



## The Status of Recyclable Solid Wastes at Sadar Upazila of Noakhali, Bangladesh

Tanuja Barua<sup>1\*</sup>, Papia Sultana Kanon<sup>1</sup> and Mehedi Hasan Munna<sup>1</sup>

<sup>1</sup>Department of Environmental Science and Disaster Management, Noakhali Science and Technology University (NSTU), Noakhali, Bangladesh.

### Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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### ABSTRACT

Most of the cities in the world, a solid waste recycling process is a part of the effective and sustainable waste management system. Although the local authorities ignore the recyclable solid waste materials during waste management activity, a number of self-waste collectors and dealers have been performing recycling activity as a source of acquirement for long periods of time in Bangladesh. In our present study, a traditional recycling practice of solid waste was executed and analyzed in Sadar Upazila of Noakhali, Bangladesh. This study also identified a complete concatenation from waste collectors to recycling industries in different private sectors. The study revealed that 41% metal, 37% paper, 14% tin and 8% plastic of Sonapur was recycled daily. On the other hand, the study also revealed that 44% metal, 21% paper, 19% tin and 16% plastic of Maijdee was recycled daily. The shop owners were only interested with Recyclable Solid Wastes (RSW). RSW collected by the shop owners including glass, paper, plastic, iron, tin etc. All the recyclable materials were collected and transported in different industries of Dhaka. For new products, those retrieved materials were used as raw materials.

*Keywords:* Recyclable solid waste; recycling; waste collectors; recycling dealers.

\*Corresponding author: E-mail: [tanujafescu28@gmail.com](mailto:tanujafescu28@gmail.com);

## 1. INTRODUCTION

Waste Management has emerged joined of the best challenges facing urban native authorities throughout Asian country although their associates obligatory perform of it. Asian country may be a densely inhabited country. Its population is going to be concerning seventeen cores by in an exceedingly country like Asian country, urban solid waste creates an improbable environmental hazard and social drawback in town lives [1]. For many years currently, waste utilization has been attracting wide attention from policy manufacturers and different environmental stakeholders so as to deal with the problems of waste production [2]. Behavioral and fashion changes square measure wide control to be a significant resolution to this issues of waste production. Our foremost methodology of reducing wastes like plastics is thru usage, wherever helpful materials together with glass, plastic, paper, and metals are recovered in order that they'll be wont to produce new product [3].

Recycling is taken into account joined of the simplest choices within the solid waste management hierarchy to cut back the impacts bestowed post-consumer packaging plastic wastes by end of use (EoU) and end of life (EoL). Aside from causative to municipal solid waste management by entertaining materials that have amount from the most waste flow, so reducing quantities of waste to be collected and disposed [4,5], recycling provides the chance to use recovered plastics to manufacture a replacement product [6,7]. For these reasons, recycling provides opportunities for recovered polymers to cascade through multiple stages throughout their lives therefore causative to property producing. Recycling is recognized as the "most environmentally sound" strategy for managing Municipal Solid Waste (MSW) following solely the preventive strategy of supply reduction and use indicated that recycling can be classified because the most absolutely received style of solid waste management observe and as an important a part of sound waste management [2,8]. It's clearly a waste management strategy however also can be one current example of implementing the concept of commercial ecology whereas in an exceedingly natural scheme there aren't any wastes however solely product [9,10].

By aggregation and examining information from many communities with different employment choices, it's attainable to check whether or not theoretical predictions are found to be effective in

apply, additionally to aggregation info helpful to native governments for future policy-setting as cost-effectiveness might probably be improved if it's renowned that programs lead to bigger employment of high-valued materials [4]. Improper and ineffective management of different categories of solid waste is one of the causes of environmental pollution and degradation in several cities. Low collection coverage, unavailable transport services and lack of proper waste treatment methods, recycling and disposal facilities are the reason for unsatisfactory waste management. Water, land and soil pollution are the results from improper waste management practices in respective areas. Establishment of the door-to-door waste collection system is not always available to the local people [11,12].

This current study was conducted in Noakhali Sadar upazila, Noakhali to identify the current status of recyclable waste materials and assess the quantity of different types of discarded materials.

## 2. METHODOLOGY

### 2.1 Background of the Study Area

The study was done to find out the current status of recyclable materials among the shops of Sonapur to Maijdee Bazar of Noakhali Sadar upazila. The aim of the study is to identify the current status of total recyclable items and their types of two different areas. Noakhali Sadar Upazila is a vital upazila of Noakhali district in the division of Chittagong, Bangladesh. Noakhali Sadar Upazila has a total area of 336.06 square kilometers (129.75 sq. mi). It coordinates 22°50' N 91°6' E. It borders Begumganj Upazila to the north, Kabirhat Upazila to the east, Suborno Char Upazila to the south, and Kamalnogor and Lakshmipur Sadar Upazila of Lakshmipur district to the west. From the 2011 Bangladesh census report, Noakhali Sadar Upazila had 100,219 households and a population of 525,934 or 24.9% of total population living in urban areas. The literacy rate of this upazila (age 7 and over) was 51.7%, compared to the national average of 51.8%. The study areas (Fig. 1) were selected according to the availability of recyclable materials shops. There are about twelve shops of recyclable material in which six of Sonapur and six of Maijdee Bazar. Maijdee is a town located in Noakhali district part of the Chittagong division. Thugarbhanga is the administrative center of Noakhali district and its main town. It is also known as Maijdee court town. It consists of 9

wards and 36 mahallas. It has an area of 12.61 km<sup>2</sup>.

## 2.2 Study Design

The study design includes both type of the study (e.g. descriptive, correlation, semi-experimental, review, meta-analytic) and sub- study type (e.g.

descriptive-longitudinal case study) which are correlated with research problem, hypotheses, independent and dependent variables, experimental design and if applicable, data collection methods and a statistical analysis plan. A research design is a framework (Fig. 2) that was developed to provide answers to the research questions is presented below:

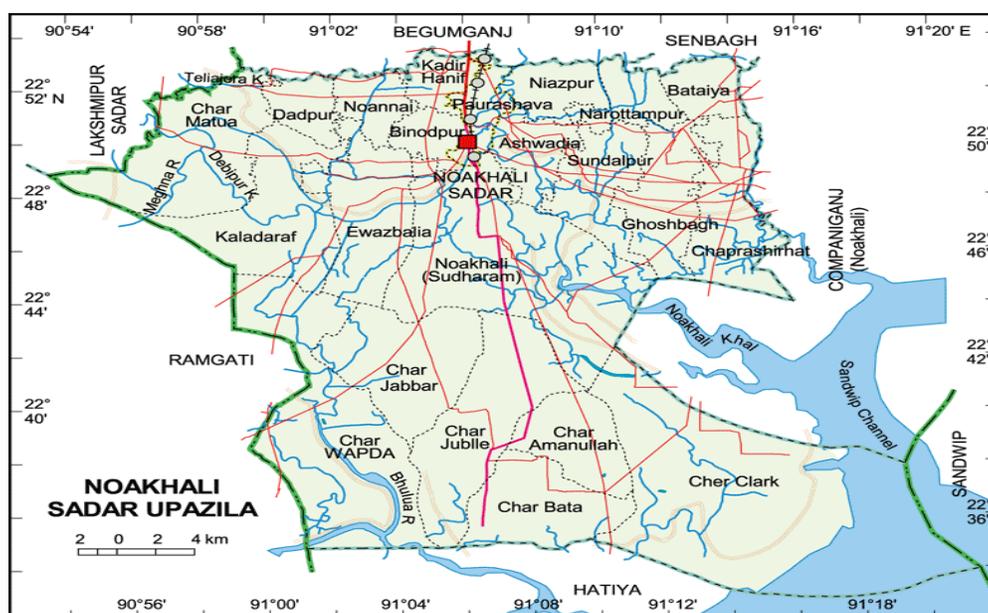


Fig. 1. Location of the study area (source: Google Maps, 2019)

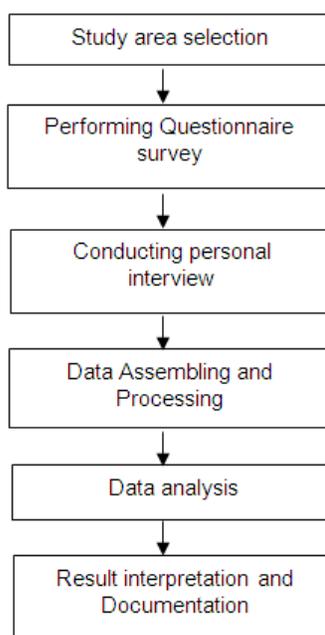


Fig. 2. Flow chart of research study design

### 2.3 Data Collection

This present study was conducted with questionnaire survey method. Primary data were collected from the recycling item collecting shops of study areas. Total 12 shops are studied for conducting the survey. Relevant data for this study were collected directly from the area of study by using a secondary sources and a personal interview. Data collected through frequent visits in the study area and interviews from different shops of recyclable materials.

### 2.4 Data Assembling and Processing

At the end of data collection, data were compiled, tabulated and analyzed. After collecting relevant information, all the data were accumulated carefully in Microsoft Excel Software to produce figures and graphs for easy visualization and interpretation. The data were analyzed by using MS-Excel & SPSS and the results are presented in textual, tabular & graphical forms to understand the present status of recyclable solid waste in Noakhali Sadar Upazila.

## 3. RESULTS AND DISCUSSION

### 3.1 Status of Recyclable Solid Wastes in Noakhali

From the study it was found that there was no proper management of solid waste in Noakhali. In Sonapur and Majidee, there were found some recyclable shops of discarded solid waste where recycling has developed on a commercial basis. These activities include the recycling of paper, plastic, tin, glass, metal etc. from discarded materials. Agents receive collected products and transport them to the factories on behalf of the companies. In spite of this recycling, a large

amount of solid waste still found in mixed waste going to the landfills. There are about twelve shops of recyclable solid wastes in Sonapur and Majidee Bazar. In Sonapur, there are six shops of recyclable solid waste and six shops at Majidee Bazar are found while conducting this study (Table 1). They recycle solid wastes from discarded materials. It includes paper, plastic (plastic bottles), metal (iron), tin and others (such as silver, glass etc.).

#### 3.1.1 Recycling of paper at Sonapur

The status of daily paper recycling in Sonapur (Fig. 3) is varies from shop to shop. In Sonapur maximum paper recycling is found 700 kg per day for shop number three. And the second highest value is found for shop 6 is about 500 kg per day. And the lowest value is found for shop number one is about 100 kg per day. The average value is found 367 kg/day in the Sonapur. This paper item is used for making cardboard, paper bags, toilet paper, tissues etc. It is the second largest recyclable item in the study area.

#### 3.1.2 Recycling of plastic at Sonapur

In Sonapur maximum plastic recycling is found 100 kg per day for shop number three and six. And the lowest value is found for shop number two and four is about 50 kg per day. This plastic is used for making plastic containers, takeout food containers, ice cream containers, trash bags, traffic cones, countertops, packing materials etc. This area is an underdeveloped area consists of less developed villages. The average value of plastic materials (Fig. 4) is about 75 kg/day. The plastic generation rate is found the lowest (8%) among other items.



Fig. 3. Recycle of Paper (kg/day) in different shops

### 3.1.3 Recycling of metal at Sonapur

It is observed that there are maximum 500 kg scrap metals are found per day in shop two and shop four in Sonapur while conducting this study. And the lowest value is found for shop number five is about 250 kg scrap metal per day. Recycled Scrap metals are found from common metals iron, steel, aluminum, brass, copper etc. Iron once used commonly for pipes, barbecues, gas heaters and more can be found in older items around the home or industrial site. Steel is one of the most widely used metals in large appliances and products. This item shows (Fig. 5) the highest rate amongst other items is about 41%. The average per day scrap metal is 400 kg. There is a large bus stop in this area and

has several garages. These are the common sources of metal items in that area.

### 3.1.4 Recycling of tin at Sonapur

The tin recycling in Sonapur area is not at satisfactory level. In Sonapur maximum tin recycling is found (Fig. 6) 300 kg per day for shop number two and four. And the lowest value is found for shop number one is about 30 kg per day. The average tin recycling is about 143 kg per day and it covers the 14% of the total recycling items. Most of the houses and shops in this area is made of tin. These are the common sources of discarding tin here. It is used for making different aluminum cans, car bodies etc.

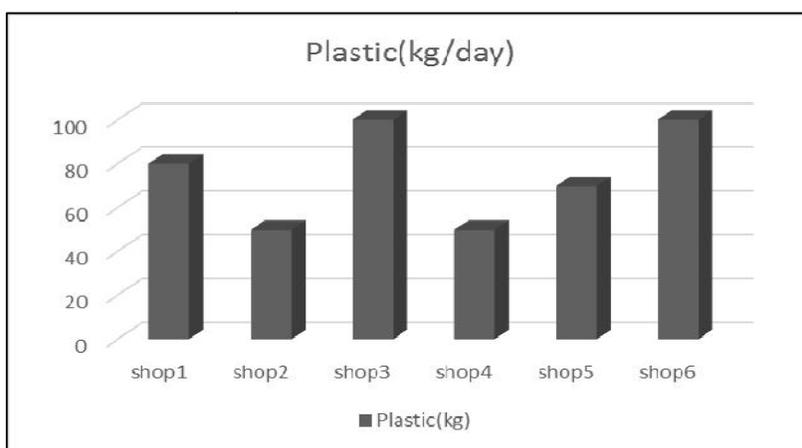


Fig. 4. Recycle of Plastic (kg/day) in different shops

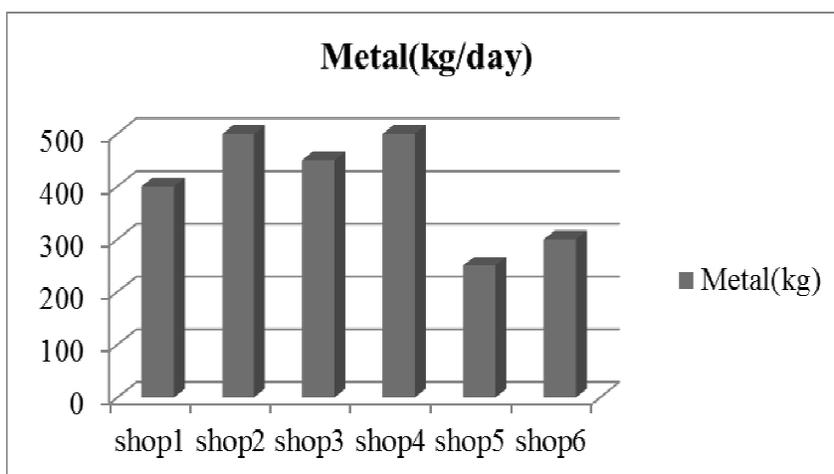
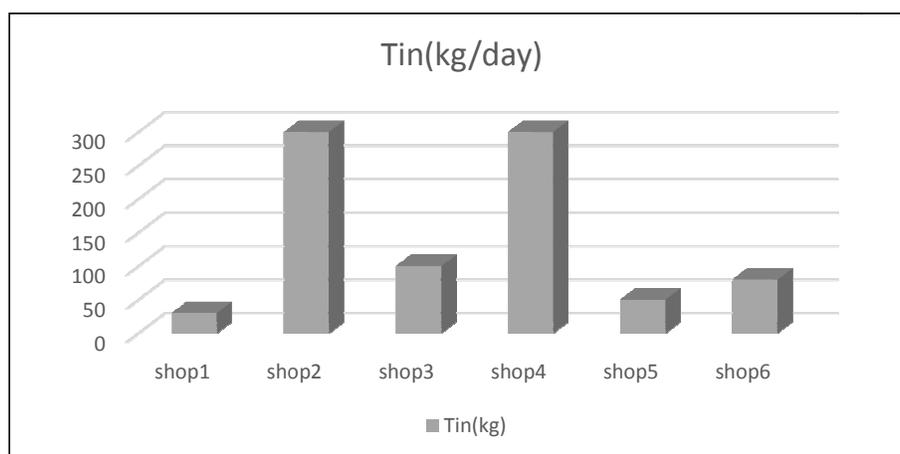
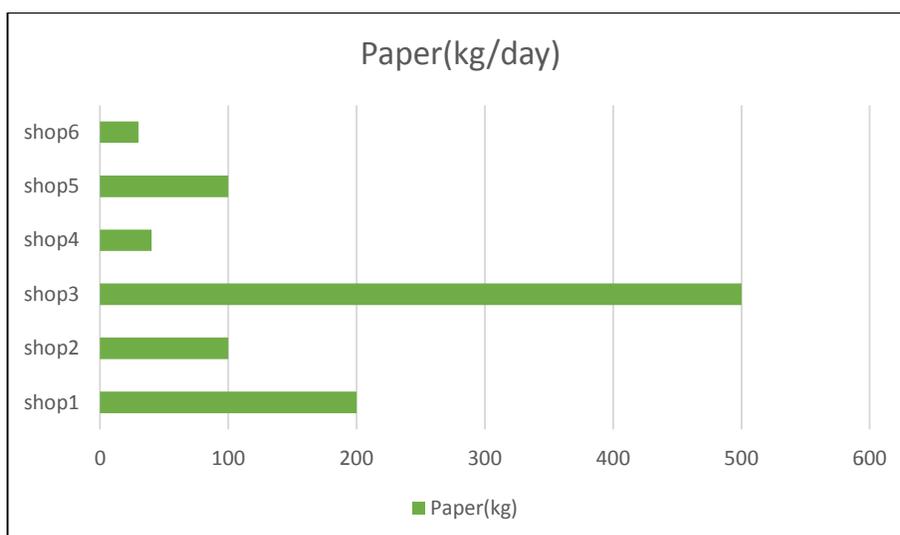


Fig. 5. Recycle of metal (kg/daily) in different shops



**Fig 6. Recycle of tin (kg/day) in different shops**



**Fig. 7. Recycle of paper (kg/day) in different shops**

### 3.1.5 Recycling of paper at Maijdee Bazar

In Maijdee Bazar area, the used paper and paper products are collected by the shops. In Maijdee Bazar, maximum paper recycling is found (Fig. 7) for shop number three is about 500 kg per day.

And the second highest value is found for shop number one is about 200 kg per day. And the lowest value is found for shop number six is about 30 kg per day. The average discarded paper is about 162 kg/day in this area. This is the second highest (21%) recycled materials amongst others. This is a semi-urban area of the Noakhali. Most of the shops, markets, hospitals and other government and non-government

institutions are situated. These are the common sources of used paper and relevant items.

### 3.1.6 Recycling of plastic at Maijdee Bazar

In Maijdee Bazar, maximum recyclable plastic is found 350 kg per day for shop number three. And the lowest value is found for shop number four and six is about 30 kg per day at Maijdee Bazar. The average plastic collection (Fig. 8) is about 122 kg/day. It covers only 16% of total waste items. The value is lowest among the other item. It poor collection rate than plastic generation is one of the signs of mismanagement of the solid waste in this area. The common consequences of this are water clogging and often discarded plastics are found in natural water courses. Open

dumping of plastic items are one of the common phenomenon in the study area.

### 3.1.7 Recycling of metal at Majidee Bazaar

The study reveals that there are maximum 500 kg scrap metals are found (Fig. 9) per day in shop number one, three and six at Majidee Bazaar while conducting this study. And the lowest value is found for shop number four is about 50 kg scrap metal per day. The average scrap metal for the study area is about 334 kg/day. This is the highest recycled item which covers about 44% of total recycling.

### 3.1.8 Recycling of tin at Majidee Bazar

At Majidee Bazar, the status of daily tin recycling is found to different among the shops. In Majidee Bazar, maximum tin recycling is found 300 kg per

day (Fig. 10) for shop number three. And the lowest value is found for shop number four is about 30 kg per day. The average per day tin collection for recycling is about 147 kg and it covers 19% of the total recycled items.

### 3.2 Comparison of Recyclable Solid Wastes between Sonapur and Majidee Bazar

The amount of discarded paper, metal and tin is larger at Sonapur than Majidee Bazar. In case of being situated near rural areas, the recycling trend of paper, metal and tin is more at Sonapur. And the amount of recyclable plastic wastes is lower at Sonapur than Majidee Bazar. As Majidee is a town, the generation of plastic is more here than Sonapur. That's why recycling trend of plastic is found more at Majidee Bazar.

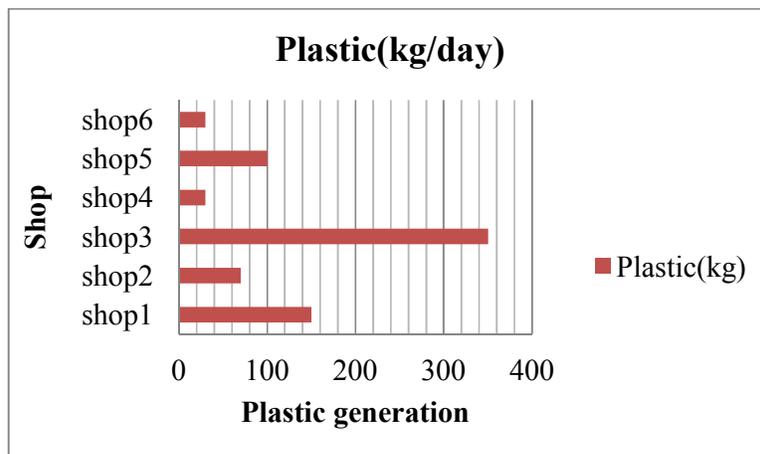


Fig. 8 Recycle of plastic (kg/day) in different shops

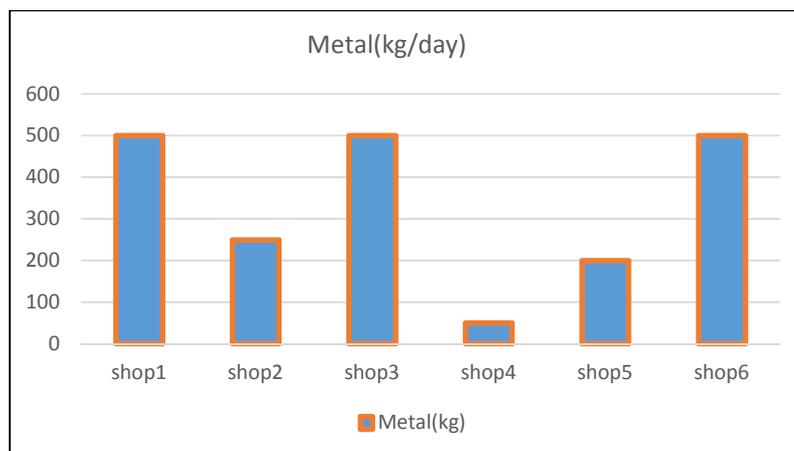


Fig. 9. Recycle of metal (kg/day) in different shops

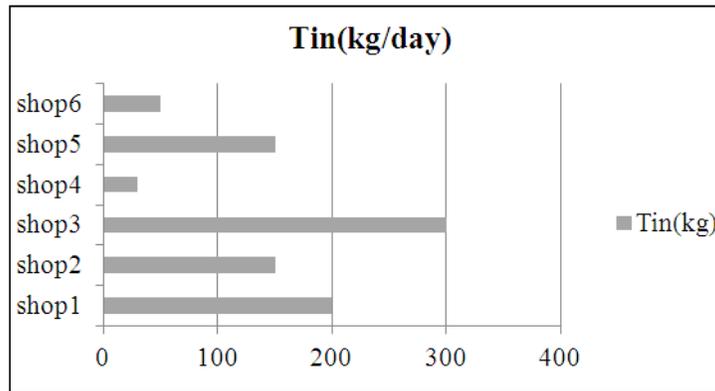


Fig. 10. Recycle of tin (kg/day) in different shops

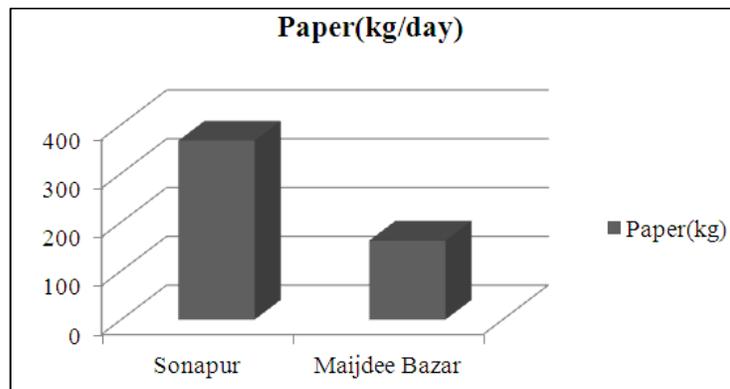


Fig. 11 Recycle of paper between Sonapur and Maijdee Bazaar

### 3.2.1 Recyclable paper between Sonapur and Maijdee Bazar

From the study, it can be said that the discarded paper of Sonapur is larger than Maijdee Bazar. In Sonapur, about 366.67 kg recyclable paper wastes are collected daily in an average (Fig. 11). And about 161.67 kg recyclable paper wastes are collected daily in an average at Maijdee Bazar. One of the causes behind this difference is the establishment of several educational institutes along with a public university in the Sonapur. The paper items are likely to be found more in this area rather than Maijdee Bazar.

### 3.2.2 Recyclable plastic between Sonapur and Maijdee Bazar

The study shows that (Fig. 12) the discarded plastic wastes of Sonapur is lower than Maijdee Bazar. In Sonapur, there are about 75 kg recyclable plastic wastes are collected daily in an average. On the other hand, there are about 121.67 kg recyclable plastic wastes are collected daily in an average at Maijdee Bazar. From this

result it can be depicted that the area named Sonapur is rural area where plastic consumption rate is lower due to unavailability than Maijdee Bazar. On the other hand in Maijdee bazar a lot of commercial institutions are situated, which are the major sources of producing different types of plastic items.

### 3.2.3 Recyclable scrap metals between Sonapur and Maijdee Bazar

After conducting the study, it is found that the discarded scrap metal of Sonapur is larger than Maijdee Bazar. In Sonapur, there are about 400 kg scrap metal are collected daily in an average (Fig. 13). On the other hand, there are about 333.33 kg scrap metals are collected daily in an average at Maijdee Bazar. There is a large bus stand situated in the Sonapur area. The discarded metals show the highest the value here than Maijdee Bazar. Moreover there are several garages situated in this area and they are one of the sources of scrap metals and metal parts of the large vehicles and local transport systems.

### 3.2.4 Recyclable tin between Sonapur and Majidee bazar

It is measured that the discarded tin of Sonapur is lower than Majidee Bazar. In Sonapur, there are about 143 kg recyclable tin are collected daily in an average. On the other hand, there are about 146.67 kg recyclable tin are collected daily in an average at Majidee Bazar (Fig. 14). The most common sources of tins are houses and shops the areas.

### 3.3 Percentage of Recyclable Solid Wastes at Sonapur

The percentage of recyclable solid wastes from Sonapur is not same for different recyclable materials. It shows that among different types of

solid waste there are the highest 41% is found (Fig. 15) for scrap metals and second most recyclable item is paper 37%. The other type of items are tin (14%) and Plastic (8%) found the lowest.

### 3.4 Percentage of Recyclable Solid Wastes at Majidee Bazar

The recyclable solid wastes from Majidee Bazar reveal that most of solid wastes are recycled commercially. It shows that (Fig. 16) among different types of solid wastes there are the highest 44% is found for scrap metals and second most recyclable item is paper 21%. The other type of items are tin (19%) and Plastic (16%) found the lowest.

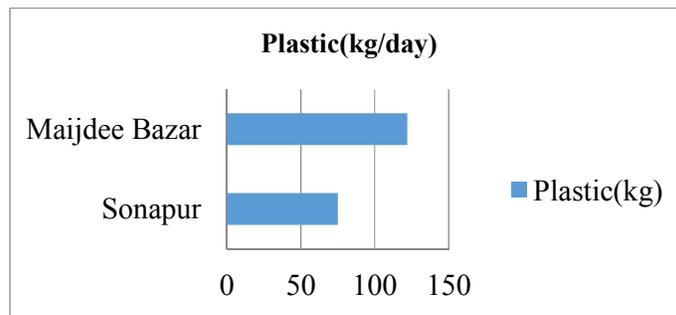


Fig. 12. Recycle of plastic between Sonapur and Majidee Bazar

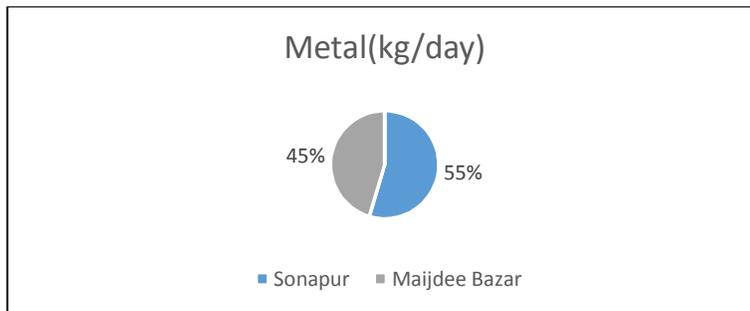


Fig. 13. Recycle of scrap metals between Sonapur and Majidee Bazaar

Table 1. The mean and standard deviation of collected items by area and types

Item	Place	Shop No.	Mean	Std. Deviation	Level of significance
Paper	Sonapur	6	366.67	216.025	Ns
	Majidee bazar	6	161.67	176.456	
Plastic	Sonapur	6	75.00	22.583	Ns
	Majidee bazar	6	121.67	120.734	
Metal	Sonapur	6	400.00	104.881	Ns
	Majidee bazar	6	333.33	194.079	
Tin	Sonapur	6	143.33	123.720	ns
	Majidee bazar	6	146.67	99.331	

\*ns: not significant

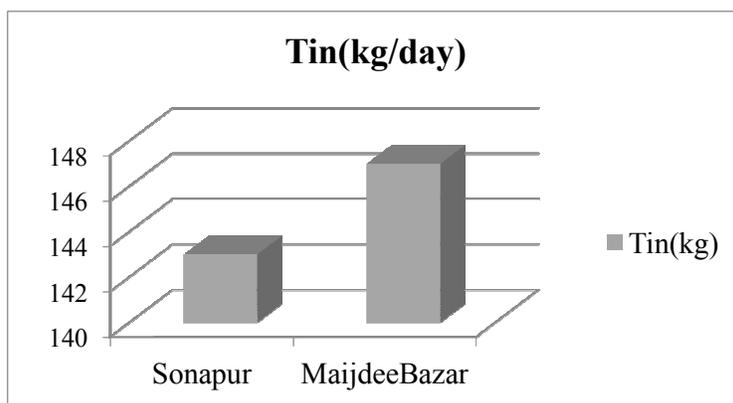


Fig. 14. Recycle of tin between Sonapur and Maijdee Bazaar

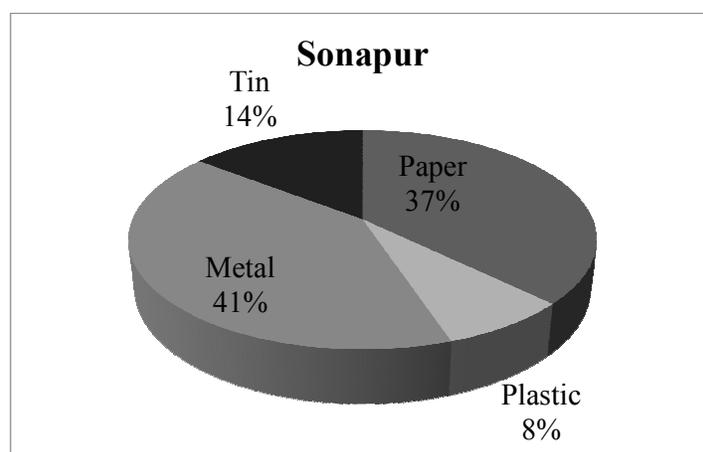


Fig. 15. Recyclable solid wastes at Sonapur

### 3.5 Status of Solid Waste Recycling between Sonapur and Maijdee Bazar

The recycling trend of tin is almost same in both Sonapur and Maijdee Bazar. And the next nearest trend of recycling is metal and plastic between two areas. There is a little difference with the recycling trend of paper between Sonapur and Maijdee Bazar (Fig. 17).

The study is conducted in a small area of Noakhali Zila of Bangladesh, These two areas named Sonapur and Maijdee Bazar is situated in rural and semi-urban areas respectively in Noakhali zila. The facility of recycling is limited here and moreover there is a lack in managing discarded items. The study reveals that there is no significant difference (Table 1) between recycling of waste items in the study area due to small sample size. But the study identified the items which are being used for recycling

within limited facilities and indicates the poor waste collection systems of these growing city areas.

### 3.6 Current Price Values of Recyclable Solid Wastes at Sonapur and Maijdee Bazar

From the study, it is found that (Table 2) there was no fixed price value of discarded solid wastes. The price varies and sometime increases or decreases depending on local market. Store owners buy the discarded solid wastes from tokai or feriwala at lower price and sell at a little higher price to the factory owners or others with the purpose of recycling of solid wastes. Generally the store owners transported a large amount of recyclable solid wastes through trucks to Narayangonj, Dhaka. After collecting these items from these local shops they use to recycle these in a week or month.

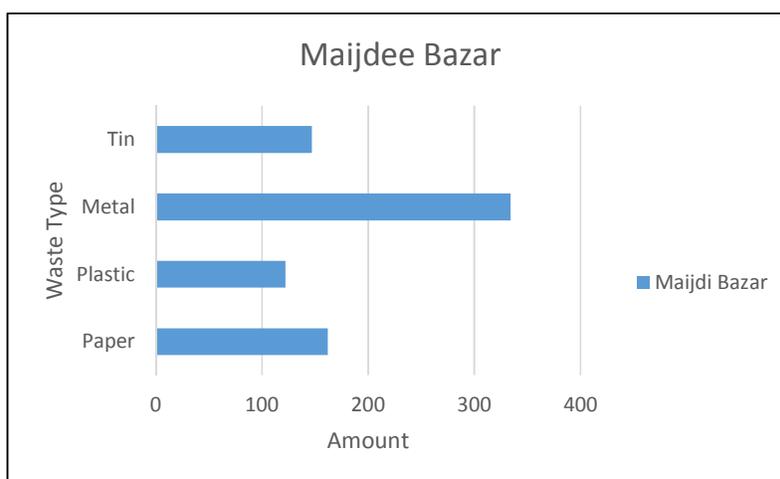


Fig. 16. Recyclable solid wastes at Maijdee Bazar

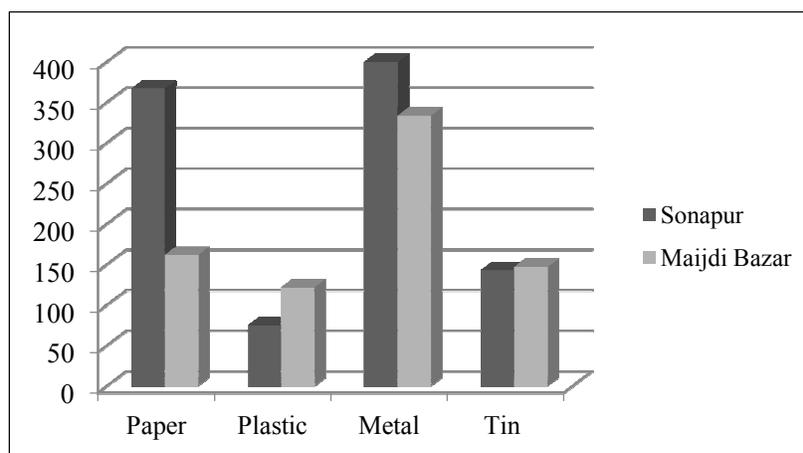


Fig. 17. Solid waste recycling between Sonapur and Maijdee bazaar

Table 2. Price values of recyclable solid wastes

Items	Sonapur		Maijdee Bazar	
	Buy (tk/kg)	Sell (tk/kg)	Buy (tk/kg)	Sell (tk/kg)
Paper	10	12	13	15
Plastic	20	25	28	30
Metal	30	32	27	32
Tin	23	26	23	26

#### 4. CONCLUSION

The global waste generation is increasing by competing with the growing population which can be recycled in a scientific and sustainable way to minimize the environmental impact. The existence of waste, mainly the recyclable solid waste has opened up quite an extensive possibility for the various groups of the community in Noakhali to utilize it. Among the

different types of recycled solid wastes are mainly paper, plastic, iron, glass, tin etc. The recycling of solid wastes is presently carried out by many waste collectors, a series of dealers and industries. Although the recycling of solid waste is not included in the waste management policy of the local government, it has become one of the main sources of income for several groups of people from the private sector. Noakhali Municipality is not fully involved in the waste

recycling process or neither provided incentives to the waste recycling sectors. The daily estimated wastes of Noakhali Sadar Upazila are dumped into a place named Ashwadia. The overall waste recycling facility in the study area is not satisfactory. Irregular waste management and lack of proper waste system are one of the major causes of not booming up of recycling system in the Noakhali. In order to achieve proper solid waste management and to improve recycling rates, one of the major challenges of Bangladesh is how to best effort with the informal sector to improve their working conditions, technologies and efficiency in recycling. Proper storage and source separation system can be adopted for recovering useable and recyclable paper and plastic. Adequate recycling facilities should be increased by the local government in order to sustainable waste management. Moreover, solid waste management strategies in Bangladesh should be reorganized to include a separate collection and processing system for the recyclable solid waste to avoid mixing with biodegradable waste. That can work parallel with the traditional systems operated by the informal sector for waste separation, processing and final recycling.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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