A Study on Characteristics of Small-Scale Plastic Industries in Dhaka North and South City Corporations

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Abstract

Small scale plastic industries have become an important sector in Bangladesh as it covers a significant portion of the informal economy. The study aims at identifying the characteristics of these industries which makes the condition more vulnerable. In this research, both qualitative and quantitative data have been collected through questionnaire and observation surveys. For identifying the characteristics of industries, owners and workers of 240 industries have been surveyed. The study reveals that most of these industries are concentrated in Old Dhaka due to raw materials and labor availability and market proximity. In most of the cases, the land uses of these industries are incompatible as around 57% of these industries are developed in mixed use areas or more specifically in the residential neighborhood. There are mainly two types of machines used in these industries, of which the local 'Dana machine' creates more environmental pollution. Though these industries provide various types of products, it also has left a negative impact on our daily life and environment as well. At the same time, the existing procedure of utilizing the waste to produce new goods cannot also get rid of the contribution to environmental pollution. As most of these industries have low capital investment and have established in congested residential areas, it is quite impossible for these industries to reduce environmental pollution by providing ETP and CETP because of space and resource scarcity. So, these industries should be segregated from the residential neighborhoods and an environmentally sustainable community treatment plant for all of these industries should be designed comprehensively. It can be beneficial to reduce the pollution caused by these industries.

Introduction

Plastic products have become an inevitable part of the world in the recent past. In 2008, global plastic production was around 245 million metric tons which reached at 311 million metric tons in 2014 (Statista, 2017). Asian countries are now becoming the largest producers of plastics in the world. The infrastructures, cheap labor and government policy have promoted these countries to get into the market of the world plastics (Statista, 2017). In a small scale, plastic industry in Bangladesh has been rising. After the liberation war of 1971, it started in the older part of the capital city Dhaka and mainly after 1990 the establishments of these type of industries have been accelerated. Now a

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day, there are a good number of large and small-scale plastic industries exist in the country.

According to BPGMEA in 2016, plastic industries in Bangladesh consist of about 5000 manufacturing units with an average growth rate of more than 20% each year for the last 20 years. About 70% of these manufacturers belong to the small enterprises that are mainly self-financed and have capital investment not more than 5 million and 50 workers on an average (BPGMEA, 2016). The small-scale plastic industries produce goods like accessories for Ready Made Garments (RMG), kitchen ware, furniture, packaging, healthcare, building and construction materials, electrical and electronic equipments, industrial applications etc. Because of environment threatening production and recycling process and generation of hazardous wastes, these industries are classified as Orange B category industry (Environmental Conservation Act, 1997).

These industries are always tried to keep away from residential establishments and environmentally sensitive areas due to their nature of endangering human life and environment (Hendricks, 2014). But in Dhaka, majority of these industries are located in such areas, where they overlap with residential neighborhood. According to DMDP, new industries should be established only in four Special Incentive Zones, such as Savar, Tongi and Gazipur Municipality and the Dhamsona area and one Special Rehabilitation Incentive Zone in Narayanganj (DMDP, 1997, page no: 74-75). However, the growth of these industries is still evident inside the residential neighborhood areas.

Robbani (2011) studied distribution and characteristics of small-scale informal industries in Dhaka city and the factors influencing their location and distribution. In his research, he selected four Thanas from the total 21 Thanas of Dhaka city and studied eight categories of small-scale industries in these four Thanas. Earlier Ahmed (2001) studied forward and backward linkages of informal plastic waste recycling industries, their problems and constraints.

Objectives and Methodology

The current research studied the characteristics of small-scale plastic industries to have a comprehensive idea. Because currently people associated with this industry is about 1.2 million among which indirect employment is 0.2 million (BPGMEA, 2016). It provides employment opportunity to a great number of unskilled people. For this, the primary aim of the study is to carry out a baseline study to investigate the condition of small-scale plastic industries in Dhaka City Corporation (including north and south).

According to BPGMEA, among 3500 small scale plastic industries around 70% are located in Dhaka, among which around 2000 industries are in both Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) areas (BPGMEA, 2016). These small-scale plastic industries are mainly concentrated in the following areas: Islambag, Lalbag, Posta, Shohidnagar, Begumbazar, Rahmatganj, Azimpur, Hazaribag, Mirpur, Kamrangirchar, Koilarghar under the following Thanas: Lalbag, Chalwkbazar, Hazaribag, Kamrangir Char and Mirpur (Community Series, 2012), which indicates that most of the small-scale plastic industries are concentrated in the older part of Dhaka. These industries have been traditionally developed there because of the advantage regarding transportation of raw materials and finished products through Buriganga

river. Main hub of small-scale plastic industries, Islambag is located on the northern side of Buriganga river and Kamrangir Char on the southern side.

For conducting this study, mainly primary survey has been conducted to collect the data. Two methods have been followed to collect primary data for the research. These methods include questionnaire survey and observation survey. Questionnaire survey has been conducted for collecting social data, whereas observation survey has been used to collect physical data.

As these surveyed plastic industries are similar from the perspective of categorization of plastic industries, systematic sampling has been chosen for data collection. But there is variation in these industries from the perspective of their production scale, produced product categories, type and amount of raw materials used, characteristics of worker and entrepreneur. So, for addressing these variations in these plastic industries and conducting questionnaire survey, from 2000 industries at 90% confidence interval 240 industries have been surveyed. Every 8th industry has been surveyed. The sample size selected from every study area has been proportional to the number of plastic industries located in that particular study area (Figure 1).

The surrounding land uses and environmental compliance of the small-scale plastic industries have been explored through qualitative data analysis. There are a wide variety of methods that are common in qualitative data measurement, such as, participant observation, direct observation, unstructured interviewing, case studies, etc. (William, 2006). Direct observation tends to be more focused and not to take as long as than any other method, we have used this method for data collection on environmental compliance of plastic industries. For this, a checklist has been formulated for understanding the environmental compliance of these plastic industries.
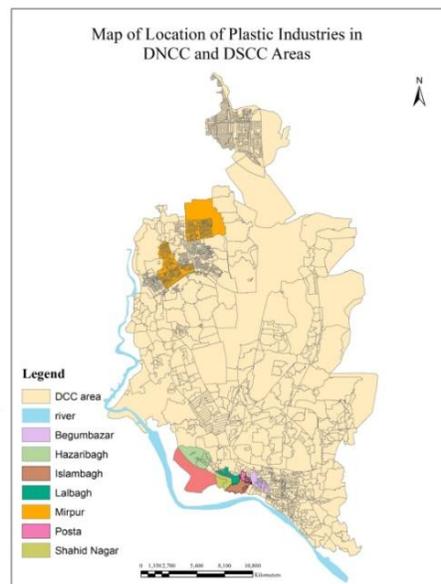

Figure 1: Location of plastic industries in Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) areas

Literature Review

Existing Scenario of Plastic Industry around the World: In today's world, almost all spheres of daily life involve plastics. The increasing usage of plastic is mainly due to its being inexpensive and durable, which leads to high levels of plastics used by humans. The production of plastics has increased substantially over the last 60 years from around 0.5 million tons in 1950 to over 260 million tons today in the world (Devi, 2014). In Europe alone, the plastics industry has a turnover in excess of 300 million euros and employs 1.6 million people (Devi, 2014). It has dominant use in transportation, telecommunications, clothing, footwear and as packaging materials that facilitate the transport of a wide range of food, drink and other goods. There is considerable potential for new applications of plastics that will bring benefits in the future, for example as novel medical applications, in the generation of renewable energy and by reducing energy used in transport (Devi, 2014).

Workers in developed countries need high school education, post-secondary training, certification or licensing and must have mechanical aptitude and skill to work well with tools and various materials. According to the U.S. Department of Labor, earnings for material handlers in the plastics industry varied widely, depending of the job. Median earning of plastic industry workers in 2005 was about $25,064 annually (Career Research, 2005). Most plastics industry workers work 40 hours per week because plants operate on three shifts (Career Research, 2005).

For both Ireland and Northern Ireland, employment in the plastics sector constitutes approximately 5 per cent of total manufacturing employment. Most of the industries have been developed during the 90's era due to increasing demand for plastic products throughout world during the period and there are few firms more than 35 years old (7 per cent in Northern Ireland and 13 per cent in Ireland). In Ireland, there is a significant concentration of firms in County Dublin: 19 per cent of the all-island industry (Inter Trade Ireland, 2006). The reasons for this are manifold logistical advantages, the location of Trinity College, Dublin and proximities to skilled employment and consumer bases. This case is almost similar as our concentration of industries in Old Dhaka. To define the sectors and its levels of exports, the volume of exports cannot estimate the levels of actual trade. This is because many firms are supplying components into sectors, such as medical, where the final product is exported, but is not categorized as plastic. Again, the types of products and markets are also varied for different sizes of plastic industries in Ireland (Inter Trade Ireland, 2006). Thus, plastic goods are not only going to consumer directly but also go to other sectors as intermediate goods like our country (Inter Trade Ireland, 2006).

In India, different types of manufacturing technique are used for producing different types of products and different scale of production as well. Among these, extrusion is the most popular process in India (FICCI, 2014). Injection molding is the widely-practiced technique in Bangladesh. In India, plastic industries are playing a dominant role in providing employment opportunity. Indian plastic units are providing job opportunity for more than 3.5 million workers (Karthikeyan, 2012). Central Institute of Plastic Engineering and Technology (CIPET) and Indian Institute of Packaging (IIP) are the institutions providing safety training service for the plastic industrialists and labors (Karthikeyan, 2012). An article focused on the public health impact of plastic goods and

production procedure states that in India most of these industries have less than 5-7 employees and cannot be covered under labor law. Plastic processing and reprocessing industries are also exempted from monitoring by Pollution Control Board (Rustagi, 2011).

A paper titled "Involvement of Informal Sector in Plastic and Paper Recycling in Pakistan" has addressed the issues and trends in the plastic and paper recycling industry in Pakistan. In Pakistan, plastic is considered as one of the useful items in the solid waste and is used to make plastic pellets for recycling. These pellets are used up for the manufacture of toys, household items and the things for use in industrial activities. The informal plastic sector in Pakistan has good forward linkages with different type and scale of industry. Major industrial sectors using virgin and recycled plastic in Pakistan are textile, construction, machinery and electrical goods (Moten, 2002). Household plastics, comprising PVC, PP, PE, and PET, are mainly used in packaging and utensils. PET is generally used for making mineral water and soft drink bottles, which are easy to recover (Moten, 2002).

Plastic Industries in Bangladesh

History of Plastic Industries in Bangladesh: The plastic industries in Bangladesh are relatively very new comparing with the other industries like Textile and leather industries. Plastic industry has begun its journey like a small industry in 1960's. A milestone and rapid development of plastics industry in Bangladesh has been observed after 1990's. In recent times the size of the plastic industry is growing day by day. The development of plastic industries in Bangladesh is shown in Table 1.

Table 1: History of plastic industries in Bangladesh

Year	Technology and products
1960's	Used handmade mold to make small products, such as, plastic toys, photo frame and plastic spare parts for the jute mills.
1970's	Automatic manufacturing machines were installed to manufacture household utensils, such as, plastic jugs and plates.
1980's	Introduction of film blowing machine to manufacture plastic bags.
1990's	Started production of plastic accessories, such as, hangers for exportable garments.
2000's	Plastic recycling took place through locally developed machines such as shredder, ex-trader and the companies started making plastic chairs, tables and water tank by rotation molding machine.

Source: Shimo, 2014

Existing Scenario of Plastic Industry in Bangladesh: In Bangladesh, plastic industry has shown remarkable growth in the last decade. Not only the domestic market expanded but also growth in the export market has been impressive. These industries are associated with different sectors. Sometimes the produced goods go to another sector as intermediate products and participate in making another good by adding its value. Sometimes, it goes direct to the consumer. These industries produce different types of

products which are used as accessories for RMG sector; household, tableware and kitchenware; furniture ware; packaging; healthcare; building and construction material; electrical and electronic equipment and agricultural products (Hossain, 2016).

Most of the industries were established by the side of the river Buriganga. Easy river communication, opportunity of processing plastic wastes (i.e., sorting, washing, burning, and drying) on embankments of that particular river encouraged entrepreneurs to establish the industries in that locality. Moreover, most of the employees of industries were urban poor of Dhaka City who live in temporary slums established on the embankment (Ahmed, 2001).

It is a matter of regret that one of the major components of solid waste in municipal areas is plastic waste due to lack of proper management in the recycling process resulting in long term environmental damage by virtue of its biodegradable nature (Moazzem, 2016). The continuous rise in plastic consumption in Dhaka city has been contributing to the waste of the community. The share of plastic waste in Dhaka city has increased from 1.74 percent in overall landfills in 1992 to 4.1 percent in 2005 and to 6.5 percent in 2014 (Moazzem, 2016). The prevailing recycling process in our country has been carried out mainly from commercial motive so far. As a result, the plastic waste having less or no commercial value is left behind in the landfill to cause damage to the soil and the environment (Moazzem, 2016). At the same time, another matter of concern is that the small and cottage type plastic industry are all located in congested urban areas. In a study funded by Katalyst and conducted by Waste Concern, a non-government organization found that these industries were not only environmentally non-compliant but also hazardous to the lives of the workers. These industries are also susceptible to severe fire hazard for the people living nearby (Hossain, 2016).

Analysis and Results

Small-scale plastic industries are located in different parts of DNCC and DSCC areas in different concentration. In order to describe the characteristics of these small-scale plastic industries: amount of capital investment, plot size and its use, characteristics of used machinery in production, status of utility facilities, factors behind the establishment of small-scale plastic industries in a particular area are stated here.

Year of Establishment: From Table 2, it is observed that most of the plastic industries have been established within the period of 2010 to 2015. This is because in developing markets like Bangladesh, population growth, rising disposable incomes, urbanization and changing lifestyles have driven demand for plastic even further-particularly for plastic packaging, building and construction, automotive and healthcare industries (ANZ, 2012). Global plastic consumption has roughly tripled in the past twenty years. Asia's expected growth rate in per capita plastic consumption was 5.5% over the five-year period from 2010 to 2015 (ANZ, 2012). This increasing demand and prospect of the plastic industries in both home and abroad have accelerated the establishment of plastic industries within this period.

Table 2: Distribution of industries (in %) according to their location and establishment year

Location of the industry	Year of establishment					Total (frequency)
	before 2000	2000 to 2005	2005 to 2010	2010 to 2015	after 2015	
Begumbazar	0.0	0.4	0.8	0.4	0.0	4
Chawk Bazar	1.3	0.0	2.1	3.4	1.3	19
Hazaribag	0.0	0.0	0.4	0.4	0.4	3
Islambag	4.6	5.0	10.1	18.5	5.0	103
Kamalbag	0.4	0.0	0.4	2.9	1.7	13
Kamrangir Char	0.4	2.1	3.8	7.6	0.4	34
Lalbag	0.8	0.8	1.3	3.8	0.4	17
Mirpur	0.0	0.4	1.3	1.3	0.0	7
Posta	1.7	0.8	2.1	4.2	0.0	21
Rahmatganj	0.8	2.1	1.7	2.1	0.4	17
Total (frequency)	24	28	57	106	23	238

Source: Authors, 2016

Table 2 also illustrates that, establishment of plastic industries have been started mainly in Bangladesh at Islambag, Chawk Bazar and Posta since before 2000. In most of the study areas: Chawk Bazar, Islambag, Posta, Lalbag, Kamrangir Char, Rahmatganj and Mirpur, during the period between 2005 to 2015, establishments have been done in a large scale.

It is seen from Table 3 that most of the industries have a capital investment between 10 to 20 lakh BDT. The number of industries having different amount of capital investment is also significant. Different factors play important roles behind the variation in capital investment of these industries. Some noteworthy factors are year of establishment, plot area, ownership pattern, location of the industry, opportunity of getting loan etc.

Table 3: Distribution of industries (in %) according to their year of establishment and capital investment

| Year of Establishment	Capital Investment in BDT						Total (frequency)
	below 500,000	500,000 to 1,000,000	1,000,000 to 2,000,000	2,000,000 to 4,000,000	4,000,000 to 6,000,000	above 6,000,000	
before 2000	4.2	1.3	1.7	1.7	0.8	0.4	24
2000 to 2005	1.3	3.4	3.8	2.1	0.8	0.4	28
2005 to 2010	2.5	7.1	6.3	5.9	2.1	0.0	57
2010 to 2015	3.4	8.4	14.3	11.8	3.8	2.9	106
after 2015	0.8	3.8	1.3	2.5	0.4	0.8	23
Total (frequency)	29	57	65	57	19	11	238

Source: Authors, 2016

Capital Investment: It has been seen that, the number of establishments of small-scale plastic industries during the period of 2010 to 2015 is very significant. It is because of the increasing demand of plastic products both in domestic and global market. The amount of capital investment for establishing plastic industries in this period differs with respect to location. According to Table 4, in Islambag and its nearby areas, the usual capital investment have ranged between 5 to 10 lakh but in Kamrangir Char the most frequent capital investment have ranged between 20 to 40 lakh. The cause behind this difference is that in Islambag the industries are agglomerated. So, a new industry can enjoy the utility facility, market facility with the marginal cost. But in Kamrangir Char where this type of industries is new, owners have to pay more for setting different utility lines, arranging transportation facilities etc. Again, this type of industries is less popular in Kamrangir Char, so the owner has to pay in advance there. The plot size also plays a role here behind these differences, but it does not get that much significance.

Table 4: Distribution of industries (in %) according to their location and capital investment during 2010 to 2015

| Location of the industry	Capital investment in BDT (2010 to 2015)						Total (frequency)
	below 500,000	500,000 to 1,000,000	1,000,000 to 2,000,000	2,000,000 to 4,000,000	4,000,000 to 6,000,000	above 6,000,000	
Begumbazar	0.0	0.0	0.9	0.0	0.0	0.0	1
Chawk Bazar	0.9	0.9	3.8	0.9	0.0	0.9	8
Hazaribag	0.0	0.0	0.0	0.0	0.0	0.9	1
Islambag	2.8	12.3	15.1	4.7	3.8	2.8	44
Kamalbag	0.0	0.9	0.9	2.8	0.9	0.9	7
Kamrangir Char	0.9	2.8	4.7	8.5	0.0	0.0	18
Lalbag	1.9	0.9	1.9	2.8	0.9	0.0	9
Mirpur	0.0	0.0	0.0	1.9	0.9	0.0	3
Posta	0.9	0.0	4.7	0.9	1.9	0.9	10
Rahmatganj	0.0	0.9	0.0	3.8	0.0	0.0	5
Total (frequency)	8	20	34	28	9	7	106

Source: Authors, 2016

Plot Use: The small-scale plastic industries are mainly located in old part of Dhaka which is already developed. So, there is less possibility to get plot in this area which can be used entirely for industrial purposes. As a result, maximum industries have been established in plots which are used for multiple purposes. Figure 2 depicts that about 53% industries hold mixed plot uses.
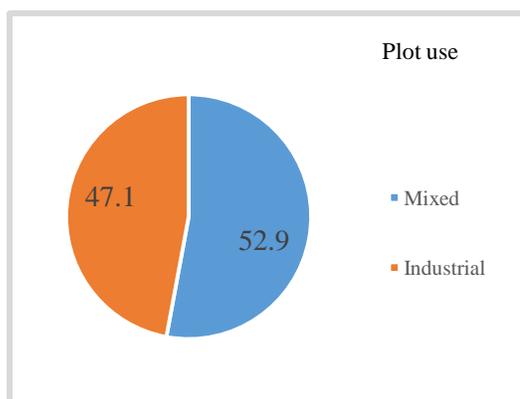
Source: Authors, 2016

Figure 2: Distribution of industries according to plot use
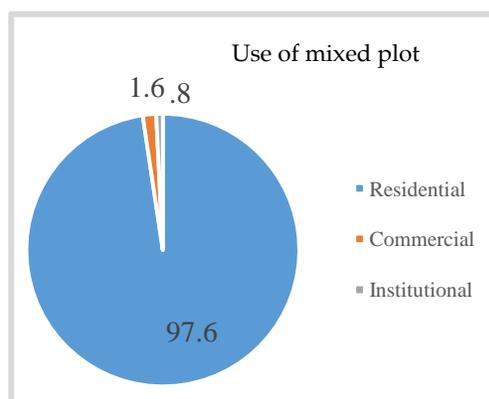
Source: Authors, 2016

Figure 3: Distribution of plot use for mixed use

Figure 3 presents that plot holding mixed uses, mainly has residential uses as subsequent land use. The reason behind this is that most of the plastic industries have been developed in the locations of high-density residential areas. Table 5 presents that industries in Islambag areas are mostly developed on mixed used plots (27.5%) and in Kamrangir Char the industrial use of the plot (12.9%) is more prominent. The reason behind is that areas adjacent to Islambag are developed as residential areas which have been stated before. Being newly developed area and having large chunk of land available, industries in Kamrangir Char areas hold industrial uses of plot in most cases.

Table 5: Distribution of industries (in %) according to their location and plot use

Location of the industry	Plot use		Total (frequency)
	Mixed	Industrial	
Begumbazar	0.4	1.3	4
Chawk Bazar	5.0	2.9	19
Hazaribag	0.0	1.3	3
Islambag	27.5	15.4	103
Kamalbag	3.8	2.1	14
Kamrangir Char	1.3	12.9	34
Lalbag	5.8	1.7	18
Mirpur	2.1	0.8	7
Posta	6.3	2.5	21
Rahmatganj	0.8	6.3	17
Total (frequency)	127	113	240

Source: Authors, 2016

Plot Size: Table 6 depicts the fact that most of the industries (119 out of 240) have a plot size between 0.75 to 1.5 katha within the study areas and the demand for large size plots is relatively low. The amount of 1.5 to 3.0 katha plot is also significant. In Islambag, the percentage of small sized plots (below 0.75 katha) is very significant comparing to other areas because of high percentage of mixed plot use in this area.
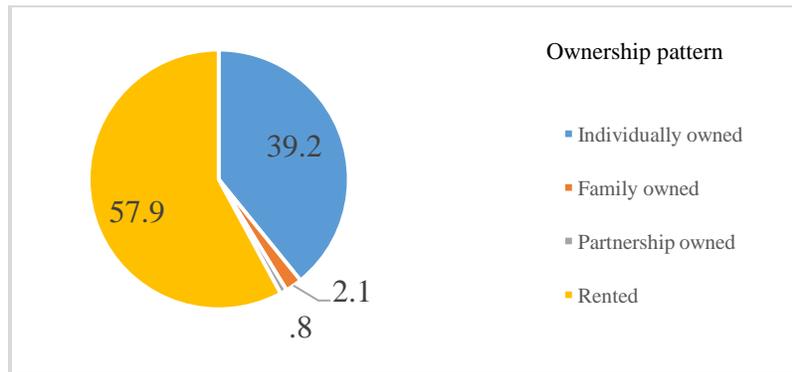
Table 6: Distribution of industries (in %) according to their location and plot siz**e**

Location of industry	Plot size in katha				Total (frequency)
	below 0.75	0.75 to 1.5	1.5 to 3	above 3	
Begumbazar	0.0	1.7	0.0	0.0	4
Chawk Bazar	1.3	3.8	2.9	0.0	19
Hazaribag	0.0	1.3	0.0	0.0	3
Islambag	9.2	19.2	13.8	0.8	103
Kamalbag	1.3	2.9	1.7	0.0	14
Kamrangir Char	1.3	5.4	4.6	2.9	34
Lalbag	1.7	4.2	1.7	0.0	18
Mirpur	0.4	1.7	0.8	0.0	7
Posta	1.3	4.6	2.9	0.0	21
Rahmatganj	0.4	5.0	1.3	0.4	17
Total (frequency)	40	119	71	10	240

Source: Authors, 2016

Kamrangir Char was a dumping ground for Dhaka's waste before. This area is still not developed like other areas and has a large number of slums where these plastic industries have been started to develop. So, to acquire these places for large sized plot for industrial development is not a hard task compared to other study areas.

Ownership Pattern: Figure 4 presents that in most cases, the ownership pattern is rented. A large number of industries have been established in any floor of a residential building, more specifically in the ground floor of the residential building. This situation happens mostly in the old Dhaka. Though the rent in the residential building in old Dhaka is higher than the rent of industrial plot in Kamrangir Char, people want to run their business here to get the benefits of agglomeration. The number of industries has individually owned is also very significant. This commonly goes to the people either have got their business from their ancestors or being the local people having a piece of land in these areas. It reveals that it is profitable for both the person whether he has rented the plot or has used his own plot for running this type of industry.

Source: Authors, 2016.

Figure 4: Distribution of industries according to ownership pattern

Structure Type: The types of structure for the industries are influenced by their location. Table 7 presents that most of the structures holding these industries are pucca structures (62.9%).

Table 7: Distribution of industries (in %) according to their location and structure type

Location of industry	Structure type			Total (frequency)
	Kutcha	Semi-pucca	Pucca	
Begumbazar	0.0	0.0	1.7	4
Chawk Bazar	0.0	2.1	5.8	19
Hazaribag	0.0	0.0	1.3	3
Islambag	0.0	13.3	29.6	103
Kamalbag	0.8	1.3	3.8	14
Kamrangir Char	0.0	12.5	1.7	34
Lalbag	0.0	2.1	5.4	18
Mirpur	0.0	0.0	2.9	7
Posta	0.0	0.8	7.9	21
Rahmatganj	0.0	4.2	2.9	17
Total (frequency)	2	87	151	240

Source: Authors, 2016

The main hub of plastic industries, Islambag and its adjacent areas: Begumbazar, Chawk Bazar, Posta, Lalbag mostly hold pucca structure, as the industries in these areas are developed on plot having mixed uses. As a result, most of the industries in these areas have got concrete structures. The industries which have been established in industrial plots mainly in Kamrangir Char areas are semi-pucca structures. Industries established on rented plots are situated near the market places or the local shop areas. So, these structures are made just like as the local shop structures. Kutcha structure mainly finds in Kamalbag areas (0.8%) due to high value of land in this area.

Source: Authors, 2016

Figure 5: Semi-pucca structure of industry

Source: Authors, 2016

Figure 6: Kutcha structure in Kamalbag area

Machinery Information: Table 8 presents that most of the industries use machines which are operated automatically (82.9%) due to technological improvement and use of these machines do not require experienced or highly technical workers to handle. So, people searching for job can easily get job opportunity in these industries. Semi-auto machine mainly use in those industries which produce plastic resin from plastic chips. Use of machine operated manually is negligible compared to other type of machines, because this type of machine requires more workers.

Table 8: Distribution of industries according to machinery information

Attributes	Variables	All cases (%)
a) Machine operation	Manually	.4
	Automatically	82.9
	Semi-auto	16.7
b) Machine manufactured	Local	39.6
	Foreign	60.4

Source: Authors, 2016

Foreign manufactured machines are mainly used in these small-scale plastic industries because amount of wastage of raw material is low for this type of machines. As most of the industries have been established in the recent time period and they are concerned about increasing their production level, most of the industries have used foreign manufactured machines. Local machines are mainly used by industries which have started their businesses with small capital investment to reduce their capital cost.

Source: Field survey, 2016   Field survey, 2016

Figure 7: The machineries and environment. Figure 8: The processing unit.

Utility Facilities: For accelerating and enhancing daily production, small-scale plastic industries require supply of all utility facilities. Electricity facility is must for all the industries for machine operation. A small number of industries, specifically who produce plastic resin, use water in their production process. As, these industries do not require high volume of water, they pay a lumpsum amount for the water they use. All industries have legal connection pattern, as they are established on previously developed land. According to industry owner, they use water repeatedly in their production and they do not discharge any water outside. But, from field level it has been found that they directly discharge their used water without treatment in the drain. This water is highly toxic and hazardous containing high concentration of chemicals in it.

Factors Influencing the Location of the Industry: From Table 9, it has been understood that 'availability of easily accessible raw materials' is more preferable factor than the other seven factors because industries can easily purchase their raw materials from local markets and local factories. The main market of raw materials used in these small-scale plastic industries is situated in Urdu road of Old Dhaka. According to industrial location theory, industries are generally established near the market of raw materials. For this reason, most of the small-scale plastic industries are also established in different areas of Old Dhaka. The newly developed industries in Kamrangir Char also enjoy this facility to some extent, as Urdu road is not so far from that area. Moreover, raw materials producing industries have also been established in Kamrangir Char in a significant amount.

Table 9: Frequency distribution of factors influencing the location of the industry

Factors influencing the location of the industry	Frequency
Low cost of worker	117
Availability of easily accessible raw materials	215
Availability of skilled worker	191
Low transport cost	70
Low house rent or land cost	29

Factors influencing the location of the industry	Frequency
Easy access to road to go to market	49
Link to other similar industries in the area	151
Tax free government land	0

Source: Authors, 2016

The next more influencing factor is 'Availability of skilled worker' in the study areas. As most of the workers working in these industries have been involved for a long time, it is easy to get more skilled labor in the study areas. Except Mirpur most of the study areas have this opportunity as Mirpur is so far from the other study areas. So, the workers especially skilled workers do not want to go there except very high wage, as the number of industries is also less in Mirpur.

Both the raw materials and finished product before reaching to the direct user level have to pass through different stages and require the value addition by other types of industries. As, different types of plastic industries are located in Old Dhaka area, there is a linkage developed among themselves. Finished product of one industry is used as raw materials for other industry. For this reason, 'link to other similar industries in the area' appears as next influential factor for the establishment of industries in any particular area.

As most of the small-scale industries are concentrated in Old Dhaka, industries can hire labor at low costs. The reason behind this is more concentration of industry results in sufficient and easy availability of workers. A new worker without any training and experience can get employment in these industries at low wage rate. So, for availability of sufficient number of workers enforces the factor 'low cost of worker' behind the establishment of industries in the studied areas.

As the backward and forward sectors (markets of raw materials and finished products) of these small-scale plastic industries are located in close proximity to these industries, this results in 'low transport cost' for buying and supplying of raw materials and finished products.

Most of the access roads in Old Dhaka area are very narrow and congested. In comparison to Old Dhaka area, roads in other areas, Hazaribag, Mirpur, Kamrangir Char are relatively wide. So, the industries in Old Dhaka locating adjacent to main road of the locality and in other areas, identify 'easy access to road to go to market' as influential factor behind their locational preference.

In some areas, like Mirpur and Kamrangir Char, house rent or land cost is comparatively cheaper than rest of the studied areas. 'Low house rent or land cost' factor works as influential factor for those areas. As for these small-scale plastic industries, government does not provide tax free land, this factor has no influence on location distribution of the industries.

Major Findings

The situation of the small-scale plastic industries in Dhaka is complex. These industries have different types of characteristics. The establishment of these industries was started

in West Islambag and has been expanded mainly after 2005 and the expansion has been accelerated during the period between 2010 to 2015. Now these industries are found not only in Old Dhaka but also in Kamrangir Char, Hazaribag and Mirpur.

Around 53% plots used by these industries are mixed use, and of which 97% industry share their place with residential neighborhood. Most of the industries in the mixed land use are situated in old Dhaka which has been established in the ground floor of the residential buildings. The factories have surrounding land use as industrial are mostly situated in Kamrangir Char.

The tendency of most of the owners (27.4%) is to establish a small sized industry with a capital investment about 10 to 20 lakh BDT regardless the time period of the establishment though the rent per katha is comparatively greater for small sized plot. Almost 67.5% industries have plot size less than 1.5 katha who have to pay rent up to 40000 BDT per katha. Only 4.3% industries have plot size more than 3.5 katha and the maximum rent for these industries is 15000 BDT per katha. One of the cause behind this scenario is that the owners of these industries seldom get the opportunity of bank loan. The rent amount is less in Kamrangir Char and Mirpur than old Dhaka.

Easily accessible raw materials, low labor cost, skilled worker availability, proximity to market and forward and backward linkages with the nearby industries play the dominant role behind the high concentration of these industries in old Dhaka. Due to lack of these opportunities, the concentration of industries is low in Kamrangir Char, Hazaribag and Mirpur.

Conclusions

Small scale plastic industries are playing a dominant role in our economy. Though most of these industries are small in size and capital investment, they provide employment opportunity to a large number of people. These industries are mainly concentrated in old Dhaka but in the recent past it has been expanded to Mirpur, Hazaribagh and Kamrangir Char. The land uses of these industries are incompatible as most of these industries can be found in residential plots. The factors working behind the concentration and locations are proximity to market (both for raw materials and finished products), labor availability, forward and backward linkages with the nearby industries etc. Mostly two types of machines are used in these industries which are 'Dana machine' and 'Injection molding machine'.

Though these industries provide various types of products, it also has left a negative impact on our daily life and environment as well. At the same time, the existing procedure of utilizing the waste to produce new goods cannot also get rid of the contribution to environmental pollution. As most of these industries have low capital investment and have established in congested residential areas, it is quite impossible for these industries to reduce environmental pollution by providing ETP and CETP because of space and resource scarcity. Again, to get an alternative of the products of these industries by the twinkling of an eye is nothing but a daydream because of its being inexpensive and having various products and markets. So, these industries should be segregated from the residential neighborhoods and an environmentally sustainable community treatment plant for all of these industries should be designed comprehensively.   It can be beneficial to reduce the pollution caused by these industries.

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