PROBLEMS AND PROSPECTS OF INFORMAL PLASTIC RECYCLING INDUSTRIES IN DHAKA CITY.

by

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THESIS

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Certificate of Approval

We hereby recommend that the thesis presented by **Shaheen Ahmed** entitled "**Problems and Prospects of Informal Plastic Recycling Industries in Dhaka City**" be accepted as fulfilling this part of the requirements for the degree of Master of Urban and Regional Planning (MURP).

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ABSTRACT

Plastic goods have become so much a part of our lives that we can no longer do without them. Though the City Dwellers of Dhaka are somehow concerned about the harmful effects of plastic products to environment and civic life. They are exposed to different negative consequences like inhaling noxious gases emitted from different unauthorized/informal plastic industries established in residential and other areas of Dhaka City. Another troubles of plastics are their longevity. If they are not properly dealt with, these can cause harm to soil, human health & drainage system. So, managing these plastic wastes has become a matter of great concern for all. Recycling of plastic wastes has become an important part of urban planning for saving costs both of manufacture and of waste management. It makes delay of plastic wastes return to environment. An environment-conscious world has made the latter imperative more worthy of careful consideration The Informal Plastic Recycling Industries can play an important role in managing plastic wastes and hence improving quality of environment of Dhaka City. They not only provide employment to a large number of urban poor of Dhaka City but also produce a wide range of goods from recycled plastic waste that are supposed to be left to cause environmental degradation of Dhaka City. The present study tries to give an alternative thought to decision-makers and environmentalists to come forward to combating plastic waste problem through recycling them in different informal plastic recycling industries. The study gives brief ideas of the location, technology, recycle and trade chain, raw materials used, employees, backward and forward linkages, outputs and factors influencing the establishments of these industries in Dhaka City. Finally the problems of these informal plastic-recycling industries are identified and priority ranked to draw policy guidelines and hence guide their prosperity in near future

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AHRTAG: Appropriate Health Resources and Technologies Action Group
BSCIC. Bangladesh Small & Cottage Industries Corporation
BCIC: Bangladesh Chemical Industries Corporation
BSEC: Bangladesh Steel Industries Corporation
BTMC: Bangladesh Textile Mills Corporation
BJMC: Bangladesh Jute Mills Corporation
BSFIC: Bangladesh Sugar and Food Industries Corporation
BFIDC: Bangladesh Forest Industries Development Corporation
BBS: Bangladesh Bureau of Statistics
BOI: Board of Investment
BEPZA: Bangladesh Export Processing Zone Authority
CFCs: Chloroflurocarbons
CBO: Community Based Organization
CGA: Credit Guarantee Association
DCC Dhaka City Corporation
DoE: Department of Environment
DEPC: Department of Environment Pollution Control
DIT: Dhaka Improvement Trust
DMDP: Dhaka Metropolitan Development Plan
DMCH: Dhaka Medical College Hospital
DWASA: Dhaka Water and Sewerage Authority
DESA: Dhaka Electric Supply Authority
EPS: Expanded Polystyrene
ESDO: Environment and Social Development Organization
EIA: Environmental Impact Assessment
EPB: Export Processing Bureau
EPZ. Export Processing Zone
GO: Governmental Organization
GoB: Government of Bangladesh
hrs.: Hours
HDPE: High-density Polyethylene
IPRIs: Informal Plastic Recycling Industries
ILO: International Labor Organization (United Nations)
JOBS: Job Opportunities and Business Support
LDPE: Low-density Polyethylene
LGED: Local Government Engineering Department
MoEF: Ministry of Environment & Forest
NGO Non Governmental Organization
NEMAP National Environment Management Action Plan
NBR: National Board of Revenue
PVC: Polyvinyl Chloride
PEM: Preventive Environmental Management
PET: Polyethylene
PP: Polypropylene
PS. Polystyrene
PWD: Public Work Department
PRIs. Plastic Recycling Industries
RAJUK: Rajdhani Unnayan Kartipakkha
RHD: Road and Highways Department
SWM: Solid Waste Management
SWR: Solid Waste Recycling

SPSS: Statistical Package for the Social Sciences
SIs: Small Industries
SCIs: Small Cottage Industries
T & TB: Telegraph and Telephone Board
TG: Titas Gas
UNDP: United National Development Program
WHO: World Health Organization (United Nations)
yrs.: Years

CHAPTER:01 INTRODUCTION

1.1 Background & Present State of the Problem

Dhaka, the capital of Bangladesh is one of the fastest growing metropolises of the world with an average growth rate of 6.6 percent. Only in the Dhaka City Corporation (DCC) area the present population is estimated at 6 million in an area of 276 sq. Km. The population of Dhaka megacity with an area of 1353 sq. Km. is estimated at 10.41 million in 1999. Like all metropolises, the six million population of Dhaka city corporation area generates about 3500 metric tons of municipal solid waste per day (Sinha, 1999). Two waste management systems exist side by side in Dhaka City. One is what might be called the "Formal system" which is based on the concept of collection, transport and dumping of waste & managed by the urban local government-DCC (Dhaka City Corporation). Another one is "Informal System" which is characterized by extensive waste recovery where scavengers and other groups involved in the collection process and recycled by small enterprises at small-scales. Only 42% of the total generated wastes in Dhaka city is collected by DCC and rest of them both biodegradable & non-biodegradable lie in road sides, open drains, low lying areas- contributing to the deteriorating quality of Dhaka's environment. Because disease spread by rotting garbage, non-biodegradable wastes block drains & cause harmful effects to soil. (Enayetullah, 1995).

On the other hand, recognition of waste as resource is growing gradually & it has been revealed that recycling is the best option for managing solid waste in both developed and developing countries. In Dhaka 15-20% recyclable are collected from the total generated wastes by more than 87,000 people from the informal sector (Khan, 1998). Among them, inorganic (non-biodegradable) portion of waste in the residential as well as commercial areas of Dhaka city are collected by the waste pickers who extract most of the readily recyclable materials from the waste stream. Major portion of the collected wastes is plastic waste. Actually plastic wires, polyethene bags and PVC products are now a part of urban life style. The used and old plastics can be easily remolded to produce new products. The used polyethene bags are being salvaged and converted into alternative plastic products. The recovery and recycling of plastics are contributing towards the reduction of anticipated plastics related to environmental degradation (Ahmed, 1994). Thus several types of informal plastic recycling industries with different degree of recycling activities have been established where a large number of people are involved. The activities of these recycling industries are interrelated with one another and even with the formal sector.

Although, there is no reliable data on the exact number, category and location of these recycling industries, it can be easily seen that day by day the number of people involved in recycling is increasing in different parts of Dhaka City. It's popularity as a livelihood is directly related to the number of people and the degree of poverty. But their activities are somehow important to the economy and welfare of the society especially in case of SWM (Solid Waste Management) & Environmental Quality Improvement

Thus though SWR (Solid Waste Recycling) in Informal Plastic Recycling Industries reflects a positive role in the urban economy & urban environment of Dhaka City. But there are limited studies of the problems and prospects in this sector. So this is an unexplored area, which need to be studied by the urban planners. This is why there is a need to study the problems and prospects of informal plastic waste recovery and recycling practices of Dhaka City.

1.2 Objectives of the Study

Objectives

The following objectives have been set for the study:

(1) To study the forward and backward linkages of informal plastic waste recycling industries in order to contribute to waste management & environmental improvement.

(2) To identify the problems and constraints faced by the informal plastic recycling industries.

(3) To find out areas where the informal plastic recycling industries need help or support.

(4) To recommend policies for the development of informal plastic waste recycling industries of Dhaka City.

1.3 Statement of the Study

The specific aims of the study are to formulate policies for the development of informal plastic recycling industries for the SWM and improvement of urban environment of Dhaka City. This study may also help different organizations of GO's, NGO's, CBO's and private entrepreneur to make sustainable projects of plastic waste recycling through the informal sector & also take initiatives against environmental degradation.

1.4 Rationale of the Study

The study is highly needed because of the increasing environmental concern at global context and improving the conditions of informal sector especially in industry sector that will facilitate more employment to mass people and thus help to reduce poverty in urban areas. It is also needed to help urban SWM program in the case of recycling. It is expected that the result of the study will provide policy guidelines for the development of informal recycling options which city govt. such as DCC and DoE may utilize for better SWM & Environmental Improvement of Dhaka City.

1.5 Selection of the Study Area

The city chosen for this study is under the jurisdiction of the Dhaka City Corporation (area of 344 sq. km.). It is the capital and Prime City of Bangladesh. It is the center of government politics and business. As recycling activities are being practiced at different parts of all over the city, emphasis has been given on certain where plastic recycling is extensive. According to a report of the Daily Ittefaq, a national newspaper of Bangladesh, (Pothae Prantare, 26 Sep., 1998), it has been reported that there are more than 200 plastic recycling industries in Dhaka City which are located in Islambagh, Lalbagh, Kamrangir Char, Dholaikhal, Tejgaon, Mohammadpur, Tongi, Demra, Savar and other areas. From the reconnaissance survey, a number of clusters of plastic recycling industries were identified. Among the clusters the prominent three areas were found at Lalbagh, Islambagh, Kamrangir Char & Tongi. Due to limitation of time and fund, three prominent clusters mentioned above (Lalbagh, Islambagh & Kamrangir Char) were selected for detail questionnaire survey.

1.6 Scope and Limitation of the Study

Due to time & resource constraints appropriate sample size can not be taken for the study & also the scope is limited to particular fields for questionnaire survey.

1.7 Organization of the Study

The present study is divided into eight (08) chapters to fulfil the objectives of the study. **Chapter One** is called the introductory chapter which basically discuss about background, objectives, statement of the problem, rationale of the study, selection of study area, scope and limitation of the study and finally organization of the study. **Chapter Two** is the literature review section, which talks about different aspects of recycling especially plastic recycling. It includes topics like Solid Waste Management (SWM), Preventive Environmental Management (PEM), 4R Concept of SWM, Basic approaches of recycling in developing and underdeveloped countries, Plastic use in Bangladesh, Existing environmental policies of Bangladesh regarding environment, Awareness of Environmental Management in Bangladesh & finally examples of plastic recycling practice in two Asian Cities. **Chapter Three** deals with research design and survey methodology. A flow chart is provided to show the design process which includes literature survey, inventory/reconnaissance survey, type of survey, sample size, data gathering method, type of survey data, location-time & day of survey, questionnaire preparation and conducting survey, discussion with concerned authorities and finally data analysis and representation. **Chapter Four** is named by the existing pattern of Informal Plastic Recycling Industries (IPRIs) in Dhaka City. Briefly this chapter discusses the types of plastic wastes generated in the Solid Waste Stream of Dhaka City, possible application of recycled plastic waste, the plastic recycling system's flow and dynamics, technology used in plastic recycling industries, different sectoral involvement in plastic recycling trend especially the informal sector-their types, extent, interface with the formal sector, different actors involved in informal plastic recycling and finally the impacts of plastic recycling industries in Dhaka City. **Chapter Five** is called general description of the study area. This chapter comprises some maps showing the location of IPRIs in the city region of Dhaka and some brief description of the study area. Finally different factors/issues related to

IPRIs are discussed in short to get some ideas about the problems of IPRIs which lately come in the proceeding chapter. **Chapter Six** is the analysis and presentation of data chapter It provides certain information (in tabular form) about profile, behavioral psychological & socio-economic data like age structure, sex, educational status monthly income & expenditure, ownership pattern, capital investment, rent, size of industry, types of recyclable plastics, number of similar industry, year of establishment, number of employees with job specification, wage type & rate, working hrs, land use, information of machinery regarding plastic recycling, maintenance cost, negative consequences of plastic recycling, utility services, forward & backward linkages, factors/reasons for establishment of plastic recycling industry in the surveyed areas and finally identification & priority ranking of problems of informal plastic recycling industry in Dhaka City. **Chapter Seven** is the findings of the study. It comprises the general findings come from the analysis chapter. **Chapter Eight** is the final chapter of the study. It is called conclusions and recommendations chapter. It comprises an introduction, people' s participation concept in solving problems and finally policy guidelines for solving problems and enhancing prosperity of IPRIs in Dhaka City.

2.1 Introduction

In this Chapter relevant literature has been reviewed to get a better understanding of different issues related to Recycling of Solid Wastes (especially plastic wastes). It also describes recent recycling trends and practices observed in some Asian Metropolises.

2.2 Solid Waste Management & Environment

Solid Waste Management (SWM) is to be addressed as one of the most important and prior issues for action. This is needed for our sustainable living on this common earth. Solid Waste generates from the areas of habitats as well as other areas with wide range of classification. It generates basically from residential, commercial, industrial and other land uses It can primarily be classified as perishable and non-perishable. Perishable wastes are biodegradable and contains organic substance whereas non-perishable wastes are non/slow biodegradable and contains inorganic materials. SWM is necessary because disease spread by rotting garbage and blocked drains. Risks from hazardous wastes especially plastic wastes are often acute. It has effect on productivity as it hinders for suction of nutrients from soil for the trees and plants, also pollutes ground water resources.

Thus Waste Management is of primary environmental concern. Everything produced and consumed will end up as waste-sooner or later As waste is normally a mixture of different products, it is easy to understand why waste causes serious problems when handled and treated. It is also obvious that waste contains many constituents of worth recycling which conserves materials and energy. It is thus obvious to strive to reduce the quantity of residual products from production and consumption and to ensure that the residual products occurring are as possible to process and recycle. This lead to a potential approach to SWM called Preventive Environmental Management (PEM).

2.3 Preventive Environmental Management

The most effective approach to improved SWM involves minimizing or eliminating the generation of wastes. In Europe this approach is often referred to as low-waste technology or clean technology. In the U.S. the term pollution prevention and waste minimization or waste reduction are most prevalent. While each term has a somewhat different meaning, they are increasingly used interchangeably. They are integral parts of an emerging concept that can be termed as Preventive Environmental Management (PEM). PEM can be defined as that approach to managing resource consumption and environmental residuals in such a way as to minimize or eliminate generation of undesirable side effects. PEM takes into account the multimedia interconnections of waste and the close relationship between post-consumer solid waste generation and upstream hazardous waste generation. There are different stages and levels of SWM in PEM. One of them is the 4R concept.

2.4 The 4R concept of SWM

Four basic strategies- the four R's of PEM – exist for minimizing or eliminating wastes and the risks they entail are-

- Reduce
- Redesign
- Replace
- Recycle

2.4.1 Reduce

This is the technologically simplest strategy: it entails using fewer resources per unit, as well as using units. Both producer and consumer roles are vital for this strategy. The simpler the product, the fewer variations in product models, and the less complex a product is, the fewer resources that will be the necessary to manufacture it, and thus, the fewer residuals emanating from its manufacture. The less complicated a service the less energy and resulting residuals will have to go into it. Similarly, the fewer resources utilized by consumers, the less the potential for waste: an effective set of reduction strategies for products and services can be practiced by consumers with no technological changes involved.

2.4.2 Redesign

Significant pollution prevention can be achieved by redesigning both product and process. While more involved technologically and economically than the first strategy, this approach can yield significant prevention result.

2.4.3 Replace

Redesign of a product or process may involve substituting feedstock and energy sources to achieve optimal reduction of residuals. Converting to renewable energy and substituting a non-halogenated solvent for a halogenated one are two examples.

2.4.4 Recycle

Reuse and recycling, both in production processes and in the post-services period phase, is a proven prevention strategy that generally does not interfere with product service design or size nor involve sophisticated technology. It is so far the best Solid Waste Management Option viable in developed, developing and underdeveloped countries.

2.5 Recycling –an element of integrated SWM

Most solid waste management professionals recognize that there is no single, simple solution to solid waste problems. Instead an integrated approach is necessary combining the elements of several techniques stated above. Thus solid waste management is a comprehensive strategy- involving the following elements in a hierarchical manner:

- Reducing the volume and toxicity of the solid waste that is generated;
- Recycling or re-using as much as possible of what is generated;
- Recovering energy from the remaining waste through combustion systems equipped with the best available pollution control technology, and
- Utilizing landfills with adequate environmental controls

2.6 Basic Approaches of Recycling in developed countries

There are basic two approaches to recycling of solid wastes in developed countries. They are-

- The first involves separating recyclable materials by the waste generator and separately collecting and transporting these materials to recycling markets.
- The second involves collecting mixed wastes or commingled recyclable materials and separating them at a central processing facility.

Prior separation of recyclable materials has the advantage that other wastes do not contaminate the materials. However, this requires the waste generator (e.g. householder) to separate the wastes correctly and store them in separated form Also the generator needs to transport the separated material to recycling centers or separate or compartmentalized collection vehicles need to be used. Key factors in success of pre-separation efforts are the cooperation and willingness of the generator to participate in the program over the long term, and the additional collection and transport costs that may be required.

The second approach consists of the construction of a new local processing centers or materials recovery facilities i.e. central processing plants. Some plants process segregated recyclable: other separate mixtures of glass bottles, aluminum cans, plastic wastes; still others process mixed residential or commercial wastes, separating the recyclable materials. Undoubtedly these plants are highly expensive and sophisticated technology-oriented The success of these plants depends on the processing costs and the quality of the recyclable material produced.

2.7 Recycling Phenomenon in developing and underdeveloped countries

There is a different point of view of recycling solid wastes in developing and underdeveloped countries. These are due to socio-economic characteristics of people in these countries. Actually in resource-scarce Third World cities, much consumption is frugal and waste of all kinds are extensively exploited by poor people and by small and large formal and informal recycling and other industries Some aspects of solid waste recycling in these countries are described in the following paragraphs.

2.7.1 Resource Recognition

A new philosophy of resource management is beginning to transform in solid waste management worldwide especially in developing and underdeveloped countries. It is grounded in what can be called '**Resource Recognition**' Most waste materials can be regarded as unusual resources, so environmentally sound waste management entails the reduction of waste in production and distribution processes and the

enhancement of re-use and recycling. Resource recognition has become an alternative thinking which seems to be more effective in Third World countries because its approach is to social betterment of poor people. It includes-

- Assisting poor people whose livelihoods depend on wastes to do safer, more acceptable work;
- Promoting the separation of wastes to facilitate more through or more efficient recycling;
- Developing community/private sector/ municipal partnerships;
- Furthering environmental education; and
- Pragmatic accommodation of informal activities in waste recovery and recycling.

Waste avoidance, waste reduction and recycling are the principals by which the industrialized countries are mean while trying to cope with their mountains of reuse. In many respects the concept has still not been implemented in practice, above all as regards waste avoidance and recycling.

The recovery of materials before they enter the waste stream has the greatest effect on reducing the volume of municipal solid waste. Some examples of recovery includes street peddlers collecting paper, plastic residues, broken bottles, aluminum and other metal residues from residential areas and also from industries. Sorting and recovering materials at intermediate transfer stations also reduces the volume and therefore the cost of final transport.

In most Developing countries material recovery and recycling from the inorganic fraction of municipal solid waste has been practiced for quite some time. However, it is important to realize that in the case of developing countries the reduction of the amount of solid waste to be disposed of has usually not been the main reason for the existence of extensive recycling activities. These have mostly been carried out by the informal sector which is driven by the large number of unemployed and unskilled labor on one hand and the existing but often unpredictable market for recovered inorganic material on the other Although organic waste possesses the major portion of generated solid wastes, there are very limited fields of organic waste recycling in these countries.

2.7.2 Recycling Pattern of Domestic Waste

In the developing countries recycling and reclamation are being strongly prompted for conservation of resources and prevention of environmental degradation. Whilst extensive recycling is being practiced in the poorer parts of the developing country, recycling is not a part of national waste management plan. The recycling pattern of solid waste is more or less same in most of the developing countries. For example, in Bangladesh waste of some market value are being reclaimed or salvaged in four stages. In the **first stage** the street/announced hawkers purchase the source-separated items. Salvage activities have some economic incentive and are in practice in all households of low to average income. The **second stage** waste is salvaged from the waste bin and dumpsite by two types of actors, one picks from the waste bin called

waste bin tokai and other one picks from the dump site called dump tokai. Their scavenged items include broken glass, cans, card board, waste paper, rags, plastics, metals and miscellaneous commercial wastes discarded by the household. The **third stage** of this recycling trade is dominated by various types of buyers. All the items purchased and retrieved from the households, waste bins and dumpsites by one way or other come to these buyers. In the **fourth stage** two types of manufacturers, they are large formal manufacturers and small informal manufacturing enterprises. These manufacturer are creating the demand of recyclable material which acts as a driving force behind the extensive collection, processing and recycling by the informal sector.

2.7.3 Quantity and Characteristics of Solid Waste in Selected Asian Metropolises

According to a study of Bhide (1990, p.17) it has been found that quantity and characteristics of solid waste depend upon number of factors such as food habits, cultural traditions, socio-economic and climatic conditions. Refuse characteristics and quantity vary not only from city but even in the same city itself, from area to area and also seasonally. Table 2.1 shows the comparison on the characteristics of solid waste in Asian Metropolises. Another study of Cointreau (1985, p XI) showed that the nature of municipal solid waste is a function of relative consumption and production activities within countries, according to their stage of economic development. Table 2.2 shows range of municipal refuses generation rates, compositional values, and density characteristics for cities in countries of low-income, middle-income and industrialized.

Table 2.1 Comparison on the Characteristics of Solid Waste in Asian Metropolises

City	Dhaka	Bombay	Bangkok	Manila	Singapore	Tokyo
Area (Km^2)	344#	466.35	1,568.74	636	618.1	599.73
Pop. (m)	4.51 ('81)	8.24 ('81)	5.61 ('87)	7.56 ('88)	2.61 ('87)	8.35 ('87)
Refuse Comp. (%)						
Moisture	47.55*	40	59.1	40.6	53.4	47.9
Combustible	-	22	35 7	33.8	32.8	45.0
Incombustible	-	38	5.2	23.6	13 8	7.1
Physical Comp (%)						
Paper	10.5#	10	13.9	14.5	28.3	42.0
Glass	0.3#	0.2	2.0	2.7	5.7	1.2
Metal	0 2#	0.2	1.8	4.9	4 8	1.2
Plastic	**0.2#**	**2**	**11.0**	**7.5**	**11.8**	**8.5**
Textiles	I 1#	3.6	6.9	1.3	3.3	3.8
Wood/grass	0.4#	20	14.9	7.7	44.4	4 7
Food wastes	83.0#	20	36.5	31.8		32.9
Ash/soil	4.2#	38	12.6	6.0	2.0	0.1
Others	0.1#	6	0.4	23.6		5.6
Refuse Density (kg/m^3)	650	325	330	330	210	185
Low Calorie Value (Kcal/kg)	-	800-1000	1130	1468	1388	1898
Waste Generation (Kg/cap/day)	0 47#	0 50-0 60	0.88	0.50	0.98	1.44#

Sources: # UNDP et. Al., (1992)
Bhide (1990)

From the above table some points can be noted that are worthy to plastic waste recycling in Asian cities including study area Dhaka:

a. Physical composition of solid wastes in Dhaka City shows the very low presence of paper, **Plastics**, and metal indicates extensive recycling of these components of the refuse
b. The ratio of paper, glass, metals, **plastic**, rubber etc. are decreasing gradually with the decrease of economic state. In Tokyo the proportion of plastic is 8.5% whereas in Dhaka the proportion is 0.2%. From this we can say that volume of Non-food item in the urban solid waste is directly proportional to income of that area

Table 2.2 Patterns of Municipal Refuse Quantities and Characteristics for Low, Middle and Industrialized Countries

Characteristics	Low Income Countries	Middle-Income Countries	Industrialized Countries
Waste Generation (kg/cap./day)	0 4-0.6	0 5-0.9	0.7-1.8
Waste Densities (kg/cubic meter)	250-500	170-330	100-170
Moisture Content (% of wet weight at point of generation)	40-80	40-60	20-30
Composition (% by wet weight)			
Paper	1-10	15-40	15-40
Glass, Ceramics	1-10	1-10	4-10
Metals	1-5	1-5	3-13
Plastics	**1-5**	**2-6**	**2-13**
Leather, Rubber	1-5	-	-
Wood, Bones, Straw	1-5	-	-
Textiles	1-5	2-10	2-10
Vegetable/Putrescible	40-85	20-65	20-50
Miscellaneous inert	1-40	1-30	1-20
Particle size(% greater than 50 mm)	5-35	-	10-85

Source: Cointreau (1985, p. xii)

From table 2.2 several conclusions can be drawn regarding plastic wastes of low income countries:

a. Waste densities are high, generally two or three times higher than industrialized countries,
b. % by wet weight composition of plastic wastes is comparatively lower (1 to 5%) in low-income countries. But practically the number of plastic product used in these countries is large. As plastic products are light weighted, their vigorous use is not comprehended by the stated composition This low numerical value is also an indication of extensive recycling of plastic wastes in these countries

2.8 The Basics of Plastic Recycling

2.8.1 History

First invented by Alexander Parkes in 1860, plastics have only been used widely in the past few decades. Plastic production worldwide now exceeds 80 million tons a year.

2.8.2 Definition

According to Webster's dictionary, Any of various complex organic compounds produced by polymerization, capable of being molded, extruded, cast into various shapes and films, or drawn into filaments used as textile fibers.

The term "plastics" encompasses organic materials, such as the elements carbon (C), hydrogen (H), nitrogen (N), chlorine (Cl) and sulfur (S), which have properties

similar to those naturally grown in organic materials such as wood, horn and rosin. Organic materials are based on polymers, which are produced by the conversion of natural products or by synthesis from primary chemicals coming from oil, natural gas or coal

2.8.3 Some Properties of Plastic

Plastics are strong, waterproof, lightweight, durable, microwavable, and more resilient than glass. For these reasons they have replaced wood, paper, and metallic materials in packaging and other applications. In short, plastics are polymers --long chains of molecules made up of smaller molecules called monomers The polymers are made in large vessels under special conditions of temperature and pressure, using special catalysts. At this stage the polymers are in the form of resin pellets or powder.

Plastics generate toxic by-products when burned and are non-biodegradable when landfilled, they also take up 30% of landfill space even though their weight percentage in only 7% to 9% Recent research has found that paper dose not degrade in landfills either and because of compaction in the garbage truck and in the landfills, the orginal volume percentage of 30% in the kitchen waists basket is reduced 12 % to 21% in the landfill, In additions, plastics foul the ocean and harm or kill marine mammals Other problems in clued the toxic chemicals used in plastics manufacturing, the reliance on nonrenewable petroleum products as their raw material, and the blowing agents used in making polystyrene foam plastics, such as chlorofluprocarbons (CFCs), which cause ozone depletion. CFCs are now being replaced by HCFC-22 or pentane, which does not deplete the ozone layer but does contribute to smog. For these reasons, recycling appears to be natural solution to the plastic disposal problem.

2.8.4 Plastic Recycling

Plastic Recycling is still a relatively new and developing field of recycling. It is considered to be extremely effective materials to recycle for two primary reasons. **First**. There are projected to be more and more uses of plastics in our everyday products. Given this, the demand for raw materials will increase and recycled plastics will serve as a necessary source. **Second**· Most plastics do not break down with recycling. The recycling process does not shorten the grains, strands or fibers within the material and consequently does not reduce its strength. Other materials do not have such positive recycling qualities.

Virtually all types of plastics can, in theory, be recycled. Most plastics are recycled into same type. Often recycled product is of slightly lower quality than that of virgin material, which means it can't always be used in the same way. Food regulations in many countries, for example, prevent recycled plastic being used in food containers (although recent developments in technology have lifted this restraint for recycled PET- one by sandwiching used PET between two layers of virgin material, and the other by breaking the polymer down into monomers and then repolymersing it into new PET).

Different plastics can be recycled together to produce a mixed plastic. Currently, this is of limited use because of the difficulties with quality control and consistency. New technologies are, however, under development that may see the commercial development of a product, or range of products, utilizing mixed plastic and cellulose

fibber (from vegetable matter). An essential requirement of all recycling is careful sorting. The plastics industry has development a resin identification code to aid this sorting. It is important to note that the code does not imply that a product using it is going to be recycled, or even that it is recyclable-it simply identifies which resin the product was manufactured from. Currently a very high proportion (>90%) of the wastes generated during plastics product manufacture are recycled by the manufacturer, or a contracted recycling company

2.8.5 Types of Plastic Recycling from different Points of View

With advancement of technology for reprocessing of collected plastic wastes, improved collecting techniques of waste and hygienic landfill disposal, the waste generation as municipal waste is becoming less with years. It is anticipated that the waste in the open dump yards will be reduced significantly in near future. Polyolefins constitute the majority of plastics in disposal area followed by styrenics and polyvinyl chloride polymers. The mixture plastic waste has to be separated effectively for effective utilization for recovery of economic value. The more popular technique is the sinkfloat method. Plastic mixture containing high-density polyethylene (HDPE), low density polyethylene (LDPE), polypropylene (PP), polystyrene (PS) and poly - vinylchloride (PVC) is normally subjected to separation using water (Sp. gravity 1) water-alcohol mixture (Sp. gravity 0.93, 0.910) and salt water (Sp. gravity 1.20). Polymer having higher specific gravity normally sinks while polymers having lesser specific gravity floats. Therefore the abundantly available PE plastic product could be separated from the rest of the plastic wastes using these techniques.

Plastic wastes could be reprocessed or recycled for recovery of economically valuable products. The post consumer items made from PET and HDPE resins have found reliable markets within the US and in Asia. The various recycling steps are primary recycling, secondary recycling, tertiary recycling and quarternary recycling. Primary recycling is normally carried out for uniform and uncontaminated plastic waste. Secondary recycling utilizes plastic waste not suitable for direct reprocessing using standard plastic processing equipment. Tertiary recycling is adopted to produce useful chemicals from plastic waste, which would otherwise have to be incinerated or disposed of by land filling Quarternary recycling is carried out for recovery of energy from combustion of solid plastic wastes. All these categorization are based on chemical engineering point of view.

Primary Recycling

In order to be reprocessed plastic waste has to be ground to a particle size close to that of virgin resin. Scrap plastics are subjected to cryogenic grinding using liquid nitrogen to get pellets or granules suitable for processing Rigid PVC, flexible PVC, agglomerated PVC, polyethylene and polyurethane are subjected to cryogenic grinding before reprocessing. With primary recycling only thermoplastic waste can be directly reprocessed. It can be used alone or most often added to virgin resin at various ratios. The main technical problems encountered in primary recycling are:

1. Degradation of the material due to repeated processing, resulting in a loss in such properties as appearance, chemical resistance, processibility and mechanical characteristics.

2 Contamination of the reprocessed plastic and
3. Handling of low-bulk-density scrap such as film or foam Low-bulk-density plastic wastes such as film, fiber or foam may be reprocessed by cryogenic grinding, followed by extrusion. The reprocessed products include pipe, sheet and film.

Secondary Recycling

Plastic wastes of various origins can be reprocessed. These wastes include post consumer plastic wastes recovered from municipal refuse, post consumer plastics waste obtained from returnable packages, mixed industrial plastic wastes. The limitations of this recycling are the high contamination with non-plastic substances (metal, sand) and incompatibility of various plastic present in the waste. The mixed plastic waste is used as filler in virgin plastic and non-plastic material and as matrix in combination with low cost filler. Sandwich structures with plastic waste, as core can be prepared. Processing techniques of instrusion molding, co-extrusion and co-extrusion are used. Products such as shoe soles, luggage handles, seals, toy animals, bicycle saddles, pedals, doors shops, cable housing and auto parts are produced by secondary recycling technique.

Tertiary Recycling

Most municipal solid waste can be converted into an economically viable form using tertiary recycling. Pyrolysis of solid municipal wastes yield various organic products, such as gas, tar, light oil, ammonia and liguor, Polymers decompose into monomers or smaller molecules, depending on their structure and the conditions of reaction. The waste plastic pyrolyzate, which has low molecular weight, is similar to petroleum with saturated and unsaturated hydrocarbons and aromatic compounds but without sulfur compounds

Quarternary Recycling

Incineration of municipal refuse is adopted mainly to reduce the volume of combustible waste. Inert residue is formed with high temperature combustion. Incineration is capable of reducing the weight of refuse by 80% and the volume by over 90% The residue formed is inert and may be disposed of in landfill. Because of recent rapid increase of cost and energy, more attention has been focused on the possibility of utilizing energy from the combustion of solid municipal and industrial refuse. Energy recovery from municipal solid refuse is put in practice with steam generating incinerators and heat exchangers. The municipal waste containing non combustible components has a calorific value of 4000-6000 Btu/lb as compared to 11000-12000 Btu/lb for coal. The calorific value of the refuse can be increased by the removal of some non combustible components.

Degradable Plastics

In mid 1980s polymers were considered as macro pollutants with low toxicity and side effects. The sudden change observed in recent years is essentially due to rapid development of plastic materials in the packaging industry and to a large increase in untreated plastic wastes.

In response to attention focussed on protection of our environment from solid wastes, it is now time to develop polymeric systems aimed at serving as materials and which can undergo degradation at a controlled and predetermined rate after the use. Basically, degradation means loss of properties. In the case of plastics, their loss of property can occur because of changes in the assemblies of macromolecules, which form the material, or because of breaking of macromolecules or both. Fragments are initially formed which can be small enough to disappear. The breakdown of macromolecules can be triggered either by a chemical process, such as hydrolysis or oxidation or by biological agents such as microorganisms or released enzymes or both (Jayabalan, 1998).

According to Social Point of View plastic and other solid waste can be recycled in many ways. Cointreau (1985) categorized three ways in which solid waste can be recycled:

Level 1: Mainly called Primary Recycling. After sorting and cleaning, discarded items are reused, repaired or remanufactured Sorting and Classifying in this step is usually done by hand in developing countries. It involves direct reuse of a product of material without changing its basic form and or function of the item. A common example is reusing (after sorting and cleaning) a packaging container such as a plastic can, bottle or box.

Level 2: Usually called Secondary recycling In this level waste material is sorted, cleaned, processed and recycled into a new material or product of comparable composition. For example, polythene bag and other plastic wastes are recycled to new plastic products like water pot, plate, shoe, glass, toy, container etc.

Level 3: Basically called Tertiary Recycling. In this level waste is converted into a different material or form of energy. Compost made from organic waste, or bio-gas produced through anaerobic digestion of organic waste is example of this level of recycling.

2.8.6 Plastic Identification Guide

Many people are confused about which plastics are recyclable. Much of the confusion results from the fact that a recycling symbol (three arrows) appears on the bottom of most plastic container's, thus making it seem as if all of them are recyclable. In theory this may be true, but in reality not many plastics containers are widely recyclable. There are seven basic kinds of plastics used for most containers. Which kind a manufacturer used is based largely on the type of product to be contained and the properties of the various resins available. For example, PVC is chemically resistant, a characteristic which is important for holding detergents and other harsh materials. The code number inside the recycling symbol help greatly in the task of identifying the different kinds of plastics, many of which look similar. The different resins usually must be reprocessed or recycled separately. Table 2.3 [(a) & (b)] gives us a distinct picture of different plastics that could be recycled.

2.8.7 Mechanical Process of Plastic Recycling

Plastics may be molded and shaped by many methods, but in every case each kind of product requires a separate molding tool (mold or die) Depending on the product

Table: 2.3 (a) Plastic Identification Guide with Recycling Code

Full Name	Typical Products	Features	Appearance	Physical Properties	Plastic Code	Special Applications
PETE **Polyethylene**	Bottle' (soft drink-with or without Code I symbol),honey,liquor cold medicine, some ovenable food trays, peanut butter jars	High strength high resistance	Transparent with gloss', clear or colored', no seams', injection molding nub on bottom or opaque with dull finish	Tough ', highly resilient slick surface', semi- rigid , hard to scratch', sinks in water	 **PETE**	Carbonated soft drink bottles, pillow and sleeping bag filling, textile fibers etc
HDPE ***natural* (without color)** **High density polyethylene**	Jugs: milk, cider, distilled water and spring water ', bottles; juice (not clear), rubbing alcohol, large vinegar, grocery bags.	Features Chemical and moisture resistant tough	Appearance Translucent matte finish (not shiny)	physical properties Slightly waxy to touch', – semi-rigid to flexible', dose not crack when bent', scratches to some degree ', floats in water.	 **HDPE**	Crinkly shopping bags, freezer bags, milk bottles, bleach bottles, buckets, rigid agricultural pipe, milk crates etc.
HDPE *colored* **High density polyethylene**	Bottles: laundry & dish detergent, fabric softner, saline solution, bleach, motor oil and antifreeze	Chemical and moisture resistant, tough	Opaque matte finish (not shiny)	Slightly waxy to touch; semi rigid to flexible; does not crack when bent; scratches to some degree, floats in water.		
PVC **Polyvinyl Chloride**	Bottles imported mineral water, salad dressing, salad and vegetable oil, floor polish, mouthwash, liquor, some translucent pharmaceutical bottles; bottle liners and cap coatings, blister pack "bubble" for batteries, tile and drainage pipes.	Hardy, chemical resistant	Can be transparent, translucent, or opaque (colored, usually high gloss), bottles have seams: clear bottles sometimes have faint blue tint; bottom has blowmolding smile	Tough; very smooth surfaces; forms opaque white line when bent; semi-rigid; scratches easily, sinks in water.	 **V**	Electrical conduit, plumbing pipes and fittings, blister packs, wall cladding, roof sheeting, bottles, garden hose, shoe soles, cable sheathing, blood bags and tubing, watch straps etc.

Cont.

Full Name	Typical Products	Features	Appearance	Physical Properties	Plastic Code	Special Applications
LDPE **Low density polyethylene**	Usually appears in flexible film bags for dry cleaning, bread, produce, trash, etc., also some rigid items such as food storage containers and flexible lids; coatings, and recycling bins. caps; rope and strapping; combs; snack wraps; bags; some yogurt cups and lids (those that do not crack easily when bent).	Good optics; tough; lightweight, flexible	Can be nearly transparent (e.g., dry cleaning bags) or opaque; can be colored; low to high gloss.	Slightly waxy to touch; flexible; stretches before tearing when pulled; scratches easily; floats in water	 LDPE	Garden bags, squeeze bottles, black irrigation tube, black mulch film, garbage bins etc
PP **Polypropylene**	Battery cases, medical containers; oil additive containers, some dairy tubs, cereal box liners; bottle caps; rope and strapping; combs; snack wraps, bags, some yogurt cups and lids (those that do not crack easily when bent).	Hard, good tensile strength	Transparent, translucent, or opaque clear or colored; can have shiny or low gloss finish	Smooth surfaces; semi-rigid; tough; cannot scratch; floats in water.	 PP	Potato crisp bags, drinking straws, microwave ware, plastic kettles, plastic garden settings, baby baths, plastic hinged lunch boxes etc.
PS **Polystyrene**	Some yogurt cups and tubs, cookie and muffin trays, clear carry-out containers; vitamin bottles; most fast food cutlery; waste baskets, VCR cassettes.	Good optics; stiff flexible.	Transparent or opaque, clear or colored; high gloss; only wide mouthed containers (no bottles)	Slick, smooth surfaces; cracks easily when bent, brittle to semi-rigid, hard to scratch; sinks in water	 PS	Plastic cutlery, imitation 'crystal glassware', low cost brittle toys, video cases etc.
EPS **Expanded (or foamed) polystyrene**	Carry-out containers (clamshells, etc.), meat and produce trays, hot cups; egg cartons. packing peanuts.	Lightweight; heat resistant, buoyant	Opaque only; smooth to grainy finish, foamed, thick walled.	Smooth surface, cracks easily when bent. lightweight and fluffy, easily scratches, floats in water.	 PS	Foamed polystyrene hot drink cups, hamburger take-away clamshells, foamed meat trays, protective packaging for fragile items etc
Other **Varies**	Plastics other than the six most common or made of multiple layered resins, blends, or different parts (i.e.: water cooler bottles; microwavable serving ware, most snack bags; squeezable bottles for condiments, etc.)	Varies	Varies	Varies		Includes all other resins and multi materials (e.g. laminates). Examples are polyamide, acrylonitrile butadiene styrene (ABS), acrylic, nylon, polyurethane (PU) and phenolics etc.

Source: Spokane Solid Waste-Recycling/Plastics-Coding System (http // www.solidwaste.org/records.htm)
Plastic Institute of New Zealand (http://www.plastics.org.nz/environment/recycle.htm)

Table: 2.3 (b) Simple Tests to identify Recyclable Plastics

Test	PE	PP	PVC
In Water	Floats	Floats	Sinks
When burning with yellow tip	Blue Flame, with blue base	Yellow Flame	Yellow Sooty Flame
Smell	Like Candle Wax	Like Candle Wax but not as strong as PE	Hydrochloric Acid
Scratch with fingernail?	Yes	No	No

Source: Appropriate Technology, Vol 23, No. 3, p. 35, December 1996

Injection molding: This is the most popular and most effective plastic processing method With the use of injection molding machines, small or large products may be manufactured, usually using thermoplastics in granular form as the raw material. Nowadays thermosetting plastics and even rubber compounds may be injection molded as well. Injection molding is economic in large-scale production. It is applicable for specially shaped objects such as cups, toys, plumbing pipes, wheelie bins etc.

Extrusion: This is a continuos process using extruders for the manufacture of thermoplastic profiles, products of indefinite length (cut according to requirements) with various cross section shapes (according to the die). In the plastic recycling industries, it is mostly used for cable insulation and sheeting, for the manufacture of pipes and hoses, sealing, etc., as well as for prefabricated sheets and sheets and films used for shaping products.

Several steps are involved in the recycling process-

- The plastics destined for recycling need to be collected This may be from a manufacturing site, a commercial operation seeking to dispose of bulk packaging, such as pallet wrap, "drop off" points such as schools, or from residents, via a kerbside collection.
- It then must be transported to a recycling plant.
- It must be sorted into types that can be re-processed together.
- It must be cleaned to remove dirt and other contaminants. This is often done by cutting the plastics into small flakes and putting these flakes through a washing and drying process.
- The flakes must then be converted into reusable granules.
- The granules, or pellets, can then be used to make new plastic products using the plastic processing method mentioned in the early paragraphs.

There are often considerable costs involved in the collection and sorting phases and, combined with the limited demand for recycled product, this inhibits the extent of recycling Buyers and consumers have a critical role here- to raise the level of recycling. They should look to buy recycled products, or products containing a portion of recyclable. Unfortunately, recycling and reuse are not easily accomplished because each type of plastic must go through a different process before being reused. There are hundreds of different types of plastics, but 80% of plastic used in consumer products is either high-density polyethylene or polyctylene terephthalate. It is not yet possibly to separate plastic by types because manufacturers do not indicate the type of

plastic used. Plastic parts of automobiles are still uncoded, so salvagers cannot separate them by type. Even if recycled polystyrene were separated and could be used as a raw material for a plastic recycling plant, such plants have just begun their activities and it is the time to see their success or failure. For these reasons, environmentalists would prefer to stop using plastics altogether in certain applications and encourage recycling at larger scale. A flow-chart (p-19) will give us a clear view of a common vocabulary of integrated plastic waste management widely accepted all over the world.

2.9 Plastic Use & Recycling in Bangladesh

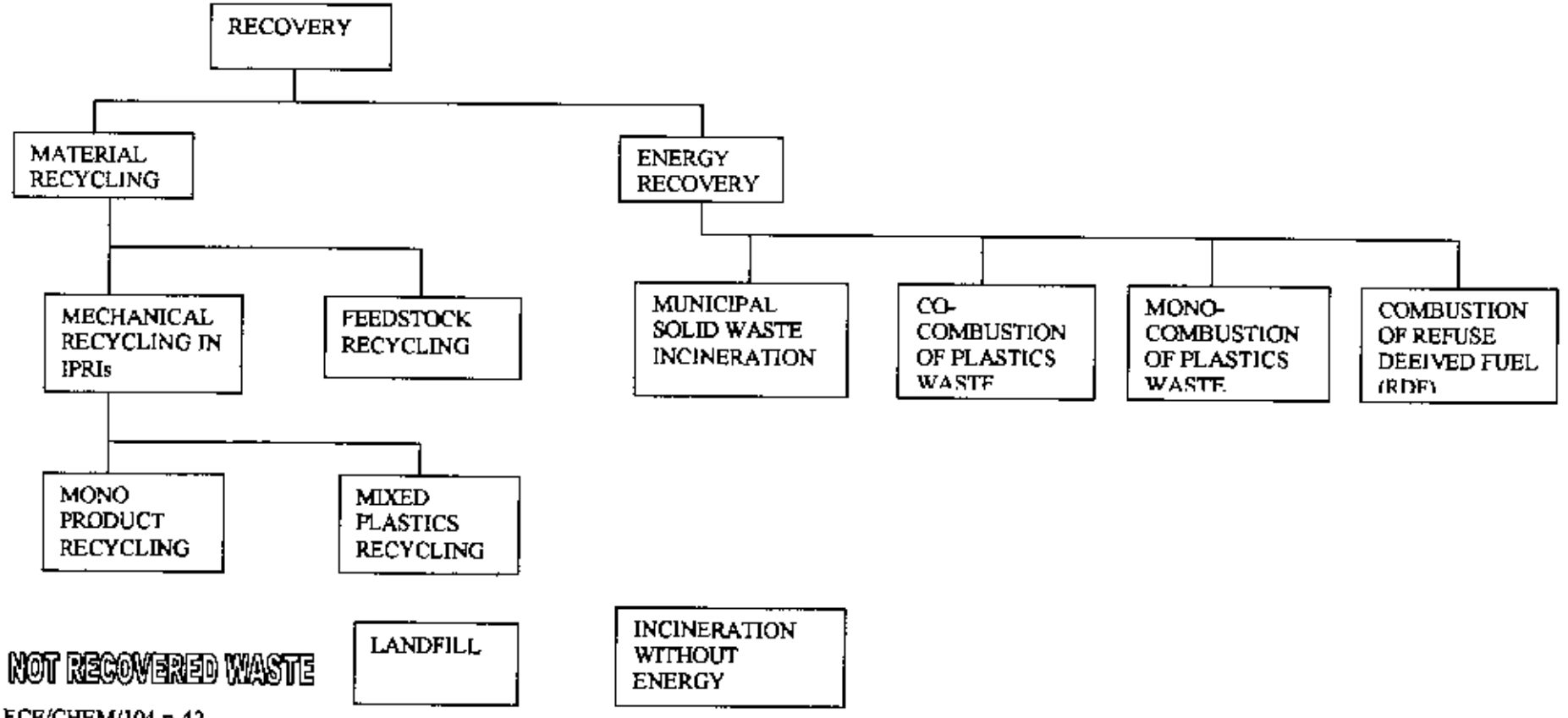
Plastic is made of polymers or long chains of homogeneous hydrocarbon molecules that are so tightly bound together that microscopic fungi and bacteria that dissolve leaves, wood, and other organic materials cannot penetrate them. This accounts for the strength and durability of plastic.

The first commercial plastic, celluloid, was developed in 1869 by a dental plates and novelty items manufacturer. In 1889, Eastman Kodak began to use celluloid in photographic film. But now the only surviving commercial use of celluloid is the manufacture of Ping-Pong balls. In the early 1900s a US Chemist-inventor was attempting to make a substitute for shellac and produced a material that was patented as Bakelite. The real commercial development of plastics began during World War II for mass production of objects such as plastic bugle canteens and dinnerware. Since then production of plastic materials has sky-rocked. In the past fifty years, plastic production has increased from virtually nothing to 50 billion pounds equivalent per annum or about 10 pounds per head for the world population.

The use of polythene or plastics does not have a long history in Bangladesh. Even a little over a decade ago people was not familiar with the polythene bags at all. They used bags made of jute, paper and clothe. But in the last decade polythene has made its way throughout the country. People buy this 'cheap' item to carry their food and other necessities when they are in a market place They hardly carry any jute bag to vegetable market. The polythene shopping bags came to Dhaka markets only in 1982. But within a year it spread all over the country Factories to manufacture polythene bags were established in the capital city as the demand increased rapidly. The first polythene factory-Islam Plastic-was established in Begum Bazar in Dhaka in 1983. The factory had daily production capacity of 0.15 tons; now the capacity is 3.5 tons- indicates the growing demand of plastic products in the country. In 1983 the country had only two formal polythene bags and plastic factories. At present they number 271 in the country with about 200 in Dhaka City alone In average a factory produces 5 tons of polythene and plastic materials (Shahriar, 1996).

Nearly 4.5 million used polythene shopping bags are dumped in Dhaka city every day. Of this only 20% is cleaned from the city dustbins and the rest 80% go into the drains, manholes, ditches, sewerage systems and in the open places. And the attack of polythene ultimately affects our health and environment. Despite the warning about the polythene and plastic materials and hazards they create their use is on the increase at an alarming rate. According to a study of Environment and Social Development Organization (ESDO) and Center for Sustainable Development, on average a family

INTEGRATED PLASTICS WASTE MANAGEMENT
A COMMON VOCABULARY



Source: ECE/CHEM/104,p-42

in Dhaka city collects six polythene shopping bags every day and throws away four of them in the streets, drains, manholes, canals and anywhere else. Only 10% used polythene bags are thrown in the designated places. There is no proper facility for disposing of the used polythene bags. In Dhaka these are simple burned in the open field in Islampur, Jatrabari, Lalbagh areas.

But the solution came forward to overcome the problems of plastic waste is the recycling of these plastic wastes in informal plastic recycling industries of Dhaka city. Actually plastic wires, polythene bags and PVC products are now a part of rural and urban life. The old and used plastics can be easily remolded to produce new products. The prices of various types of old plastics and rubbers are dependent on the quality of materials. The old plastics deteriorate with age and the number of times these are remolded for new products. There are about 3000 formal and informal factories and shops in Dhaka engaged in manufacturing and dealing plastic products. According to an estimate more than 10 million plastic bags are now being produced every day in the country (Shafique, 1992). The used polythene bags are being salvaged and converted into alternative plastic products The recovery and recycling of plastics are contributing towards the reduction of anticipated plastics related to environmental degradation. It has been estimated that more than 90% of the plastics are being recycled (Ahmed, 1996)

Though there are some controversy about the actual number of formal and informal plastic industry, their production, number, amount of plastic recycling, recycling industries etc., it is understandable that there is really need of plastic recycling industries in order to prevent environmental degradation as well as solid waste management.

2.10 Exiting Environmental Policy / Actions of Bangladesh in Industrial Sector

2.10.1 Introduction

Integrated environment and sustainable development have emerged as the greatest challenger all over world and there has been much talk on environment all around us.

Given tbe present state of industrialization in Bangladesh, industrial pollution is yet to assume major significance comparable to that prevailing in most of the developing countries.

[The Government of Bangladesh has undertaken the National Environment Management Action Plan (NEMAP) in 1994 and the NEMAP process has become a pioneering initiative in developing an action plan based on issues and concerns identified largely by the people and NGOs, as well as different government agencies Moreover, national and international development agencies working in Bangladesh are also making efforts for environment conservation.]

Like many other third world countries the small and medium enterprises dominate Bangladesh's manufacturing and service sectors. The manufacturing sector has 497 large industrial enterprises, 1302 medium industries and 38000 small industries, besides 444,000 cottage industries except sericulture and Handloom Corporation during 1987-1990 (BBS). Among the small industries (SIs) rice mill, flour mills,

bakery and biscuits, light engineering, metal products, automobile repairing shops, confectionery, leather products, wooden furniture, rubber and plastic products occupy the major shares. The majority of small enterprises are located in Dhaka and Chittagong. These are scatterdly located except a few industrial and BSCIC industrial estates. The SIs have enormous potentiality in Bangladesh in the backdrop of cheap labor force, less technological base, availability of natural resources and above all Governments liberal industrial policy

SIs generate effluent, emission and solid wastes that create pollution problems for air and water. There is noise and odor problem too. Outflow of wastewater, emission and solid waste from SI units may be small but it constitutes a large quantity if one encompasses the large amount of SIs.

2.10.2 Relevant Policies for controlling Industrial Pollution

Government of Bangladesh (GoB) is aware of the industry related environmental pollution problems and it has launched several policies, strategies and programs to reserve the process of environmental degradation. These policies and programs are targeted at strengthening the legal framework and capacities of the concerned government agencies in the fields of environmental management and pollution control.

There are two basic policies:
i) The Environment Policy and
ii) The Industrial Policy

Government of Bangladesh appreciates the need for economic development to be based on the principles of sustainability. In addition, the economic development policies are being formulated to integrate the objective of poverty alleviation, sound environmental management and conservation of natural and ecological resources.

The basic objectives of the Environment Policy are:
- Sustain the ecological balance and overall progress of the country through protection and improvement of the environment.
- Ensure sustainable, long term environmentally sound development in all sectors.
- Ensure sustainable, long term and environmentally sound utilization of all resources
- Identify and control all activities that pollute and degrade the environment.
- Actively associate all environment related international initiatives to the maximum possible extent
- Adopt phase-wise corrective measures by industries for pollution control.
- Prepare Environmental Impact assessments (EIAs) for particular groups of new indnstries in public and private sectors, as per EIA Gnidelines.
- Ban establishments of industrial units, which cause environmental pollution; close such existing industries in phases and discourage use of goods produced by polluting industries through introducing environmental sound alternatives to such products.
- Assist the development of environmentally sound technology and encourage relevant research and extension activities.

Industrial Policy

In 1991 the Government of Bangladesh (Ministry of Industries) prepared a new industrial policy with the major objectives to address the shortcomings in industrial development in the country, experienced during the preceding years. The new policy was published in its final version in December 1992.

The leading objective of the new policy is to eliminate past drawback in industrial development and to activate industrialization. In this regard the new industrial policy has the following main objectives:

- To adopt appropriate strategies and take actions to develop efficient and competitive industrial bases.
- To accelerate the growth of export oriented industries through appropriately designed export strategies and financial incentives.
- To expand the small industrial sector to alleviate poverty, generate income and to create employment opportunities.

Strategies

In order to expand the scope of environmental management and to strengthen the powers for achieving it, the government issued the Environment Pollution Control Ordinance in 1997.

The Ordinance provided for the establishment of an Environment Pollution Control Board, policy for formulation and proposing measures for their implementation. In 1982 the Board was transferred to the Department of Environment Pollution Control (DEPC). Four Divisional DEPC offices with laboratories were established in Dhaka, Chittagong, Khulna and Bogra.

To strengthen the legal basis for environmental management, to promote sustainable development, to strengthen and define the powers of the Department of Environment (DOE), a new Environment Conservation Act, 1995 came in to force from June 1, 1995.

The salient features of the Act are, inter alia, as under:

- Co-ordination of the activities of any authority or organization having aims and objectives similar to those of the Act.
- Taking safety measures and decision and giving necessary directions to guard against possible accidents that may cause environmental degradation and pollution.
- Examining any place, premise plants, machinery, production or any other process, ingredient or substances. With a view to develop environment it is necessary to issue necessary orders and directives to concerned agencies and persons for environmental pollution abatement, control and reduction.
- Advising Government to ban those production processes, substances/materials that might cause environmental pollution

- Declaring environmentally degraded areas as ecologically critical.
- Issuing environmental clearance to industries and other development activities.

A summary of the institutional arrangements for control of industrial pollution in Bangladesh is as follows:

The Factories Act, 1965

Provides for the adoption and approval of layout plans and designs of buildings in which industrial/manufacturing units can be located Also includes requirements for treatment of industrial effluents before discharging into water and purification of dust and fumes before emission into air. Any manufacturing unit employing ten or more workers (with or without use of power) is required to be registered under Factories Act, 1965 (Act iv of 1965) with the office of the Chief Inspector of Factories and Establishments, 4, Rajuk Avenue, Dhaka (Phone: 955546, 9568068). The Act is primarily to regulate the working conditions and to ensure safety measures in the factory.

Ministry of Environment and Forest (MoEF)

The apex body responsible for the protection of environment in Bangladesh. It co-ordinates the environmental management activities between itself, DoE (which is its subsidiary department) and other relevant sectoral ministries and government agencies, such as, ministries of industries, energy and mineral resources, water resources, agriculture, fisheries and livestock, land etc.

Department of Environment (DoE)

The functions include liaisoning with related environmental authorities or associations, giving environmental clearance to the newly established industries; conducting inquiry into environmental problems or allegations of industrial pollution; advising and where necessary directing any person engaged in the import/export of hazardous materials, undertaking any other measures necessary for conservation and improvement of environment and for the prevention of pollution. All industries set up will require a certificate in response of proper arrangement for anti-pollution and safety measures from the Department of Environment, Poribesh Bhaban, Plot no. E-16, Agargaon, Shere-e-Bangla Nagar, Dhaka.

National Environmental Policy (NEP), 1992

The main emphasis of the policy is to ensure the protection of environment and to undertake development and to undertake development activities on a sustainable basis. It includes provisions to update relevant laws for the purpose of implementation of this policy. It serves as a basis for chalking out detailed action plans for the protection of the environment.

Environmental Protection Act, 1995

For the first time it includes the mandatory requirements for environmental clearance for any new industry to be set up. It empowers the Director General of DoE to visit and examine any place, premises, plant, equipment, process, ingredient and material with the end to protect the environment and direct the appropriate authority or person to take appropriate measures to stop and control pollution. Also includes detailed punitive provisions for non-compliance

National Environmental Management Action Plan (NEMAP)

Includes a "menu" for a large number of actions and alternative strategies for environmental management, identifies the actors from public and voluntary organizations to carry out suggested actions. The proposed actions include strengthening of DoE, capacity building for NEMAP Secretariat in MoEF, strengthening environmental expertise in other line ministries and agencies assisting environmental activities of NGOs, environmental awareness programs etc. The Government's Fourth Five-Year Plan (1990-95) described the government's environmental objectives as follows:

- To control pollution and degradation related to soil, water and air;
- Promote environmental friendly activities in the development process;
- Preserve, protect and development of natural resource bases;
- Strengthen the capabilities of public and private sectors to mange environmental concerns as a basic requisite for suitable development, and
- Create people's awareness for participation in environment promotion activities.

Income Tax Ordinance 1984 (as amended in 1996)

Recently amended, allowing tax incentives in the form of accelerated depreciation for investment in plant and machinery used in the treatment of and disposal of toxic and environmentally hazardous wastes.

Implementing Authorities of different Industrial Policies & Programs

The Metropolitan Planning Authority of Dhaka i.e. RAJUK was established in 1956 which was previously known as Dhaka Improvement Trust (DIT). It is the main planning agency in the city. RAJUK has a land-use plan for Dhaka and a *mixed use zoning* system (the zoning system is not particularly rigid and allows a mix of different uses) is usually employed as a regulatory plan. As for development control measures, each industrial establishment has to obtain planning permission from RAJUK and follow certain setback rule, height regulations and floor area ratio. The department of Environment and Pollution Control (DEPC) s responsible for environmental quality in the city and asks for Environmental Impact Assessment (EIA) for the polluting firms. RAJUK recently prepared a strategic plan for the city in 1995, known as Dhaka Metropolitan Development Plan (DMDP) for the period 1995-2015. DMDP has three main components: a structure plan, an urban area plan and a detailed area plan. This plan if implemented will be the guideline for future development of the city. The DMDP strategic plan, however, does not presume to embrace an economic plan or strategy, rather to adopt policy, which seek to structure

and reinforce economic growth by integrating that growth into overall development strategy. The policies relate mainly to locational issues and as such seek to inform existing private sector business vested interest groups, would be investors, and the public sector of DMDP's intention. It has set out locational priorities, related infrastructure investment programs, and inducement and conditions for industries in relation to its main policies and programs (DMDP, 1995)

In Dhaka City Region, there exists a number of institutions for planning and promotion of industries The Ministry of Industry, Board of Investment (BOI), National Board of Revenue (NBR), Export Promotion Bureau (EPB), Bangladesh Export Processing Zone Authority (BEPZA), Dhaka City Corporation (DCC), Dhaka Water and Sewerage Authority (DWASA), Dhaka Electric Supply Authority (DESA), Public Works Department (PWD), Telegraph and Telephone Board (T & TB), Roads and Highways Department (RHD), Local Government Engineering Department (LGED), Titas Gas (TG) are important government agencies in this connection other than RAJUK and DEPC. Other government agencies include Bangladesh Chemical Industries Corporation (BCIC), Bangladesh Steel Industries Corporation (BSEC), Bangladesh Textile Mills Corporation (BTMC), Bangladesh Jute Mills Corporation (BJMC), Bangladesh Sugar and Food Industries Corporation (BSFIC), Bangladesh Forest Industries Development Corporation (BFIDC), Bangladesh Small and Cottage Industries Corporation (BSCIC), Bangladesh Handloom Board, Ministry of Textiles, Departments of Textiles, Ministry of Jute, Department of Jute, Tariff Commission, Privatization Board and Ministry of Commerce. There is considerable overlap in terms of responsibility between many of these agencies and the lack of proper coordination and integration is one of the impediments to the industrial development process in the metropolitan region In spite of the government's various attempts to promote industry by land-use and infrastructure investment policies, it has been clear in recent decades that many industries have chosen to locate in areas other than the industrial estates or industrial satellite towns. Often firms have developed in an unplanned manner in different areas of the city (Hasan, 1998)
It is also important to state that, the different environmental policies/actions are applicable only to larger establishments with over 10 workers and therefore does not target informal sector establishments. USAID is the only foreign mission concertedly involved in activities related to the issue of environment and working condition in the informal sector, through a Comparative Risk Assessment project in Khulna, and to a lesser extent a program called JOBS (Job Opportunities and Business Support). There are few NGOs working in Dhaka directly with informal establishment owners and employees to increase awareness and encourage changes in the work place to ensure the health of the workers (E Child, 1998). Thus at present there is no specific policy regarding NGO participation in development activities especially in case of plastic recycling industries. The involvement of people from different walks of life is necessary to make all the segments of society conscious of environmental problems. It is therefore desirable that government should encourage the NGOs to play an active part in environment sector

In the case of plastic products, in October 1993 the Government of Bangladesh decided to ban the production of polythene bag outside the Export Processing Zone (EPZ) It promulgated a legislation to be effective from January 18, 1994. The use of polythene bags as nursery pots was permitted under this new legislation. But on

January 13, 1994 the Prime Minister declared that time frame for the ban on polythene production outside the EPZ would be extended beyond January 18, 1994. This brought some comforts to the polythene manufacturers. They were further pleased when a cabinet meeting on January 24, 1994 postponed the implementation of the ban for an indefinite period. With government decision to restrict polythene production (not implemented) the production of polythene fell dramatically-from 5 tons to 2 tons in each factory. But the production came to its original position when the proposed restriction was postponed for indefinite period.

Therefore, there is no government policy found about plastic recycling industries, as these are mostly informal.

2.11 Awareness of Environmental Management in Bangladesh

The Environmental Movement in Bangladesh today is one and half decades old. One of the most important gains made during this period is the consensus that has emerged with regard to the major environmental issues, which the country has to tackle. This relates to the need to prevent any further degradation and depletion of the nation's natural resources and life support systems of land, water and vegetation, and to provide all human settlement with at least clean drinking water, proper waste management and a minimum level of sanitation.

Time and again, the plastic wastes are held responsible for the pollution of the environment, especially soil, water and air. This is due to the fact that no chemical process can take place without by-products and losses- however small the amount and, one has to admit, it is impossible to prevent waste and product residues from finding their way into environment during the process of production and consumption. With the growth of industrialization and the conglomeration of complete plastic industries in certain areas (Islambagh, Lalbagh & Kamrangichar), the danger of degradation of environment and living being became apparent Like vinyl chloride of plastic causes health effects of lung & liver cancer, depression of central nervous system & suspected embrytoxin

To get 'On Top' of the environmental issues, the technical professionals must realize that the capital spending on environmental control will slowly climb up and hence command their attention A through knowledge of environmental auditing methods, current technologies and major literature resources provide the tools for a 'game plan' that can lead to 'winning' management of the environment with proper regulatory compliance and technological integrity.

Pollution Control Programs have become a part and parcel of corporate policies and culture of corporate giants in the developed countries. The Plastic Recycling Industry should take a leadership role in co-operating with the government to implement needed reforms and new precautions. In Bangladesh, population explosion, high urban migration, low educational levels and to an extent weak environmental enforcement have created a special vulnerability, which need to be checked. There should not be any delay in establishing programs to self-police operations that are especially hazardous. There should be recurring reviews of hazardous facilities. There should try to ensure that needed proper equipment, precaution, worker training and

community emergency plans that have to put in place. If public and private sector companies want access to market and materials, then they will have to set new precedents in co-operating to achieve environmental protection Measures such as these can reduce and control risks, but ultimately the possibility of leaks, blowouts, blocking of drains, flash flood, fires and other mishaps will remain.

It is imperative that in the Industrial operation of informal plastic recycling industries, there is need for steps to be taken for hazard control/minimization right from the feasibility study stages. During Process Design selection, stress should be laid on consideration of intrinsically safer processes Efforts should be made to select the least hazard route with regard to the overall economics both short term as well as long term. Before finalization of plot plan, EIA should be carried out. This involves generation, disposal and effect of these factors on the operating personnel and people living in the nearby area. During the process design stage, hazard and operability studies should be conducted; the risk analysis of specific major hazards identified should be carried out During actual operation of the plant/industry, periodic safety audit is also a must. Due care should be taken that the detailed engineering organizations with good standards & Practices can be followed to minimize environmental degradation It should be remembered that a good number of hazards could be removed by using sound engineering practices. Human endeavor has always been to face a challenge and then find a solution rather than overlooking the problem The responsibility of urban planners is to maintain the beauty and balance of nature and the environment can not be overemphasized.

2.12 Plastic Recycling- Experience of some Asian Cities

Some literatures are sorted to get idea and knowledge of plastic recycling practices in Asia though plastic recycling in the developing countries contrasts sharply with that in developed countries However, Experience in Japan & India seems a little bit similar to the situation of plastic recycling in Bangladesh. So their examples are stated in the following paragraphs

2.12.1 Experience in Japan

Of all household trash discarded by Japanese consumers in the course of their daily lives, plastic accounts for about 11 percent of the total by weight and 40 percent by volume. About 65 percent of the discarded plastic consist of containers and packaging for food and beverages. Various types of plastic are used to accommodate the need for diverse functions, which include the creation of a gas barrier, transparency, flexibility and printability

Also, different types of plastic are often used together, or materials such as paper or aluminum foil are glued onto the plastics to further enhance functionality For these reasons, it is extremely difficult to sort and recover single types of plastic from household trash. The two most important things that can be done to solve this problem are 1) to avoid over packaging in the first place; and 2) to avoid using multiple plastics or complex materials Still, containers and packages made of multiple plastic and complex materials continue to be discarded Therefore, the practical policy that

has been adopted in this field is to begin with the things that can be recycled. In 1995 the Package Recycle Law was enacted with the provision that PET (Polyethylene telephthalate) bottles would be collected and recycled along with cardboard boxes, paper containers and glass bottles beginning in April 1997.

THE HIGAHIS-MURAYAMA EXAMPLE

Most of the transparent plastic bottles used for beverages are made of PET They usually weigh about 50 grams apiece Being heavier than plastic wraps or bags, they are also easy to separate from household trash and to clean. Fortunately they are also easier to recycle than many other kinds of plastic because the recycled resin doesn't degrade as much, making it easier to reuse. In 1993, the Japan PET Bottle Association and a private company called with PET Bottle Recycle built and began operating a PET bottle recycling facility at Nishi-Tsuboyama Industrial park in Tochigi Prefecture. The facility has a processing capacity of 5,000 tons per year. Currently, PET bottles collected primarily from local governments in the Kanto area are reduced in volume and brought to this facility for reprocessing into pellets of reconstituted resin. The rapidly growing bedroom suburb of Higashi-Murayama (population 136,000) in western Tokyo provides a good example of how this system works. City collection trucks visit every household twice a month to collect PET bottles, which are sorted and reduced in volume with compression presses at an intermediary facility before being taken to With PET Bottle Recycle. It costs about $ 440 to transport one seven–ton load of reduced plastic to the recycling facility. Through this method, about ten tons of PET bottles are collected every month, accounting for about 80 percent of all PET bottles used in the city. The system has been effective in reducing both the amount of general household trash and the amount of money spent by the city to cover the administrative costs of handling garbage. The secret to Higashi-Murayama's success has been the PR (Plastic Recycling) efforts of the mayor and other city officials, who held repeated explanatory meetings over a three–month period to impress upon the citizen how important recycling is in terms of protecting the environment. In this way, the municipal administration and the citizens themselves have succeeded in establishing a cooperative system that has proven very effective. In 1994, only 35 local governments became actively involved in PET recycling programs, resulting in the collection of approximately 2,500 tons of plastics (a recovery ratio of 20 percent). With the promulgation of the new recycling law in 1997, however, the national government has set a goal of a 50-percent recovery ratio for PET bottle recycling by 2000. If this goal is to be achieved, it is important to expand the applications for the reconstituted resin pellets and establish new plastic recycling industry. Current applications include packing for futons and use as a raw material for automotive carpeting, but the actual amounts involved is very small. Ideally, the resin should be used to make new PET bottles, but bottles made from recycled resin have not been approved for use as food containers, either by the U.S. Food and Drug Administration or by Japan's Ministry of Health and Welfare and Ministry of Agriculture, Forestry, and Fisheries. Until the safety of recycled PET bottle & other plastic products is proven, plastic recycling is unlikely to establish a firm foothold in society neither do the future prospects of formal and informal plastic recycling industry (Harada, 1997). Soft drinks, cosmetics, medicine and food seasonings often come in plastic bottles. The bottles generally end up in an incinerator or a landfill site. But they contain valuable material that can be reused as polyester

fiber and synthetic resin to make a surprising variety of goods-even office supplies, clothing and furniture (Nipponia, 1999).

Special Feature ★
Recycling in Japan

Even These Things Come from Plastic Bottles

Soft drinks, cosmetics, medicine and food seasonings often come in plastic bottles. The bottles generally end up in an incinerator or a landfill site. But they contain valuable material that can be reused as polyester fiber and synthetic resin to make a surprising variety of goods—even office supplies, clothing and furniture.

Photos by Hara Hirofumi

Sportswear
Students wear this sportswear (left) to school and in gym class. It is more than 50% recycled polyester.
The outer cloth layer of these Wave Rider shoes on the right is an artificial leather which is 40% recycled polyester.
(Shoes and sportswear courtesy of Mizuno Corporation.)

Stationery
The cap and body of the pen for this Jimnie Clare ball point pen are made from recycled materials.
(Courtesy of Zebra.)

Fig. 01 "Even These Things Come from Plastic Wastes"- Courtesy. Recycling in Japan (Special Feature), Nipponia, No 7, January 15, 1999, Tokyo, Japan

Fig. 01 (*Cont.*) "Even These Things Come from Plastic Wastes"- Courtesy: Recycling in Japan (Special Feature), Nipponia, No. 7, January 15, 1999, Tokyo, Japan

2.12.2 Experience in India (Waste Recovery in Bombay)

With growing urbanization and increasing per capita consumption, waste is becoming an urgent societal problem in many developing cities. As a result, developing countries have been recovering and using recyclable materials from their municipal solid waste for many years The collection of waste mainly take place in towns. The amount generated increases with incomes and population. throw-away consumer behavior is more manifest in cities, and collecting waste usually becomes easier as population density grows. In Bombay, it was found that about 69 percent of the disposed of plastic wastes had been recovered from total disposal of 210 thousand tons of plastic waste in 1993 (Beukering, 1997)

The recovery of recyclable plastic waste in Bombay is an activity at present mainly done by the informal sector. Government agencies are almost completely absent. The largest group in the informal sector is the waste pickers & recycling industry. Partly owing to the increased attention of the media, these groups are generally seen as the figurehead of recycling in developing countries. Therefore, one would think that what is good for the waste picker & recycling industry is also good for the recycling sector. This is not necessarily the case. Waste pickers are dependent on the recyclable waste disposed of by households and institutions Policies aiming to improve waste recovery at source will therefore have a negative impact on the activities of waste pickers and consequently the plastic recycling industry. This dependence implies a trade-off between social costs on the other hand and economic and environmental gains on the other. Waste pickers depend on inefficiencies in society. Yet social advantages also occur with the improved recovery of waste. Increased unemployment among waste pickers can be balanced by the growing need for labor in the expanding waste trading network and recycling industries. Another social gain is that waste pickers do not have to perform unhealthy work, which has low status, although having no job is clearly a worse alternative NGOs and policy makers should not restrict their views to the well being and functioning of waste pickers.

Other important groups are the generators of recyclable waste, such as households, institutions and factories. To prevent unnecessary contamination and damage to valuable secondary resources, early separation of recyclable materials from the main waste stream is crucial. This improves the environmental performance as the process of entropy of resources is reduced, and less waste is landfilled or burned. It also facilitates a higher degree of reuse, which is certainly very important for waste management. Since it is often poorer servants and caretakers who gain from this process, separating waste at source also generates social benefits. The main question remains how the public will respond to policies of plastic waste recycling

As links in the informal recovery sector, the buyers and wholesalers of recyclable plastic waste receive only limited attention. This trade network forms a solid foundation for improving the recovery rate of plastic waste. Yet the municipal attitudes towards informal recycling are discouraging in Bombay in case of plastic waste recycling. The municipal officers support the concept of recycling, but their plans are at the level of installing composting plants and generating energy from waste. Local governments can improve informal plastic recycling process provided their policies build on existing trade networks and take into account prevailing market forces. Only they can increase recovery rates, subsequently reducing landfill costs.

Yet, besides policies directly focussed on the supply of recyclable waste, indirect policies stimulating local demand for secondary materials can be regarded as effective tools. These demand policies, such as providing financial incentives to informal plastic recycling industries to use more recyclable or designing government procurement specifications to encourage more plastic recycling, can also have significant positive effects on the plastic waste recovery rate

3.1 Introduction

Outline of methodology/experimental design is limited to Literature Survey, Inventory/Reconnaissance Survey, Selection of Sample Size, Questionnaire Preparation & Survey, Discussion with Concerned Authorities & Local Bodies, Data Analysis & Representation. The following methodological procedures will be followed to fulfill the objectives of the study and it is shown in a flow diagram.

3.2 Literature Survey

An intensive literature survey will be undertaken to acquire knowledge of plastic recycling activities by informal sector in developed and developing countries.

3.3 Inventory/Reconnaissance Survey

Initial inventories/reconnaissance survey has to be done to identify the informal plastic recycling industries of Dhaka City. Spatial distribution of recycling industries, collection of recyclable by different groups from different parts of Dhaka City may be shown on a map

3.4 Survey Design

Survey design of the study is divided into five steps. They are types of survey, sample size, and data gathering method, type of survey data and location, time & day of survey.

3.4.1 Type of Survey

A simple Random Survey & Visual Survey has been selected to achieve the objectives of the study.

3.4.2 Sample Size

A sample size of 50 respondents (about 16% of total population) has been pre-selected from an non-probabilistic homogeneous population (i.e informal plastic recycling industry) of 300 informal plastic recycling industry at Lalbagh, Islambagh & Kamranghichar [Source: Ahmed, 1994 & Daily Ittefaq, Pothae Prantare, 26 Sep., 1998].

3.4.3 Data Gathering Method

Face to face interview has been selected to gather data using a detailed questionnaire. Direct Visual observation was done for identifying the problems of IPRIs and these problems were noted and photographed at possible positions A set of problematic points have been identified and showed in plates attached to appendices.

3.4.4 Type of Survey Data

The survey data comprises a combination of profile data, psychological & behavioral data.

3.4.5 Location, Time & Day of Survey

Time selected to questionnaire survey is off class hours & days are weekdays and location is at informal plastic recycling industry of Lalbagh, Islambagh & Kamrangichar. The reasons behind choosing these are that workers & owners are possibly available at that time period and location.

3.5 Questionnaire Preparation & Survey

A detailed questionnaire will be prepared & then surveyed to study the problems and prospects of informal plastic recycling industries emphasizing on different aspects such as supply of recyclable, demand for products from recycling, proximity to market & raw materials, Type of technology used, Cause of choosing location, size of the plant, number of employee, other raw materials, need for capital, power supply, water supply, communication, mode of transport, infrastructure development, geographic condition, working condition, environmental factors, safety, coping with problems & some open ended portion to make respondents participate in finding solution of different problems related to informal plastic recycling in Dhaka City.

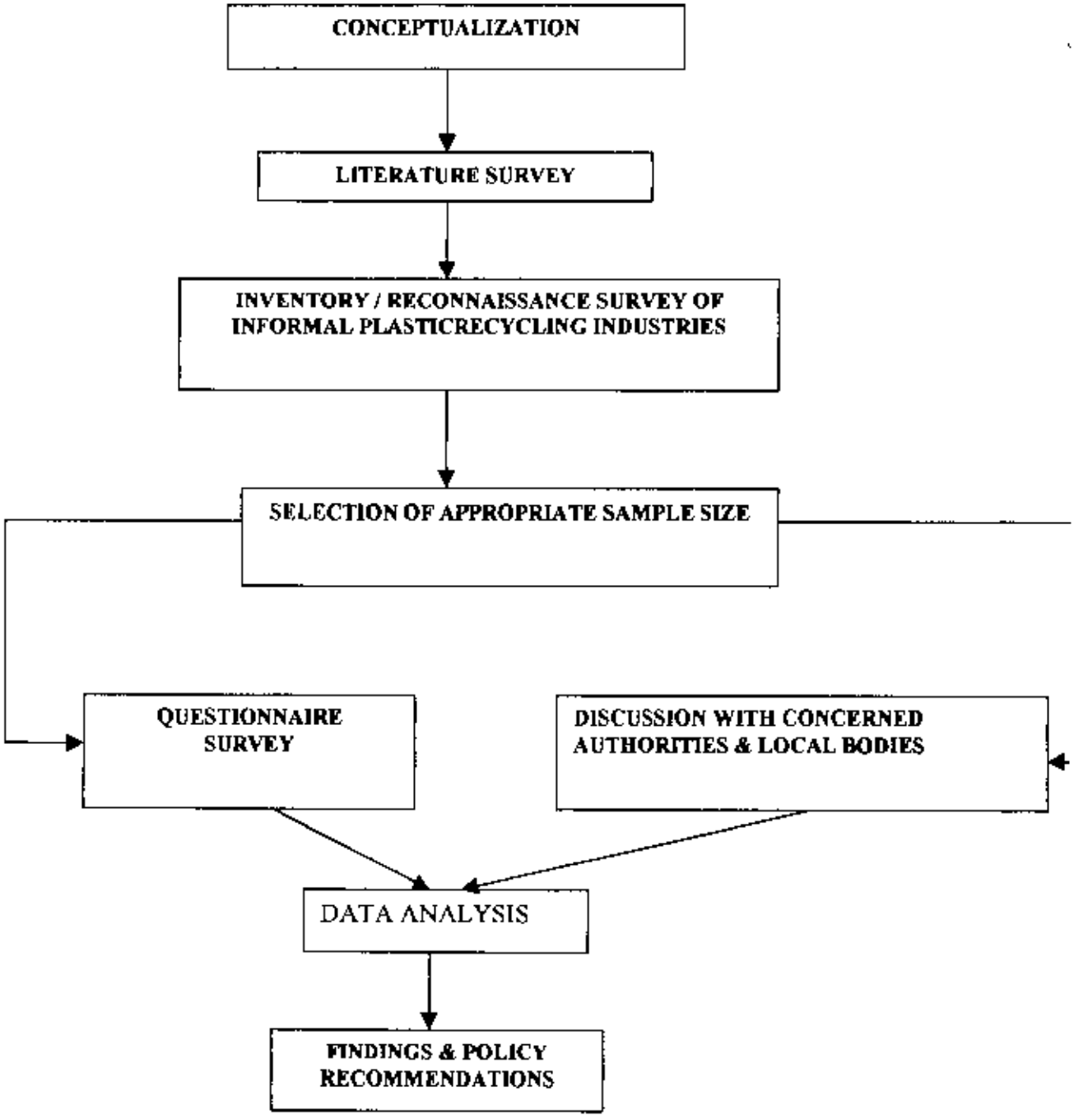
3.6 Discussion with Concerned Authorities & Local Bodies

Discussion with concerned authorities & local bodies such as DCC, DoE, BSCIC & others will be done for different policy formulation

3.7 Date Analysis & Representation

Computer statistical package for the social sciences (SPSS) and MS Excel will be used as the main tool in analysis of the data. Simple frequencies, percentage and cross tabulation will be done for study and GIS Arc View 3.2 will be used for graphical presentation of the findings.

FLOW DIAGRAM OF RESEARCH DESIGN



CHAPTER:04 THE EXISTING PATTERN OF INFORMAL PLASTIC RECYCLING INDUSTRIES IN DHAKA CITY

4.0 Introduction

Bangladesh appears to have one of the most efficient plastic recycling systems in the world, as a result of the economic necessity that is associated with poverty Plastic recycling started in the late 1960s, using small scale and simple manual machinery. Economic and social forces have concentrated all the stages of the recycling process in the older part of Dhaka City. By the beginning of the 1990s, considerable improvements had been made in the plastic waste processing and reprocessing technology based on local resources Consequently, the recycling rate of both pre and post user waste had reached almost 100 percent efficiency and thus, no sortable plastic of immediate market value is now incinerated or used for landfill (Haque & Bell, 1998). However, despite this advantage in recycling technology, the initial operations of the system, i.e. collecting, cleaning, sorting, washing, loading, unloading, and transporting the recyclable, still depend on manual means developed informally in Bangladesh.

4.1 Types of Plastic Waste in the Solid Waste Stream

The term "waste" is used to indicate all those items which end users need to dispose of- either by selling to waste hawkers (if the item has good market value) or to discard at a waste dump (if the item has insignificant market value due to its small size or contaminated condition) Thermosetting plastics cannot be recycled and so attention was focused on thermoplastic waste. All thermoplastic waste from domestic, hospital, industrial, commercial and institutional premises is referred to as "plastic waste" that are used in the informal plastic recycling industries in Dhaka city.

Classification based on source: Three different classes of plastic waste are recycled in Dhaka City. First, **Producer Scrap** which is the relatively clean trimmings or rejects, and is readily processed within factory premises or elsewhere Recycling of pre-user waste within the factory premises is practiced by all manufacturers of recycled plastic products. The second is **Commercial & Industrial Scrap**, packaging or cushioning material, reasonably pure and often available in substantial quantities from garment factories, shopping areas, and assembly plants. The third is **Post-consumer Scrap**, found in the municipal solid waste stream, which consists mainly of scrap plastic containers, film, utensils, pipes, shoes, slippers, office accessories, syringes, saline and blood bags, saline sets, and catheters. This post-consumer waste is usually dirty, consists of a mixture of various polymer types, is intermingled with domestic and hospital organic waste, and is contaminated with metal, glass, and paper attachments and pathogenic substances Post-consumer scrap is labor-intensive to collect, difficult to sort and clean, and limited after recycling to various low-grade applications in informal plastic recycling industries of old part of Dhaka City.

Classification based on resin types: Table 4 1 shows the different types which the sorters (scavengers) and the merchants are able to identify and the items which these comprise, partly based on a literature search of the characteristics and uses of different plastics. The principal plastics recovered in Dhaka, either for reuse or recycling, are Low-density polyethylene (LDPE), High-density polyethylene (HDPE),

Polypropylene (PP), Polyvinyl Chloride (PVC), Polystyrene (PS), and Polyethylene Terephthalate (PET), mostly in rigid form. LDPE film, PP film, and HDPE carrier bags are also substantially recycled

The off-cuts of HDPE carrier bags are processed by separation on the basis of color, then shredded and palletized to produce new HDPE carrier bags or other products. In contrast, dirty HDPE carrier bags and a small fraction of LDPE film recovered from municipal refuse, are used for low-grade products. LDPE is the most extensively-used polythylene for packaging, film, and bags in Bangladesh Reclaimed PS waste is used for a wide range of applications including office accessories, household utensils, cosmetic casing, and herbal medicine containers. Two major forms of PS. HIPS (High Impact Polystyrene) and EPS (Expanded Polystyrene) shapes- are available only in the urban waste streams for recycling, as they are not used in the rural areas.

TABLE:4.1 POSSIBLE APPLICATIONS OF RECYCLED PLASTIC WASTE

Plastic Type	Typical Original Use	Recycled Products
Low-density polyethylene (LDPE)	Film for wrapping, carrier bags, horticultural sheeting, and packaging for dairy products, toys and cable insulation.	**Reuse:** LDPE packets are reused as plant pots. **Recycled:** toys, seed-bed covers, shading for seedlings and young plants, roofing huts, sheds, boats and protection against rain.
High-density polyethylene (HDPE)	Carrier bags, bottle caps, cosmetic casing, bottles for pharmaceuticals, buckets, jerry-cans for vegetable oil, and other domestic articles	Carrier bags, jerry-cans, toys, household articles, and office accessories.
Polypropylene (PP)	Wrappings for garments, biscuits, crisps, and sweets, disposable syringes, ballpoint pens (one-time use), string and netting, auto bumpers and batteries, and road mats.	Ballpoint pens, PP sheeting, motor belts, Packaging belts, and string for furniture.
Polyvinyl chloride (PVC)	Bottles for mineral water, body care products, shampoo and household cleaners, pipes, sanitary fittings, shoes, slippers, soles, containers, saline bags and sets, catheters, cable insulation, and office folders.	Pipes, sanitary fittings, shoes, slippers and soles, containers, jerry-cans, cable insulation, toys, and children's cycle tires.
Polystyrene (PS)	Ice-cream cups, fizzy drinks glasses, toothbrushes, cleaning brushes, ballpoint pens, bottle caps, cosmetic packaging, jewelry and its casing, and cutlery and trays.	Coat hangers, office accessories, and toys.
Polyethylene terephthalate (PET)	Fizzy drinks bottles.	Reuse: Reusing for drinking water.
Mixed plastics	Carrier bags, once-or twice-recycled plastic products, and unidentified resins	Products with poor mechanical properties, containers for different preparations of tobacco, corks, and lids.

Source: Haque & Bell, 1998

Processing and reprocessing discarded PVC shoes and slippers into new shoes and slippers are two of the major activities of the plastics recycling industry in Islambagh. Reprocessed PVC is also used for many other applications as shown in the above table Recycled PP is used for many important applications such as stationery items,

string, furniture, motor belts, ballpoint pens, and PP sheeting. Only fizzy drink bottles are made of PET and these are reused, so that plastic waste made up of this material is not currently available in quantities for recycling separately, thus sorters only recover small amounts

4.2 The Plastic Recycling System's Flow and Dynamics in Dhaka City

The concentration of recycling in the old part of Dhaka city, particularly in Islambagh, Lalbagh & Kamrangichar is the result of (a) minimization of transport costs for materials from one stage to another by enabling manual methods to be used; (b) maximization of economic benefit to each recycling unit by providing services from complementary factories located in the same place, involved in production and repair of recycling equipment: (c) utilization of quay facilities on the river for unloading recyclable and loading recycled products: (d) acquisition of business facilities from the nearby wholesale markets for recycled goods: and (e) availability of skilled workers from among the lower-income groups in this residential-industrial area. Thus, these areas can be characterized as a central place for plastic waste processing and reprocessing, rather than as a source of waste generation. Consequently, the flow of the plastics recycling system points in a single direction-towards Islambagh and its periphery areas Recyclable plastics collected from Dhaka and throughout the country are transported to Islambagh where processing, reprocessing and ultimately recycling take place. Recycled are then delivered throughout the country Therefore, the plastic waste, which is accumulated and recycled in Islambagh and its nearby areas, is of relevance for the whole of Bangladesh.

Determinants of the number of stages in plastics recycling

There are between five and eight intermediate stages in the current plastics recycling system in Dhaka City:

> Disposal ⇒ Collection ⇒ Accumulation and Categorization⇒ Cleaning and Sorting into Resin Types ⇒ Shredding ⇒ Washing and Drying ⇒ Palletizing/ Agglomerating and Granulating ⇒ Molding

A major hindrance to optimizing recycling efforts and also a cause for additional recycling stages, is the wide range of conditions that the collected plastics are in, when they arrive Similarly, the number of units operating at each stage of recycling also varies in accordance with the volume of work at each particular stage. In the surveyed areas, the highest number of units and employees was accounted for the sorting and washing stages, followed by molding and shredding.

Post-user reusable and recyclable are usually reclaimed at their source of generation for sale to waste hawkers The **collection** and **sorting** of the waste are two important steps involved in post-user plastics recycling At the first level of collection, the waste hawkers go from door-to-door buying and collecting reusable and recyclable. At the second level, waste pickers/scavengers play a major role in collecting plastics from the dustbins, curbsides, and landfill sites. At the third level, municipal waste cleaners

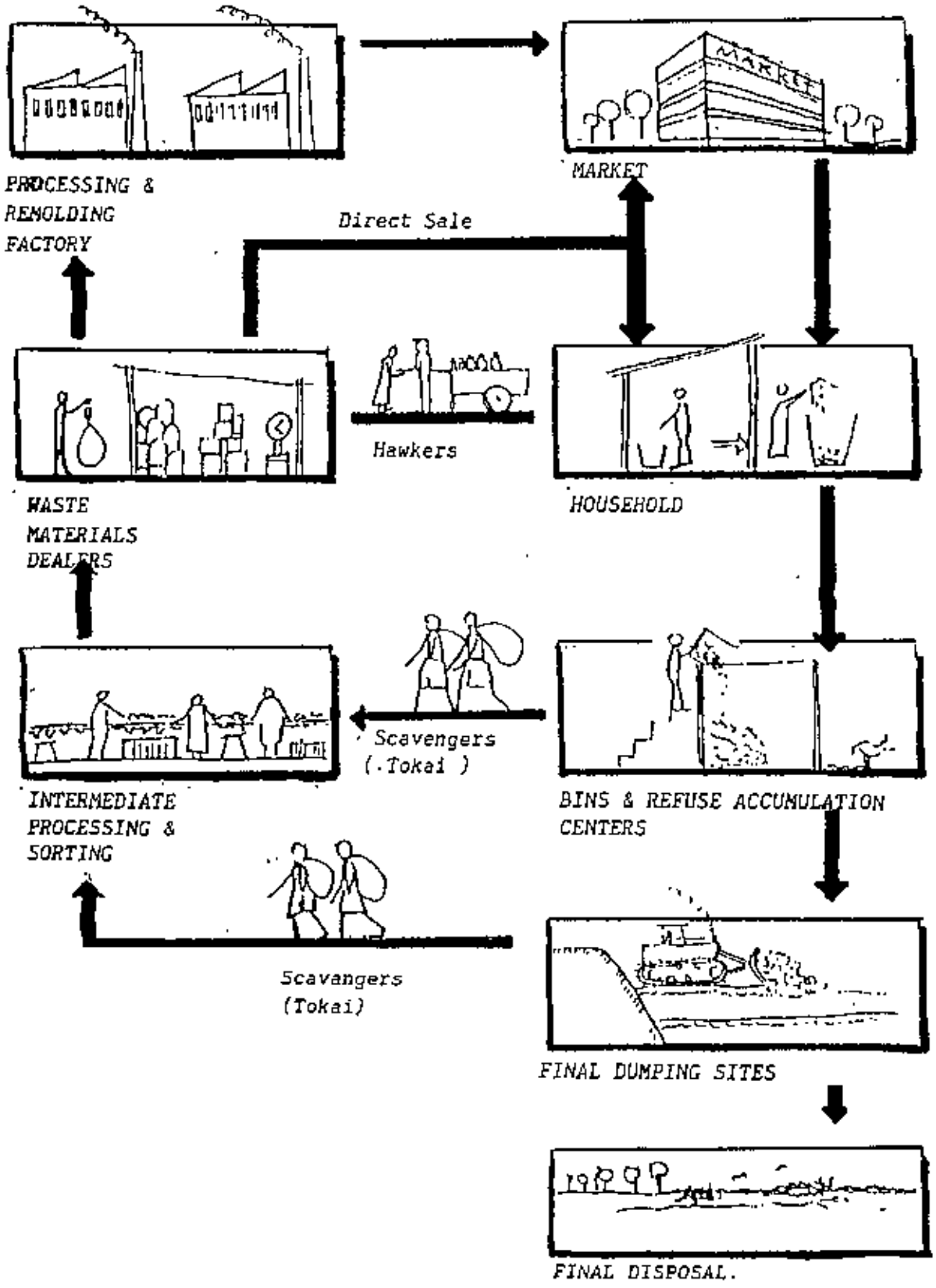


Fig. 02 Modified Hypothetical Plastic Recycling Pattern in Dhaka City
(Source: Ahmed, 1994)

collect recyclable, which remain with non-recyclable waste while they clean the dustbins. Waste merchants at the community level **accumulate** the recyclable waste, carry out limited **cleaning** to remove impurities attached to the waste, and then **categorize** it into major classes. A similar system of waste collection by waste pickers and accumulation at purchasing shops/Vangari Dokans occurs in other cities and rural areas. In the latter case, **village hawkers** are the only people collecting different types of recyclable, including plastics, which they transport to waste merchant shops in the nearest suburb. All other recyclable waste is subsequently transported by boat and/or truck from these cities and suburbs to the waste merchants in Dhaka, which are concentrated around two quays on the north bank of the Buriganga River in the older part of the city.

Although waste is already **sorted** into major categories according to its value as determined by the waste merchant at the community level, **further sorting** by the waste merchant at the city level is necessary for itemization according to product and resin types. Accurate sorting according to resin type is performed at the next stage of processing – called **sorting-cum-washing**. Two different units are involved in sorting the plastics from among the mixed plastic waste stream: those for non-film rigid plastics and those for plastic film (sheeting). Sorters of non-film rigid plastic waste separate the mix into different resin types if possible to identify. They also separate the waste into different color categories. Women and children are involved in separating the mix of different plastic film into HDPE carrier bags, low-density polyethylene (LDPE) film, polypropylene (PP) film, and non-recyclable plastic packages. Those packages with dark color-coated outer surfaces and metallic inner surfaces cannot be recycled using existing machinery. All sorted plastics have to pass through the **shredding** stage for processing into flakes, followed by **washing, sun-drying,** and **palletizing** or **agglomerating.** With some exceptions, it is most convenient to wash plastics after shredding. Once the recovered plastic waste is ready as feedstock, the material is transported to a molding unit to produce the final products in the informal plastic recycling industries.

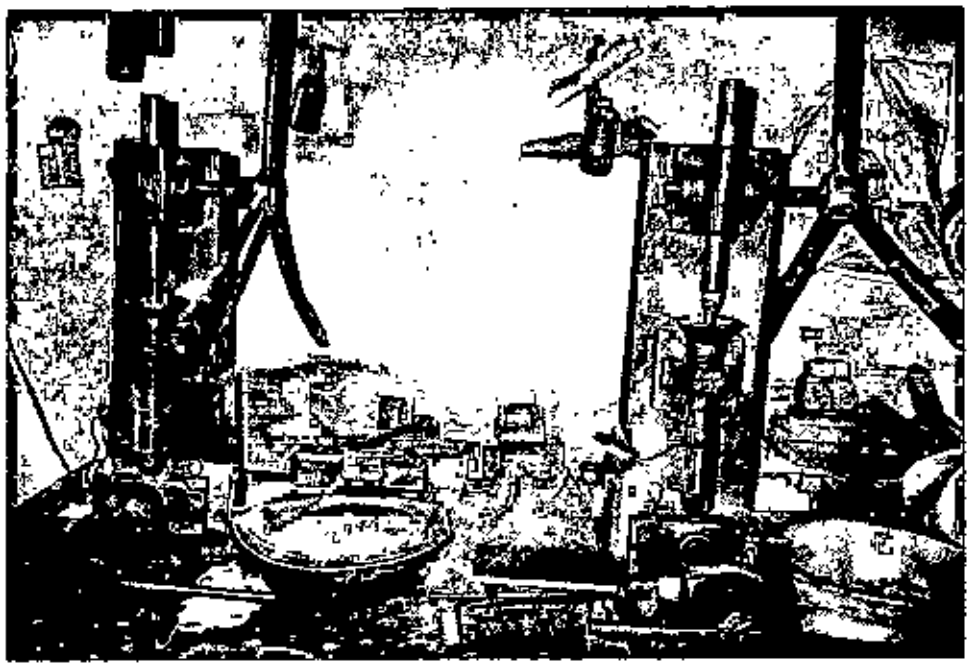
4.3 Quantity of Generated and Recycled Plastic Waste in Dhaka City

According to Haq and Bell (1998), plastics in urban solid waste accounted for only 1.8 percent by weight in Dhaka. Plastics ranked fourth in both 1990 and 1994, but there was a decrease in the percentage weight of plastics from 2 percent in 1990 to 1.8 percent in 1994. However, this does not reflect decrease in the recycling rate, rather an increase in the waste reclamation rate at source, either for reuse and/or sale to waste hawkers. This efficient waste reclamation system causes a reduction in the proportion of plastics in the waste stream. A grand total (both pre- and post-user) of 49.65 tons per day of plastic waste from all sources was generated throughout the country as a whole, and subsequently, accumulated and recycled in IPRIs in Dhaka and other places with 10 percent of total weight as processing loss. Domestic and institutional predominated in generating plastic waste in Dhaka (28.49 tons per day), followed by industrial-commercial (1.27 tons per day) and the rest by medical premises. The amount of post-user plastic waste recycled represents only 37.5 percent of the average daily consumption of 88.61 tons of unused thermoplastics imported into Bangladesh. The remaining portion of imported thermoplastic presumably

remains in use as a consumer or producer goods or is disposed of in small quantities a s landfill, if small or difficult to collect.

4.4 Technology Used in Plastic Recycling Industry

There are two machines- a plastic molding machine and a paper/card ball press machine were designed by UBINIG, a social development and campaigning agency in Bangladesh and the Appropriate Heath Resources and Technologies Action Group (AHRTAG) in the UK, funded by the British Government's Overseas Development Administration and the World Health Organization (WHO) to use in plastic recycling industry. They are simple to operate and maintain neither requiring expensive inputs, and both using plastic waste materials that in many places are free. They were made to be tough and strong so that they could be transported over difficult roads, and were designed to be used as occupational therapy for long-stay patients, or by disable workers. The plastic molding machinery is made up of two parts, a machine that cuts up or granulates the waste plastic, and another that then heats and remolds these small pieces into other outputs. Different kinds of plastic can be used, as long as they are sorted before use and not mixed. One can use plastic form carrier bags, hoses, buckets, ballpoint pens, and even tough polypropylene (PP). The granulator is driven by a belt from an electric motor, so that old plastic fed into a hopper on top falls through into a cutting chamber where rotating blades cut it up before passing it through a grill into a collecting bin underneath. The injection molder consists of an electric heating element around a hollow tube into which the plastic granules are loaded at the top. When the plastics is hot enough, a hand-operated plunger forces the molten or very soft plastic into a range of different-shaped moulds through a nozzle on the bottom. For example, in the project shown in the figure, round pill containers were made in two sizes, approximately 45mm and 55mm high, of about 30mm diameter, with either screw-thread or Snap-On lids. The ball–press matching is entirely hand operated and stamps out shapes from waste plastic and card for folding into boxes and toys by hand. This comprises a hand--press operated by a large, heavy wheel, mounted horizontally for momentum and pressure, and a specially designed blade which stamps out shapes form flat plastic resin and card stacked under the blade. After the shapes have been cut out they are then folded and glued by hand into boxes and other products, onto which label can be printed or stuck. The plastic or card therefore is reuse/recycled and must therefore be of reasonable quality. These types of plastic recycling machinery are being successfully used in Mexico, Bhutan and Bangladesh (Long, 1991). Both machines work well technically, can be built locally, are strong, and do not need much support and maintenance. The machines proved easy to use by non-technical people, disabled or not.



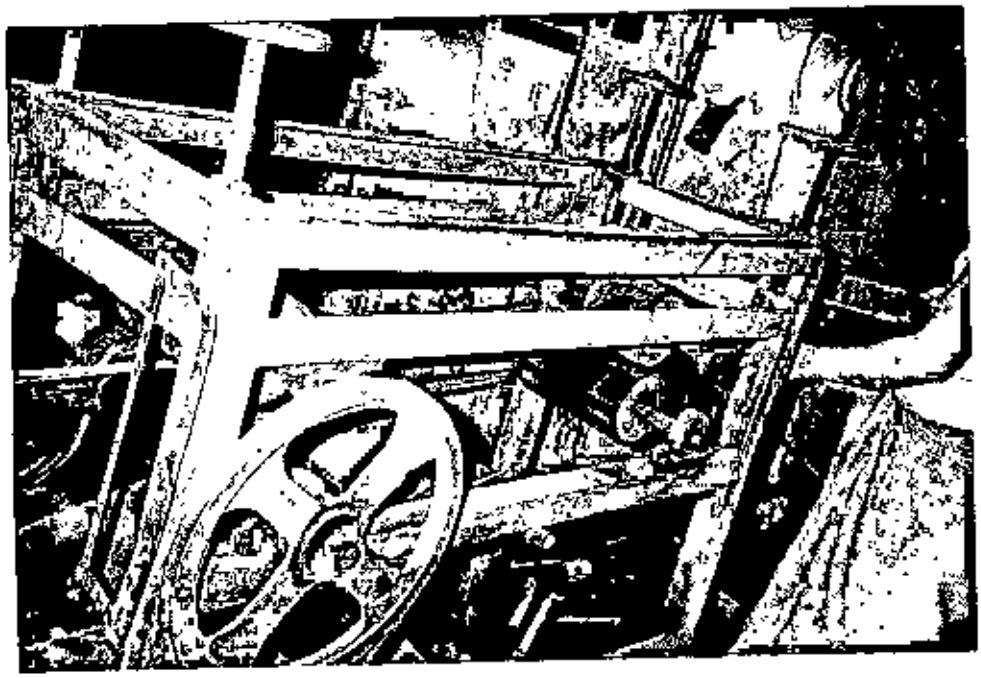


Fig. 02 Different Plastic Recycling Machinery developed by UBINIG & AHRTAG.

4.5 Different Sector Involved in Plastic Recycling Trend

The present study deals with informal plastic recycling industries in Dhaka City So it is an attempt to give a brief idea about the informal sector of Dhaka City in the following paragraphs. It specially talks about definition, extent, types and interface of informal sector regarding plastic recycling in Dhaka City.

4.5.1 Definition of Informal Sector Activities

The term "informal sector" was coined in the 1970's. While the definition of informal sector has been interpreted in different ways, the general meaning of the term is fairly clear, with variation arising mainly from geographical differences and the local nature of economic activities. The informal sector mainly refers to independent enterprises owned and operated by a single individual for income generation, as well as micro enterprises with fewer than 10 workers. The other defining characteristics is that informal establishments are not registered with government authorities and therefore unregulated. In Bangladesh, operators either ignore or are not aware of municipal regulations which require all economic activities to obtain a permit prior to operation (Child, 1998).

In addition to these two defining characteristics, informal sector enterprises are characterized in the following way:

- Usually in urban areas, particularly for manufacturing types of enterprises,
- Need low capital costs for establishment,
- Engaged in activities that are labor intensive,
- Produce low quality goods,
- Often lack basic utilities and facilities, including electricity, water & sanitation,
- Are engaged in highly competitive and unstable activities, etc

4.5.2 Extent of Informal Activities in Bangladesh

The ILO/UNDP (1993) estimate that 56.8 percent of the total number of workers in the urban areas in Bangladesh are working in the informal sector micro enterprises (defined as less than 10 workers). Although not defined as informal, the BBS (1993) indicated that 69 percent of manufacturing establishments are in temporary establishments or are household-based, constituting 44 percent of the manufacturing labor force. Regardless of the exact numbers, it can be concluded that the informal sector constitutes a significant part of the country's economy and social fabric. This significance has been increasing over the recently years and is expected to continue to gain in performance. Not only does the informal sector provide a wide range of goods and services to the formal sector, in some instances, such as recycling & repairing activities, there are few formal sector alternatives. For example, Recycling of inorganic (non-biodegradable) waste is popular in Dhaka City. A significant portion of informal sector is working with inorganic waste.

4.5.3 Types of Informal Activities

Types of informal sector activities can be categorized into the following:

- Manufacturing- e.g. Metal works, ***Plastic Processing & Recycling***, furniture making etc. According to a definition stated in Appropriate Technology (Vol 23, No. 1, June 1996), manufacturing means the transformation of raw materials into

industrial and consumer products It is an area in which there are many opportunities for increased economic activity.

- Services- e.g. All repairing, Barber, Sign-making etc.
- Trade- e.g. Street Vending, Petty Retail, Scavenging etc.
- Construction- e.g. Brick breaking, Earth digging, Masonry etc.
- Transport- e.g. Rickshaws, Baby Taxis, Tempos, Carts etc.

Within the informal sector of Dhaka City, transport workers constitute the overwhelming majority, constituting about 38 percent of the informal labor force, followed by petty traders (22%), then by day laborers (15%), workers in small factories (10%), skill/semi-skilled technicians (8%) and by domestic employees (Amin, 1991). Plastic Recycling Industries are prominent providing informal jobs in small factories.

4.5.4 Formal Sector & Informal Sector Interface

There is clear distinction between the formal sector and informal sector (Table: 4.2) though there are interrelated, inter-linked, intermingled and inter-dependable in different ways and in different patterns.

Table: 4.2 Difference between Formal and Informal Business

Attributes	*Informal*	*Formal*
Title to Land	No	Yes
Registered Business	No	Yes
Adheres to business laws	No	Probably
Formal employment contracts	No	Yes
Ability to take risks	Nil	Varies with size
Capital accumulation	Very low	Varies with size
Size	Small	Varies

Source: Appropriate technology, Vol. 15, No.4 (March 1989)

Petty traders provide goods and services to the workers of the formal sector in convenient locations and often at a cheaper price than the formal retail shops. Small factories in the informal sector often provide different raw materials and semi-processed inputs to the formal sector. And in many cases, several small enterprises start in the informal sector and with the increase in machinery or turnover, these firms gradually enter into the formal sector. For many formal sector enterprises, there are few alternatives other than using informal sector techniques, repair, recycling and maintenance services. Concurrently, when a worker is fired from the formal sector, he or she can quickly find a job in the informal sector. In case of solid waste recycling, informal sector and formal sector are interrelated during collection, transportation & disposal of recyclable wastes at different sites starting from household to landfills. Thus, different interactions, linkages and co-existence of the formal and informal sector is clearly found in Dhaka City, and which, in many cases, reduce the probability of unemployment in both of these two arena.

4.5.5 Informal Sector & Plastic Recycling in Dhaka City

There are many stages in the plastic recycling process including the waste generators (households and businesses), wastebin pickers/ scavengers (tokais'), dump site

pickers/scavengers, hawkers ('ferriwallas'), shops buying broker/ used items ('vhangari Dokans'), wholesalers, manufacturers (both formal and informal), and the brokers/ middlepeople. In Bangladesh it seems that almost all plastic manufacturing is done in Dhaka with used plastic (and other garbage) collected in other centers and rural areas being transport to Dhaka for re-processing & recycling.

One of the steps in the recycling manufacturing process is plastic burning. Most of these establishments are located near by the river Buriganga. The waste polythene is washed in the river and dried under the sun It then burned in ovens (chulli) and made into round balls to be used for manufacturing other plastic items in the informal plastic recycling industries. This all takes place outdoors. The burning creates a lot of black, toxic smoke and smell. This type of activity is among the most informal activities observed in these specific areas of Dhaka City It requires minimal capital investment (oven only, no buildings or tools) and the workers appeared to be particularly poor. The working conditions were arduous under the sun and rain, and exposed to plastic containing rotten and other dangerous garbage and smoke and fumes from the burning. Several informal industries use this method of plastic burning to manufacture other plastic products directly. All types of discarded plastic goods (bowls, jugs buckets, sandals, etc.) were washed, dried, and burned to form balls. For instance, one establishment make plastic curry pots another a variety of plastic goods (buckets jugs, soap containers), and another plastic toys and games (small cars, dolls). This is done by molding the plastic balls by machine as well as using hand tools like cutters and die to form the finished good. In the case of the toy manufacturing, the plastic balls are dyed into different colors and cut into chips to make the finished product. The hazards are similar to that described above for the sorting, washing and burning activities. In addition, these establishments have bad smell and fumes from plastic molding process, creating a respiratory risk to the informal workers

Much of the plastic used for making plastics goods is in the form of 'granules' or 'chips' (hard plastic pellets), locally called 'dana' These granules are made from waste and defected polythene that are washed and dried and cut by machine into small pieces. They are then cut even finer, almost into a powder, which is put into a molding machine to form thin plastic ropes that are cooled by passing through water. The ropes are then cut into pieces of a few millimeters in length to make the chips. These are sold as the raw materials for many other processes.

A wide variety of goods are manufactured from used plastic. One of these is plastic shopping bags. These are made by machine from the plastic pellets described above by rolling, cutting, and shaping into bags. There are other industries, which make toy parts from the plastic granules, using a hand-press type of machine that melted the pellets and molded it into the described form. Table 4.3 will give us a brief idea of different actors involved in informal plastic recycling system of Dhaka City.

Table: 4.3 Different Actors involved in Informal Plastic Recycling

Basic Approaches to Recycling Solid Wastes	Actors involved	Sub Actors
1. Separating Recyclable plastic materials by the waste generator	1. Housewives and House servants	1. Ferrywala / Hawker
2. Collection of mixed or commingled recyclable plastic materials from bins & refuse accumulation centers and separating them at particular central areas	2. Tokais/scavengers	2 (i) Waste Bin Tokais (ii) Dump Site Tokais (iii) Municipal area Tokais
3. Intermediate Processing and Sorting	3 Plastic Recyclable Processing workers	3. Mostly woman & children
4. Marketing of recyclable plastic materials	4 Waste materials dealer	4.(i) Vhangari Dokan (ii) Mohajan (iii) Wholesaler (iv) Broker (v) Manufacturer (vi) On street seller
5. Reprocessing and Recycling of Plastic Recyclable	5. Entrepreneurs & workers of Informal Plastic Recycling Industry	5. (i) Formal Industry (ii) Retailer (iii) Wholesaler/dealer (iv)Ferrywala/Mobile Shops (v) Market System (vi) Hawkers (vii) Middlemen/ sub- contractors

Source. Field Survey, 1999

4.6 Impacts of Plastic Waste Recycling

Informal Plastic Waste Recycling and their related industrial developments have some positive impacts in socio-economic and environmental point of view in Dhaka City. These positive impacts are called direct and indirect benefits of informal plastic recycling industries in the present research. Negative consequences are also not ignored in this study. The following paragraphs discuss about these points briefly.

4.6.1 Direct Benefits

The contribution of informal plastic recycling industries to the national economy should not be underestimated as it plays a large role in reducing municipal and industrial plastic waste disposal problems, conserving scarce resources, reduces the amount of energy used to manufacture products, reduces the cost of waste treatment, reduces the volume of solid waste that must be disposed by the municipal authorities and saving the foreign exchange required to import new unused plastic. IPRIs are significant potential growth areas for employment in swelling urban populations especially for urban poor that are increasing day by day. The jobs and livelihoods created in IPRIs include opportunities for unskilled and semi-skilled youth to gain expertise that will improve their livelihoods in the future, enhancing the security of whole communities of Dhaka City.

4.6.2 Indirect Benefits and Negative Consequences

Plastic products may cause great harm to the environment if their negative consequences are not properly dealt with. They can clog/block drains and

underground sewerage systems, as they are not easily biodegradable and decomposable. Their large-scale proliferation and use in the urban and rural areas can cause serious threats to agriculture, forestry and the ambient air quality. These inorganic materials have proved to be the most dangerous in destroying the moisture and fertility of soil. If these plastic waste are not properly burnt in scientific incinerator (See appendix- Proper Waste Incinerator), they produce bad odor and noxious gas like Vinyl Chloride, di-oxone, CO, SO_2 etc. which may cause lung and liver cancer, suffocation, depression of central nervous system, suspected embryotoxin, bronchitis asthma & other respiratory diseases, eye infection, skin rashes etc. So taking out the plastics for recycling will prevent one of the major sources of air pollution in incinerator-flue gases. It has some role of conserving landfill space. Thus practice of Informal Plastic Recycling Industries reduces the chance of these negative consequences and thus help in improving, conserving, and protecting environmental conditions & ecology of overall Dhaka City. So the indirect benefits of Informal Plastic Industries are their role in environmental quality improvement and management. Moreover, they help the respective authorities that are responsible to maintain a sustainable livable environment to the City dwellers.

CHAPTER: 05 GENERAL DESCRIPTION OF THE STUDY AREA

5.0 Introduction

Dhaka City, the capital of Bangladesh, is one of the fast growing metropolitan cities of the world, and it has a number of diverse peripheral settlements. Some of these are already being developed for manufacturing industries. Plastic recycling industries are within the category of manufacturing industries. Though recycling has been practiced in the whole city region of Dhaka, the recycling industries are established in certain tannery areas of Hazaribagh, the Postagola area, Islambagh and Kamrangir Char. So, the survey of IPRIs are limited to these areas.

5.1 Location of Informal Plastic Recycling Industries in City Region

The manufacturing establishments of Dhaka City are often classified into two broad categories: the *formal* and the *informal* sector, on the basis of particular criteria. The formal sector mainly includes employees and workers in government-registered factories (public, private and multinational companies) and employees in government, semi-government and private offices The informal sector is often defined to include those enterprises which employ less than 10 persons per unit and which simultaneously satisfy one or more of the criteria such as business operation from open premises, housed in a temporary or semi-permanent structure, operation not from any officially assigned place, operation from residence or backyards, and not registered under Factory or Business Establishment Act. At present, five distinct industrial areas can be identified within Dhaka City. These are the Tejgaon Industrial Estate, the tannery area of Hazaribagh, the Postagola area, Islambagh and Mirpur. Of these, the first two were planned industrial areas with attendant facilities including transport and communication links. The third area (Postagola, Lalbag), situated in the extreme southest of the city, is a spontaneously developed area for formal and informal industries. Its location on the northern bank of the Buriganga River, its proximity to the main Dhaka-Narayanganj road and the Postagola railway station led to the development of this area. Most of the informal plastics recycling industries are situated in these areas (See figure. 1, 2, 3 & 4). A brief description of these areas is given below:

Postagola: situated on the south east of old Dhaka, this industrial area was planned to facilitate relocation of small manufacturing firms from within residential areas, and its establishment was completed with administrative measures to induce firms to located there.

Lalbagh: the entire Lalbagh thana is urban area and mostly a part of Dhaka City Corporation and the rest are proposed to be included. It consists of 1 union, 6 mozas, 11 wards (including parts of 3 wards) and 119 mahallahs and occupies an area of 9.14 sq. km. area. It is bounded on the north by Dhanmondi and Ramna thanas, on the east by Kotwali thana, on the south and on the west by Keraniganj thana. Most of the formal and informal plastic industries are situated in this area and ideally a recycling network has been formed focussing on this area.

Islambagh: this is the earliest industrial location in Old Dhaka. Indigenous industries and a number of small firms mainly occupy the area.

MAP : 01

DHAKA CITY

THE STUDY AREA

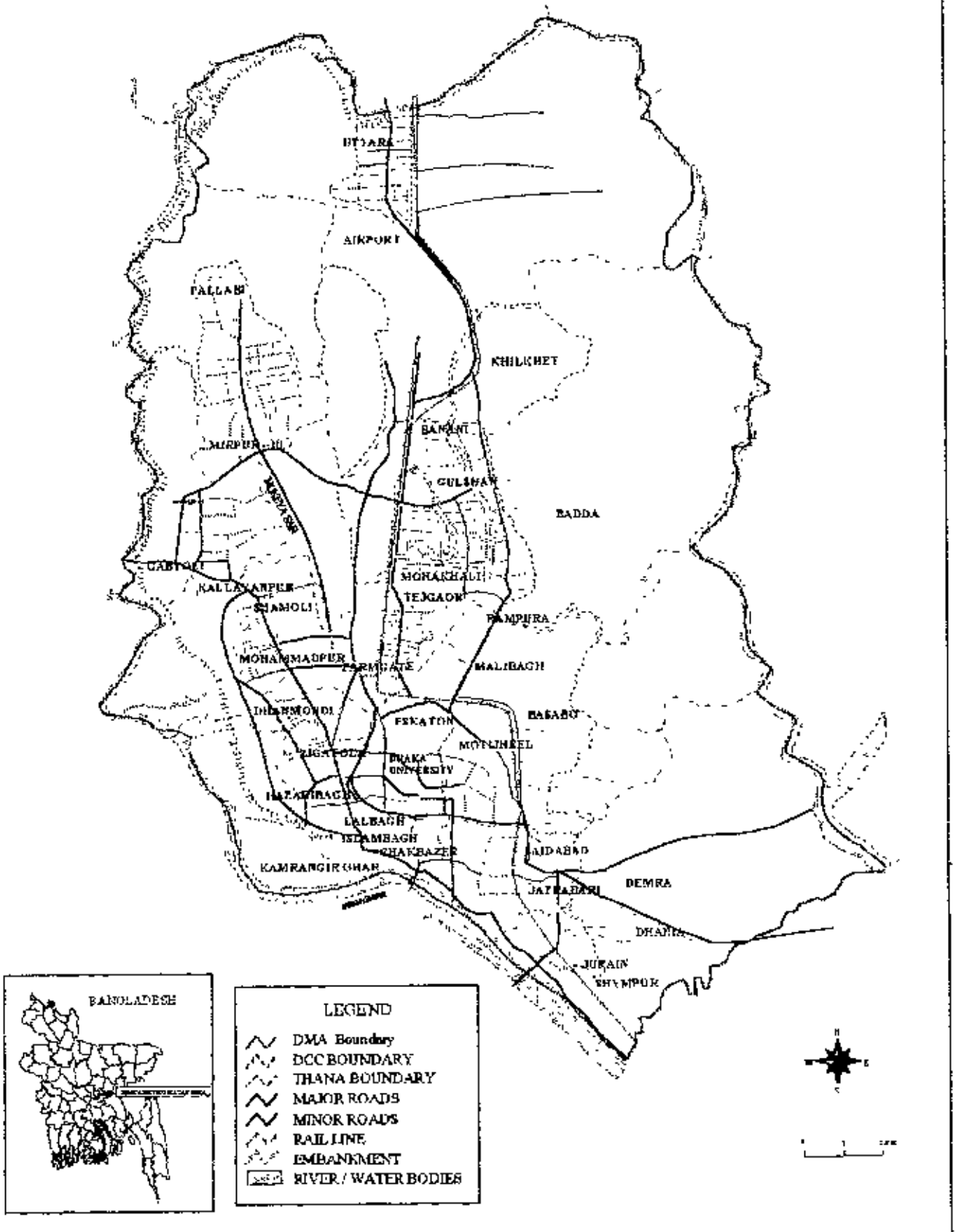


Fig - 01 The Study Area (Dhaka City)

MAP : 02

DHAKA CITY

Spatial Pattern of Informal Plastic Recycling Industries

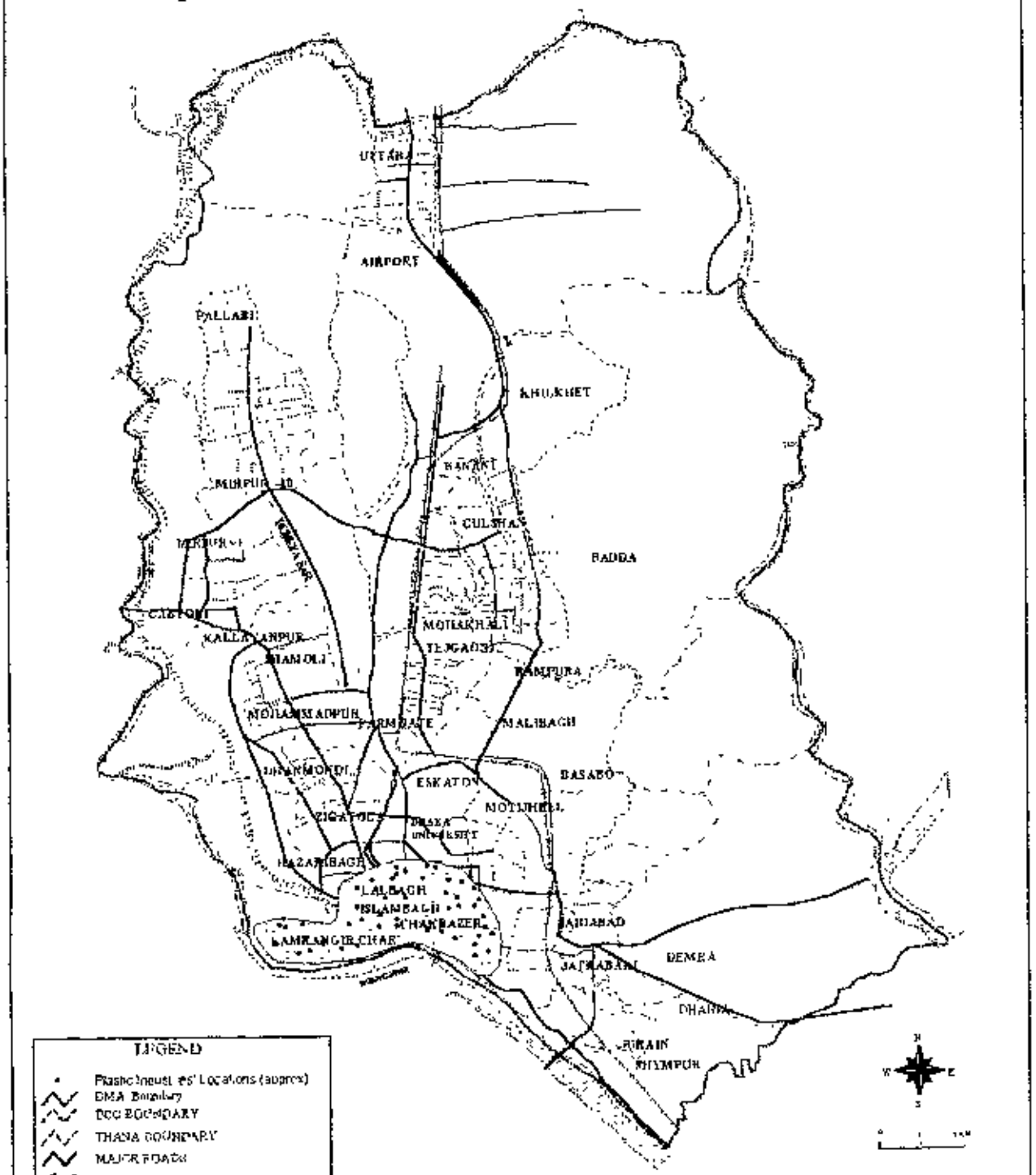


Fig .02 Spatial Pattern of Informal Plastic Recycling Industries in Dhaka City.

MAP : 03

LANDUSE MAP OF DHAKA CITY 1999

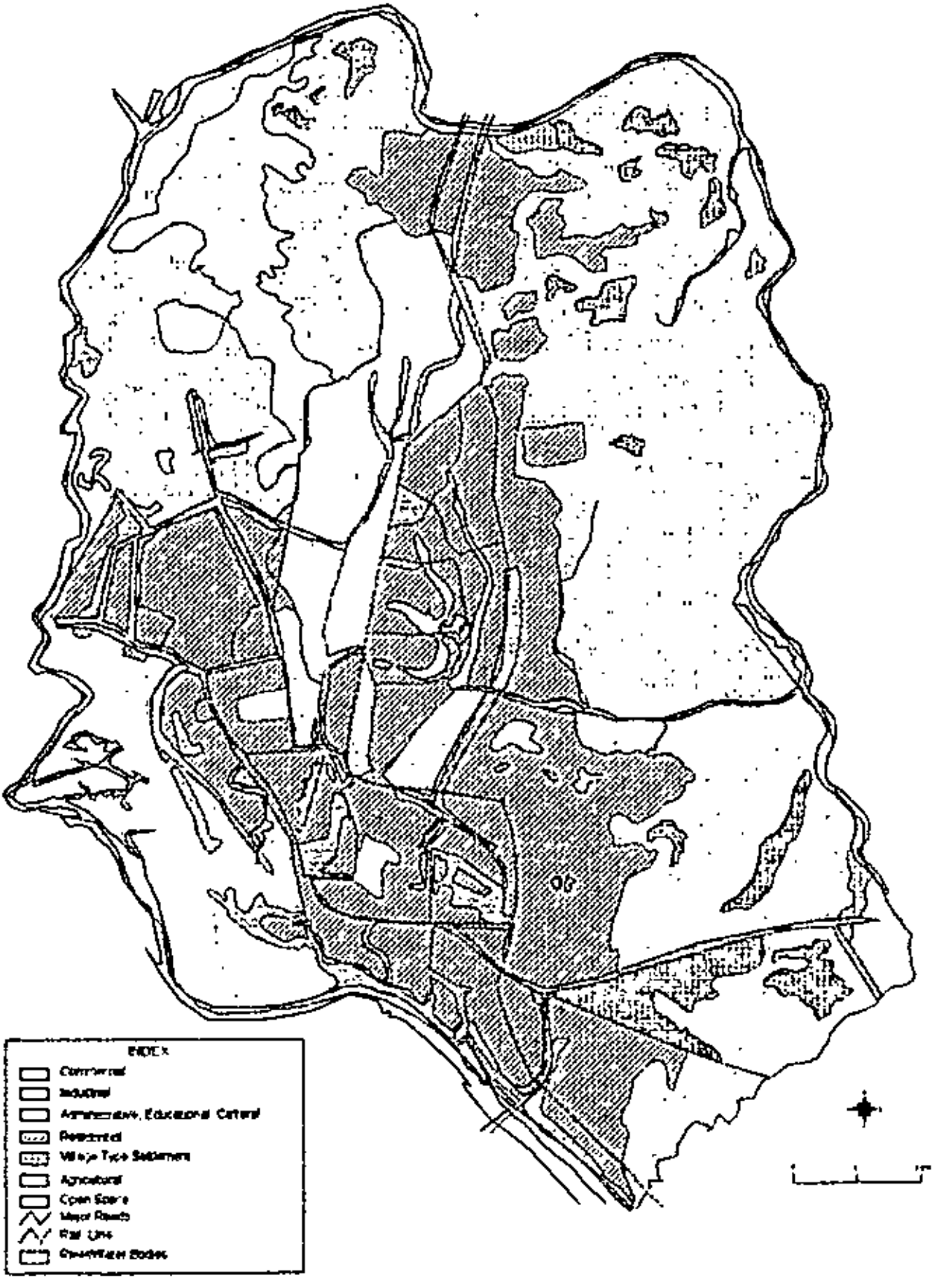


Fig 03 Landuse Map of Dhaka City (Source: CUS, Dhaka)

MAP : 04

LANDUSE ENCROACHMENT BY INFORMAL PLASTIC RECYCLING INDUSTRIES

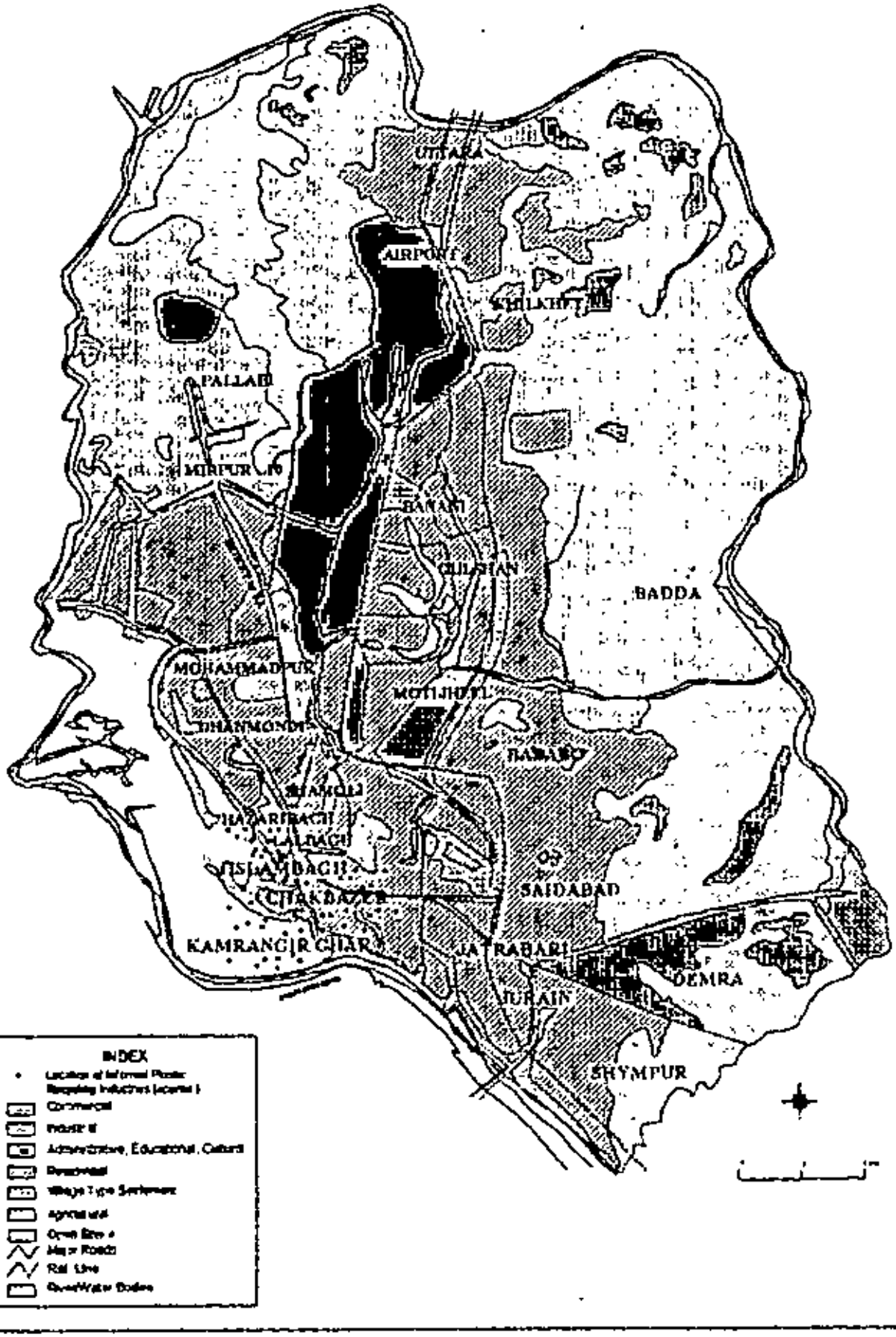


Fig 04 Land use Encroachment by Informal Plastic Recycling Industries. 51

Kellar Morh(Hazaribagh Unit): is located adjacent to Katashur Khal, where Kamrangi Char, the densely populated island like isolated part of city lies outside the embankment and a vast amount of low lying inundated vacant land inside the embankment.

Kamrangir Char: is located at the periphery of Dhaka City, adjacent to the Buriganga river. This is an island and separated from old Dhaka by tributary of Buriganga. It is a mouza in Sultanganj Union at Lalbag Thana. Presently, there are some settlements on this periphery of Dhaka, where industrial development is taking place, and there is also a future prospect for industrial investment in this townships-particularly for plastic recycling industries.

5.2 Factors/Issues related to Plastic Recycling Industries

Different factors are responsible for the establishment of IPRIs in the survey areas. Imbalance of some of these factors creates problems to these industries, which consequently hampers the prosperity of these industries. So, these factors or issues are carefully discussed in the following paragraphs along with the remarks made by entrepreneurs

Quality Standards: Quality control of the plastic recycled products must be the priority after establishing the backward linkages. Without good quality products the whole backward linkages would be the wastage of huge amount of money. To produce very high quality product IPRIs should start from raw materials up to finished goods. For quality products any industry needs quality machine, material and manpower. In IPRIs, quality control mostly depends on quality & cost of raw materials, voltage up down, adequate pressure, production cost (quality α production cost), proper dies, skilled & experienced laborer and good recycling machinery. The quality of finished products must be very high and free from any defects. The test of good plastic products is the durability of its color. It is said that quick production always produces inferior quality products. So the goods produced in IPRIs will be the right size, shape and style for the local market, and regular contact between sellers and buyers means that designs can respond to changing needs and quality standards will be acceptable, at least. Improper plastic product should not be sold to any retailer or wholesaler rather should be used as raw materials. There are no prescribed standards for plastic products or inspection of quality marking and standardization maintaining in IPRIs No IPRIs have quality control worker like the garment sector of Dhaka City.

Industrial Location: The locational pattern of industry is important-the industrial clustering and locations of different industrial types in relation to residences, the transportation network, prevailing wind patterns and natural watercourses. Zoning of industry is most effectively accomplished as part of strategic planning. DMDP can be reviewed to search possible recycling industrial zone

Marketing Difficulty: The informal sector has often been described as a natural center of innovation. In reality it is more a center of imitation. Almost every product is made to a standard design, using a set range of tools and processes The situation is made worsen by the standard nature of the products: the consumer, faced with choosing

between identical products, will always go for the cheapest. It is often seen in IPRIs that demand of recycled product decreases with seasons. The market value of recycled product decreases when products are available at market. Forward linkages of IPRIs should be improved to reduce marketing difficulty of finished recycled plastic products. Transaction with forward linkages often becomes harassment to IPRIs as most of the recycled products are supplied to party on credit. It is difficult to collect dues from market. Most of the times, it requires frequent reminders for payments. Credits remain confined most of the time. Some other problems of IPRIs related to marketing are: more competition, lack of sufficient orders to supply, lack of marketing representatives, supply of recycled products at producers' cost, storage problem during off season as godown are filled with products, return of supplied products from market, hartals and other forces hampering the supply of products to market, presence of artificial or mimicry products and deprivation of actual product prices usually created by party/influential buyers/moneylenders. Forward linkages can prevent supply of inferior quality mimic products by not buying from such producers. Entrepreneurs have started providing sales commission to retailers, which has already given some fruitful results. Retailers and wholesalers begin to help IPRIs by providing information about the market for various plastic products especially new and improved ones, technology, potential clients, prices, government legislation and other things relating to business operations. Access to such information can expose IPR business to both money-saving and moneymaking opportunities. IPR business can increase their security (the probability of their survival and of increased sales) by controlling markets, which they can do by securing their existing markets or moving into new ones, obtaining government set-asides or forming associations, practicing cash transaction instead of credit. There are also several sources that support market control. These include special government procurement programs, business fairs and organizational development. NGOs can come forward to representing recycled products to consumers.

Raw Materials: Plastic chips comprise the principal raw material used in IPRIs. Plastic chips are of two types: (i) high quality imported chips; and (ii) chips locally produced from recycled plastic wastes. A die is usually designed by the entrepreneurs of IPRIs in local engineering shop. The die is then used in a molding machine (plastic recycling machine) to produce new recycled plastic products The problems related to raw materials are: low quality, delay of delivering/supply of raw materials due to other forces like hartal, varying buying prices of raw materials, Out of market problem of certain raw materials (example: powder), higher transportation cost, loss of raw materials due to higher contamination, high price of quality raw materials, high price of dye that provides the outer look of recycled plastic products, inadequate supply of certain raw materials (PP, HDP) etc. It is noticeable that price of raw materials increases with demand of recycled plastic product. Some IPRIs are trying to buy raw materials directly from the frontier actors of their backward linkages (i.e. Scavengers/Salvagers) to reduce the price of raw materials.

Backward linkages (wholesalers, party, middlemen, vhangari mahajans, and scavengers) should be concerned about providing providing quality-salvaged plastics i.e. less contaminated plastic waste to keep recycling process smooth and steady. There should be certain market system so that rate/prices of raw materials may not

vary much or remain stable for certain time period It will increase supply of raw materials when there is sufficient demand. If there were certain markets of raw materials closer to IPRIs, the price of raw materials would be less which, ultimately would feedback the entrepreneurs.

***Capital/Financial Incentives*:** Small capital, borrowing capital, insufficient running capital, high interest rate of capital borrowed from informal sources are some problems related to capital information of IPRIs. General practice is that, IPRIs have to buy raw materials in cash whereas they have to sell their recycled products on credit to forward linkages. It reduces the cash capital of these industries. Sometimes, they can not even pay the rent of the premises, increase number of machinery, buy quality raw materials or machinery, expand the industry or even can not employ more workers. If they have sufficient capital, they could have stock raw materials at available opportunities. It is often seen that if an entrepreneur wants to increase his capital from his own income it pressures his own living. Capital of IPRIs could be increased through government grant, loan at low interest or no interest from banks or other organizations just like SCIs. According to owners, increasing capital could increase profit margin.

***Seasonality*:** Usually the demand for plastic products increases during the winter season, when there are a number of fairs and festivals in the city. Extra people are employed to handle the increased level of production and sales. The duration of peak varies from four to seven months (October to March). Although demand for all plastic products increases during the winter, the demand for toys and household goods continues at a reasonably uniform level during the off-peak season. Most favorable month for IPRIs is January. When goods remain unsold the production is not in progress. Factories remain closed during flood because they are quite vulnerable to flood.

***Employment*:** Both permanent and temporary employment is available in IPRIs. During peak period, temporary workers are provided with employment to meet the increased demand of plastic products. Permanent workers do the major work by operating the plastic recycling machinery whereas the temporary workers are involved in finishing and packaging.

***Assets*:** Assets include own premises, advances paid for rental premises, recycling machinery and equipment, ancillary equipment and fixtures and fittings. Apart from these, the inventory of raw materials and finished goods is also important.

***Profitability*:** IPRIs appear to be profitable. There has been a smooth growth of these industries in the last few years. With the growing use of plastic products, a large number of new enterprises are being set up all over the country every year so do the IPRIs The profitability of the IPRIs can be estimated from two sources: (i) profitability as stated by the entrepreneurs; and (ii) profitability based on raw materials purchases and output sales It is observed that price of recycled products falls with decreasing demand and this incident is frequent Low profit margin is seen in off-season or when backward linkages become scarce. IPRIs have to sell their products to wholesalers. So there is small profit in comparison with retail market.

There is loss when products remain unsold. To keep the price stable, IPRIs should provide quality products, prevent imitation and reduce competition among them.

Environmental Clearance: According to EIA Guidelines for Industries in Bangladesh, IPRIs may fall under the Amber-A and Amber-B categories of industry which can not be set up in residential areas As these are informal settlements, they do not follow EIA guidelines. But their negative consequences must not be overlooked by DoE that requires environmental clearance from these industries.

Air Quality: Activities of major concern are the burning of plastic waste, the emission of dust and smoke, and the emission of chemical impurities such as noxious and toxic-gases. Principal effects are on human, aesthetic values (sight and smell), adjacent land uses, temperature modification and humidity changes

Noise: The intensity, duration and frequency of industrial noise can have a direct effect on biological and human communities. Noise during sleeping hours will have a major effect on the human community while excessive noise during operating machinery may have a major direct effect on workers. It hampers the working environment and finally reduces the hearing power of the workers.

Physical Safety: The risk of injury to workers is an important consideration Most industries and development project have inherent risk of injury. Bnt in IPRIs, there are level of risk acceptance as most of the workers are poor, unskilled and temporary workers. These people have no choice but electing to place themselves at risk. Most of the IPRIs have no first aid facility/box though minor accidents are frequent. It is expected that the entrepreneurs should take measures to minimize the risk to the unwitting people.

Utilities and infrastructure needs: Basic services such as water supply, electricity, sewerage, rubbish collection and disposal are essential for any industrial development. For IPRIs, uninterrupted power supply is highly necessary. Otherwise no recycling machinery could be operated No work no money is the principle followed by the entrepreneurs. Workers suffer due to the interruption of utility services. Sometimes there is no electricity all day long. It consequently hampers the working efficiency of the IPRIs. Some of the problems related to utility services in IPRIs are: Frequent Load Shading (usually continues for 2-3 hr.; 2 times a day), Voltage up-down, Less electric supply than demand, Less water supply during day time (only 3-4 hr. DWASA water supply available). It takes more time to heat the recycling machinery during power interruption. Low voltage depreciates the recycling machinery. Electric lines are not properly maintained and checked by DESA & PDB. Sometimes, variants wires are found in main electric lines. As a result, IPRIs are at vulnerable stage at short circuits, storms and other natural calamity. As water level is decreased in Dhaka City, hand tube well can not pump sufficient water for IPRIs. No new gas and water connection is being provided in the surveyed area. Narrow access roads create problem for IPRIs during handling of large amount of inputs and outputs. Developing ring roads to connect the peripheral settlements emerges to be a powerful device to promote plastic recycling industries in Dhaka City, especially on the periphery. Upgrading existing roads and developing new routes can be explored in this connection. Appropriate

authorities of utility services should operate properly to ensure adequate and stable supply of these utility services. Technological innovations may be searched to operate recycling machinery by gas or solar panel instead of electricity. Illegal & improper connections should be eliminated to prevent hazards.

Training and Skill Formation: Basic training is required to operate recycling machinery in IPRIs. Otherwise accidents can occur. As skilled workers are assets of any industry, it is necessary to train unskilled laborers It is easy to operate some recycling machinery. Generally it takes some days to convert semi-skilled laborer to skill one. Quality of recycled plastic product decreases due to shortage of skilled laborers. Sometimes production varies too. Skilled laborer costs more money than unskilled laborer because they are limited in number. Skilled laborers frequently change their jobs. They always look for better opportunities So there is always a scarcity of skilled laborer in IPRIs Entrepreneurs can come forward with innovative short-term training mechanism to build skills of their workers. Different organizations (vocational/academic/technical-technological training centers) or experts can help them with subsidized training and skill development. Entrepreneurs should keep better relations with skilled laborers to hold them longer in their recycling industries

Technology: The issue of technology improvement has received a wide coverage related to the development of IPRIs. It is always difficult to cover all aspects of technology improvement. For example, some technologies are developed in other countries but these are not feasible in context of informal plastic recycling in Bangladesh. Local innovations in technology regarding cheap recycling always get the emphasis. Sometimes composition of local technology with foreign technology is found quite effective in case of plastic recycling. More research should be carried out in proper organizations to innovate new and improved technology for plastic recycling

Management: Entrepreneur-ship development, industrial management, financial management, marketing management and general management are some categories that the IPRIs deal with. The problems associated with these categories are delay of getting money from party in case of sold products, lack of unity among IPRIs, compromise to get orders and raw materials, lock out, allocation of more laborer, lack of communication between backward and for ward linkages, joint venture etc. Financial management has been found the most crucial one. Credit sale often causes problems of paying rent and wages to employees. Low running capital makes the scenario worse The entrepreneurs are all in all in IPRIs. Though they are not educated but they understand the recycling business quite well. As a result these IPRIs are surviving in spite of all adverse situations. They need to be united and form cooperatives or committee to preserve their rights.

Sectoral Linkages: Sectoral linkages are important to promote subcontracting and ancillary relationships. But there are few linkages between formal and informal sectors in case of plastic recycling. Though there are tremendous scope of this linkage. Informal sector highly depends on informal people for raw materials As a result their backward linkages are strong with informal sector. IPRIs have strong forward linkages with different market system (wholesalers, retailer, and contractors)

to get contract and therefore distribute and sell their recycled products. They face competition with formal industries in the same market system. They have to maintain good relationship with forward linkages The usual practice is that if IPRIs provide recycled plastic products on credit, the relation with forward linkages improves but opposite scene to backward linkages & vice versa. To maintain good sectoral linkages, IPRIs need adequate running capital so that they can buy sufficient raw materials form backward linkages and therefore timely supply products to forward linkages.

Informal Credit: The role of informal credit in financing working capital and accelerating sales turnover is very important in IPRIs. A variety of informal financial arrangements are found. They are: the urban moneylender, Samity, Dadon, Credit Purchase, Credit Sales and relatives. Most of them are found rudimentary to IPRIs due to their high interest rate and difficulty to maintain. Interest rate varies from 3% to 9% per month, which is quite high in comparison with govt. bank. But informal credits are not found all the time. Micro credit from bank and NGOs can eliminate informal credit and save IPRIs from moneylenders.

Informal Taxation: IPRIs have to pay subscription to different clubs on various ceremonies. The main collectors of informal tax from IPRIs are local musclemen, miscreants and law enforcing officials like police. Sometimes they block the supply of raw materials and finished products. IPRIs should be united to prevent this informal taxation for their development.

Financing: IPRIs can not get credit from formal sector, as they have no registration. In this case a joint approach could be innovative. NGOs & CBOs can operate with banks; banks can provide investment funds and NGOs can provide working capital to IPRIs. They should initially extend short-term loans and later move to medium and long term loans to older IPRIs. They can also combine efforts with BSCIC; NGOs provide financing and BSCIC provides technology and training Such type of credit access could be boost to IPRIs.

Legal Status: A feature that accompanies the adverse conditions of operation of the IPRIs is non-registration. Whether due to a lack of transparency regarding formal regulations, the fear of taxation, or simple a lack of information, most informal sector operators do not register their units, and thus find themselves vulnerable to legal action or harassment from law-enforcing agencies. More importantly, without formal status it is often difficult to gain access to any form of institutional support, credit or extension services. It is therefore important to devise a sensitization campaign, which emphasizes the benefits of registration with respect to gaining credit access and delinks it from any negative legal consequences on other counts. Non registration can be tied to the issue of land rights for physical space on which the informal activity is practiced.

Urban Planning & Regulations: The basic mandate of city and urban development authorities is to provide civic amenities to the inhabitants of the city and ensure an orderly development of urban areas, given the importance of informal economic activities from the point of view of employment in towns, they must feature as an

important element in any urban planning exercise. The mandate of city authorities may also have to be broadened to incorporate this development aspect into their traditional tasks. In general, regulations related to the operation of the informal sector need to be simplified and implemented in a transparent manner. One important need in this context is the provision of authorized work sites with due regard to proximity to the demand for goods and services provided by informal activities. As IPRIs are established on mixed-use area, it may be an idea to examine the feasibility of declaring the study area as industrial zone for recycling which in some cases resole the problems of land use.

Occupational Health and Safety: Occupational injuries due to accidents at work place cause deaths and other illness to number of employees working in the informal sector. It reduces work efficiency of employees. Not only do informal accidents tend to go unmonitored and unreported, but also the hazardous conditions tend to be greater than in formalized establishments. Injuries and deaths are only the direct cause-and-effect measurement of workplace hazards. Different factors of occupational hazards in IPRIs are excessive noise, bad odor of plastic burning, dusts, poor lighting, poor air quality, vibration, radiation, excessive heat, excessive humidity, overcrowding, physical accidents, chemical exposures through handling and inhalation, inappropriate tool/machinery design, harassment etc. In IPRIs, there is always health risk during sorting and washing contaminated plastic wastes Dust and dirt hurt eyes, sorting of sharp and hard plastics with bare hands causes wounds to hands, washing with hot water has risk of burning. Workers suffer from different respiratory diseases It is quite difficult to work at dry season due to high temperature produced during plastic recycling process. Burning of hands and legs are frequent during working with hot raw materials; melting temperature of plastic wastes varies from 700°C to 1100° C which is quite high. Children and women have nausea during sorting and washing of plastic wastes. It is also irritating to skin. Some recycling machinery requires more physical energy top operate. Regular working on that type of machinery affects health. There are always chances of being struck by electricity. Usually workers drink milk after got electric shock. It is often risky to work in certain machinery, which are faulty and need maintenance. IPRIs do not provide medical facility to their employees. Dhaka Medical College Hospital (DMCH) is the only hope for workers. Yet they do not get good treatment there. Owners do not bear the whole expenditure of treatment during accidents So occupational health and safety are not ensured at IPRIs. There are some options for IPRIs to ensure occupational health and safety· Use proper preventive measures (sun glass, gloves, masks, shoes etc.); Replace manually operated & semi-auto machines with auto-machines; Careful operation of recycling machinery; Placement of Caution Signs; Purchase of health insurance policy of owners, which covers some percentage of their workers; Use exhaust fan & other ventilation measures to reduce heat inside IPRIs; Spraying water per hour to reduce dust etc. Along with these, workers should be always careful

Govt. Harassment: As PIRs are informal, they do not have trade license and therefore have no invoice during procuring raw materials and marketing of finished products. Traffic police often halts the trucks of recycled plastic products and demands bribes or illegal subscription. Electricity inspector or bill collectors behave the same. Even the bank officials' demand bribes when loans are sought at banks. The possible

solutions of these problems can be eliminated through initiating special type of trade license for recycling business. This will reduce lifting subscription of police and others. Ease tax system can be introduced so that IPRIs could be included in the Govt. tax system without harassment

Technical Assistance: It is difficult to find technical assistance/technicians in due time to repair faulty recycling machinery. Technicians charge more money, as they are not employees of IPRIs. It causes recycling machinery out of order for long time. Technicians are usually found at Islambagh and Dholikhal areas. If workshops are nearby IPRIs, it will take less time to repair recycling machinery. Entrepreneurs should develop technical knowledge of some skilled labor so that they can do the maintenance work when necessary. Govt vocational training centers should come forward creating technical hand of recycling. Another thing, technical assistance charges should be reasonable.

Transportation of Inputs & Outputs: IPRIs bear high cost of delivering recycled plastic products. Trucks can not enter due to narrow road system. Traffic jam also creates problem during supply or delivery. As IPRIs are at the periphery areas of Dhaka City, it takes more time and money to reach raw materials. The raw materials have to draw to this area. IPRIs should possess their own Van or carts to delivery recycled products to market system. Proposed ring road & access roads can solve this problem of IPRIs. They can also utilize water route. Establishment of a wholesale market of recycled plastic product at nearby area will also reduce the severity of this problem.

Proximity to Medical Facilities: No medical centers are found nearby IPRIs. Only available medical center is DMCH. Narrow roads do not let ambulance to enter to take the accident victim of IPRIs. There is a need of establishing local hospitals/clinics at close proximity of IPRIs to provide medical facility to industrial workers.

Fire Protection/Fighting: IPRIs are always vulnerable to fire as plastics either raw material or finished products are quite combustible. Most of the time, raw materials are dried and melted by fire at closer distance. It is very risky. Moreover close structures/premises let spread fire quickly. Narrow roads do not let access to fire service trucks to accidents. There is also lack of fire fighting instruments in these poor industries. They are usually prepared themselves with water and sands in large pots inside the factory.

Lack of Govt. Policies: Most of the IPRIs are found unhappy with the Govt. intervention abont them. No grant is available for them. There are no govt. endeavors, efforts and initiatives to develop IPRIs both in the government and non-government sector. No specific policies are found in this field.

Accidents: Some IPRIs have no accident record since their establishments. On the other hand, to some IPRIs accidents are regular incidents. Accidents include fire due to short circuit or other sources, wounds (mainly burning and cutting) of hands and legs during operation of recycling machinery, faint due to electric shock etc.

According to entrepreneurs, most of the accidents occur due to carelessness of workers. But the opinion from workers is different. Certain steps can be taken to prevent accidents, such as repairing of faulty electric wires and machinery, prompt action of fire service authority, practice of drinking milk after any electric shock and finally be careful of both the entrepreneurs and workers of IPRIs.

Working Environment: Working environment in IPRIs is not up to mark in the surveyed area. Dirty environment exists with dart, dust, gases, noises, improper ventilation, bad odor, accumulation of garbage in bins, exposed drains and lastly dense structures or premises. Owners are found hot-tempered Noise pollution hampers sound sleep of workers who live in the same premise. Each industrial unit needs adequate light and air.

Social Acceptance: IPRIs are not socially accepted in the surveyed areas due to their negative consequences As they are established in residential or mixed use areas, there is often objection or complaints from neighbors about excessive noise, heat, dust, gases, bad odor etc. But their products are accepted and used by the people of Dhaka City. Most of them do not know how and from what they are produced. IPRIs could get social recognition if the negative consequences are reduced and the area is designated as plastic recycling zone. Plastic recycling could get some social respect if environmentally concerned people upheld the role of recycling to society and environment.

Maintenance of Machinery & Equipment: It is essential to any industrial establishment. In IPRIs, sometimes they do their own maintenance, as most of them do not employ technicians. There is always a need of skilled technicians in IPRIs. They have to go to work shop or replace machinery that is not worthy to repair. Spare parts are usually costly and scarce. Old machinery troubles much though some machinery of this type is found operating in IPRIs beyond their life span.

Intermediate Treatment Site of Plastic Wastes: is available as tributary of Buriganga river is close to IPRIs Slum dwellers on the embankment sometimes do not let workers wash and clean the contaminated plastic wastes in the river as they use it as one of the prime sources of water. Most of the IPRIs do not need it due to DWASA connection. But the backward linkages need it much. They have to use available ponds.

Proper Legislative & Regulatory Measure: No specific legislature or regulatory measures are available for IPRIs Though there is a great scope of regulating IPRIs in order to protect environment through helping them There should be certain regulation to improve working environment, occupational health and safety, air qnality control, registration of new industry, issuance of trade license etc. It should be remembered that no one has the legal right to do anything on his private land

CHAPTER: 06 ANALYSIS & PRESENTATION OF DIFFERENT FACTORS CONTRIBUTED TO THE PROLEMS AND PROSPECTS OF INFORMAL PLASTIC RECYCLING INDUSTRY IN DHAKA CITY

6.0 Analysis of Data

Every respondent was asked certain questions that provided certain profile, behavioral psychological & socio-economic data like age structure, sex, educational status monthly income & expenditure, ownership pattern, capital investment, rent, size of industry, types of recyclable plastics, number of similar industry, year of establishment, number of employees with job specification, wage type & rate, working hrs, land use, information of machinery regarding plastic recycling, maintenance cost, negative consequences of plastic recycling, utility services, forward & backward linkages, factors/reasons for establishment of plastic recycling industry in the surveyed areas and finally identification & priority ranking of problems of informal plastic recycling industry in Dhaka City. The following table gives a quick view of the factors that help to fulfil the objectives of the present research:

Table: 6.0 Basic Factors discussed in the Analysis Chapter

Objectives	Factors
1. To study the forward and backward linkages of informal plastic waste recycling industries in order to contribute to waste management & environmental improvement.	Socio-economic & demographic characteristics of respondents, Industry Type, Year of Establishment, Working days, Location of Industry, Machinery Information, Utility Services, Connection Pattern, Negative/Adverse Consequences, Reasons for selecting the areas, Name-Source-Price-Demand & supply of raw materials & semi/unfinished/finished recycled plastic products.
2. To identify the problems and constraints faced by the informal plastic recycling industries.	Problems related to raw materials, Capital/Financial Incentives, Govt. Harassment, Occupational Health & Safety, Technical Assistance, Energy/Utility Services, Availability of Skilled Labor, Quality Control, Marketing, Deprivation of actual product prices due to other forces, Transportation of both inputs and outputs, Seasonal (On/Off), Proximity of Medical Facilities during Accidents, Lack of Fire Protection/Fire fighting, Lack of First Aid or other preventive measures, Lack of Govt. Policies, Power interruption/Load Shading, Accidents, Health Risk during sorting & washing, Management, Co-relation Problem between linkages, Low Profit Margin (B/C < 1.0), Working Environment, Quality marking and standardization maintenance, Inferior quality, Social Acceptance, Marketing Difficulties, Informal Taxation, Informal Finance (Credit & Interest Rate), Maintenance of Machinery & Equipment, Intermediate Treatment Site, Proper Legislative & Regulatory Measure, Proper Organization/Committee, Industrial Zone.
3. To find out areas where the informal plastic recycling industries need help or support.	After finding the facts certain problematic areas will be identified through priority ranking.
4. To recommend policies for the development of informal plastic waste recycling industries in Dhaka City.	After finding the problematic areas as well as facts and reviewing the existing guide lines & expert opinions, final policy formulation will be made.

6.1 Age Structure

It has been found through the survey that 38% of the respondents are in the age group of 30-39 years & 20-29 years with the similar percentage comprise the major respondents. Only 8% of the respondents are within the age group of below 20 years while 2% of the respondents are in the older age group of 50-59 years. These demographic data depicts the similarity of earning age group of national level.

Table: 6.1 Age Structure of the Respondents

Age Group	Frequency (F)	Percentage (%)
0-19	4	8
20-29	19	38
30-39	19	38
40-49	7	14
50-59	1	2
60+	-	-
Total	50	100

Source: Field Survey, 1999

6.2 Educational Status of the Respondents

From Survey, it is found that major portion of the respondents (44%) had lower level of education i.e. primary schooling. Only 4% of the respondents are graduate whereas 10% of the respondents are totally illiterate. There is no Master degree holder among the respondents. Table: 6.2 Educational Status of the Respondents

Educational Status	Frequency (F)	Percentage (%)
Illiterate	5	10
No Schooling	4	8
Read Only	2	4
Primary Schooling	22	44
Secondary Schooling	11	22
Higher Secondary	4	8
Graduate	2	4
Masters	-	-
Others	-	-
Total	50	100

Source: Field Survey, 1999

6.3.a Monthly Income

It has been found from field survey that 36% of the Plastic Recycling Industry earned less than or equal to Tk. 10 thousand per month. Another 36% earned Tk 11 to 20 thousand per month. There are only 2% which income per month goes over 30 to 60 thousand per month.

Table: 6.3 (a) Monthly Income (in '000 Tk.)

Amount ('000 Tk.)	Frequency (F)	Percentage (%)
⊆ 10	18	36
11-20	18	36
21-30	8	16
31-40	1	2
41-50	1	2
51-60	3	6
60+	1	2
Total	50	100

Source: Field Survey, 1999

6.3.b Monthly Expenditure

Expenditures of most of the Informal Plastic Recycling Industry (28%) go over Tk. 5 thousand per month. There are expenditures of Tk. 10-20 thousand per month of Plastic Recycling Industry (18-24%) which are the second highest expenditures found from the survey. Apparently the gross benefit found from survey is very low considering the monthly Income & expenditures.

Table: 6.3 (b) Monthly Expenditure (in Tk.)

Amount (Tk.)	Frequency (F)	Percentage (%)
⊆ 5000	14	28
5001-10000	8	16
10001-15000	12	24
15001-20000	9	18
20001-25000	3	6
25001-30000	1	2
30001-35000	-	-
35001-40000	2	4
40000+	1	2
Total	50	100

Source: Field Survey, 1999

6.4.a Ownership Pattern

It has been found from the survey that 52% of the respondent industry is of 'Rent Category' whereas 46% is 'Owned Category'. Only 2% of the surveyed industry have ownership pattern of leasing or buying position. Among owned pattern 48% of the respondent possess the industry as family business whereas 34% & 17% are individual & partnership pattern respectively

Table: 6.4 (a) Ownership Pattern

Type	F	%	Sub Type	F	%
Owned	23	46	Individual	8	34.78
			Family	11	47.83
			Partnership	4	17.39
Rented	26	52	Total	23	100.0
Others (Lease/Buying Position)	1	2			
Total	50	100			

Source: Field Survey, 1999

6.4.b Amount of Rent

From field survey, it has been found that 46.15% of the respondent which ownership pattern is 'rent' pay less than Tk 2000 per month as rent. There are 3.86% of the respondent who pay higher rent of above Tk. 8000 per month. This type of industry is less in number and their size is
quite big (>= 3500 sq. ft.)

Table: 6.4 (b) Amount of Rent

Amount (Tk.)	Frequency (F)	Percentage (%)
⊆ 2000	12	46.15
2001-4000	5	19.23
4001-6000	4	15.38
6001-8000	4	15.38
8000+	1	3.86
Total	26	100.0

Source: Field Survey, 1999

6.5 Capital Investment

Most of the Industry (34%) has Capital Investment of more than Tk. 2 lac. These are mostly due to the cost of machinery. The higher the industry size, the more number of machinery & so do capital investment. It is also important to observe that there is also 34% industry whose capital investment is less than Tk. 50000. This is the reverse situation of high capital invested industry.

Table: 6.5 Capital Investment

Amount (Tk.)	Frequency (F)	Percentage (%)
⊆ 50,000	15	30
50001-1 lac	12	24
1 lac-1.5 lac	4	8
1.5 lac-2 lac	2	4
2 lac+	17	34
Total	50	100

Source: Field Survey, 1999

6.6 Size of the Industry

Most of the surveyed industry (56%) has lower size (<=500 sq. ft.). Only 4% of the surveyed industry are big in comparison to smaller industry. Land is limited & costly in the survey area.

Table: 6.6 Size of the Industry

Area (sq. ft.)	Frequency (F)	Percentage (%)
⊆ 500	28	56
501-1000	8	16
1001-1500	9	18
1501-2000	2	4
2001-2500	1	2
2501-3000	-	-
3001-3500	-	-
3500+	2	4
Total	50	100

Source: Field Survey, 1999

6.7 Type of Recyclable Plastics

Although there is a large variety (>30) of recyclable plastics found from the survey, it has been found that 66% of the surveyed industry do recycle only 1-2 items, 22% of the industry recycle 3-4 items. Only 2% of the plastic recycling industry do large scale of plastic recycling comprising 7 to 10 items. The recyclable plastics are: Plastic Dana (red, white, blue, yellow, green, locally made /foreign, Powder, Hard Dana (HDP), PP Dana, Rejected Polythene, Shopping bag, Plastic bag, Bodna, Gallon, Balti, Pipe, Plastic Bottle, Jug, Boyam, Foot of Rickshaw, Wall Cloth, Recksin (Baby Taxi, Bus Seat Cover), Road Khasta, Plastic Shoe, Fita, Mandex LD, Hyem Pex, Crystal, Fertilizer Bag, Milk Bag, Plastic Paper (SDP), Bobin, Gamla, Sole of Shoe, High Broz, PVC Pipe, Hyne Bag, Titaneum, DUP. Alkathene, Marlex Powder etc.

Table: 6.7 Type of Recyclable Plastics

Type	Frequency (F)	Percentage (%)
1-2	33	66
3-4	11	22
5-6	4	8
7-8	1	2
9-10	1	2
10+	-	-
Total	50	100

Source: Field Survey, 1999

6.8 Number of Similar Industry in Survey Area

It has been found from the survey that most (40%) of the Plastic Recycling Industry is situated in Lalbagh-Islambagh area. But a lot of variation in case of similar industry came out of the respondents For example, in Lalbagh, 75% of the respondents told that there were<= 50 similar industry in that area whereas 15% of the respondents told it 50 to 100, 5% told 101-150 number of similar industry exist there. These figures vary because these industry are informal, have no registration, tax file or record. So it is quite difficult to identify the proper number of similar type of industry. Even there is no organization to keep the track of these industries. From survey, it has been found that in Lalbug, the Plastic Recycling Industry is mostly situated in Ward No. 3, 59, 60, 63, 64 & 65 i.e. Postagola, East Islambagh, Itawalaghat, Chunawalaghut, Kamalbagh, Urdu Road (Noakhali Building), Shaheed Nagar & Killar More; in Rahmatganj, these industry are situated at Water Works Road, Nizambug & Chadnighat whereas in Kamrangichar, mostly situated in Nurbagh & Aslambagh which is the south periphery of Dhaka City.

Table: 6.8 Number of Similar Industries in Survey Area

Area	Kamrangichar		Lalbagh/Islambagh		Rahmatganj	
Range	F	%	F	%	F	%
⊆ 50	5	84	30	75	2	50
51-100	1	16	6	15	-	-
101-150	-	-	2	5	2	50
151-200	--	-	1	2.5	-	-
200+		-	1	2.5	-	-
Total	6	100	40	100	4	100

Source: Field Survey, 1999

6.9 Year of Establishment

It has been found that most of the Plastic Recycling Industry (36%) was established within 1990 to 1995. There is a trend of growth increase from 1971 to update. So it is obvious that Plastic Recycling is giving emphasis with the increase of plastic use. From literature review, it is found that plastic is being used for years but the concern of plastic recycling started in our since 1983 as the first formal plastic industry named Islam Plastic launched their recycling program in the same year at Begun Bazar in Dhaka. Though informal plastic recycling has been going on since 1971 in Dhaka City.

Table: 6.9 Year of Establishment

Year	Frequency (F)	Percentage (%)
1971-1975	4	8
1976-1980	1	2
1981-1985	5	10
1986-1990	10	20
1991-1995	18	36
1996-2000	12	24
Total	50	100

Source: Field Survey, 1999

6.10 Working Days in last Fiscal Year

It has been found from the survey that most of the Plastic Recycling Industry (about 50%) had working days of 250 to 300 days in the last fiscal years. There are some interruptions due to flood as the survey areas (Lalbagh, Rahmatganj, Kamrangichar) are sometimes vulnerable to natural disasters. During survey some remarkable answers were found in case of working days. Some told that their working days in last fiscal year is equal to Govt.'s working days. This showed their attitude & commitment towards plastic recycling.

Table: 6.10 Working Days in last Fiscal Year

Days	Frequency (F)	Percentage (%)
≤ 200	4	8
201-250	11	22
251-300	25	50
301-350	10	20
350+	-	-
Total	50	100

Source: Field Survey, 1999

6.11 Type of Industry

It has been found from the survey that all the surveyed industry were informal. We make sure that no formal industry can come to our analysis. Most of the IPRIs (about 90%) are called by the name of the owner like Gafur's Plastic, Eusuf's Factory where Gagur and Eusuf are the owners of the informal plastic recycling industry (See Appendix- Name, Address and Owner of the Surveyed IPRIs).

Table: 6.11 Type of Industry

Type	Frequency (F)	Percentage (%)
Formal	-	-
Informal	50	100
Total	50	100

Source: Field Survey, 1999

6.12.a Total Number of Employees/Workers

It has been found from the survey that 46% of the Plastic Recycling Industry have employees less than 5 persons, 26% of the surveyed industry have employees 6 to 10 persons. Only 10% industry has employees more than 15 So it is obvious that these industry are larger in comparison with the first one.

Table: 6.12 (a) Total Number of Employees/Workers

Range	Frequency (F)	Percentage (%)
≤ 5	23	46
6-10	13	26
11-15	3	6
16-20	5	10
21-25	1	2
25+	5	10
Total	50	100

Source: Field Survey, 1999

6.12.b Gender of Employees/Workers with Job Specification

It has been found from the survey that 81% of the workers are male, 15% are female & only 4% workers are children. From survey it is found that there are different types of job occurred in plastic recycling industry. These are. Cutting, Molding, Machine Operating, Packaging, Porting, Washing, Cleaning, Sorting, Hand machine operating, Spraying, Dye mixing etc. Women & children are mostly used in sorting & cleaning heterogeneous plastic wastes. Most of the employees have to do multiple jobs in the same industry.

Table: 6.12 (b) Gender of Employees/Workers with Job Specification

Gender of Workers	Frequency (F)	Percentage (%)
Male	428	81
Female	78	15
Children	23	4
Total	529	100

Source: Field Survey, 1999

6.13.a Wage Type

From survey, it has been found that 50% of the industry pay their employees on monthly basis whereas 30% of the Plastic Recycling Industry pay on day basis. There are also weekly payments & contract cum production based payments (Wage/Gruce, 1 Gruce = 144 pieces or 12 dozens) though low in percentage. It is also noticeable that wage rate varies with job specification & importance. It maintains higher to lower hierarchy.

Table: 6.13(a) Wage Type

Type	Frequency (F)	Percentage (%)
Day Basis	15	30
Monthly Basis	28	56
Hourly	-	-
Weekly	1	2
Contract/Production Basis	6	12
Total	50	100

Source: Field Survey, 1999

6.13.b Wage Rate

It has been found through the survey that 38% of the surveyed industry pay salary of Tk. 1501-2000 per month to their employees. 26% of the Plastic Recycling Industry pay less than Tk. 1500 per month to their employees. 22% of the surveyed industry pay higher wage rate of more than Tk. 2500 per month

Table: 6.13 (b) Wage Rate (in Tk./Month)

Amount (Tk.)	Frequency (F)	Percentage (%)
≤ 500	-	-
501-1000	1	2
1001-1500	12	24
1501-2000	19	38
2001-2500	7	14
2500+	11	22
Total	50	100

Source: Field Survey, 1999

6.14 Working Hours/Day

50% of the surveyed industry have their employees with working hr. ranges from 9 to 16 while 48% of the industry run according to ILO (International Labor Organization) Working Hr. Schedule i.e. 8 hr.s /day. It is also found that the working hr.s over '8' is not counted as 'over time' in all the surveyed industry.

Table: 6.14 Working Hours/Day

Working Hr.	Frequency (F)	Percentage (%)
≤ 8	24	48
9-16	25	50
16+	1	2
Total	50	100

Source: Field Survey, 1999

6.15 Land Use of Surrounding Area

It has been found from the survey that, 98% of the industry is located in mixed land use area i.e. area where residential, commercial & industrial uses are intermingling. This provides lower transportation cost of workers providing lower living cost within their working areas.

Table: 6.15 Location of Industry / Land Use of Surrounding Area

Area	Frequency (F)	Percentage (%)
Residential	-	-
Commercial	1	2
Industrial	-	-
Mixed Land Use	49	98
Others	-	-
Total	50	100

Source: Field Survey, 1999

6.16.a.i Number of Plastic Recycling Machinery

It has been found from the survey that 46% of the Plastic Recycling Industry possess 2 to 3 recycling machinery. 32% of the industry have only one recycling machine. It is also worthy to mention that only one surveyed industry has no plastic recycling machine. It do only sorting.

Table: 6.16 (a) i. Number of Plastic Recycling Machinery

Range	Frequency (F)	Percentage (%)
≤ 1	16	32
2-3	23	46
4-5	8	16
5+	3	6
Total	50	100

Source: Field Survey, 1999

6.16.a.ii Type of Plastic Recycling Machinery

It has been found from the survey that 51% of the Plastic Recycling machine is Plastic Hand Molding type, Chapti machine & Dana machine are 12% each. Other machines are less in number & use. For single machine plastic industry, plastic hand molding machine is prominent.

Table: 6.16 (a) ii. Type of Plastic Recycling Machinery

Type	Frequency (F)	Percentage (%)
Chapti	17	12
Cutting	11	8
Dana	17	12
Blue Auto	2	1.5
Plastic Hand Molding Machine	71	51
Production	10	7
Hambowling	6	4
Air Machine	3	2
Cooling	1	1
Injection	2	1.5
Total	140	100

Source: Field Survey, 1999

6.16.b Operation Type

From survey, it has been found that 44% of the surveyed industry operate their plastic recycling machinery manually, 18% of the industry has automatic machine & 34% industry has semi-auto machine which are operated both automatically & manually.

The 'others' category consists no machine & both manually, auto & semi-auto recycling machines

Table: 6.16 (b) Operation Type

Type	Frequency (F)	Percentage (%)
Manually	22	44
Automatic	9	18
Semi-auto	17	34
Others	2	4
Total	50	100

Source: Field Survey, 1999

6.16.c Machinery Manufactured in

From survey, it has been found that 90% of the plastic recycling industry have their machinery manufactured locally, 4% has foreign or imported recycling machinery. Another 4% have plastic recycling machinery assembled locally but parts are foreign. It is noticeable that 2% of the surveyed industry have mixed recycling machinery i.e. some foreign & some locally made Small helpful machinery is being tried to manufacture locally to reduce the capital cost.

Table: 6.16 (c) Machinery Manufactured in

Type	Frequency(F)	Percentage (%)
Locally	45	90
Foreign/Imported	2	4
Mixed	1	2
Others*	2	4
Total	50	100

Source: Field Survey, 1999

Note: * Locally Made & Imported Machinery Separately

6.16.d.i Maintenance of Machinery

It has been found through the survey that 64 percent of the plastic recycling industry consider the maintenance of their machinery to be easy. 36 percent found it to be difficult though not any plastic recycling machinery found impossible to maintain or repair. It is an encouraging matter of continuing plastic recycling.

Table: 6.16 (d) (i) Maintenance of Machinery

Type	Frequency (F)	Percentage (%)
Easy	32	64
Difficult	18	36
Impossible	-	-
Total	50	100

Source: Field Survey, 1999

6.16.d.ii Average Maintenance Cost per month

It has been found through field survey that 28% of the surveyed industry have maintenance cost of their machinery less than Tk. 500 per month. 26% of the industry has maintenance cost greater than Tk. 2000 per month. Some machinery is difficult to repair but maintenance costs is cheap & vice versa.

Table: 6.16 (d) (ii) Average Maintenance Cost per month

Amount (Tk.)	Frequency (F)	Percentage (%)
⊆ 500	14	28
501-1000	10	20
1001-1500	10	20
1501-2000	3	6
2000+	13	26
Total	100	100

Source: Field Survey, 1999

6.16.e Negative Consequences of Machinery

It has been found from the survey that 'Extreme Heat' (60%), Noise (60%), Flammable (18%), Hazardous & Noxious Gas Emission (16%) are prominent negative consequences of Plastic recycling Machinery. The negative consequences are mutually exclusive i.e. many negative consequences are common to different industry. The workers could not tell the names of noxious & hazardous gases but they feel that they are producing something that is injurious to health & also harmful to environment. The workers seemed to be used to the negative consequences or they are being adapted. Some negative consequences create respiratory diseases, some are irritating to eyes & skin resulting wounds to hand. It is observed that severity of negative consequences vary.

Table: 6.16 (e) Negative Consequences of Machinery (Multiple Choices)

Type	Frequency (F)*	Percentage (%)
Excessive Heat Producing	30	60
Smoke Provoking	8	16
Hazardous & Noxious Gas Emission	8	16
Flammable	9	18
Irritating	8	16
Noisy	30	60
Hazardous By-product	2	4
Others**	15	30

Source: Field Survey, 1999

Note: * Out of Sample '50'

** Odor & Dust

6.17.a Utility Services

Electricity is the vital utility service needed to plastic recycling industry. As a result all the surveyed industry (100%) have power/electric supply. 24% of the surveyed industry have water supply (for cooling & washing) and only 14% of the plastic recycling industry has drainage facility i.e. connected to Municipal drainage system.

Table: 6.17 (a) Utility Services

Type	Frequency (F)*	Percentage (%)
Power/Electric Supply	50	100
Water Supply	12	24
Drainage Facility	7	14

Source: Field Survey, 1999

Note: * Out of sample '50'

6.17.b.i Cost of Power Supply per month

It is found from the survey that 48% of the plastic recycling industry pay more than Tk. 3500 per month for electric bill 34% of the surveyed industry pay less than Tk. 1500 per month. Electric is subject to industry size, no. of machinery & working hrs. It is also observed that most of the industry has no electric meter.

Table: 6.17 (b) (i) Cost of Power Supply per month

Amount (Tk.)	Frequency (F)	Percentage (%)
⊆ 1500	17	34
1501-2000	1	2
2001-2500	1	2
2501-3000	5	10
3001-3500	2	4
3500+	24	48
Total	50	100

Source: Field Survey, 1999

6.17.b.ii Cost of Water Supply per month

50% of the surveyed industry that have water supply (sample 12) spend more than Tk. 600 per month. 42% spend less than Tk. 200 per month. Water bill is included to rent to some plastic recycling industry. Some bought water from Tube well

Table: 6.17(b) (ii) Cost of Water Supply per month

Amount (Tk.)	Frequency (F)	Percentage (%)
⊆ 200	5	42
201-400	-	-
401-600	1	8
600+	6	50
Total	12	100

Source: Field Survey, 1999

6.17.b.iii Cost of Drainage Facility per month

Only 7 (seven) out of 50 surveyed industry have drainage facility and they spend less than Tk. 200 per month for drainage facility. Other has self-drainage line (slope-wise) which ultimately contribute to municipal drainage system.

Table: 6.17 (b) (iii) Cost of Drainage Facility per month

Amount (Tk.)	Frequency (F)	Percentage (%)
⊆ 200	7	14
201-400	-	-
401-600	-	-
600+	-	-
Total	7/50	

Source: Field Survey, 1999

6.18 Source of Water Supply

From field survey it has been found that 38% of the surveyed industry (sample 13) have WASA connection, another 38% have tube well inside the industry. 16% of the surveyed industry collect water from other sources like buying water, bringing water through illegal motor pump on WASA water lines

Table: 6.18 Source of Water Supply

Source	Frequency (F)	Percentage (%)
WASA	5	38
Tube Well (Hand/Deep)	5	38
River	1	8
Other*	2	16
Total	13	100

Source: Field Survey, 1999

Note: * collecting water through motor pump

6.19 Connection Pattern of Utility Services

It has been found from the survey that 90 percent of the surveyed industry has legal connection of utility services. Only 5 percent of the surveyed industry have illegal connection of utility services. There is no contract based or other connection pattern of utility services found in the survey.

Table: 6.19 Connection Pattern of Utility Services

Pattern	Frequency (F)	Percentage (%)
Legal	45	90
Illegal	5	10
Contract	-	-
Other	-	-
Total	50	100

Source: Field Survey, 1999

6.20 Priority Ranking of Factors/Reasons for the selection of this area for Plastic Recycling

Twenty-six factors or reasons were primarily identified for the selection of the surveyed area (Lalbagh/Islambagh, Rahmatganj & Kamrangir Char) potential for informal plastic recycling industry in Dhaka City. Each respondent was asked to give score of priority to particular factor/reason according to his/her individual perception about the potentiality of that particular factor for the establishment of informal plastic recycling industry to that particular area. The most important factor/reason, therefore, was assigned a value of 26, the 2nd important factor was assigned a value of 25 and so on. This procedure (Hossain, 1992 & Khan, 1996) was followed for twenty-six potential factors of informal plastic recycling industry establishment The sum of the value assigned by the respondents against each of the factor potential for informal plastic recycling industry establishment was calculated. The highest score oriented factor/reason of plastic recycling calculated by above method was given the rank one or 1st priority and the 2nd most important factor was assigned rank two and so on. Ranking of all factors/reasons for informal plastic recycling industry establishment is shown in Table: 20. It has been found from that analysis that the top 10 factors/reasons of informal plastic recycling industry establishment to that particular surveyed area in Dhaka City are: Low Rent (Score: 1080), Availability of Raw Materials (971), Social Facilities (Score: 906), Low Capital Cost [Score: 899], Low Labor Cost (Score: 831), Local Characteristics (Score: 809), Availability of Unskilled Cheap Labor (Score: 782), Low Housing Cost of Workers (Score: 711), Easy Access of Raw Materials (Score: 698) & Low Carrying Cost of Finished Products (Score: 692). It is interesting to state that two factors, Proper Management & Flood free zone, got the same priority ranking (both ranked no. 19 with same score of 591). Similarly

Protection from Govt & Other Harrashments and Scope/Sites of Intermediate Treatment of Plastic Wastes, these two factors ranked no. 24 with same score.

Table: 6.20 Priority Ranking of Factors/Reasons for the selection of this area for Plastic Recycling

Rank	Selection Factors/Reasons for Industry Establishment	Obtained Score*
1	Low Rent	1080
2	Availability of Raw Materials	971
3	Social Facilities	906
4	Low Capital Cost	899
5	Low Labor Cost	831
6	Local Characteristics	809
7	Availability of Unskilled Cheap Labor	782
8	Low Housing Cost of Workers	711
9	Easy Access of Raw Materials	698
10	Low Carrying Cost of Finished Products	692
11	Proper Business Linkages	677
12	Low carrying Cost of Raw Materials	676
13	Easy Communication to market/Accessibility	671
14	Availability of Skilled Labor	662
15	Easy Repair of Machinery	640
16	Availability of Technically Trained labor	634
17	Pleasant Working Environment	622
18	Adequate Utility Services (Gas, water, Electricity & Drainage)	597
19	Proper Management	591
19	Flood Free Zone	591
20	Low Land Value	584
21	Easy Marketing of Finished/Unfinished/Intermediate Products	509
22	Availability of Technical Help from Experts	504
23	Good Law and Order Situation	437
24	Protection from Govt. & Other Harrashments	388
24	Scope/Sites of Intermediate Treatment of Plastic Wastes	388

Source: Field Survey, 1999

Note: * See Appendix- 01

6.21.a Backward Linkages of the Plastic Recycling Industries

It has been found from the survey that all (100%) of the surveyed industry have backward linkages & they collect different types of raw materials from various sources or actors/market systems. From survey, it has been found that 68 percent of surveyed industry collect at least 2 (two) types of raw materials from backward linkages. 28% of the surveyed industry collect 3 to 5 types of recyclable. Very few (only 2%) collect more than 6 (six) types of recyclable from backward linkages.

Table: 6.21 (a) Backward Linkages of the Plastic Recycling Industries

Type of Raw Materials	Frequency (F)	Percentage (%)
≤2	34	68
3-5	14	28
6-8	1	2
8+	1	2
Total	50	100

Source: Field Survey, 1999

6.21.b Type of Actors in Backward Linkages of Plastic Recycling Industries

It has been found from the survey that 72 percent of the surveyed industry collect raw materials from wholesale & retail market situated mostly in Urdu road, Islampur, Bongsal, Noyabazar, Islambagh & Beribandh. 12 percent of the surveyed industry collect recyclable from Vangari Dokan. Only 2 percent collect recyclable from factory & hawkers. In others category, 4 percent industry collect recyclable from outside of Dhaka.

Table: 6.21 (b) Type of Actors in Backward Linkages of Plastic Recycling Industries

Type of Actors/Market System	Frequency (F)*	Percentage (%)
Vangari Dokan	6	12
Tokai/Scavengers	4	8
Wastage of Factory	1	2
Industry	3	6
Market	36	72
Hawker	1	2
Party/Middle man	3	6
Others	2	4

Source: Field Survey, 1999

Note: * Out of sample '50' (mutually inclusive/ multiple choices)

6.22.a Number of Actors/Market System in Forward Linkages

It has been found from the survey that 24% of the surveyed industry has forward linkages to Chalk Bazar, a well-known market system or actor for both retail & whole sale of finished, unfinished & intermediate plastic recycled products. Urdu road comes at third position with 10% recycling industry support. There is 24% in others category for forward linkages which comprises Bongsal market, Company & factory.

Table: 6.22 (a) Number of Actors/Market System in Forward Linkages

Type	Frequency (F)*	Percentage (%)
Gulistan	1	2
Chalk Bazar	12	24
Imamganj	2	4
Mitford	6	12
Urdu Road	5	10
Bakery	1	2
Whole Sale Market	4	8
Alu Bazar	1	2
Screen Print Factory	1	2
Islambagh (Lalbagh)	3	6
Order wise/Party	4	8
Medicine Company	1	2
Others	12	24

Source: Field Survey, 1999

Note: * Out of sample '50' (mutually inclusive/ multiple choices)

6.22.b Type of Forward Linkages

It has been found from survey that 62% of the surveyed industry has forward linkages with finished product while 32% have forward linkages with unfinished or

intermediate products. Only 6% industry has forward linkages with market system or actors providing both finished & unfinished recycled plastic products.

Table: 6.22 (b) Type of Forward Linkages

Type	Frequency (F)	Percentage (%)
Finished	31	62
Unfinished/Intermediate Product	16	32
Others (Both F & UF Product)	3	6
Total	50	100

Source: Field Survey, 1999

6.22.c Type of Finished/Unfinished/Intermediate Products

It has been found from the survey that all (100%) of the surveyed industry have forward linkages & they supply different types of finished, unfinished & intermediate products to various actors/market systems [Table: 21(a)]. The products are supplied to factory & wholesaler of Lalbug, Noyabazar, Bongsal & Islambug. It has been found from the survey that 72 percent of the surveyed industry supply at least two of the above finished products while 22 percent industry supply 3 to 5 items. Only 6 percent of the plastic recycling industry supply more than six items to forward linkages.

Table: 6.22 (c) Type of Finished/Unfinished/Intermediate Products

Range	Frequency (F)	Percentage (%)
≤2	36	72
3-5	11	22
6-8	3	6
8+	-	-
Total	50	100

Source: Field Survey, 1999

6.23 Inputs and Outputs from IPRIs

It has been found from field survey that more than fifty items come out as Recycled Products from about forty different types of salvaged plastic wastes. It signifies the diversity of plastic products in the plastic recycling chain of Dhaka City. Though there is no implication of adopting plastic recycling code during the recycling process. So mixed plastics are being salvaged & consequently recycled I throughout Dhaka City.

Table: 6.23 List of Inputs and Outputs from IPRIs

Inputs (Salvaged Plastic Waste)	Outputs (Recycled Product)
Plastic Dana/Clups	Nail Polish Caps, Tool/Bench (Mora), Glass, Cup (Bati), Chair, Veil/Blinker (Dhakna), Box, Cup-Plate-Saucer, Small Hand Fan, Ball, Top. Sword, Mirror Frame, Dolls, Spectacles, Hair Clip and Band, Watch, Comb, Bangle (Churi), Plastic Shoe, Toys, Ornament Tray, etc.
Vangari & Industrial Scrap/Wastage	Plastic Gallon, Dana, Jar (Boyam), Toys, Pitcher (Plastic Kolshi), PET Bottle etc.
Oil Gallon, Bobin	Water Pitcher/pot (Bodna), Slate, Playing Bat, Ink Pot, Jar etc.
Plastic Bag, Shopping Bag, Black Polythene, Fertilizer Bag, Milk Bag	Chapti, Plastic Dana, Container of burnt Tobacco (Gul's Pot), Buscuit Dizes, Veil, Wall Cloth etc.
Plastic Resin	Glue Container (Aika)
Rickshaw Foot, Wall Cloth, Seat Recksin	Padel, Brake Shoe of Rickshaw
Discarded Slipper/Sandal, Shoe, Lace, Sole	Dana, Chapti, Shoe of different Color
PP, Malless, Alkatin, PVC, Crystal, Hiempex, HDP, High Bros	Water Container (Bulti), Dana, Football, Pipe, Elbo, T, Sanitary Pan, Kayol, Filter Cap, Foot Palenger, Scale, Plastic Slate, Gallon Cap, Medicine Cap, Spoon, Drop Boule, Gallon, Jug, Colander/Sieve/Strainer (Jasri), Poly bag, Flux, Clip Hanger etc
Drum Chapti, Black Hard Plastic (Cover of Radio/TV)	Tobacco Powder Container, Cap etc.
Molted LD, SDP	Plastic Dana

Source: Field Survey, 1999

6.24 Priority Ranking of Problems Faced by Plastic Recycling Industry

Thirty-four problems were primarily identified that are related to plastic recycling of informal industry in Dhaka City. Each respondent was asked to give score of priority to particular problem according to his/her individual perception about the plastic recycling problem. The most important problem, therefore, was assigned a value of 34, the 2nd important problem was assigned a value of 33 and so on. This procedure was followed for thirty-four problems of informal plastic recycling industry. The sum of the value assigned by the respondents against each of the problem of plastic recycling was calculated The highest score oriented problem of plastic recycling calculated by above method was given the rank one or 1st priority and the 2nd most important problem was assigned rank two and so on. Ranking of all problems of informal plastic recycling industry are shown in Table: 23 It has been found from that analysis that the top 10 problems of informal plastic recycling industry in Dhaka City are: Power Interruption/Load Shading Problem (Score: 1550), Capital/Financial Incentives Problem (1309), Raw Material (Score: 1256), Low Profit Margin Problem (B/C < 1.0) [Score: 1236], Energy/Utility Services (Score: 1188), Marketing Problem (Score: 1186), Seasonal Problem (On/Off Season) [Score: 1172], Availability of Skilled Labor Problem (Score: 1053), Lack of Fire Protection/Fire Fighting Problem (Score: 1030) & Accidents (Score: 1000)

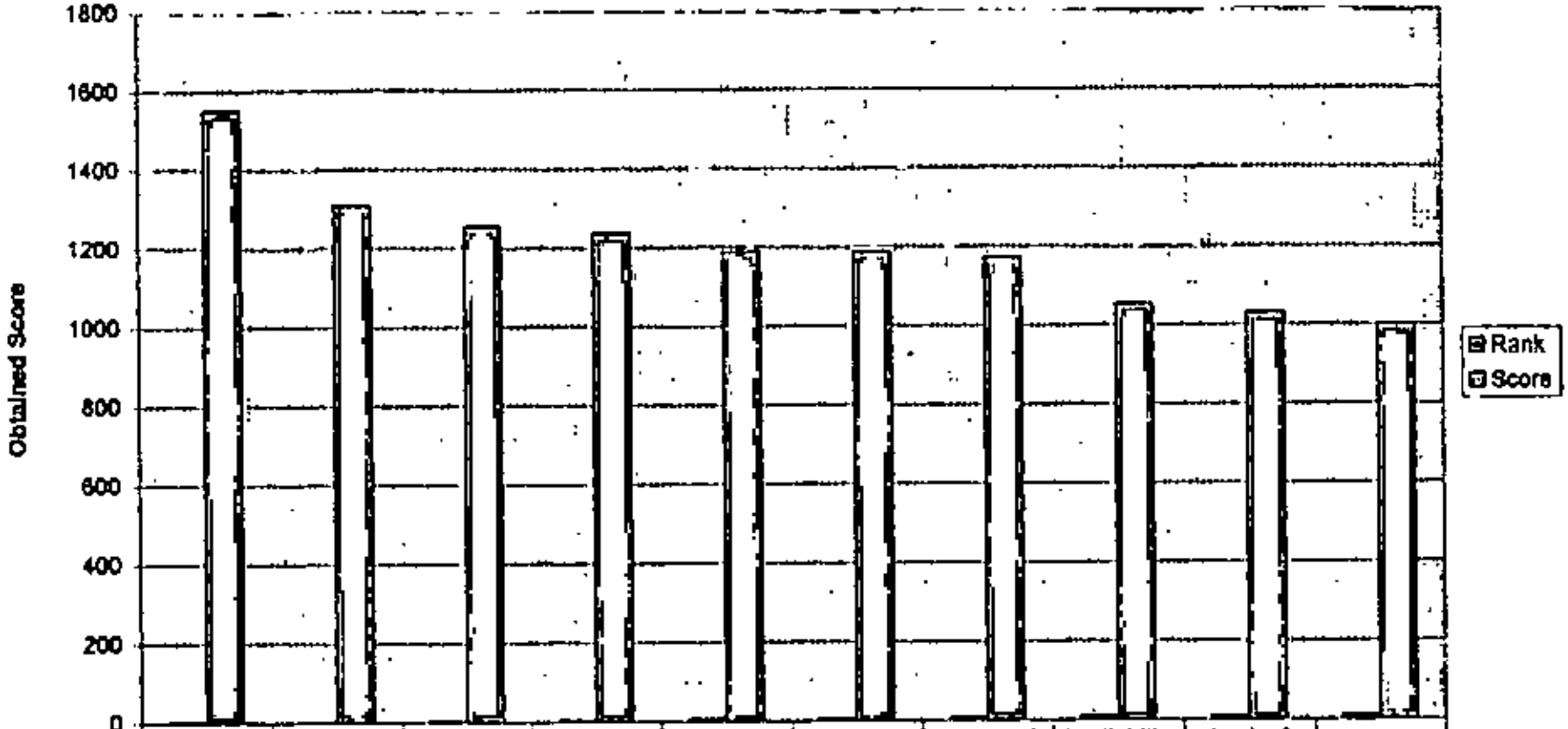
Table: 6.24 Priority Ranking of Problems Faced by Plastic Recycling Industry

Rank	Problems Related to	Obtained Score*
1	Power Interruption/Load Shading Problem	1550
2	Capital/Financial Incentives	1309
3	Raw Material	1256
4	Low Profit Margin Problem (B/C < 1.0)	1236
5	Energy/Utility Services	1188
6	Marketing	1186
7	Seasonal Problem (On/Off Season)	1172
8	Availability of Skilled Labor	1053
9	Lack of Fire Protection/Fire Fighting	1030
10	Accidents	1000
11	Technical Assistance	966
12	Occupational Health & Safety	943
13	Proximity to medical Facilities during Accident	929
14	Marketing Difficulties	901
15	Lack of Govt. Policies for Plastic Recycling Industry Improvement	887
16	Health Risk during Sorting & Washing	834
17	Quality Control	824
18	Lack of Proper Organization/Committee	823
19	Management Problem	800
20	Lack of First Aid & Other Preventive Measures	763
21	Transportation Problem for both Input & Output	762
22	Informal Finance Credit & Interest Rate	758
23	Govt. Harassment	718
24	Deprivation of Actual Product Prices due to other forces	707
25	Working Environment	682
26	Co-relation Problems between Linkages	671
27	Quality Marking & Standardization Maintaining	668
28	Inferior Quality Problem	660
29	Maintenance of Machinery & Equipment	657
30	Socially Acceptance Problem	629
31	Lack of Industrial Zone	594
32	Informal Taxation	544
33	Intermediate Treatment Site Problem	533
34	Proper Legislative & Regulatory Problem	507

Source: Field Survey, 1999

Note. * See Appendix- 02

Graph: 01 Top 10 Problems Faced by IPRIs



	Power Interruption /Load	Capital/Financial Incentives	Raw Material	Low Profit Margin (B/C<1.0)	Energy/Utility Services	Marketing	Seasonal Problem (On/Off)	Availability of Skilled Labor	Lack of Fire Protection	Accidents
Rank	1	2	3	4	5	6	7	8	9	10
Score	1550	1309	1256	1236	1188	1186	1172	1053	1030	1000

Problems related to

CHAPTER: 07 SUMMARY FINDINGS AND RECOMMEDATIONS

7.1 Introduction

Throughout the field survey on numerous aspects of informal plastic recycling industries at Dhaka City, it is observed that different problems associated with plastic recycling are intermingled and interrelated to each other On the basis of the analysis of the data collected by questionnaire survey, some generalizations have been pointed out and some policy guidelines are formulated.

7.2 FINDINGS

1. The sex ratio (Male : Female) of workers/employees in surveyed IPRIs is 1 : 0.18 i.e. the sample is a male dominated one. This is because, most of the works in informal plastic recycling industries are somehow technical and male workers are usually familiar to technical works (operating & maintaining machinery) rather than female workers Female workers and child labors are employed in early stage of plastic recycling chain. They do the jobs of sorting, washing and cleaning of heterogeneous plastic wastes and make it ready to be used as raw materials in the recycling industries.

2. The surveyed sample is also an earning group dominated one (76%) with an age limit of twenty to below forty. Most of them are found to be entrepreneur and at the same time worker of the surveyed informal plastic recycling industry

3. It is found that most of the entrepreneurs (44%) of IPRIs have lower level of educational background i.e. only primary schooling. So, it hampers the better understanding and communicating to different organizations that may come forward to discovering the prospects of IPRIs in Dhaka City

4. Apparently it has been found from the survey that IPRIs are nominal profit making considering the monthly income and expenditures.

5. The ownership pattern of IPRIs depicts the relationship of hardship and survival of these industries in spite of different problems identified by the entrepreneurs. From survey, it is found that most of the IPRIs are established on private houses where the owner started the business in his territory. So most of the IPRIs are called by the name of the owner. Some industries are rented though the rents are house rents not the rent of an industry. These industries are family businesses that survive with the family of the entrepreneur. So most of the rents of surveyed IPRIs are below Tk. 2000 per month that resembles rents of residential housing.

6. It has been found from the survey that capital investment of IPRIs varies with industry size, number of employees, no & type of recycling machinery, inputs & future scope of expansion. As most (56%) of the IPRIs has lower industry size (<=500 sq. ft.), their capital investment is not so high (>= 2 lacs.). It is also important to state that land is limited & costly in the survey area. So it is quite difficult to make expansion of these IPRIs. Moreover, more technical recycling machinery is not affordable by the poor entrepreneurs.

7. It has been found that a wide variety (>30 units) of plastic wastes are being recycled in the IPRIs of Dhaka City which are similar or acceptable according to Plastic

Identification Guide stated in the earlier chapter (Table: 2 3) though there is no attempt to recycle plastics according to resin type or plastic codes. Most of the recycling is done on mixed plastic resins that consequently reduce the quality of outputs of these IPRIs i e. inferior quality products ultimately comes out of these industries. Some plastic waste got names used by local user which need more chemical research to identify their recycle codes and properties.

8. Most of the IPRIs are found in the locality of Ward No. 3, 59, 60, 63,64 & 65 of DCC where the surrounding land use is mixed. These wards are situated at the south periphery areas of Dhaka City with easy access to river Buriganga. Easy river communication, opportunity of processing plastic wastes (i.e. sorting, washing, burning, drying) on embankments of that particular river encourage entrepreneurs to establish the IPRIs in that locality. Moreover, most of the employees of IPRIs are urban poor of Dhaka City who live in temporary slums established on that embankment.

9. It has been found form the survey there is trend of growth increase of IPRIs since 1971 and the most growth update was found in between year 1991 & 1995. Eighteen more IPRIs were added with the existing IPRIs within that time frame. There are still chances of establishing newer industry in this sector with the growing concern of protecting and conserving environment of Dhaka City.

10. It has been found from the half of the surveyed IPRIs that they remained open at almost all working days throughout the last fiscal year. This is quite encouraging commitment towards plastic recycling & also showed their professionalism in industrial sector.

11. Most (46%) of the surveyed industries have employees less than five persons and have no registration. So the industries resembles informal as per definition of informal industry.

12 It has been found from the survey that some portion of informal sector of Dhaka City is employed into diversified jobs in these IPRIs The job specifications are found as Washing, Cleaning, Sorting, Cutting-Molding-Hand Molding etc. Machine Operating, Spraying, Dye Mixing, Stacking etc. Most of the employees have to do multiple jobs in the same industry, as the owners can not afford to keep separate employee for each different type of job needed in his industry.

13. It has found from the survey that most of the IPRI pay their employees on monthly basis. Some industries pay on production or contract basis but they are limited in number. No industry was found that pays on hour basis. It was noticeable that wage rate varies with job specification and importance. It maintains higher to lower hierarchy. Like operators at the early stage of plastic recycling system (Female & Child labor) are paid less than end operators who work inside the industry with recycling machinery. Though operators at the early stage of recycling work at more vulnerable conditions.

14. Most of the employees work 9 to 16 hours but the hours over eight hours are not counted as "over time" in any of the surveyed IPRIs

15. Most of the IPRIs (46%) possess 2 to 3 recycling machines whereas 32 percent of surveyed industry possess only single recycling machine. Among ten types of different recycling machinery Plastic Hand Molding Machine, Chapti Machine and Dana Machines are found most popular. Other types of machines like cutting, blue auto, production, hambowling, cooling & injection are less in number and use. Most of these machines are operated manually with some exception of auto and semi-auto machines. Most of the

machinery are found locally manufactured with easy maintenance. The average maintenance cost found in most IPRIs is Tk. 500 per month. Some machinery is difficult to repair but maintenance costs is cheap and vice versa.

16. Constant supply of basic utility services (power, water) is highly necessary for the smooth production and sustainability of these industries in the total industrial sector of the country. Because no recycling machine can be operated without electricity. This need has been given the most priority by the surveyed IPRIs. As the IPRIs are informal and have registration, they do not possess electric meter in their compounds. But 95 percent of the IPRIs have legal connection of utility services and they pay more than Tk. 3500 per month for power consumption. It is also found that 50 percent of the IPRIs have water supply from DWASA where they spend more than Tk. 600 per month for water that is highly needed for washing and cleaning of contaminated plastic wastes. Some industries used washed and cleaned inputs done on the embankments by some actors of plastic recycling system. Only seven out of 50 surveyed industries have drainage facility and they spend less than Tk. 200 per month for drainage facility. Others have self-drainage line (slope-wise) which ultimately contribute to municipal drainage system.

17. From survey, it is found that the workers got used to different adverse consequences occurred in IPRIs. The entrepreneurs seemed ignore those negative consequences and kept going on. It is found that the working environments of these industries are quite hampered by extreme heat, noise, flames, noxious gas emission, dust and dirt. These negative consequences are undoubtedly injurious to human health and environment if adequate preventive measures are not taken

18. Twenty-four factors that influence in selecting the survey area potential for informal plastic recycling industry development were identified from field survey by using participatory approach. Then to sort the hierarchy of important factors or to find where our priority lies, a priority ranking method was applied. The following factors are responsible for the establishment of IPRIs in survey areas after applying the priority ranking method. Low Rent, Availability/easy access of Raw Materials, Social Facilities, Low Capital & lobar Cost, Local Characteristics, Availability of unskilled Cheap labor, Low cost Housing of workers, Low Carrying Cost of Finished/Unfinished/Intermediate Products, Proper Business Linkages (Both Backward & Forward Linkages), Low Carrying Cost of Raw Materials, Easy Communication to Market/Accessibility, Availability of Skilled Labor, Easy Repair and Maintenance of Recycling Machinery, Availability of Technically trained labor, Pleasant Working Environment, Availability of adequate utility services, Proper management, Flood free zone, Low land value, Availability of Technical Help from Experts, Good Law and Order Situation, Protection from Govt. & other harassment & Sites/Scope of Intermediate Treatment of Plastic Wastes.

19. It has been from found the survey that all of the surveyed IPRIs have backward linkages and they collect different types (>40) of raw materials from various sources or actors/market system. They are Vangari Dokan, Tokai/Scavengers, and Wastage of Factory, Industry, Market (mostly situated in Urdu Road, Islampur, Bongsal, Noyabazar, Islambagh, Shahidnagar Beribandh), Hawker/Ferriwalas, Party/Middle man & others. These actors in backward linkages are interrelated and inter-dependable. It has been found that 68 percent of surveyed industry collect at least 2 (two) types of raw materials

from backward linkages 28% of the surveyed industry collect 3 to 5 types of recyclable. Very few (only 2%) collect more than 6 (six) types of recyclable from backward linkages.

20. It has been found from the survey that more than fifty items come out as recycled products/outputs from the surveyed IPRIs. Some come out as unfinished/intermediate products, which are used as raw materials to different formal industries. It has been found from survey that 62% of the surveyed industry has forward linkages with finished product while 32% have forward linkages with unfinished or intermediate products. Only 6% industry has forward linkages with market system or actors providing both finished & unfinished recycled plastic products The market system of forward linkages of IPRIs is mainly situated at Gulistan, Chalk Bazar, Imamganj, Mitford, Urdu Road, Noabazar, Bongsal, Alu Bazar & Islambagh (Lalbagh). Actors of forward linkages are retailers and wholesalers of these market system, Bakery, Screen Print factory, Orderwise/Party, Medicine Company and others. It has been found from the survey that 72 percent of the surveyed industry supply at least two of the above finished products while 22 percent industry supply 3 to 5 items. Only 6 percent of the plastic recycling industry supply more than six items to forward linkages.

21. Thirty-four problems that hinder the prosperity of informal plastic recycling industry in the surveyed areas were identified from field survey by using participatory approach. Then to sort the hierarchy of adverse problems or to find where our priority lies, a priority ranking method was applied It has been found from that analysis that the top 10 problems of informal plastic recycling industry in Dhaka City are: Power Interruption/Load Shading Problem (Score: 1550), Capital/Financial Incentives Problem (1309), Raw Material (Score. 1256), Low Profit Margin Problem (B/C < 1.0) [Score: 1236], Energy/Utility Services (Score: 1188), Marketing Problem (Score. 1186), Seasonal Problem (On/Off Season) [Score: 1172], Availability of Skilled Labor Problem (Score. 1053), Lack of Fire Protection/Fire Fighting Problem (Score: 1030) & Accidents (Score: 1000). It is also noticeable that all the above problems are inter-related and consequences of others. So remedies of one problem somehow reduces the severity of other problems.

7.3 Recommendations/Policy Guidelines for solving problems and enhancing prosperity of IPRI

- Upgrading of recycling industries through formalization, registration, legalization, credit schemes and other support on the basis of economic, city planning and employment related criteria. Then proper & uninterrupted utility services should be ensured at subsidized rate especially energy and water to IPRIs.
- *Financial assistance* should be provided to IPRIs for meeting fixed and operating capital through different government-affiliated institutions for the promotion of IPR business activities. A cooperative of informal plastic recycling industries can be formed. To receive a loan from a financial institution, this cooperative must have its loan guaranteed by a Credit Guarantee Association (CGA) which are non-profit making organizations supported by government. CGAs in turn apply to different financial institutions to insure the guarantee.
- *Cooperatives:* aid for the joint business activities (such as joint production, joint processing, joint sales, etc.) of different IPRI cooperatives. The role of cooperatives could further be extended to arrange training for the owner-operators and for operatives. It can further provide marketing services and a link with formal institutions and Government agencies to increase exposure of this sector to outside manufacturing activities.

- *Personnel/Vocational training (for human resource development):* a variety of training programs at government institutions for IPR business owner-operators/entrepreneurs and basic training courses for operatives/workers can be arranged.
- *Technological development:* technical training courses at institutions for IPR business and technical assistance by related public and private research institutions. It will help in improving product quality and product diversification.
- *Promotion of small enterprises:* special loans for management improvement, equipment modernization, equipment-leasing system, leasing of high technology & energy-saving equipment can be arranged if there are feasible perspective.
- *Organizing fairs:* For widening IPR trade areas and also technology fairs for IPRI entrepreneurs with modern inventions in Plastic Recycling.
- *Improve Working Environment at all stages of the IPR system.* For example: Hygienic approach (using mask, gloves, rubber shoes, and specially designed collector) should be followed during picking, sorting, cleaning, washing and processing plastic wastes. Proper ventilation and heat reducing mechanism should be available inside of each IPRI. Fire fighting devices and first aid boxes should be available
- *Public awareness* in plastic waste management through should be raised through mass media for cooperation from city dwellers. They can try to do so by using multi-media techniques, like demonstration projects, plays, brochures, processions/rally, T-shirts etc..
- *A new recycle law* should be enacted to encourage or mandate recycling which conserve scarce resources and help to protect the environment with the provision that PET (Polyethylene telephythalate) bottles would be collected and recycled along with card board boxes, paper containers and glass bottles. Plastic recycling policies should be included in the integrated waste management projects of Bangladesh government.
- *Declaration of specific areas* like Lalbag, Islambag and Kamrangichar as *Recycling Zone* and hence Installation of "Waste Industrial Estates" for non-organic (recycling) wastes which different cooperatives, the community based private sector and local authorities would participate in and benefit from
- *Consumer could make a difference by* Changing our attitudes to trash ensure more socially acceptability. They *helping informal plastic recycling by*
  - **Shop carefully-** Avoid single use disposable products ... choose to reuse! *Reuse plastic bags instead of taking a new bag every time one goes to a shop*
  - **Give manufacturers feedback by asking them to use recycle plastic for packaging and other uses.**

7.4 Conclusions

Simply banning the use of a certain plastic material is unlikely to reduce the amount of plastic wastes and its relevant negative consequences. To better manage our plastic waste, we need to create markets that encourage more profitable recycling of paper, plastic, glass, and metals. We need research on the proper infrastructure for more profitable plastic recycling. Therefore, government intervention is necessary in terms of providing access to credit, acquiring improved technology, and training to produce and develop products and marketing services. All these efforts should be in proper integration with other environmental policies through the adoption of environmentally acceptable technology possible.

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APPENDIX:01 PRIORITY RANKING MATRIX FOR FACTORS/REASONS OF SELECTING THE STUDY AREA POTENTIAL FOR INFORMAL PLASTIC RECYCLING INDUSTRIES

Factors/Reasons of Selecting Area for Plastic Recycling Industry	Respondents Scoring of Different Factors/Reasonss For Industry Establishment																								Total Score
	Respondent/Score																								
	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	
Low Rent	22	26	15	13	26	26	26	25	25	26	23	25	25	26	25	24	23	25	25	20	26	2	12	9	26	
Low Land Value	21	18	12	11	16	19	11	4	6	7	8	7	7	5	24	26	1	9	3	2	3	1	2	1	9	
Low Capital Cost	15	17	10	26	17	18	24	18	11	17	26	24	24	23	26	25	25	26	26	26	22	4	1	14	8	C
Flood Free Zone	26	25	2	10	3	1	1	5	9	1	20	13	13	16	8	6	24	22	14	19	2	19	3	10	16	
Low Labor Cost	25	24	9	22	19	17	15	12	14	16	22	26	26	17	23	19	26	21	24	25	10	12	16	6	19	O
Availability of Technically Trained Labor	14	23	7	24	13	15	25	14	12	13	21	10	10	24	11	11	14	7	13	9	1	7	17	20	7	
Availability of Skilled Labor	24	22	6	23	15	16	14	15	13	15	7	1	1	4	5	1	2	5	7	8	19	22	5	21	21	N
Availability of Unskilled Cheap Labor	13	21	25	21	21	23	23	24	24	20	24	18	18	20	22	23	15	24	20	21	18	11	4	3	22	
Low Housing Cost of Workers	23	16	19	3	20	22	8	11	5	10	12	12	12	22	19	20	22	10	16	13	9	16	13	13	20	T
Adequate Utility Services	10	20	5	12	1	2	10	1	3	5	14	17	17	18	15	14	18	15	17	22	6	5	14	19	23	
Local Characteristics	12	19	26	20	24	21	22	13	26	23	11	6	6	3	16	2	3	3	5	4	17	17	26	26	2	I
Availability of Raw Materials	11	15	24	25	23	20	21	23	23	24	25	22	22	25	13	22	17	20	21	15	25	26	25	24	24	
Easy Access to Raw Materials	20	13	22	5	22	14	13	22	22	19	9	5	5	6	17	15	10	4	6	3	7	18	24	25	25	N
Low Carrying Cost of Raw Materials	19	14	23	9	6	4	12	21	21	14	16	20	20	13	14	3	16	19	10	14	6	6	11	22	6	
Easy Communication to Market/Accessibility	18	12	1	19	4	12	20	20	20	25	6	21	21	21	7	16	4	18	22	16	15	23	23	11	4	U
Low Carrying Cost of Finished Products	17	9	21	7	9	3	19	10	4	18	13	23	23	19	21	16	21	23	23	24	5	24	18	8	5	
Marketing of Finished/Unfinished/Intermediate Products	9	8	18	4	11	8	7	8	19	8	2	4	4	7	4	4	5	11	11	10	23	10	19	7	18	E
Proper Business Linkages	16	5	8	8	5	11	18	9	2	11	17	16	16	14	18	8	20	14	12	11	4	25	22	23	15	
Easy Replacement of Machinery	7	7	20	18	12	13	5	19	18	12	5	14	14	15	12	17	19	12	19	23	18	21	10	15	17	
Availability of Technical Help from Experts	8	10	17	17	10	7	4	18	17	9	10	3	3	8	2	9	11	17	8	6	14	9	7	4	1	
Scope/Sites of Wastewater Treatment of Plastic Wastes	5	8	14	2	8	9	17	2	1	3	4	15	15	2	6	10	6	2	4	7	11	3	6	5	3	
Social facilities	4	11	16	16	7	24	9	17	16	22	19	19	19	12	20	21	12	18	18	12	24	20	21	18	13	
Pleasant Working Environment	6	4	13	15	25	25	16	26	15	21	18	9	9	10	3	12	7	1	15	18	21	8	15	17	14	
Proper Management	3	3	11	14	18	6	6	3	8	6	3	11	11	11	10	13	13	6	2	17	20	15	20	12	12	
Good Law & Order Situation	1	1	4	6	14	10	3	7	7	4	15	8	8	9	9	7	9	13	9	1	13	14	9	16	10	
Protection from Govt. & Other Harrassments	2	2	3	1	2	5	2	6	10	2	1	2	2	1	3	5	8	8	1	5	12	13	6	2	11	
Source: Field Survey, 1999	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	

Factors/Reasons of Selecting Area for Plastic Recycling Industry	Respondents Scoring of Different Factors/Reasonss For Industry Establishment Respondent/Score																								Total Score
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Low Rent	26	26	25	25	26	24	1	26	26	8	6	20	25	26	26	24	23	26	23	24	18	19	19	16	26	1080
Low Land Value	3	2	2	24	25	26	26	12	3	6	3	7	9	4	21	23	22	20	25	26	6	18	10	9	21	584
Low Capital Cost	7	18	13	15	24	25	25	24	24	7	5	10	10	25	11	22	12	21	17	23	24	17	18	6	25	609
Flood Free Zone	2	17	12	23	1	1	10	6	25	15	17	9	7	24	9	15	16	5	9	4	11	26	15	3	19	591
Low Labor Cost	20	1	11	18	23	3	5	3	23	5	4	19	5	23	25	21	15	2	21	20	4	24	25	24	24	631
Availability of Technically Trained Labor	4	9	14	20	7	18	4	14	20	4	9	1	6	3	18	20	14	16	13	16	10	9	9	21	13	634
Availability of Skilled Labor	6	10	16	21	6	17	6	23	22	22	7	15	4	22	22	10	8	12	2	12	23	23	24	17	18	692
Availability of Unskilled Cheap Labor	19	11	15	22	5	15	21	2	21	3	8	4	8	21	12	9	4	17	19	1	20	15	16	10	6	782
Low Housing Cost of Workers	18	15	10	19	22	16	20	7	19	9	16	16	16	20	8	8	1	23	15	16	15	3	6	7	16	711
Adequate Utility Services	17	16	9	18	3	14	19	4	17	10	15	5	3	19	15	1	2	11	10	14	26	25	6	1	12	587
Local Characteristics	5	23	26	17	21	13	22	22	18	21	26	26	20	18	4	26	7	22	11	22	22	14	5	23	22	809
Availability of Raw Materials	25	24	23	13	20	10	18	21	15	25	24	6	15	17	23	2	24	6	22	6	21	21	23	20	7	971
Easy Access to Raw Materials	24	14	22	12	19	11	17	20	16	26	20	25	19	7	6	7	3	10	6	5	12	10	14	19	1	606
Low Carrying Cost of Raw Materials	16	13	6	14	18	12	6	9	14	12	23	11	17	5	19	13	25	3	12	21	9	6	22	14	11	678
Easy Communication to Market Accessibility	15	12	24	1	17	9	16	13	13	11	16	24	11	6	14	12	5	18	1	3	1	4	7	25	8	671
Low Carrying Cost of Finished Products	10	3	3	2	10	8	7	1	11	24	19	23	24	8	3	6	26	15	24	7	19	20	17	4	15	662
Marketing of Finished/Unfinished/Intermediate Products	8	22	21	3	16	6	12	8	12	23	14	3	14	11	20	3	10	19	4	6	8	1	13	12	5	509
Proper Business Linkages	9	21	17	4	15	5	15	19	10	20	25	22	22	16	10	11	9	13	14	9	2	13	21	11	20	677
Easy Repairment of Machinery	23	4	18	6	2	7	14	5	2	14	11	14	23	15	2	4	11	8	20	17	17	7	4	26	4	640
Availability of Technical Help from Experts	11	5	19	7	8	4	3	18	9	13	10	21	15	2	13	5	19	24	7	2	5	18	12	13	14	504
Scope/Cost of Intermediate Treatment of Plastic Wastes	1	8	1	9	9	23	23	11	1	2	12	8	2	14	1	14	6	14	16	19	7	5	3	6	3	366
Social facilities	22	25	20	11	12	22	2	25	8	19	22	18	26	13	24	25	18	25	26	25	25	22	20	22	23	906
Pleasant Working Environment	14	20	7	6	11	21	13	17	6	1	13	12	13	1	17	16	13	9	6	10	14	12	1	18	10	622
Proper Management	21	19	6	10	14	19	9	16	7	16	21	17	21	12	7	17	17	1	16	15	16	2	2	15	17	591
Good Law & Order Situation	12	7	4	5	4	20	11	10	5	16	1	13	1	9	5	16	20	4	3	13	3	11	26	5	2	437
Protection from Govt. & Other Harrashments	13	6	5	26	13	2	24	15	4	17	2	2	12	10	16	19	21	7	5	11	13	6	11	2	9	356
Source: Field Survey, 1999	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	351	

APPENDIX:02 PRIORITY RANKING MATRIX OF RESPONSES REGARDING PROBLEMS OF INFORMAL PLASTIC RECYCLING INDUSTRIES

Type of Problems Related to	Respondents Scoring of Different Problems of Plastic Recycling Industry																								Total Score
	Respondent/Score																								
	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	
Raw Materials	5	21	7	5	31	32	32	32	32	25	25	25	15	26	31	31	27	20	31	19	32	17	16	11	10	
Capital/Financial Incentives	33	34	34	2	34	34	34	33	33	34	34	33	34	33	34	34	34	32	34	34	9	34	4	24	11	
Govt. Harassment	3	9	18	4	12	4	5	13	4	2	13	5	23	6	28	14	10	13	8	15	8	31	15	10	34	
Occupational Health & Safety	2	14	31	6	17	18	17	31	26	30	15	1	8	25	11	16	26	17	30	17	21	30	23	17	9	C
Technical Assistance	32	13	27	3	33	30	21	6	3	27	24	12	24	31	12	30	8	24	29	18	26	29	22	3	22	
Energy/Utility Services	30	33	33	33	30	33	26	29	31	23	11	4	31	16	27	2	3	11	1	4	30	28	32	34	27	O
Availability of Skilled Labor	4	20	30	7	29	21	25	12	12	10	23	26	14	23	10	19	7	19	12	14	34	9	21	16	8	
Quality Control	21	32	28	8	15	20	31	28	20	14	16	17	6	18	25	18	5	23	11	22	4	7	20	9	21	N
Marketing	31	12	29	10	28	26	23	30	21	20	14	16	18	29	26	15	28	22	28	21	20	4	14	32	33	
Deprivation of Actual Product Price due to Other Forces	22	10	22	9	14	5	8	18	16	9	17	27	3	15	9	13	9	16	9	5	13	8	31	31	32	T
Transportation for both Input & Output	24	11	26	11	13	11	29	5	5	13	12	3	5	4	22	12	4	12	10	16	19	21	13	15	18	
Seasonal Problem (On/Off Season)	29	31	25	12	16	23	26	7	11	32	33	31	4	24	33	32	32	30	32	27	31	27	34	30	28	I
Proximity to Medical Facilities during Accidents	6	19	24	15	27	29	19	27	24	24	22	13	29	17	24	11	30	21	26	20	18	16	19	25	29	
Lack of Fire Protection/ Fire Fighting	25	30	13	13	26	24	24	26	30	31	31	29	30	28	23	17	29	31	27	30	12	15	33	20	20	N
Lack of First Aid & Other Preventive Measures	8	7	15	14	10	6	11	17	9	8	28	30	32	30	21	26	24	29	21	12	17	25	10	19	16	
Lack of Govt. Polices for their Improvement	28	3	3	32	25	17	7	25	22	11	29	7	20	13	19	20	14	15	13	8	11	20	30	26	4	U
Power Interruption/ Load Shading	34	29	32	34	32	31	33	34	34	33	32	34	33	34	30	33	33	34	33	33	29	26	29	33	26	
Accidents	1	28	21	1	24	25	30	11	23	28	27	28	26	14	20	29	23	28	24	29	28	32	12	27	5	E
Health Risk during Sorting & Washing	7	18	9	17	11	10	9	24	14	7	10	19	22	22	8	27	2	4	23	13	27	3	3	14	1	
Management Problem	26	27	20	21	8	22	18	23	29	19	19	15	19	12	18	25	13	10	20	6	25	14	28	23	17	
Co-relation between Linkages	23	17	17	31	9	12	10	16	10	12	3	6	2	3	7	10	11	2	2	3	24	6	11	8	25	
Low Profit Margin (B/C<1.0)	20	26	16	18	23	27	27	22	28	29	1	18	21	32	32	28	31	33	25	32	16	22	27	28	31	
Working Environment	12	8	6	16	1	2	1	15	6	1	18	14	13	21	1	9	12	14	14	7	15	13	18	13	15	
Quality Marking & Standardization Maintaining	27	25	14	19	6	13	13	4	17	18	9	11	26	8	3	4	16	8	5	10	14	11	5	4	23	
Inferior Quality	19	24	19	20	2	15	6	20	18	17	2	2	25	7	15	6	21	25	18	31	7	19	9	22	14	
Socially Acceptance	14	4	8	29	20	9	20	3	13	15	20	20	12	19	16	22	18	9	6	9	3	5	6	6	3	
Marketing Difficulties	16	23	23	22	5	19	14	21	19	26	30	24	16	9	13	23	22	6	19	26	23	12	26	7	30	
Informal Taxation	13	16	1	25	22	7	4	8	2	3	7	23	17	27	17	8	19	1	4	2	2	2	2	2	24	
Informal Financial Credit & Interest Rate	11	6	2	27	4	16	12	10	8	22	21	10	10	20	4	7	25	26	17	25	6	33	8	29	6	
Maintenance of Machinery & Equipments	18	22	12	26	21	28	15	14	27	16	26	32	27	10	5	5	15	27	16	28	33	10	17	12	7	
Intermediate Treatment Site Problem	17	15	11	28	3	1	16	2	15	4	4	9	1	1	6	24	6	3	3	1	1	1	1	18	2	
Legislative & Regulatory Problem	15	5	10	30	7	8	3	9	7	6	8	8	11	11	14	3	17	7	15	11	10	23	25	1	13	
Lack of Proper Organization/Committee	10	2	5	23	19	14	22	19	25	21	6	22	9	5	29	21	20	18	22	23	22	24	24	21	19	

Lack of Industrial Zone	9	1	4	24	18	3	2	1	1	5	5	21	7	2	2	1	1	5	7	24	5	18	7	5	12	
	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	595	

Type of Problems Related to	Respondents Scoring of Different Problems of Plastic Recycling Industry Respondent/Score																									Total Score
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Raw Materials	20	30	33	25	31	31	28	29	30	32	22	12	22	29	27	34	28	34	33	34	31	22	20	30	31	1256
Capital/Financial Incentives	26	29	34	32	30	30	27	25	18	11	30	5	29	14	17	32	34	6	22	27	7	33	27	18	23	1309
Govt. Harrashment	32	5	15	33	25	32	32	11	17	21	34	4	28	13	19	2	1	22	2	14	1	23	13	5	7	718
Occupational Health & Safety	15	28	25	24	26	29	20	4	20	31	16	30	14	30	18	24	15	5	7	26	17	8	23	17	13	943
Technical Assistance	25	4	29	20	29	28	26	24	19	10	13	11	21	15	20	1	32	1	28	30	33	1	4	32	1	966
Energy/Utility Services	33	32	30	30	33	34	33	33	33	34	32	1	8	33	32	25	23	24	13	13	34	32	15	6	8	1168
Availability of Skilled Labor	11	27	28	29	34	26	24	28	6	9	14	33	33	28	30	31	29	20	32	33	18	18	28	29	30	1053
Quality Control	21	1	24	14	24	25	25	27	9	8	23	2	10	12	15	20	27	8	23	21	2	7	14	7	16	624
Marketing	31	26	26	28	23	23	31	31	29	30	29	29	13	32	29	28	26	25	14	7	30	21	30	20	25	1186
Deprivation of Actual Product Price due to Other Forces	1	2	23	13	13	11	6	21	12	20	24	6	11	26	21	19	25	4	8	15	6	2	16	19	12	707
Transportation for both Input & Output	14	3	27	27	12	27	30	32	32	19	15	3	1	31	7	27	17	2	21	25	19	10	5	16	6	762
Seasonal Problem (On/Off Season)	24	25	10	12	27	10	23	22	31	29	28	32	34	6	28	18	16	21	3	3	29	20	29	28	24	1172
Proximity to Medical Facilities during Accidents	13	24	22	23	28	24	22	19	3	28	12	10	9	11	10	17	24	7	15	1	9	9	32	8	15	929
Lack of Fire Protection/ Fire Fighting	12	6	21	11	22	12	21	30	5	18	11	34	25	27	16	11	10	23	6	29	8	17	3	21	14	1030
Lack of First Aid & Other Preventive Measures	4	23	6	4	19	6	18	15	21	17	18	14	26	22	11	3	11	16	12	12	16	3	6	10	5	763
Lack of Govt. Policies for their Improvement	30	8	20	26	17	8	19	16	22	16	17	15	19	23	22	26	33	9	16	16	26	16	22	14	9	887
Power Interruption/ Load Shading	34	10	32	34	18	33	34	34	34	33	31	28	27	34	34	33	31	33	30	32	32	15	31	31	34	1550
Accidents	7	22	16	22	16	1	16	18	24	27	20	27	20	5	8	16	30	31	24	24	20	11	12	15	22	1000
Health Risk during Sorting & Washing	6	21	31	21	21	20	17	17	28	26	11	13	24	2	26	15	12	32	20	20	27	28	21	27	26	834
Management Problem	10	15	8	19	20	9	7	26	25	7	19	16	32	1	2	10	2	10	27	4	5	6	17	9	17	800
Co-relation between Linkages	29	33	14	5	14	5	29	13	23	15	27	19	12	25	12	9	5	19	9	8	15	34	2	4	11	671
Low Profit Margin (B/Cct 0)	28	31	19	31	32	22	15	14	26	25	26	31	31	24	33	29	14	17	34	28	28	19	11	26	29	1236
Working Environment	5	20	18	18	15	21	14	12	27	6	25	26	18	21	4	14	18	18	5	6	21	25	34	22	4	682
Quality Marking & Standardization Maintaining	8	19	5	2	2	19	11	23	7	24	8	22	16	20	13	8	6	29	29	23	3	4	1	34	19	668
Inferior Quality	22	18	7	1	9	18	10	10	13	5	5	20	6	7	5	5	9	11	19	17	14	27	7	2	10	660
Socially Acceptance	9	11	12	17	5	14	4	9	14	3	7	18	17	3	24	4	3	15	4	9	23	14	25	24	32	829
Marketing Difficulties	19	12	13	10	10	4	9	8	4	23	10	25	30	19	25	30	7	30	11	31	25	28	10	13	21	901
Informal Taxation	27	14	11	9	7	17	1	7	2	2	3	9	3	10	1	22	4	12	17	5	12	31	24	3	33	544
Informal Financial Credit & Interest Rate	18	9	17	8	8	16	5	3	16	4	9	17	23	18	3	21	8	26	26	19	13	30	33	25	18	758
Maintenance of Machinery & Equipments	3	7	1	3	3	2	2	1	1	14	1	23	4	8	9	6	22	3	1	11	4	5	18	33	3	857

APPENDIX: 0 2(Cont.)

Intermediate Treatment Site Problem	2	17	2	16	6	15	12	6	15	1	2	7	2	9	14	7	21	14	31	22	24	29	26	12	23	533
Legislative & Regulatory Problem	17	16	3	6	4	3	3	2	8	13	4	8	5	4	6	23	20	27	10	2	10	24	9	1	2	507
Lack of Proper Organizational Committee	23	34	9	7	11	7	13	5	11	22	33	21	7	17	23	12	13	13	26	10	11	12	8	11	20	873
Lack of Industrial Zone	16	13	4	15	1	13	8	20	10	12	6	24	15	16	31	13	19	28	18	18	22	13	19	23	27	594
	595	595	595	595	595	595	595	595	595	595	585	595	595	595	595	595	595	595	595	595	595	595	595	595	595	

APPENDIX:03 NAMES & ADDRESSES OF THE SURVEYED iPRIs

Sl. No.	Name of Informal Plastic Recycling Industry	Address	Name of the Respondent
1.	Progoti Plastic	# 10 East Islambagh, Ward No. 8, P. O. Postagola, Lalbagh, Dhaka-1211	Abbas Uddin
2.	Amin Plastic	Islambagh, Itawalaghat, Ward No 8	Md. Abul Hossen
3.	Golden Plastic	58/11 A East Islambagh, Chunawala Ghat, Ward No. 65, Dhaka-1211	Md. Belal Hossain
4.	Khaza Plastic	63, Water Works Road, Rahmatganj, Ward No. 65, Dhaka-1211	Md. Ayub
5.	Haque Plastic	7/19 Nurbagh, Kamrangichar, Ward No. 3, Dhaka-1310	Enamul Haque
6.	Gafur's Factory	7/20 Nurbagh, Kamrangichar, Ward No. 3, Dhaka-1310	Gafur
7.	Abul Khayer's Factory	Kamalbagh, Lalbagh, Ward No. 63, Dhaka	Abul Khayer
8.	R. S. Plastic	46/47, Urdu Road, Noakhali Building, Ward No. 66, Dhaka	Salauddin
9	Bhai Bhai Plastic (1)	46/47/A, K.B Urdu Road, Noakhali Building, Ward No. 66, Dhaka	Md. Kashem
10	Dr. Alam's House	Kamalbagh, Lalbagh, Dhaka	Abdul Mannan (1)
11	Faroque Mia's Factory	Islambagh, Ward No. 65, Dhaka	Md. Faroque Hossen
12.	Abul Kalam miah's Factory	Itawalaghat, Ward No. 65, Dhaka.	Md. Abul Kalam
13.	Ruma Plastic	Chunawalaghat, Ward No. 65, Dhaka	Md. Baker Hossen (Khoka)
14.	Raju Plastic	Rahmatganj, Ward No 65, Dhaka	Ali Ahmed
15.	Bhai Bhai Plastic (2)	Nurbagh, Kamrangichar, Ward No. 3, Dhaka	Md. Hanif
16.	Karim Mia's Factory	Nizambagh, Ward No. 3, Dhaka	Md. Karim
17.	Shakil Mia's Factory	Noakhali Building, Ward No. 65, Dhaka	Md. Shakir
18.	Ruhul Amin Mia's Factory	Noakhali Building, Ward No. 65, Dhaka	Md. Ruhul Amin Master
19.	Farid Mia's Factory	Kamalbagh, Ward No. 65	Md. Farid Master
20.	Abdul Mia's Factory	Kamalbagh, Ward No. 65	Md. Abdul
21.	Solaiman's Factory	East Islambagh, Ward No. 65	Md. Soliaman
22	Eusuf Plastic	East Islambagh, Ward No 65	Md. Eusuf Alam
23.	Ali Plastic	Chunawalaghat, Ward No. 65	Qamrul Ahsan
24.	Friendship Plastic	Water Works Road, Chadmghat, Ward No. 65	Md. Morsalin Mamun
25.	Abdul Hafiz Industry	Nurbagh, Kamrangichar, Ward No. 3	Abdul Hafiz
26.	Murad Mia's Factory	Kamrangichar, Ward No. 3	Murad Mia
27.	Abdullah Cutting	21/5 Islambagh, Ward No. 64	Motiur Rahman
28.	Khairul Alam Plastic	93 Islambagh, Ward No 65	Khorshed Alam
29	Monir Dana Plastic	94/15 Islambagh, Ward No. 65	M. M. Haque Monir

Cont.

Sl. No.	Name of Informal Plastic Recycling Industry	Address	Name of the Respondent
30.	Monsur Ahmed	Nurbagh, Kamrangichar, Ward No. 3	Monsur Ahmed
31.	Modina Plastic	Road No 6,House No 20, Kamrangichar, Ward No. 2	Abdur Rahman
32.	Osman Plastic	Aslambagh, Kamrangichar, Ward No. 2	Tajul Islam
33.	Harun Plastic Dana	Noakhali Building, Ground Floor, Urdu Road, Ward No. 64	Md. Harun
34.	Malek Plastic	Noakhali Bulding, 1st Floor, Udru Road, Ward No. 63	Abu Taleb
35.	Md. Abul Hossen's Plastic Factory	1st Floor, Noakhali Building, Lalbagh, Dhaka	Sheikh Qamruzzman
36.	Hasan's Facoty	Noakhali Buildung, Lalbagh, Dhaka.	Hasan
37.	Anwar Mia's Factory	Kamalbagh, Ward No. 65, Lalbagh, Dhaka	Md Jalil
38.	Kobir Hossen's Company	Kamalbagh, Ward No. 65, Lalbagh, Dhaka.	Kobir Hossen
39.	Shajahan Plastic	Noakahali Building, 2nd Floor, Urdu Road, Ward No. 64, Dhaka	Moazzem Hossen
40.	Azizur Rahman Plastic	31, Urdu Road, Ward No. 65, Dhaka	Md. Azizur Rahman
41.	Abdul Mannan Plastic	1/1 Islambagh, Ward No. 64, Dhaka	Md. Abdul Mannan (2)
42.	Sonamoni Plastic	70/9/1 West Islambagh, Ward No. 65, Dhaka	H. M. Toffazal Hossen
43.	Russel Plastic	37 Ali Ghat, Islambagh, Ward No. 65, Dhaka	Md. Omar Farooq
44	Shathi Plastic	58/10 C, Chunawalaghat, Ward No. 64, Dhaka	Amir Hossen
45	United Plastic	58/11, Chunawalaghat, East Islambagh, Ward No. 64, Dhaka	Md Golam Mustafa
46.	Nehar Uddin Plastic	28 Shahidnagar, Lalbagh, Ward No. 60, Dhaka	Md. Mozibur Rahman
47.	Alauddin Bapery Plastic	200/2 Shahidnagar, Lalbagh, Ward No. 60, Dhaka	Md. Alauddin Bapery
48.	Islam Plastic	27/2/1, Killar Mohr, Ward No. 59, Dhaka	Din Islam
49.	North Star Company	4/3A, Postagola, Ward No. 60, Dhaka	Md. Nasir Uddin
50.	Hafizur Rahman Plastic	Road # 5, House # 50, Nurbagh, Kamrangichar, Ward No. 3, Dhaka	Md Mizanur Rahman

Source: Field Survey, 1999

APPENDIX:04 SAMPLE QUESTIONNAIRE USED IN THE PRESENT RESEARCH WORK

Identification No. ☐

QUESTIONNARIRE ON PROBLEMS AND PROSPECTS OF INFORMAL PLASTIC RECYCLING INDUSTRIES IN DHAKA CITY

MURP THESIS
Dept. of Urban and Regional Planning
Bangladesh University of Engineering and Technology (BUET), Dhaka-1000

December 1999

[The research is conducting under the supervision of Dr. Sarwar Jahan, Professor of the Department and only applicable for study purpose]

Entrepreneurs Socio-Economic Background

1. Entrepreneur's/Respondent's Name _____
2. Age: _____
3. Educational Qualification:
   - ☐ Illiterate
   - ☐ No Schooling
   - ☐ Read Only
   - ☐ Primary Schooling
   - ☐ Secondary Schooling
   - ☐ Higher Secondary
   - ☐ Graduate
   - ☐ Masters
4. Monthly Income Tk. _____
5. Monthly Expenditure Tk _____
6. Ownership Pattern: (Tick & Circle)
   a Owned ☐ i Individual ii Family iii Partnership
   b. Rented ☐ Rent (Tk./month) = _____
   c Others ☐ Specify: _____
7. Capital Investment: Tk. _____
8. Area/Size
   - ☐ Large (_____ sq. ft / Khantha)
   - ☐ Medium (_____ sq. ft./ Khantha)
   - ☐ Small (_____ sq. ft / Khantha)
9. How many types of Plastics have been recycled: _____
   Specify.

1.	2.	3
4	5	6
7.	8	9.
10	11.	12.

10. How many Industries do exist here of similar quality: _____

INTRODUCTION TO INDUSTRY

1. Name of the Sampled Industry. _____
   Address: _____
   Ward No. _____ Date _____

2 Year of Establishment: _____

3 Approximate Working days in last Fiscal Year: _____

4. Type of Industry a. Formal (Tax Payer/Have Registration) ☐
   i. Govt. Tax ☐
   ii. Municipal Tax ☐
   iii. Other Tax ☐ Specify _____
   b. Informal (Non Tax payer/ No Registration) ☐

5. No of Employees/Workers: Total ___ (M=__, F=___, Children =__)

6. Job Specification with numbers: i Cutting ( )
   ii. Moulding ( )
   iii. Machine Operating ( )
   iv. Packaging ( )
   v. Porting ( )
   vi Others ( ) Specify _____

7. Wage Rate (day/hr/production basis): _____

8 Working hrs.:

9 Location of Industry:
   ☐ Residential Areas
   ☐ Commercial Areas
   ☐ Industrial Areas
   ☐ Mixed Land use Areas
   ☐ Others Specify: _____

10 Machinery Information:

a Types:

Name	No.
Chapti Machine	
Cutting Machine	
Dana Machine	
Others	Specify _____

b. Operation:
   ☐ Manually
   ☐ Automatic
   ☐ Semi-auto
   ☐ Others Specify _____

c. Manufactured
   ☐ Locally Made
   ☐ Foreign/Imported
   ☐ Mixed
   ☐ Others Specify. _____

d Maintenance i.
   ☐ Easy
   ☐ Difficult
   ☐ Impossible
   ☐ Others Specify: _____
   ii Average Cost of maintenance/month. Tk _____

e. Negative Consequences:
   ☐ Excessive Heat Producing
   ☐ Smoke Provoking
   ☐ Hazardous & noxious Gas Emission
   ☐ Flammable
   ☐ Irritating
   ☐ Noisy
   ☐ Hazardous By-product
   ☐ Others Specify: _____

11. Utility Services:

a. Power/Electric Supply. ☐ Yes, Pay/month = Tk. _____
☐ No

b Water Supply: ☐ Yes, Pay/month = Tk _____
☐ No

c. Drainage Facility: ☐ Yes, Pay/month = Tk. _____
☐ No

12. Source of Water Supply: a WASA ☐
b. Others Specify: _____

13. Connection Pattern: ☐ Legal
☐ Illegal

14. Factors/Reasons for selecting this area:

	Reason	Priority No.
i.	Low Rent	
ii.	Low Land Value	
iii.	Low Capital Cost	
iv.	Flood Free Zone	
v	Low Labor Cost	
vi.	Availability of Technically Trained Labor	
vii.	Availability of Skilled Labor	
viii	Availability of Unskilled Cheap Labor	
ix.	Low Housing Cost of Workers	
x	Adequate Utility Services (Gas, Water, Electricity)	
xi	Local Characteristics	
xii	Availability of Raw Materials	
xiii	Easy Access to Raw Materials	
xiv.	Low Carrying Cost of Raw Materials	
xv	Easy Communication to Market/Accessibility	
xvi.	Low Carrying Cost of Finished Products	
xvii.	Easy Marketing of Finished/Unfinished/Intermediate Products	
xviii	Proper Business Linkages	
xix.	Easy Repairment of Machinery	
xx	Availability of Technical Help from Experts	
xxi	Scope/Sites of Intermediate Treatment of Plastic Wastes	
xxii	Social Facilities	
xxiii.	Pleasant Working Environment	
xxiv.	Proper Management	
xxv.	Good Law and Order Situation	
xxvi	Protection from Govt & other Harrashments	
xxvii.	Others Specify: _____	

15. Linkages:

a. Backward Linkages (Regarding Raw Materials)

	Raw Materials		Source (Buy from)		Price (Tk./kg or lb)
i.		i		i.	
ii		ii.		ii.	
iii.		iii.		iii.	
iv.		iv		iv.	
v.		v.		v.	
vi.		vi.		vi.	
vii.		vii.		vii.	
viii		viii.		viii	

(If necessary, use the overleaf)

b. Forward Linkages (Regarding Semi/Unfinished Products):

	S/U Product		Supply/Sell to		Price (Tk./kg or lb)
i		i.		i.	
ii		ii		ii.	
iii		iii		iii.	
iv.		iv.		iv.	
v.		v		v	
vi.		vi.		vi	
vii		vii.		vii	
viii.		viii.		viii.	

(If necessary, use the overleaf)

c. Forward Linkages (Finished Products):

	F. Product		Supply/Sell to		Price (Tk./kg or lb)
i.		i		i.	
ii.		ii.		ii.	
iii.		iii		iii.	
iv		iv.		iv.	
v.		v.		v.	
vi		vi		vi.	
vii.		vii.		vii	
viii.		viii.		viii.	

(If necessary, use the overleaf)

16. Problems Faced by the Recycling Industries. (If necessary use the overleaf)

SL.	Types	Rank	Specify		Solution	
i.	Raw Materials		1.		1.	
			2.		2.	
			3.		3.	
			4		4.	
			5		5.	
ii.	Capital/ Financial Incentives		1		1.	
			2		2.	
			3.		3	
			4.		4	
			5.		5	
iii.	Govt Harrashment		1.		1.	
			2		2	
			3.		3.	
			4		4	
			5		5	
iv.	Occupational Health and Safety Problem		1.		1	
			2.		2	
			3.		3	
			4.		4.	
			5.		5.	
v.	Technical Assistance Problem		1.		1.	
			2.		2.	
			3.		3.	
			4.		4.	
			5.		5.	

SL	Types	Rank	Specify		Solution	
vi.	Energy/Utility Services Problem		1.		1.	
			2.		2	
			3.		3.	
			4.		4.	
			5		5.	
vii.	Availability of Skilled labor		1.		1.	
			2		2.	
			3.		3	
			4.		4.	
			5		5.	
viii.	Quality Control Problem		1.		1.	
			2.		2	
			3.		3.	
			4.		4.	
			5.		5.	
ix.	Marketing Problem		1.		1.	
			2.		2.	
			3		3	
			4.		4	
			5.		5.	
x.	Deprivation of Actual Product Prices due to other forces		1.		1.	
			2.		2	
			3		3.	
			4.		4	
			5.		5.	
xi.	Transportation Problem for both Input & Output		1.		1.	
			2.		2.	
			3.		3.	
			4.		4.	
			5.		5	
xii.	Seasonal Problem (On/Off season)		1.		1.	
			2.		2.	
			3		3.	
			4		4	
			5.		5.	
xiii.	Proximity to Medical Facilities during Accident		1.		1.	
			2.		2.	
			3.		3.	
			4.		4.	
			5.		5.	
xiv.	Lack of Fire-protection/Fire-fighting		1.		1	
			2.		2.	
			3.		3.	
			4.		4.	
			5		5	

Sl.	Types	Rank	Specify		Solution	
xv.	Lack of First Aid & other Preventive Measures		1.		1	
			2.		2.	
			3.		3.	
			4.		4.	
			5.		5.	
xvi.	Lack of Govt. Polices for their Improvement		1.		1.	
			2.		2.	
			3		3.	
			4		4.	
			5.		5.	
xvii.	Power Interruption/ Load shading Problem		1		1	
			2		2	
			3.		3	
			4.		4	
			5.		5.	
xviii	Accidents		1.		1.	
			2		2.	
			3.		3	
			4.		4	
			5.		5.	
xix.	Health Risk during Sorting & Washing		1		1.	
			2.		2	
			3.		3	
			4.		4	
			5.		5	
xx.	Management Problem		1.		1.	
			2.		2.	
			3.		3.	
			4		4.	
			5		5	
xxi	Co-relation Problems between Linkages		1		1.	
			2.		2	
			3.		3.	
			4		4.	
			5		5.	
xxii.	Low Profit Margin Problem (B/C < 1.0)		1.		1.	
			2.		2.	
			3.		3.	
			4.		4.	
			5.		5.	
xxiii	Working Environment		1.		1	
			2.		2	
			3.		3.	
			4.		4.	
			5.		5.	

SL.	Types	Rank	Specify		Solution	
xxiv	Quality Marking & Standardization Maintaining		1		1.	
			2.		2.	
			3.		3.	
			4		4	
			5		5	
xxv	Inferior Quality Problem		1		1	
			2.		2.	
			3		3	
			4.		4.	
			5		5.	
xxvi	Socially Acceptance Problem		1		1.	
			2.		2.	
			3.		3.	
			4.		4.	
			5.		5.	
Xxvii	Marketing Difficulties		1.		1.	
			2.		2.	
			3.		3.	
			4.		4.	
			5.		5.	
xxviii	Informal Taxation		1		1	
			2.		2.	
			3.		3.	
			4		4	
			5		5	
xxix.	Informal Finance Credit & Interest Rate		1		1	
			2.		2.	
			3		3	
			4		4	
			5		5.	
xxx.	Maintenance of Machinery & Equipments		1		1	
			2.		2.	
			3.		3.	
			4.		4	
			5.		5.	
xxxi.	Intermediate Treatment Site Problem		1.		1.	
			2.		2.	
			3.		3.	
			4.		4	
			5.		5.	
xxxii	Proper Legislative & Regulatory Problem		1.		1.	
			2.		2.	
			3.		3.	
			4.		4.	
			5.		5	

SL.	Types	Rank	Specify		Solution	
xxxiii	Lack of Proper Organization/ Committee		1		1.	
			2		2	
			3.		3.	
			4.		4.	
			5.		5.	
xxxiv.	Lack of Industrial Zone		1.		1	
			2.		2.	
			3.		3.	
			4.		4.	
			5		5.	

17. Do you think that Plastic Recycling is a part of Environmental Management Program?
    Yes ☐
    No ☐
18 If properly incentives are given, do you think that recycling sector could contribute to National GDP? How?

19. Can you draw the Plastic Recycling Chain by person to person basis in freehand?

Comments:

Thanking you.

Name of the Interviewer: _____
Date: _____

APPENDIX:05 VISUAL SURVEY

Plate: 03 Washing and cleaning of plastic wastes by backward linkages at intermediate treatment site

Plate: 04 Sorting of various plastic wastes

Plate: 05 Drying of plastics on slope of the embankment

Plate: 06 Vanghari Dokans

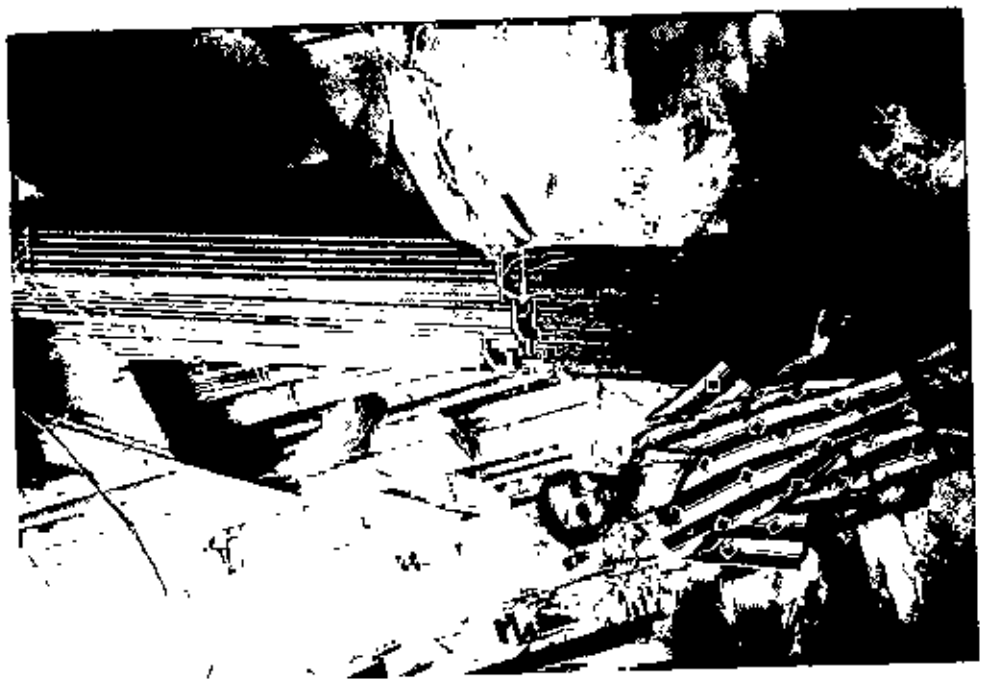

Plate: 07 Recycled PVC pipes

Plate: 08 Various Recycled Products

Plate: 09 (a) Different Plastic Recycling Machinery (Chapti)

Plate: 09 (b) Different Plastic Recycling Machinery (Cutting)

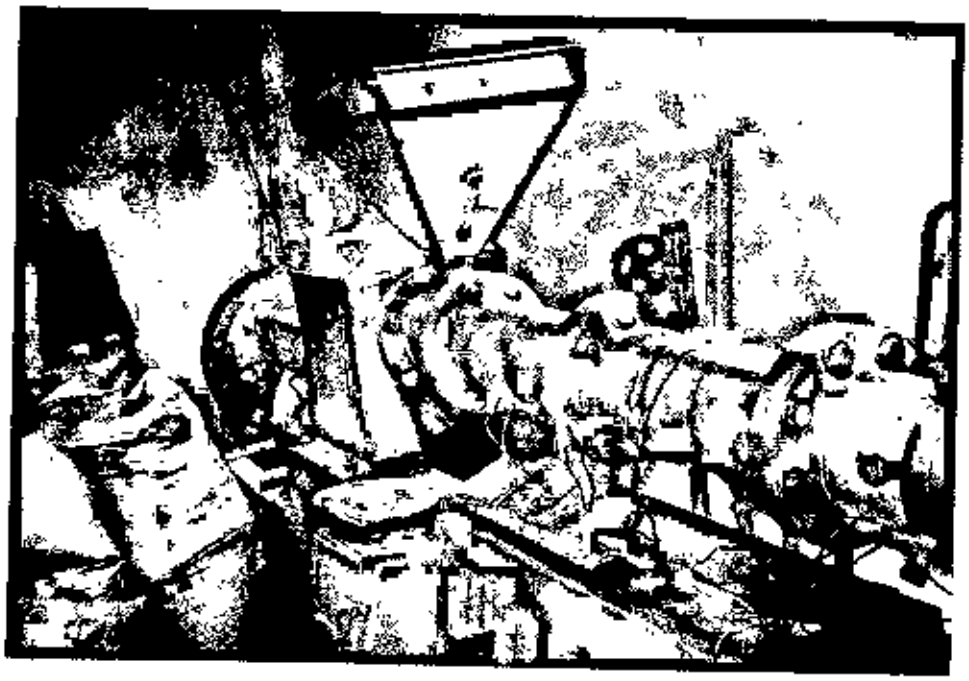

Plate: 09 (c) Different Plastic Recycling Machinery (Dana)

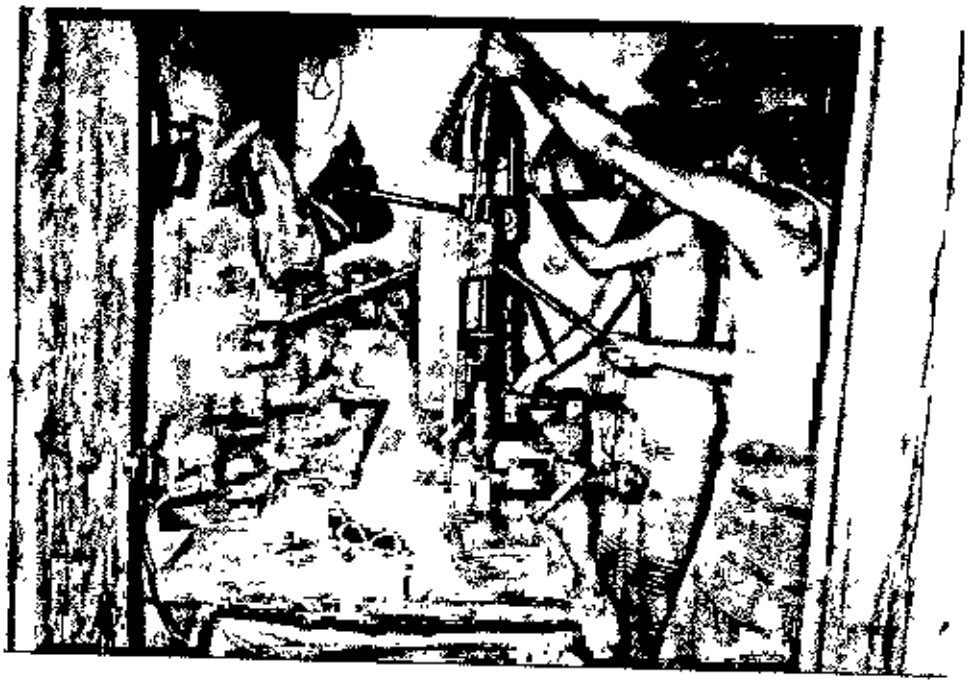

Plate: 09 (d) Different Plastic Recycling Machinery (Hand Molding)

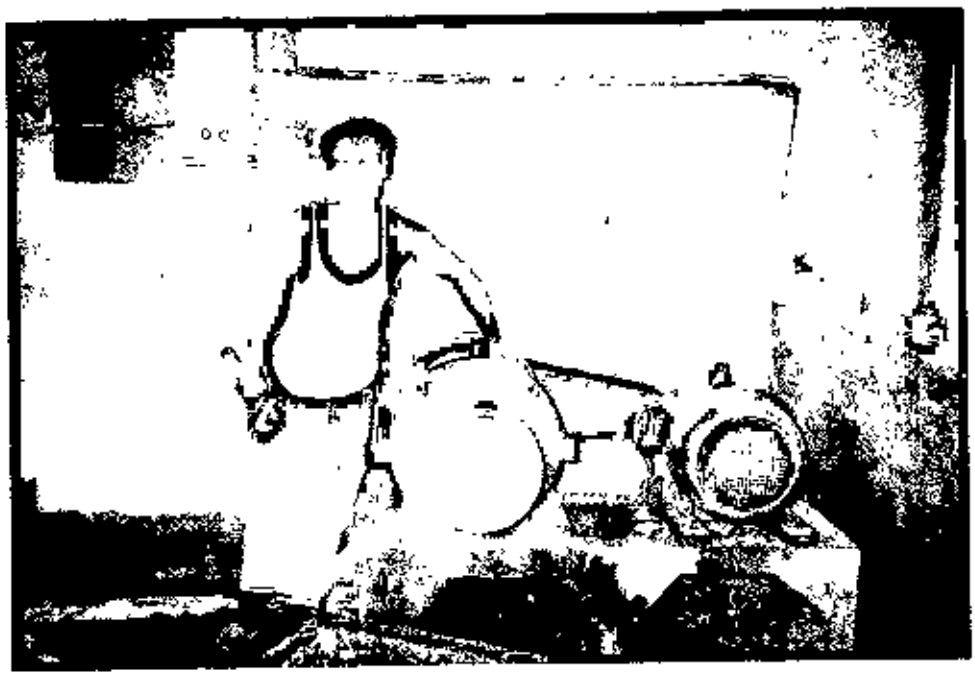

Plate: 10 Technician engaged in repairing and maintenance

Plate: 11 Women workers in IPRIs

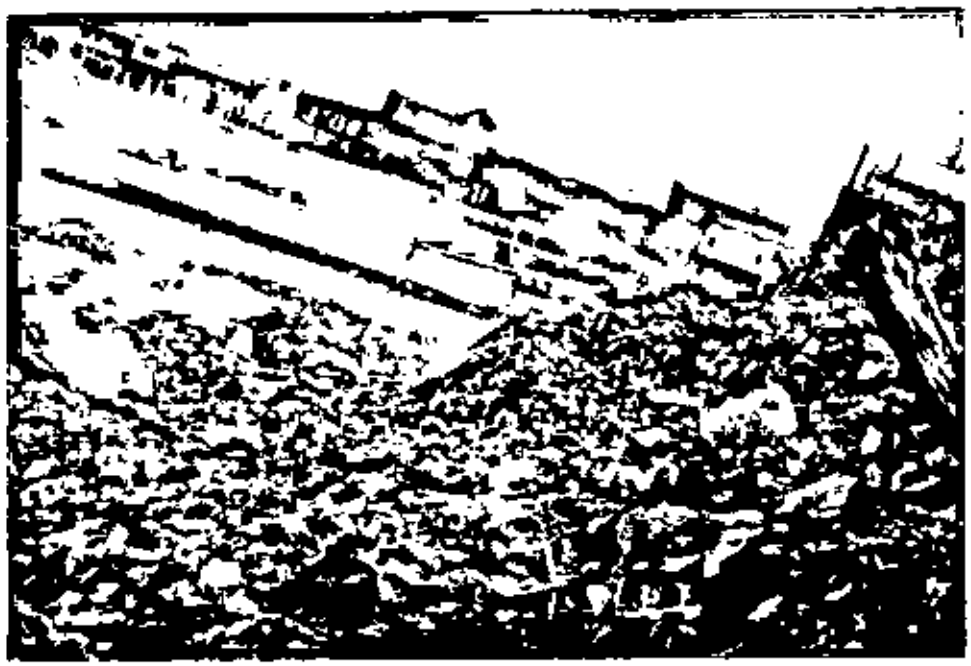

Plate: 12 Plastic waste accumulation on bare land of Kamrangir Char

Plate: 13 Storage and burning of plastics simultaneously

Plate: 14 Air circulation fan inside a IPRIs

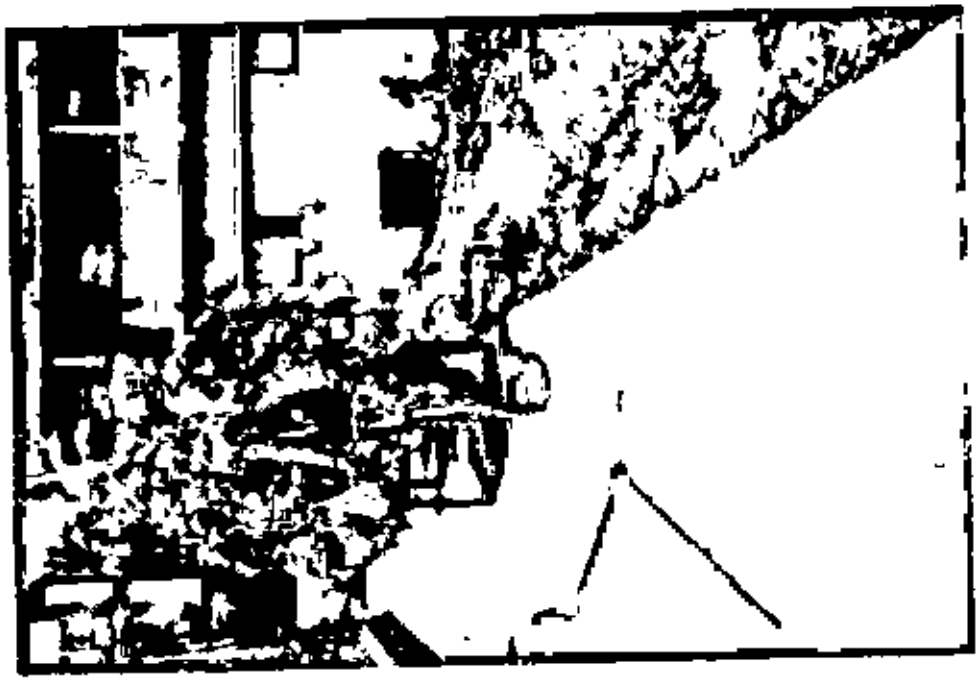

Plate: 15 Transportation of Raw materials

Plate: 16 Burning of Plastics