".

Environment and Social Development Organization-ESDO

Single Use Plastic: Hidden Costs of Health and Environment in Bangladesh



We acknowledge the support of the sufferer communities in Dhaka city, particularly in the dump site and landfill areas, plastic waste collectors, recyclers, producers, retailers and single use product packaging industries, hotel and restaurants in Dhaka, Manikganj, Savar, Gajipur, Dhamrai and Naryanganj. We are grateful to ESDO technical team members for their direct supervision and support. We also recognize the hard work of the survey team, support from government agencies and general public at large.

This report is published for current information and represents the situation of single use plastic consumption, waste generation and for most impacts to public health and environment. It does not substitute the original data compiled for full study report of the *"Single Use Plastic: Hidden Costs of Health & Environment in Bangladesh!"* as the copy rights of the Environment and Social Development Organization-ESDO, Bangladesh in 2019 and as validated under the support of Plastic Solution Fund.

We appreciate further comments and feedback from our readers and supporters and all individuals.

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Executive Summary

Indiscriminate use of Single Use Plastic (SUP) products creates significant environmental hazards and health risks. Single-use or disposable plastics are used only once before they are thrown away or discarded. Single-use plastics include plastic straws, plastic cotton buds, sachets, food packaging, plastic bags etc. Being inherently non-biodegradable and non-recyclable, single use plastic product has been identified as one of the most significant environmental pollutants of recent times. It can take up to thousands of years for single use plastic products to decompose. In the meantime, they release toxic chemicals that contaminate our soil and water and eventually enter the food chain. Non-disposable plastic wastes may turn into toxic leachate and get mixed in the food chain that gradually enters human body giving rise to severe health problems such as damage to nervous systems, lungs and reproductive organs. Accumulation of plastic litter in the drains and canals may lead to clogging that gives rise to the emergence of widespread vector borne diseases. In Bangladesh, single use plastic pollution has dramatically increased in recent years and the associated environmental health impacts have also been significantly evident. Recent outbreak of Dengue and Chikungunya diseases in the urban areas of the country may be related to this phenomenon. Again, there is an increasing speculation that the number of population suffering from health problems is somehow associated with plastic and chemical pollution.

ESDO, the Environment & Social Development Organization, has completed its second annual survey of plastic use in Bangladesh. In 2019, ESDO focused exclusively on single use plastics (SUP). The organization surveyed over 800 people in urban and rural areas of Bangladesh. Primary questions were about what types of plastic they

use, where these plastic items come from, and how they are disposed of. In addition, the study integrated the findings from ESDO's 2018 study that surveyed 1200 people from four major divisional cities (Dhaka, Chittagong, Rajshahi and Sylhet) to derive a comprehensive overview on urban situation. Both surveys have also been conducted along the outskirts of the cities to have an insight to the rural waste generation scenario. Based on the survey findings, ESDO estimates that Bangladeshies throw away about 87,000 tons of single-use plastic every year. About 96% of this is from food and personal care products packaging. About 35% of the total are sachets, which are completely non-recyclable and non-biodegradable. Most single-use plastics used in Bangladesh are not disposed of properly, and end up in the landfills, lakes, rivers, or in the ocean. The UN Environment Programme (UNEP) estimates that 73 thousand tons of plastic waste ends up in the ocean annually through Bangladesh's major rivers Brahmaputra, Meghna and Ganges.

Airlines, high-end residential hotels, restaurants and super shops have emerged as significant sources of single use plastic waste generation in Bangladesh. ESDO's study indicates that over 2,000 tons of single-use plastics are used by restaurants every year, with an additional 685 tons coming from airlines and 638 tons from high-end residential hotels.

Improperly disposed single use plastic waste is a major source of environmental pollution and degradation. It creates several environmental impacts such as air pollution, water pollution, water quality degradation, soil fertility deterioration, development of unsanitary and filthy condition and subsequent increase in vector borne diseases etc. The most obvious form of pollution associated with plastic packaging is waste in landfills. Plastics are very stable and therefore stay in the environment a long time after they are discarded, especially if they are shielded from direct sunlight by being buried in landfills. Plastics also put a big chemical burden on the environment. Single use plastic is a major source of marine pollution also and has been endangering lives of thousands of aquatic and marine organisms

worldwide. One recent study found that a single plastic teabag can release billions of micro and nano-plastics into a single cup of tea, many of which will later be directly introduced into the aquatic environment.¹

Although Bangladesh banned single-use plastic shopping bags in 2002, ESDO notes that the country has fallen behind in regulation since then. Most recently, India has announced a ban on all forms of single use plastic in October 2019, and plans to completely phase out the use of single use plastic products by the year 2022. Apart from India, China has introduced a ban on the import of plastic scraps in 2018. The carbon negative nation Bhutan has also passed regulations to ban single use plastic from September 2019. Furthermore, the island of Bali, Indonesia has banned single use plastics including bags, straws and styrofoam as of July 2019. Countries in North America and Europe have also taken or planning to take drastic steps in controlling single use plastic pollution in their respective nations. France is the first country to announce a total ban on SUP, to be effective from 2020. The city of London plans to impose ban on the usage of single use plastics to be implemented from April 2020. However, although Bangladesh is the first country in the world to ban the manufacture and use of single use polythene shopping bags in 2002, its proper implementation still remains a big challenge.

Bangladesh is yet to address single use plastic pollution issue with greater importance. This may be largely due to lack of awareness among the general mass about the harmful consequences of plastic use. ESDO's current survey report reveals that nearly half of the total single use plastic consumers lack knowledge of the adverse impacts of plastic pollution. This lack of knowledge and awareness has led to undermining the importance of the issue in ensuring environmental health and safety. However, the majority of the population (60%) has expressed interest in adopting alternatives to single use plastic indicating towards the willingness of people in embracing safe and environment friendly sustainable solutions.

¹ Hernandez et al, 2019, ES & T.

Cost effective and environment friendly alternatives to single use plastics are available in many parts of the country. For instance, straws made up of bamboo sticks are being used and manufactured in hilly regions of the country. In Kushtia district, compostable ice cream cups are made from leaves by a certain group of manufacturer. Local production of plant-based alternatives can provide rich opportunities for local sustainable manufacturing and for jobs throughout Bangladesh. Moreover, widespread manufacture and use of alternatives to single use plastic items can largely contribute in developing plastic pollution free green environment.

To cut down on single use plastic pollution, ESDO is putting forth recommendations for consumers and also for the government. ESDO strongly recommends that the government of Bangladesh pass a complete ban on single use plastic. The country must follow the examples of India and other nations in banning single-use plastics. There is a risk that plastic scraps from the neighboring nations where SUPs have been banned will ultimately find their way to Bangladesh through trans-boundary movement worsening the situation even more. To put an end to that the government needs to act quickly. Besides, the use of organic and environment friendly alternatives to single use plastic and products such as – paper packaging, leaf made products, bamboo sticks etc. should be widely encouraged.

Preface

Our day starts with a cup of tea with biscuits or breads, and a glass of water, but we are probably not aware of one of the most pervasive materials that we ingest with water, tea, biscuits and breads in our everyday meal. What is that? That's the micro and nano plastics! They come from single use plastic products and packaging materials. In our part of the world, plastic and its impact on human health is poorly understood. Yet harmful exposure to plastic is expanding into new areas of the environment and food chain. Thrown away plastic products fragment into smaller particles and concentrate toxic chemicals. With use, the risk of exposure is also rapidly expanding in each and every corner of Bangladesh.

Bangladesh alone discards 1.086 million metric tons of plastic waste every year. 73 thousand tons of plastic waste ends up in the ocean through our mighty rivers Brahmaputra, Meghna and Ganges². In Bangladesh only 5% of all plastic wastes ever produced has been recycled. About 9% incinerated, while 86% has accumulated in landfills and dump sites ultimately ending up in the natural environment. Food wrappers, drink lids, straws, sachets, drink and water bottles, bottle caps are the most widely used single use plastic items from our day to day use, according to ESDO's recent survey findings and brand audit of single use plastics. Cigarette butts, whose filters contain tiny plastic fibers, are also common single use plastic wastes in our environment. Moreover, the country generates around 86,707 tons of single use plastic wastes annually from different sources. Most of this waste is improperly managed. The sectors that largely contribute to SUP consumption and usage in Bangladesh include single use plastic

² <https://www.unenvironment.org/interactive/beat-plastic-pollution/>

packaging and products (including food wrappers, sachets, straws and cutleries), airlines, residential hotels, restaurants, groceries and super shops etc. Around 96% of the total discarded single use plastic (82,824 tons annually) comes from food & personal care packaging (food wrappers and sachets), making it the largest contributor to single use plastic waste generation in Bangladesh.

Most research on the human health impacts of plastic has focused narrowly on specific moments in the plastic lifecycle, from wellhead to refinery, from store shelves to human bodies, and from disposal to ongoing impacts as air pollutants and ocean plastic. Individually, each stage of the plastic lifecycle poses significant risks to human health. Together, the lifecycle impacts of plastic paint an unequivocally toxic picture. Plastic threatens human health on a global scale. A recently published joint study report "Plastic & Health: The Hidden Costs of a Plastic Planet"³ (ESDO is one of the contributors of the study under IPEN, GAIA and BFFP) provides a detailed overview of the health impacts associated with plastic at every stage of its supply chain and lifecycle, and it reveals the numerous exposure routes through which human health is impacted at each stage. The report details the physical impacts of ingesting, inhaling, and touching plastic, as well as the toxic chemicals associated with those plastic particles, whether chemical additives, processing agents, or byproducts of plastic.

³ <https://ipen.org/documents/plastic-health-hidden-costs-plastic-planet>

Introduction: ESDO's Study

ESDO has conducted an extensive study to derive information on the existing situation of single use plastic waste generation in Bangladesh integrating both primary and secondary information. For primary data collection, questionnaire survey method has been primarily adopted. Around 800 respondents from different stakeholder groups have been surveyed in different parts of the country. Single use plastic producers, retailers and consumers from different areas in Dhaka city (including Mirpur, Dhanmondi, Uttara, Mohammadpur, Old Dhaka etc.) have been surveyed to derive information on urban usage. However, the study has also integrated the findings from ESDO's 2018 study conducted in 4 major divisional cities including- Dhaka, Chittagong, Rajshahi and Sylhet, surveying around another 1200 people to derive a comprehensive overview on urban situation. Surveys have also been conducted along the outskirts of the cities to have an insight to the rural waste generation scenario. Respondents from Savar, Aminbazar, Nabinagar and Dhamrai along the capital city have been extensively surveyed in this regard.

Methodology

The study aims at analyzing single use plastic waste generation scenario in Bangladesh and subsequently assessing the environmental and health impacts. In this regard, data have been derived from multiple primary and secondary data sources. The methods that have been primarily adopted to gather empirical information on single use plastic usage and waste generation are Questionnaire survey, Observation and Key informants interview (KII). To supplement the collected primary data, secondary data sources have been thoroughly explored and the findings have been integrated into the study report. A major portion of the study that focused exclusively on environmental and health impacts of SUP packaging waste and SUP containing products is based on secondary literature.

Questionnaire survey is the major data collection method adopted for this respective study. Around 800 respondents from different stakeholder groups have been surveyed in different parts of the country. In Dhaka, single use plastic producers, retailers and consumers from different areas (including Mirpur, Dhanmondi, Uttara, Mohammadpur, Old Dhaka etc.) have been surveyed to derive information on urban usage. The study has also integrated findings from ESDO's 2018 study in 4 major divisional cities including- Dhaka, Chittagong, Rajshahi and Sylhet surveying around another 1200 people to derive a comprehensive overview on urban situation. Surveys have also been conducted along the outskirts of the concerned cities to have an insight to the rural waste generation scenario. For instance, respondents from Savar, AminBazar, Nabinagar and Dhamrai along the capital city have been extensively surveyed in this regard.

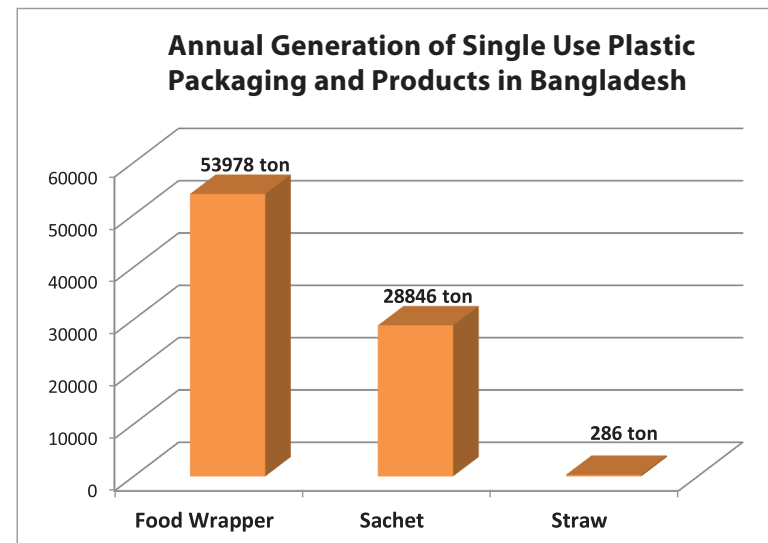
Based on the survey findings, data on single use plastic usage have been calculated for specific age groups and later age specific data have been aggregated to get the compiled information on overall usage. In that case, the population age group in Dhaka city has been considered to be

the benchmark for urban areas. Major consumer group for single use plastic items falls under the age 10 years – 45 years that comprise 71% of the entire population of Dhaka city.

Moreover, the study has incorporated information on other emerging sources of single use plastic waste generation in Bangladesh including airlines, restaurant, residential hotels and supershops. In this regard, secondary sources of information have been extensively studied and evaluated.

Key Findings

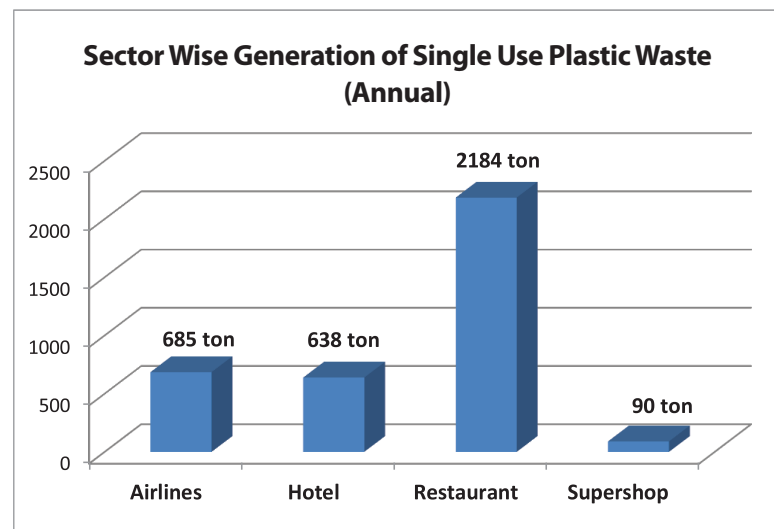
Bangladesh generates around 86,707 tons of single use plastic wastes annually from different sources most of which is reported to be improperly managed. Around 96% of the total discarded single use plastic (82,824 tons annually) comes solely from food and personal care packaging (food wrappers and sachets), making it the largest contributor to single use plastic waste in Bangladesh. Food wrappers include polythene sheets or packets used for packaging breads, biscuits, snacks, ice-cream, chocolates and other food items. Mostly non-recyclable forms of plastic LDPE and Polypropylene (PP) are used as plastic food wrappers. Sachets are bit different from the usual food wrappers. Food wrappers may consist of single layered plastic packages whereas sachets comprise of multiple layers of polythene or plastic. Sachets are used mostly for packaging food items and personal care products in small quantities such as – ketchups, coffee sachet, mini packs and tetra packs of shampoo, conditioner, toothpaste etc. Sachet is an emerging source of single use plastic waste because of their growing popularity in both urban and rural areas. As per the study findings, 33% of the total generated single use plastic wastes are sachets. Sachets are completely non-recyclable and hence are considered as major sources of single use plastic pollution around the globe.



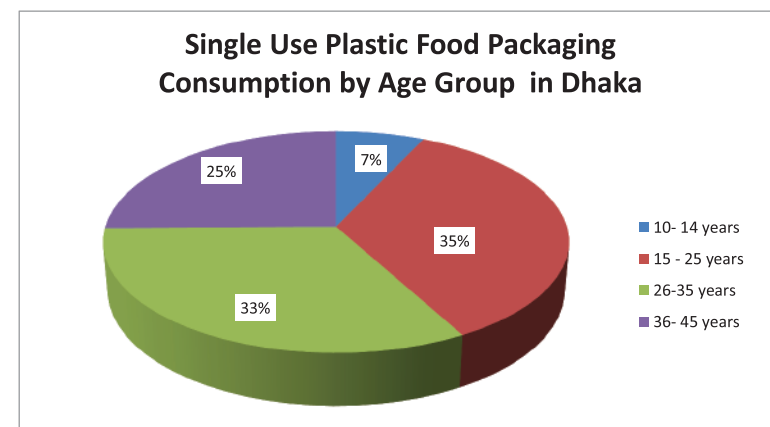
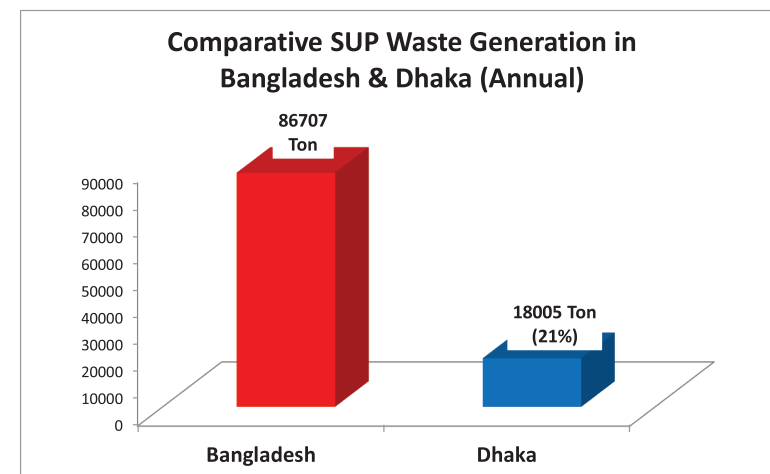
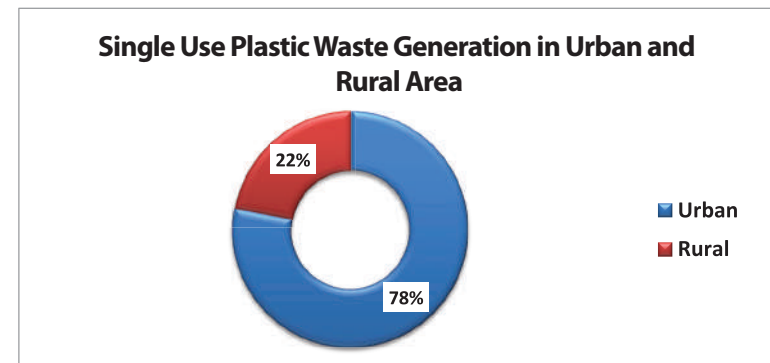
Airlines, residential hotels, restaurants and super shops have also emerged as significant sources of single use plastic waste. SUP consumption in these sectors have grown significantly over the recent years. Meals served in domestic and international flights are often wrapped into plastic packaging and polythene sheets. However, single use plastic cutleries, cups and glasses are also served predominantly to the passengers of the international routes. Discarded materials from these flights make up significant portion of single use plastic wastes on regular basis. SUP waste generated from airlines sector in Bangladesh measures around 685 tons annually. Furthermore, high end residential hotels (5 stars, 4 stars and 3 stars) throughout the country generate another 638 tons of single use plastic wastes that mostly come from room provisions including –bottled shampoo, conditioner, tooth paste tube, plastic toothbrush, sachet, tea bag etc.

Food restaurants in and around the capital city make up 2.5% of the annual SUP waste. There are estimated 7000 restaurants in Dhaka City. In restaurants, majority of the SUP wastes comes from polythene packaging, cutleries and sachets that are provided with home delivery

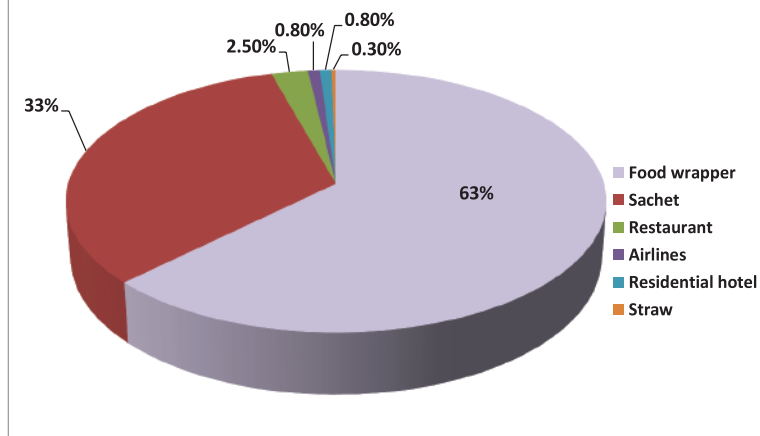
parcels and also from the styrofoam packaging, plastic cups used to serve water and drinks. Another emerging source of styrofoam plastic is the grocery super shops such as – Agora, Swapno, Prince bazar, Meena Bazar etc. They mostly sell their perishable food items in styrofoam packaging covered with polythene sheets.



Empirical evidences suggest that, single use plastic wastes are mostly generated in urban areas of the country. However, a significant portion also comes from rural usage. Sachets of food products and personal care items have grown extremely popular among the rural inhabitants in recent years. Our study reveals that, of the total generated annual SUP waste, around 78% (68136 tons) is generated from urban areas whereas the rest of the 22% (18,571 tons) emerges from usage in rural areas. Dhaka city alone generates around 18005 tons of single use plastic waste annually (21% of the country total). In Dhaka city the predominant consumer group that has been identified as users falls within the age group of 15-35 years contributing to 68% of the total usage.



Single Use Plastic Waste Generation Scenario in Bangladesh



Single use plastic is made up of harmful chemical components that get released into the environment upon disposal. The chemicals eventually enter the food chain and reach human body causing severe health impacts including – damage to endocrine, nervous, respiratory, cardiovascular, renal and immune system. Accumulated single use plastic waste also gives rise to degradation of ecological components. This includes water quality degradation, soil fertility deterioration, temperature increase, pollution and increase in vector borne diseases etc. Single use plastic wastes are also major sources of marine pollution and have been endangering lives of thousands of aquatic and marine organisms worldwide. In recent times there are reports on finding micro plastic in bodies of fish and other marine animals.

Single use plastic pollution has globally been recognized as one of the major environmental threats of recent times. Communities around the world are taking preventive measures to address the issue. However, In Bangladesh, the issue is yet to be addressed with greater priority owing to lack of public awareness. ESDO’s current study reveals that, nearly half of the total SUP consumers (around 50%) from urban areas lacks the knowledge on adverse impacts of plastic pollution. The

condition is worse in the case of village dwellers. Lack of appropriate awareness has led to undermining the importance of the issue in ensuring environmental health and safety. However, majority of the study population (60%) has expressed their interest in adopting alternatives to single use plastic. The major challenge in this case is the existing culture of production and consumption that is based upon the preference for single use plastic, particularly in the case of packaging. People have opined that the producers need to come forward and adopt sustainable solutions in this regard that will ultimately revolutionize the existing system.



Alternatives to single use plastics have been adopted by many countries in the world as well as in some local areas. Use of biodegradable packaging materials such as – leaf, paper etc. instead of polythene sheets; utensils and cutleries made up of leaves, grains or flours; bamboo sticks or leaf stems in lieu of plastic straws etc. are getting popular worldwide. These materials are widely available and compostable and hence do not create any environmental threat. In Bangladesh, the practice of using alternatives is yet not popular enough due to their limited manufacture and lack of mass awareness. The single use plastic producer group is seemingly indifferent to this issue and they



are mostly reluctant in opting for the manufacture of alternative products in fear of getting reduced revenue. However, case studies have suggested that, in very few areas of the country, alternative packaging and products are being commercially manufactured by handful of producers and they are making considerable profit out of their business without causing any environmental and health hazard. For instance, straws made up of bamboo sticks are being used and manufactured in hilly regions of the country. A group of manufacturer has been producing compostable ice cream cups made up of leaves in Kushtia district of Bangladesh. All these imply that manufacturing of alternatives has high prospect in Bangladesh.

To control manufacture and use of single use plastic, appropriate legislations and regulations have been put in place in many countries of the world. Number of Asian nations have taken remarkable initiatives in recent times. Most recently, India has announced a ban on all forms of single use plastic in October, 2019 and seeks to completely phase out single use plastic products by the year 2022. Apart from India, China has introduced a ban on the import of plastic scraps in 2018. In Taiwan, free

plastic straws with foods and beverages will be banned from 2022 and it also plans to impose a total ban on SUP from 2030. The islands of Bali, Indonesia has also banned single use plastic including bags, straws and styrofoam effective from July, 2019. In July 4, Philippines senator filed a bill seeking to phase out single use plastic Products. Moreover, countries in North America and Europe have also taken or planning to take drastic steps in controlling single use plastic pollution in their respective cities and nations. France is the first country to announce in 2016, a total ban on SUP to be effective from 2020. It followed the country's total ban on plastic bag in 2015. New York state lawmakers have approved a state wide plastic bag ban which will go into effect in March 2020. London plans to impose ban on the use of single use plastics to be implemented from April 2020. Though Bangladesh is the first country in the world to ban the manufacture and use of single use polythene shopping bags in 2002, proper implementation of the regulation still remains a big challenge.

Single Use Plastic: The Hidden Costs of Health and Environment

Plastic, more specifically Single Use Plastic, in day to day life has become the new name of epidemic in recent years. As we are moving towards achieving more advancement in our lifecycle, we are likely to lean on single use plastic more.

Plastics are present everywhere in society and the environment, especially the marine environment, where large amount of plastic waste accumulate. The knowledge of human and environmental hazards and risks from chemicals associated with the diverse plastic products is very limited. Most chemicals used for producing plastic polymers are derived from non-renewable crude oil, and several of these are hazardous. These hazardous chemicals may be released during the production, use and disposal of the plastic product.

For example, one recent study examined the effects of brewing tea on the breakdown of plastic teabags. They found that a single teabag could release billions of micro- and nano-particles into a cup of tea. In addition to direct human exposure, the discarded teabag will directly add many more microplastics to the environment. Initial assessment of the possible toxicity of these microparticles showed behavioral and developmental effects on an aquatic invertebrate test species.⁴

Extraction and Transport of Fossil Feed stocks for Plastic, the extraction of oil and gas, particularly the use of hydraulic fracturing for natural gas, releases an array of toxic substances into the air and water, often in significant volumes. Over 170 fracking chemicals that are used to produce the main feed stocks for plastic have known human health impacts. These include cancer, neurotoxicity, reproductive and developmental toxicity, impairment of the immune system, and more. These toxins have direct and documented impacts on skin, eyes, and other sensory organs. The respiratory, nervous, and gastrointestinal systems, liver, and brain are also effected by these toxins.

Toxic exposure in food packaging chemicals are common in these days. The Food Packaging Forum⁵ expressed concern over chemicals in packaging currently permitted for use in food contact materials. Several recently published articles report on the utilization of ToxCast data for chemical assessment and prioritization for further testing. ToxCast is a large screening program run by the U.S. Environmental Protection Agency (EPA). Within ToxCast, thousands of commonly used chemicals have been tested in hundreds of high-throughput toxicity assays.⁶

For most of the 1530 food-relevant chemicals found in ToxCast, data from 300-800 endpoints was available, with minimum and maximum of 95 and 1057 endpoints per chemical respectively. To distinguish

⁴ Hernandez et al, 2019, ES&T.

⁵ <https://www.foodpackagingforum.org/news/food-packaging-chemicals-in-toxcast>

⁶ <https://www.foodpackagingforum.org/news/us-epa-screening-for-hazardous-chemicals>

between overt cytotoxicity and selective bioactivity, a 'cytotoxicity center' was calculated for each chemical, and bioactivity was flagged as such only if it occurred at concentrations below a chemical-specific cytotoxicity limit. Cytotoxicity center below 1000 μM (the highest concentration tested) was estimated for 10% of DAs, 29% of FCSs, and 40% of pesticides. Four FCSs with cytotoxicity center below 2 μM were:

tributyltin chloride (0.78 μM ; CAS 1461-22-9),
dibutyltin chloride (1.07 μM ; CAS 683-18-1),
D&C Violet 2 (1.75 μM ; CAS 81-48-1),
bis(trichloromethyl) sulfone (1.94 μM ; CAS 3064-70-8).

A hazard ranking model was also developed for the hazard classes and categories in the EU classification and labelling (CLP) regulation which is based on the UN Globally Harmonized System. This model identified environmental and health hazards of chemicals used in 55 thermoplastic and thermosetting polymers. The polymers were ranked based on monomer hazard classifications, and initial assessments were made. The polymers that ranked as most hazardous are made of monomers classified as mutagenic and/or carcinogenic (category 1A or 1B). These belong to the polymer families of polyurethanes, polyacrylonitriles, polyvinyl chloride, epoxy resins, and styrenic copolymers. All have a large global annual production (1–37 million tonnes). A considerable number of polymers (31 out of 55) are made of monomers that belong to the two worst of the ranking model's five hazard levels, i.e. levels IV–V. The polymers that are made of level IV monomers and have a large global annual production (1–5 million tonnes) are phenol formaldehyde resins, unsaturated polyesters, polycarbonate, polymethyl methacrylate, and urea-formaldehyde resins. This study has identified hazardous substances used in polymer production for which the risks should be evaluated for decisions on the need for risk reduction measures, substitution, or even phase out.⁸

⁷ <https://www.foodpackagingforum.org/news/food-packaging-chemicals-in-toxcast>

⁸ <https://www.sciencedirect.com/science/article/pii/S0048969711004268>

The chemical components in packaging materials can leach into our food through a distinct process called chemical migration. Consumer to plastic packaging food items are constantly exposed to mixtures of chemicals migrating from food packaging some of which are significantly toxic and have the potential to pose severe health risks. Contamination from plastic packaging can give rise to the gradual development of chronic health problems as endocrine disruption, which can lead to cancers, birth defects, immune system suppression and development of neurological problems in children. Common health related irregularities experienced by some consumers include obesity, asthma, stomach upset, lung congestion, vision problem, skin diseases and so on. 99% of the total population suffers from at least one of these health problems on regular basis. ESDO's study suggests that, the cost spent for buying remedial medicines and for medical treatment purpose in Dhaka city is about 500 crore taka per month. An unknown part of this cost can be seen as the hidden cost of continuous exposure to chemical toxins abundantly present in single use plastic items.

Health & Environmental Impacts of Plastic:

Single use plastic made humans exposed to toxic chemicals and microplastics through direct and environmental exposure.

1. Direct Exposure:

Direct exposure of Single use plastic happens through inhalation, ingestion and direct skin contact within the plastic lifecycle.⁹

1.1. Extraction & Transport: Fossil fuel as a key ingredient contributes 99% to the production of plastic. Plastic can be made from a mixture of oil, gas, and to a lesser extent coal but it will depend on the availability and cost of raw material.

⁹ <https://ipen.org/documents/plastic-health-hidden-costs-plastic-planet>

Through the extractions processes of oil and gas various toxic chemicals release into water, air and food such as Benzene, VOCs and 170+ toxic chemicals in fracking fluid. Humans get exposed to these toxic substances through inhalation and ingestion.

Health impacts of Extraction & Transport-

- o Inhalation and Ingestion- People who work in the oil and gas extraction field and people living near the extraction field both can be affected by the toxic gases such as BTEX, particulate pollution, ground level smog pollution.
- o Also people can get affected by the waste water discharge from the extraction field, leakage of that water and using it for drinking and other purposes can cause serious health issues in humans both internally and externally.
- o When people inhale and ingest these toxic gases and waste waters, will surely affect the immune system, sensory organs, liver and kidney and have impacts like skin diseases, cancer, neurological disorder, reproductive and development toxicity.

1.2. Refining & Manufacture: After extracting the fossil fuel, the next step is to transform the fossil fuel into plastic resins and additives. In this stage carcinogenic and other highly toxic substances are released in the air, water and soil in the fenceline communities around the extraction and plastic production industries. People living around this area and working in the manufacturing industries get affected through inhalation, ingestion and direct skin contact.

Health impacts of Refining & Manufacture-

- o Inhalation, Ingestion and Skin Contact- The fenceline communities as well as the workers of plastic manufacturing industries suffer from various diseases, injury and even death as these manufacturing industries release toxic substances like Benzene, PAHs, Styrene etc., which gets mixed into the air, water and soil.

- o By inhaling and ingesting and also by using the polluted water direct skin contact happens with these chemicals which results in various detrimental health impacts like-skin diseases, cancers, neuro-toxicity, reproductive toxicity, low birth weight, and eye and skin irritation.

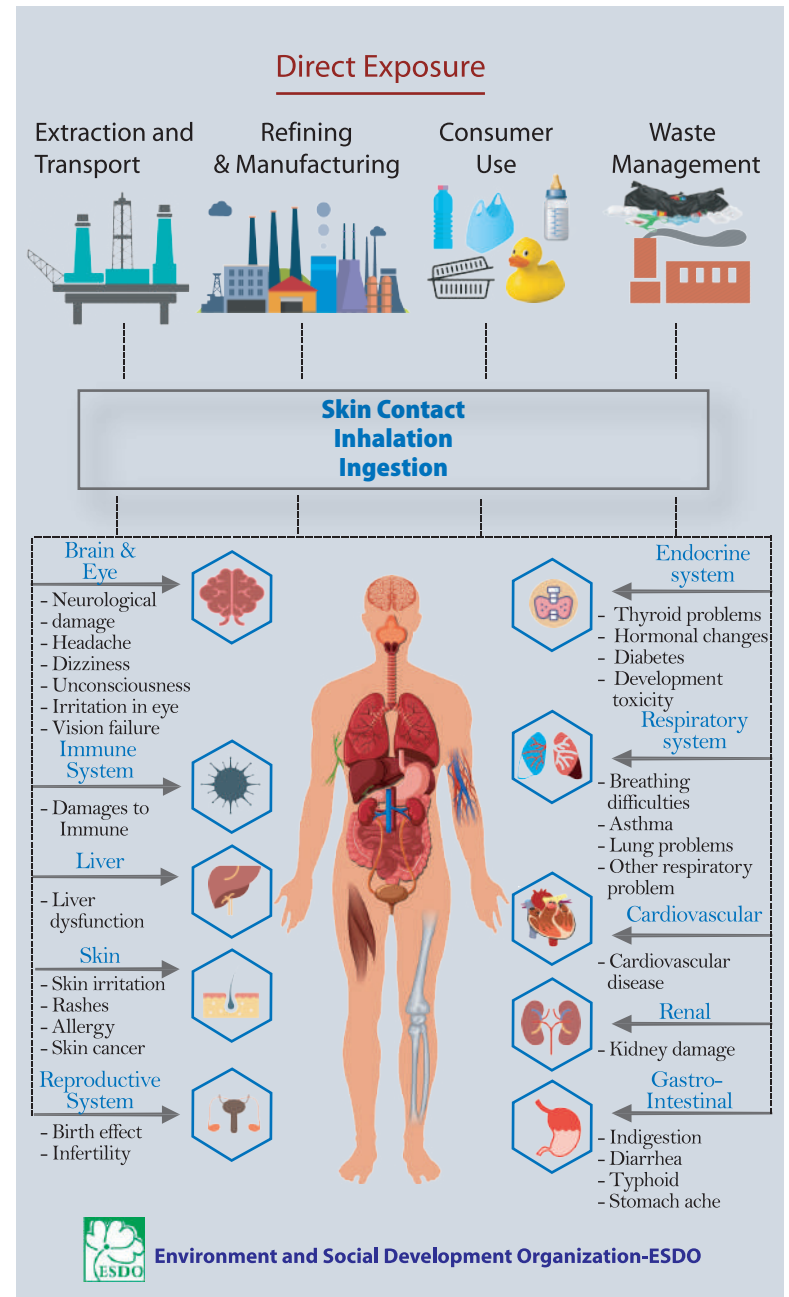
1.3. Consumer Use: Among the various uses of plastics, the single use plastic (such as packaging, containers etc.) gained its popularity in the market and comprises 42% of the overall plastic production in the world. This single use plastic product causes various damages in the long run both to human health and the environment. In this stage also humans inhale, ingest and comes in direct skin contact with the chemicals released from this products.

Health Impact of Single Use Plastic Packaging:

Globally, the use of plastic packaging is on the rise that may be attributed to the increased demand due to higher population growth and market expansion. There are also increasing concerns about the health and environmental threats posed by the increased pollution resulted from plastic wastes. These concerns include littering and accumulation of non-degradable plastic materials in the environment, generation of secondary micro plastics and nano-plastics, release of hazardous chemical components during manufacturing and use as well as following landfilling, incineration or improper disposal leading to pollution of the environment. Around 60% of all plastic packaging is used for food and beverages while the rest covers non-food applications such as healthcare, cosmetics, consumer, household, apparel and shipment packaging.

Chemical Migration from Plastic Food Packaging:

Many chemicals used to make packaging plastics are highly hazardous and therefore of significant concern for human health. The chemical components in plastic packaging can leach into our food through a distinct process called chemical migration. Consumer to plastic



packaging food items are constantly exposed to mixtures of chemicals migrating from food packaging some of which are significantly toxic and have the potential to pose severe health risks. For instance, type of plastics used for making single layered and multilayered food wrappers (e.g. of breads, biscuits and chips) predominantly includes polyolefins like – LDPE (Low-density Polyethylene), PP (Polypropylene), Polyethylene (PE) etc. In direct contact with food items for an extended time period, these materials induce migration of residual monomers into the contained food items. However, numerous antioxidants (Such as BPA, Irganox1010, BHA, BHT etc.) and plasticizers (such as Phthalate) also leach in significant amount. Phthalates are a type of plasticizer added to plastic ingredients to make them soft and flexible. They are part of a group of plastics called polyvinyl chloride (PVC). They're found in plastic wraps and some commercial food containers. They're especially prominent in commercial plastic wraps. Often chemicals from adhesives (polyethers, polyols) used to seal packaging or bind multilayer migrate into the contained food under continuous exposure. Furthermore, single layer plastic packaging (e.g. transparent packaging item often used for breads) generates another form of toxicity induced by chemicals used in printing inks. In single layer plastic packaging, the material used to protect the product is also required to promote it as a brand and provide the consumer with information on ingredients and nutritional information. Consequently, the food must be stored in contact with or in close proximity to printing inks, which can often pose a greater threat to product safety and quality than the base packaging material itself. One of the most common types of ink and varnish formulations to be used is UV curable ink. This is made up of monomers, initiators and pigments. Photo initiators such as benzophenone and other used color pigments often migrate into the food packed in single use plastic material and cause gradual contamination. Moreover, evidences suggest that, carcinogenic chemicals (e.g. antimony trioxide) leach in significant amount from the PET bottles or tetra packs used for packaging juice items.

Factors such as packaging material type, food temperature, storage time etc. affect migration of chemicals. Heating food in plastic seems to increase the amount that's transferred to food. Migration also increases when plastic touches fatty, salty, or acidic foods.

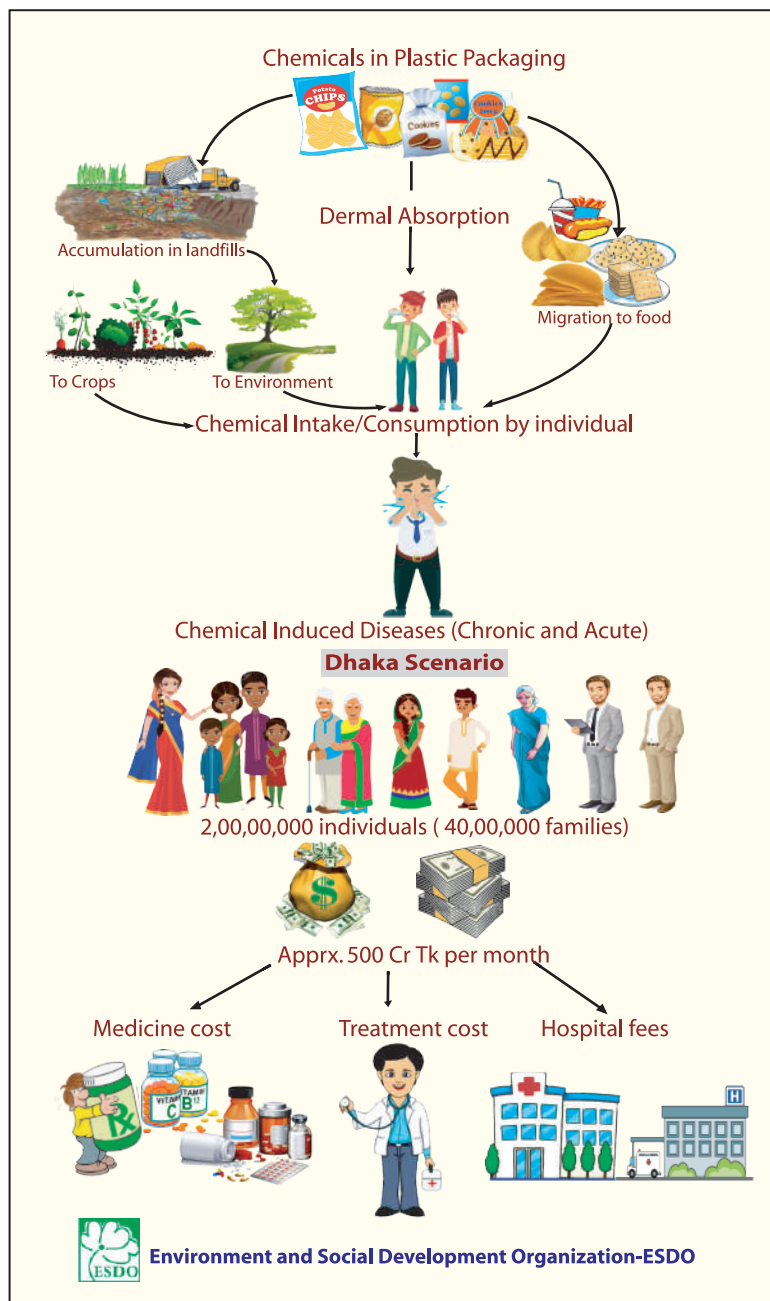
Micro-particle Release from Plastic Tea Bag:

The increasing presence of micro- and nano-sized plastics in the environment and food chain is of growing concern. Some manufacturers are creating new plastic packaging to replace traditional paper uses, such as plastic teabags. Lately, a study was conducted to determine whether plastic teabags could release microplastics and/or nanoplastics during a typical steeping process. It was found that steeping a single plastic teabag at brewing temperature (95 °C) releases approximately 11.6 billion microplastics and 3.1 billion nanoplastics into a single cup of the beverage. Furthermore, the composition of the released particles was matched to the original teabags (nylon and polyethylene terephthalate) using Fourier-transform infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS). The levels of nylon and polyethylene terephthalate particles released from the teabag packaging were found to be several orders of magnitude higher than plastic loads reported in other foods. An initial acute invertebrate toxicity assessment shows that exposure to only the particles released from the teabags caused dose-dependent behavioral and developmental effects.¹⁰

Significant Health Impacts Associated with Chemical Migration:

BPA, a chemical component, which reportedly leaches at a significant amount from most of the plastic derivatives, is known to be an endocrine disrupter. Endocrine disruptors are linked to breast and prostate cancers, infertility and metabolic disorders among other health concerns. This chemical can interfere with the endocrine (or hormone) system and derail one's hormone system causing severe health issues. Few main problems that can occur with a high level of BPA includes – Obesity, Asthma, Cancer, Heart Disease, Oxidative stress. Infants

¹⁰ Hernandez et al., 2019, ES & T



and the very young are most vulnerable to exposure because of their lower body weight and as because their growth and development are strongly influenced by hormones, the effects on health can be lifelong.

Phthalates can leach into foods that come into contact with the plastics. Fatty and oily foods are especially efficient at wicking the chemicals from food, and heating the plastic increases the rate at which the chemicals can transfer. Phthalate also is known to serve as a significant endocrine disruptor and induce health impacts as like BPA. However, even low level of exposure to phthalates has been linked to disruption in reproductive development, particularly in young boys; increased risk of diabetes and obesity in men.

Chemical contamination from plastic packaging can give rise to the development of chronic health problems as serious as endocrine disruption, which can lead to cancers, birth defects, immune system suppression and development of neurological problems in children. Common health related irregularities experienced by most of the consumers include obesity, asthma, stomach upset, lung congestion, vision problem, skin diseases and so on. 99% of the total population suffers from at least any of these health problems on regular basis.

ESDO's study suggests that, the cost spent for buying remedial medicines and for medical treatment purposes in Dhaka city alone is about 500 crore taka per month. This may be termed as the hidden cost of continuous exposure to chemical toxicants abundantly present in single use plastic items.

1.4. Waste Management: All the single use plastic products can be collected and then recycled for further usage. The main concern of this whole recycling process is that the hazardous plastics will go through further chemical analysis, which will generate more toxic substances. Recycling single use plastic will cause more toxicity in the recycled product. The people working in the recycling plants and the consumers of the recycled products will get affected by inhaling, ingesting and direct skin contact.

Health impacts of Waste Management-

- o Inhalation, Ingestion and Skin Contact- Recycling plant and recycled products emit and leach various toxic chemicals. Among them are heavy metals, dioxins and furans, PAHs, toxic recycled chemicals are significant. Also toxins from emissions, fly ash, and slag in a burn pile can deposit in soil and water and can eventually get deposited in the tissues of plants and animals. In the long run it creates impacts like skin disease, cancer, neurological damages and also affects immune system, reproductive system, endocrine system.

2. Environmental Exposure: Single use plastic leached toxic substances gets accumulated in the environment by contaminating air, water and soil, from there humans inhale and ingest these and suffer from vulnerable impacts.

2.1. Single Use Plastic in the environment: Single use plastic wastes get widely distributed throughout the marine, freshwater and terrestrial environments - into air, soil and water. Global ecosystems and human health face negative consequences due to this accumulation. Plastic debris has been found in the 7-mile deep of the Mariana trench in the western Pacific. The steps mentioned in the direct exposure have also shown relation with environmental exposures. Here microplastics (e.g. tire dust and textile fibers) and toxic additives including POPs, EDCs, carcinogens and heavy metals are very acutely present in the environment.

2.2. Air pollution through SUP: Toxic gases released from the extraction field and also from the recycling industries pollute air and the presence of microplastics makes it further contaminated.

Health impacts of air pollution-

- o Inhalation and Ingestion and Skin contact- As we are surrounded by environment, pollution in the environment will for sure affect every sphere of it. As air gets polluted by

microplastics and by other toxic gases and chemicals, humans, plants inhale these and accumulate in their bodies which will eventually affect cardiovascular, renal, gastrointestinal, neurological, reproductive and respiratory systems of human bodies and have impacts like- cancers, diabetes, neuro- toxicity, reproductive failure, oxidative stress, apoptosis, necrosis inflammation, genotoxicity, rheumatoid arthritis etc. Also it will cause severe damage to the ozone layer.

2.3. Water pollution through SUP: In the extraction of oil and gas, huge amount of water and other chemicals are used; also as by product many toxic chemicals are produced. When these waste waters are not handled properly and somehow accidentally leach into the groundwater and water flow in rivers, lakes, oceans, the result is devastating. Another way of polluting water is by throwing SUP products in to the river, lakes and ocean, which are eventually consumed by the aquatic animals or get deposited in the deep sea.

Health impacts of water pollution-

- o Ingestion and Skin contact- Water covers a major part in the world. By drinking, eating fish from polluted water sources and bathing, we expose ourselves to health hazards like cancers, diabetes, neuro-toxicity, reproductive failure, oxidative stress, apoptosis, necrosis inflammation, genotoxicity, rheumatoid arthritis etc.

2.4. Soil pollution through SUP: As like water and air, soil also get polluted by toxic gases and chemicals. These accumulate in the soil and from there it transfers into plant, crops, foods grown in such polluted soils. Also microplastics and toxins from emissions, fly ash, deposit in the soil and cause pollution.

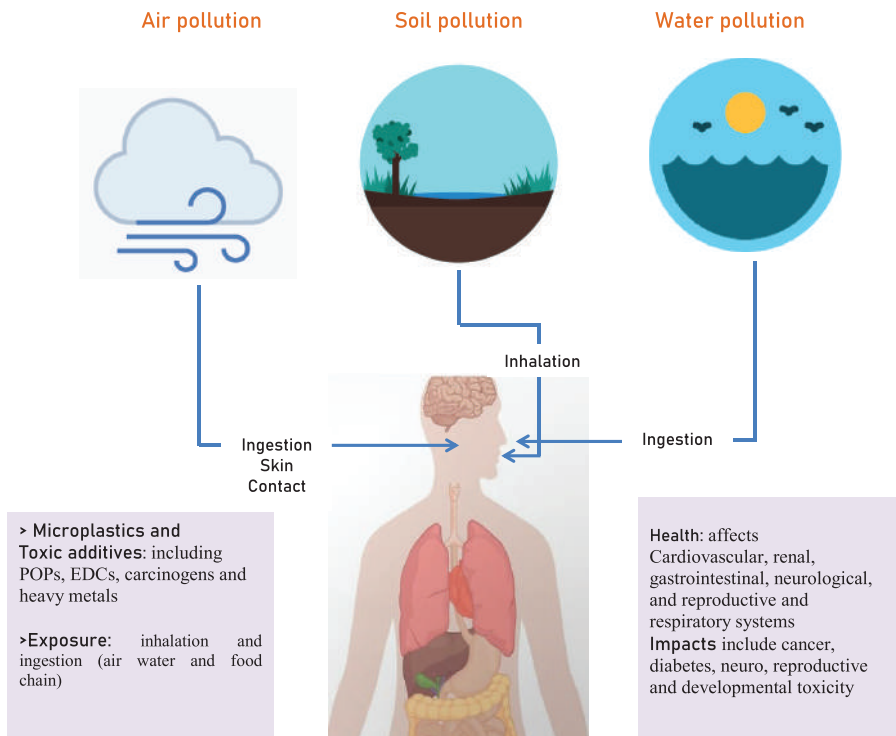
Health impacts of soil Pollution-

- o Ingestion and Skin contact- Heavy metals, microplastics and other toxic substances leached from single use plastic get

accumulated in the roots of plants, agricultural soil, food grown in those soil and eventually affect humans cardiovascular, renal, gastrointestinal, neurological, reproductive and respiratory systems and create impacts like- cancers, diabetes, neuro-toxicity, reproductive failure, oxidative stress, apoptosis, necrosis inflammation, genotoxicity, rheumatoid arthritis etc.

In Bangladesh, exposure during the time of extraction and refining of plastic is relatively low. Most exposure occurs during use, disposal and recycling of plastic products.

Environmental Exposure



How much plastic enters the world's oceans? : Global Scenario

To understand the magnitude of input of plastics to the natural environment and the world's oceans, we must understand various elements of the plastic production, distribution and waste management chain. This is crucial, not only in understanding the scale of the problem but in implementing the most effective interventions for reduction.

primary production through wastage of plastic from previous years;

In 2010 -

- Global primary production of plastic was 270 million tonnes;
- Global plastic waste was 275 million tonnes – it did exceed annual
- Plastic waste generated in coastal regions is most at risk of entering the oceans; in 2010 coastal plastic waste – generated within 50 kilometers of the coastline – amounted to 99.5 million tonnes;
- Only plastic waste which is improperly managed (mismanaged) is at significant risk of leakage to the environment; in 2010 this amounted to 31.9 million tonnes;
- Of this, 8 million tonnes – 3% of global annual plastics waste – entered the ocean (through multiple outlets, including rivers);
- Plastics in the oceans' surface waters are several orders of magnitude lower than annual ocean plastic inputs. This discrepancy is known as the 'missing plastic problem' and is discussed.
- The amount of plastic in surface waters is not very well known: estimates range from 10,000s to 100,000s tonnes.
- Bangladesh contributes 47450s tonnes a year by River stream.

Conclusion

ESDO strongly recommends that the government of Bangladesh should pass a complete ban on SUP considering its environmental and health impacts. The country must follow the example of India and other Asian nations in banning single-use plastics and act accordingly. It needs to impose ban on the import of SUP on urgent basis. Otherwise plastic scraps from the neighboring nations where SUP is banned will ultimately find their way to Bangladesh through trans-boundary movement worsening the situation even more. The government also needs to promote cost-effective alternatives to single use plastics available in Bangladesh. Straws made up of bamboo sticks are being used and manufactured in hilly regions of the country. In Kushtia district, compostable ice cream cups are being produced from leaves. Moreover, local production of plant-based alternatives can provide rich opportunities to increase local sustainable manufacturing and create jobs throughout Bangladesh while ensuring environmental and health protection.

Recommendations

- Pass regulation on banning manufacture, use and import of all forms of single use plastics in urgent basis.
- Phase out the use of plastic food packaging, sachets, plastic cutleries and plastic straws by the year 2021.
- Promote the use of organic and environment friendly alternatives to single use plastic and products such as – paper packaging, leaf made products, bamboo sticks etc.
- Encourage commercial manufacture of compostable plant based alternatives to plastic.
- Develop and widely promote cost effective business models to run the businesses of alternative goods.
- Capacity building of local manufacturers in producing sustainable and environment friendly alternatives through education and training.

Annex:

Pictorials from ESDO's Single Use Plastic Survey:







Alternatives of Single Use Plastic Products:



Environment and Social Development Organization – ESDO