

## **RECYCLING PRACTICES OF ELECTRONIC WASTE IN KHULNA CITY, BANGLADESH**

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### **ABSTRACT**

The effective life of electronic devices is relatively short and decreasing as a result of rapid changes in technology, equipment features and capabilities. This creates a large waste stream of obsolete electronic equipments, electronic waste (E-waste). Rapid increase in the quantity of E-waste has become an emerging issue throughout the world. Although the recycling of E-waste management has been ignored by the local authorities, many waste collectors, shopkeepers, repairing technicians and dealers have been performing recycling activity as a source of income for a long time in Bangladesh. The aim of the study is to find out recycling practices of E-waste in Khulna city of Bangladesh. To achieve this goal, a number of field surveys and questionnaire surveys were performed. There are 127 shops in Khulna city which perform E-waste recycling in the form of recovery, reuse and repairing. Total 726 people in this city including E-waste pickers (Tokai), E-waste collectors (Feriwala) and E-waste recycling shop workers who are involved in E-waste recycling activities as their livelihood. The amount of recyclable E-waste in Khulna city was found 614 kg.day<sup>-1</sup>. The study reveals that the items which form the major portion of E-waste in Khulna city are fan and motor (13.36%), iron, oven and rice cooker (5.37 %), refrigerator and air conditioner (37.13 %), TV, computer and laptop (36.16 %), mobile phone and battery (6.03 %), electric wire and bulb (2.44 %) and other electrical and electronic equipments (4.40 %). On the basis of the amount of E-waste, existing recycling programs and collection methods, a E-waste recycling pattern was developed to evaluate its generation (domestic), repairing, process of recycling practices, exporting and disposal. The study analyzed the income generation of the individuals involved in the whole process. The total amount of income from E-waste recycling in Khulna city was found 22,02,808 taka.month<sup>-1</sup>. More willingness of E-waste recycling practices of the people in Khulna city can reduce the effects of heavy metals containing in E-waste and hence reduce soil pollution and can increase environmental, financial and economic development of this city.

**Keywords:** *Electronic waste, Recycling practices, Recycling pattern, Income generation, Khulna.*

## **1. INTRODUCTION**

### **1.1 Background**

Solid waste can be defined as useless, unwanted and discarded matters coming from the production and consumption of materials by human and animal activities. Electrical and Electronic wastes have become a considerable part of solid waste. With the development of consumer-oriented electrical and electronic technologies, a large amount of electronic equipments have been sold to consumers. The useful life of these consumer electronic devices (CEDs) is relatively short, and decreasing as a result of rapid changes in equipment features and capabilities. This creates a large waste stream of obsolete electronic equipment (Kang H. Y. & Schoenung J. M., 2005). Any electrical or electronic devices which has reached their end of life and is destined to be recycled or dumped is considered as E-waste (Sajid M. et al., 2019). Previous studies indicate that the amount of generation of E-waste is almost 10% of the total amount of solid waste globally, but the growth rate is 2–3 times faster than other waste stream (Walden & J.L., 2012). E-wastes contains a significant amount of aseptic matters including heavy metals, inorganic pollutants and hazardous elements which has a large adverse effect on environment. Recycling of E-wastes (recovering, reuse and repairing) can reduce environment pollution as well as can be a source of income to the persons involved in this process. So recycling of E-wastes is beneficial from environmental, economical and social point of view.

### **1.2 Recycling of E-waste in Bangladesh**

The recycling of E-waste management is mostly neglected by local authorities. For the generated E-wastes in the country, disposal is often done with other solid wastes without any treatment. These large quantities of E-wastes are resulting in environmental threat due to improper handling and disposal. In this country, there are little specific scope for E-waste management. But many people of the country directly or indirectly are related to E-waste recycling as a source of income. They are involved in E-waste recycling process as the forms of collecting or buying, repairing the E-wastes, recovering useful parts from the wastes, reusing them or selling them at a higher price than buying them.

### **1.3 Scenario of E-waste Recycling Practices in Khulna City**

Khulna, the third largest city of Bangladesh, is located in the southern part of the country and is situated below the tropic of cancer, around the intersection of latitude 22.49\_N and longitude 89.34\_E. The area of Khulna city is 47 square km with a population 1.5 million (BBS, 2009). The total amount of solid waste generation in Khulna city is 520 tons/day (Waste Safe, 2005). As all kinds of electrical and electronic devices are available in this city, the amount of E-waste is also increasing day by day. The solid waste management in Khulna is performed by Khulna City Corporation (KCC). But there is no specific E-waste treatment plant in this city. But the recycling of E-waste is done by a considerable amount of People. A few portion of E-waste is recycled in Khulna city and rest of the recyclable E-wastes is sent to Dhaka, the capital of Bangladesh. Only precious gold such as gold, silver, aluminum, copper is separated in Khulna.

### **1.4 Study Aim**

The objectives of the study are being to (i) study the existing recycling practices and collection methods of E-waste in Khulna city, (ii) determine the amount of E-waste and the types of E-waste recycled in Khulna city, (iii) compare these data with related previous studies, (iv) develop a recycling pattern to evaluate E-waste generation, process of recycling and disposal and (v) analyse the income generation of the individuals involved in the E-waste recycling process.

## 2. METHODOLOGY

The methodology adopted in this study is highlighted and hence discussed in the following articles.

### 2.1 Field Visit

In this study, reconnaissance survey was performed all over Khulna city in order to get a clear concept about the E-waste recycling practices. The recycling dealers and repairing shops are found available in Shiromoni, Fulbari, Daulatpur, Khalishpur, Sheikhpara, Dakbangla, Sonadanga, Gallamari, Rupsa and Nirala. All the E-waste recycling practices are going on in these areas. These selected areas are indicated in the map of Khulna city in Figure 1.

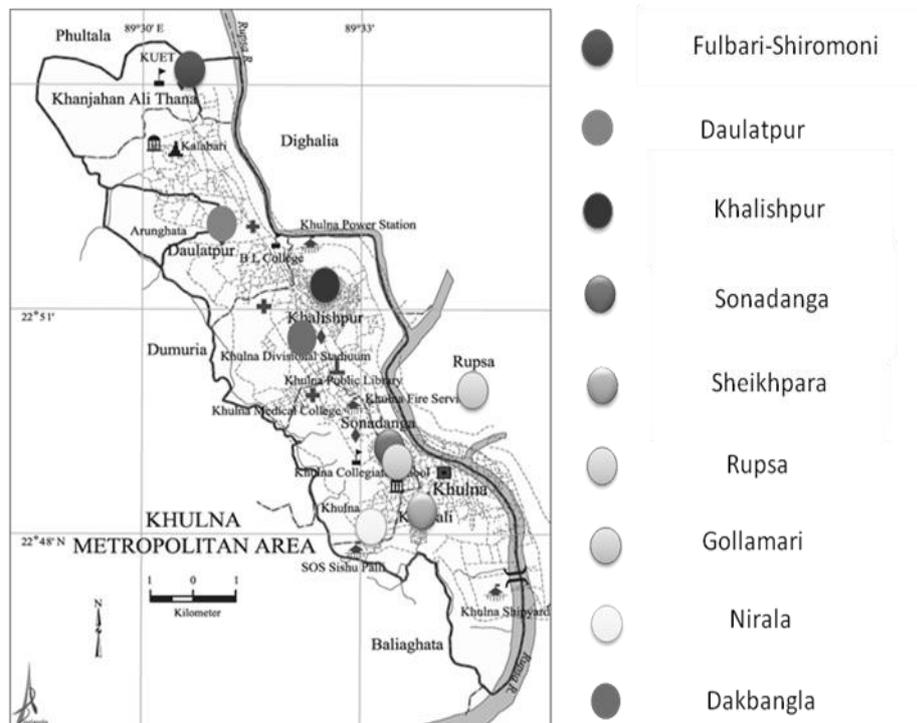


Figure 1: Selected Areas of Khulna city

### 2.2 Field Survey

Firstly, the location of Shiromoni, Fulbari, Daulatpur, Khalishpur, Sheikhpara, Dakbangla, Sonadanga, Gallamari, Rupsa and Nirala was identified through map. The characteristics, population and amount of households were collected. The E-waste recycling practices were studied in each area. The number of recycling dealers and repairing shops was counted. The types of E-wastes which are being recycled, the pattern of practices of E-waste recycling were studied in those areas.

### 2.3 Questionnaire Survey for Data Collection

A several set of questionnaires was prepared for repairing shops, workers in the shops, waste pickers (locally named as Tokai), waste collectors (locally named as Feriwala) to obtain information about the ongoing waste recycling system. All data were collected in individual tabular form through questionnaire survey. The number of tokais, feriwalas, number of workers in each shop involved in E-waste recycling was counted. The shops were categorized as large, medium and small according to their size and E-waste recycling activities. The income generations of the individuals were also collected in taka month<sup>-1</sup>. The amount of E-wastes generated for recycling in each shop was determined in kg.day<sup>-1</sup>.

### 3. RESULT AND DISCUSSION

#### 3.1 General

In this study, the characteristics of the selected areas Shiromoni, Fulbari, Daulatpur, Khalishpur, Sheikhpara, Dakbangla, Sonadanga, Gallamari, Rupsa and Nirala were observed by field visiting. The types of E-waste recycled in individual areas were noticed. Some pictures of recyclable E-wastes in Khulna city are shown in Figure 2. The population and the number of households are collected from the papers of different organizations and government departments. All the collected data are shown in Table 1.



(a)



(b)

Figure 2: Recyclable E-wastes at (a) Dakbangla and (b) Sheikhpara in Khulna city

Table 1: A Description of Selected Areas

Location	Characteristics of Area	No. of House holds	Population	Practices of E-waste Recycling	Types of E-Waste Recycled
(i)	(ii)	(iii)	(iv)	(v)	(vi)
Fulbari-Shiromoni	Mainly low income households	1515	7575	Household E-waste repairing	TV, fan, motor, iron, oven, rice cooker etc.
Daulatpur	Located in city periphery, mainly pre urban	1463	7315	Household E-waste repairing	TV, refrigerator, iron, fan etc.
Khalishpur	Industrial area located along the river	3461	17805	E-waste repairing and sales	Electric bulb, electronic wires, fan, TV, Air conditioner etc.
Sheikhpara	It is mainly a recyclable waste market area	1577	7885	E-waste sales	Mobile phone. Battery, electric meter, clock, water heater, iron, remote, calculator etc.
Sonadanga	Planned housing in built up area with higher income households	1834	9170	Household E-waste repairing	TV, refrigerator, mobile phone, air conditioner, fan etc.
Gallamari	Central area. Traditionally middle class and educated professionals live here	2877	14385	Household E-waste repairing	TV, refrigerator, mobile phone, fan etc.
Rupsa	Mainly industrial and less residential area	3498	17490	Household E-waste repairing	TV, refrigerator, mobile phone, air conditioner, fan etc.
Nirala	Mainly residential area	2038	10190	Household E-waste repairing	TV, refrigerator, mobile phone, IPS, air conditioner, fan, iron etc.
Dakbangla	Mainly commercial area	1650	8250	Household and official E-waste repairing	Laptop, Desktop, TV, printer, mobile phone, air conditioner, refrigerator etc.

Note: Column (iii) and (iv) are collected from BBS (Bangladesh Bureau of Statistics) and column (ii), (v) and (vi) are collected from Field Survey.

### 3.2 Pattern of E-waste Recycling in Khulna

In this study, it was observed that the waste pickers locally known as Tokai primarily collect E-wastes with other solid wastes from domestic households and sell them to larger waste collectors locally named as Feriwala. They separate the easiest parts which is usable or recyclable and directly sell them to the consumers or to different markets of Khulna city. The shopkeepers whose business is related to E-waste recycling buy them. The recycling process is done by them in the form of recovery, repairing or reuse. Then they sell them to the consumers or to the dealers. The dealers further sell them to the

related electronic companies mainly located at Dhaka the capital of Bangladesh. In each steps of this process, the non-recyclable parts of the E-wastes are gone for disposal. The overall pattern of E-waste recycling in Khulna city is shown in the flow-chart in Figure 3.

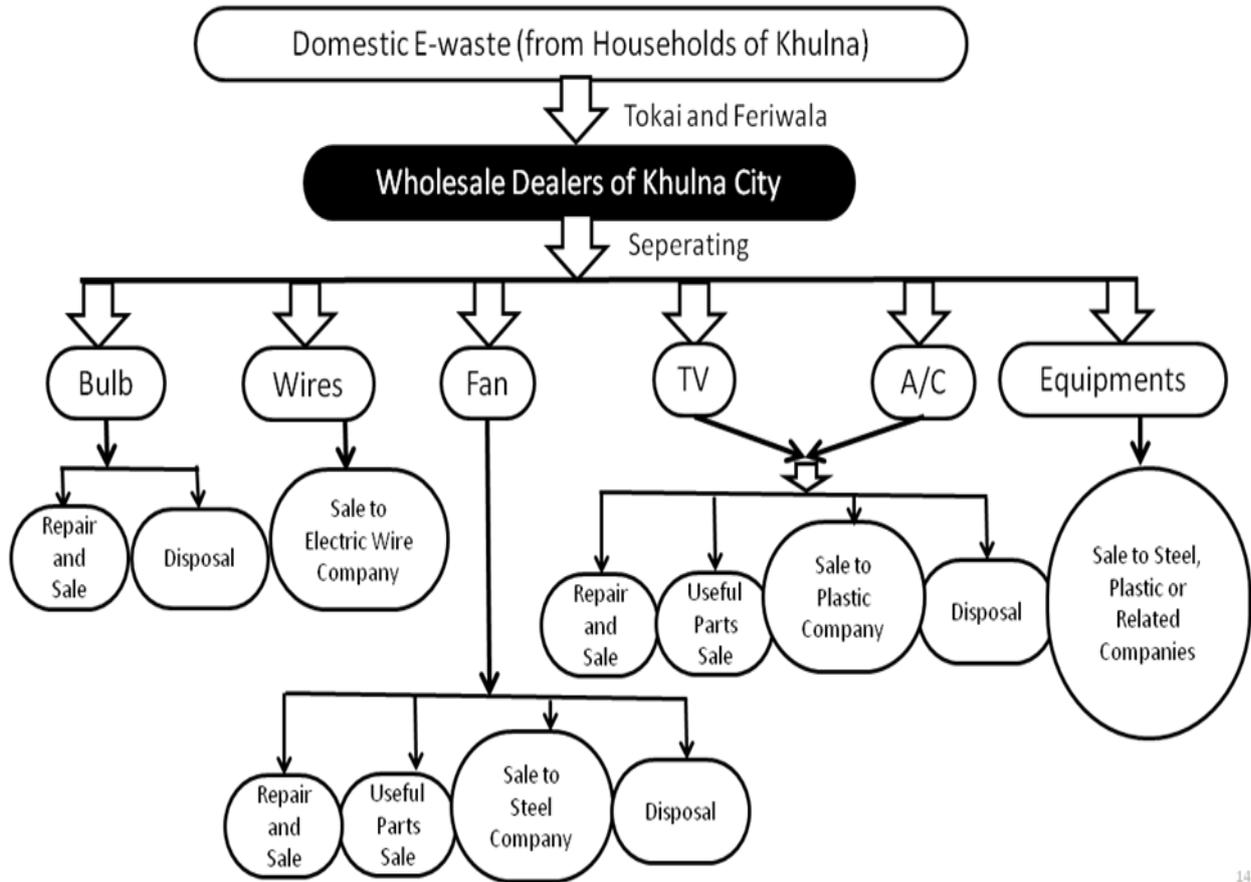


Figure 3: Flow-chart of E-waste Recycling Pattern in Khulna City

### 3.3 Number of Shops and Number of People Involved in E-wastes Recycling in Khulna City

The study reveals that several types of people such as Tokais, Feriwalas, repairing shop workers and E-waste dealers are involved in E-waste recycling process in Khulna city which are discussed below.

#### 3.3.1 Number of Shops and Number of Shop Workers Involved in E-waste Recycling

By performing field survey, the collected data for estimating the amount of shops and the amount of workers in the shops involved in E-waste recycling in Khulna city are given in Table 2.

Table 2: Number of Shops and Number of Workers in the Shops Involved in E-wastes Recycling in Khulna City

Location	Number of Shops			Total Number of Shops	Average Number of Workers (persons/ shop)			Total Number of Shop Workers in the Area
	Large Shops	Medium Shops	Small Shops		Large Shops	Medium Shops	Small Shops	
Sheikhpara	0	0	25	25	-	-	2	50
Dakbangla	0	7	18	25	-	4	2	68
Daulatpur	0	0	5	5	0	0	2	10
Fulbari-Shiromoni	0	0	8	8	-	-	2	16
Khalishpur	0	1	6	7	-	3	2	15
Sonadanga	3	5	10	19	8	5	2	69
Gallamari	1	2	6	10	7	4	2	27
Rupsa	1	2	4	9	7	3	2	21
Nirala	2	3	10	15	8	4	2	48
Other Places	1	2	5	8	8	5	2	28
<b>Total</b>				<b>127</b>				<b>354</b>

### 3.3.2 Total Number of People Involved in E-waste Recycling

The Total number of workers including Tokais, Feriwalas, E-waste recycling shop workers in different areas of Khulna City is shown in Table 3.

Table 3: Total Number of People Involved in E-wastes Recycling in Khulna City

Location	Number of E-waste Recycling Shop Workers	Number of Tokais	Number of Feriwalas	Total Number of People Involved
Sheikhpara	50	100	30	180
Dakbangla	68	50	18	136
Daulatpur	10	10	3	23
Fulbari-Shiromoni	16	8	2	26
Khalishpur	15	10	5	30
Sonadanga	69	20	7	96
Gallamari	27	15	5	47
Rupsa	21	12	4	37
Nirala	48	15	5	68
Other Places	28	50	5	83
<b>Total</b>				<b>726</b>

### 3.4 Daily Total Amount of Recyclable E-waste in Khulna City

In this study, it was found that different areas of Khulna city produce different amount of recyclable E-waste. Even the types of E-waste and their amount also varies from area to area. All the collected data and hence the total daily amount of recyclable E-waste in Khulna City are shown in Table 4.

Table 4: Daily Total Amount of Recyclable E-waste in Khulna City

Location	Fan and Motor (kg. Day <sup>-1</sup> )	Iron, Oven and Rice cooker (kg. Day <sup>-1</sup> )	Refrigerator and Air Conditioner (kg. Day <sup>-1</sup> )	Electrical Wire and Bulb (kg. Day <sup>-1</sup> )	Mobile Phone and Battery (kg. Day <sup>-1</sup> )	TV, Computer and Laptop (kg. Day <sup>-1</sup> )	Other devices (Remote, Clock, charger, Calculator etc.) kg. Day <sup>-1</sup>	Total (kg. day <sup>-1</sup> )
Sheikhpara	10	5	-	5	5	-	10	35
Dakbangla	8	-	15	-	10	48	5	86
Daulatpur	6	3	10	-	-	14	-	33
Fulbari-Shiromoni	10	5	-	-	-	20	-	35
Khalishpur	5	-	10	5	-	10	2	32
Sonadanga	8	-	47	-	-	37	-	92
Gallamari	-	-	53	-	5	18	-	76
Rupsa	10	-	12	-	5	20	-	47
Nirala	15	10	46	-	2	30	5	78
Other Places	10	10	35	5	10	25	5	100
<b>Total</b>	<b>82</b>	<b>33</b>	<b>228</b>	<b>15</b>	<b>37</b>	<b>222</b>	<b>27</b>	<b>614</b>
Percentage (%)	13.36	5.37	37.13	2.44	6.03	36.16	4.40	

### 3.5 Comparison of Present Amount of Recyclable E-waste with Related Previous Study

From collected data of previous study done in Khulna city, daily amount of recyclable E-waste generated in Khulna city was 1877 kg.day<sup>-1</sup> in 2013 (Ali M. H., 2013) and 368.94 kg.day<sup>-1</sup> in 2017 (Nahar W., 2017). which are compared with present amount of Recyclable E-waste (614 kg.day<sup>-1</sup>) in Figure 4.

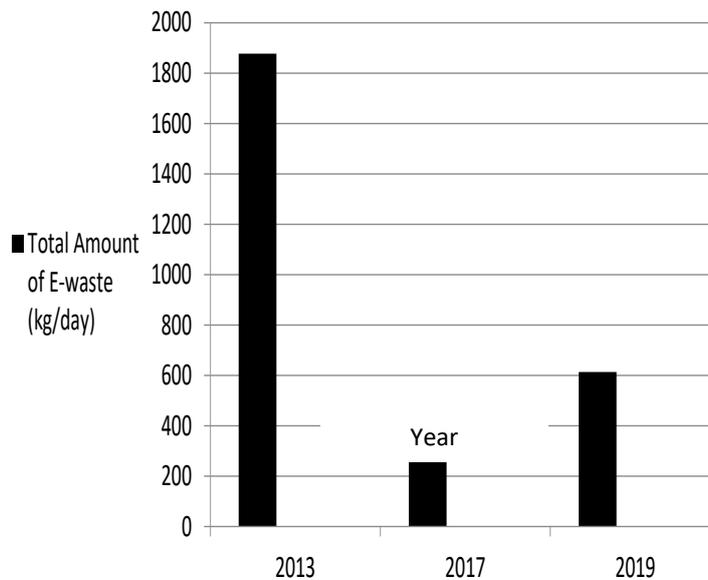


Figure 4: Comparison of Present Amount of Recyclable E-waste with Related Previous Study

### 3.6 Income Generation from E-waste Recycling in Khulna City

The profit generated from E-waste Recycling varies from shop to shop and person to person. The Feriwalas income more than the Tokais and the shop worker's income more than the Feriwalas. Similarly, big shops' income is more than the medium and small shops'. The total income generation from E-waste recycling was determined by multiplying their number with the approximate average income of the individuals collected from questionnaire survey. The amount was expressed in taka. month<sup>-1</sup>. Total income generated from E-waste recycling is shown in Table 5.

Table 5: Income Generated from E-waste Recycling in Khulna City

Location	Number of E-waste Recycling Shop Workers	Avg. Income of Shop Workers (taka. person <sup>-1</sup> . month <sup>-1</sup> )	Total Income of Shop Workers (taka. month <sup>-1</sup> )	Number of Tokais	Avg. Income of Tokais (taka. person <sup>-1</sup> . month <sup>-1</sup> )	Total Income of Tokais (taka. month <sup>-1</sup> )	Number of Feriwalas	Avg. Income of Feriwalas (taka. person <sup>-1</sup> . month <sup>-1</sup> )	Total Income of Tokais (taka. month <sup>-1</sup> )	Total (taka. month <sup>-1</sup> )
Sheikhpara	50	3935	196750	100	1700	170000	30	2850	85500	452250
Dakbangla	68	4328	294304	50	1680	84000	18	3050	54900	433204
Daulatpur	10	4125	41250	10	1500	15000	3	2680	8040	64290
Fulbari-Shiromoni	16	4107	65712	8	1600	12800	2	2700	5400	83912
Khalishpur	15	4116	61740	10	1450	14500	5	2650	13250	89490
Sonadanga	69	4376	301944	20	1600	32000	7	3100	21700	355644
Gallamari	27	4266	115182	15	1500	22500	5	3000	15000	152682
Rupsa	21	4188	87948	12	1480	17760	4	3000	12000	117708
Nirala	48	4293	205344	15	1550	23250	5	3050	15250	243844
Other Places	28	4278	119784	50	1500	75000	5	3000	15000	209784
<b>Total</b>			1489958			466810			246040	<b>2202808</b>

## 4. CONCLUSIONS

Recycling of E-waste is an important matter of concern in this modern era of electronics and technologies. In this study, the existing recycling practices and collection methods of E-waste in Khulna city were found out and an E-waste recycling pattern was developed. The characteristics of the selected areas (Shiromoni, Fulbari, Daulatpur, Khalishpur, Sheikhpara, Dakbangla, Sonadanga, Gallamari, Rupsa and Nirala) and the types of recyclable E-waste were collected by field survey. But the number of households and the population of each area were found different in different journals. So approximately the best data were selected. The number of E-waste recycling shops, the number of workers including Tokais, Feriwalas and E-waste recycling shop workers involved in the whole process of E-waste recycling were estimated in this study. The daily amount of recyclable E-waste was found out through questionnaire survey. Although correct data were tried to collect, it may slightly vary from the actual data. In comparison to previous studies, the amount of recyclable E-waste was reduced in 2017 than 2013 may be due to availability of all kinds of electrical and electronic devices in Khulna city and was increased in 2019 than 2017 may be due to increased population of this city. As the income generation from E-waste recycling practices varies from person to person, average income of the individuals was taken to determine the monthly total income generation from E-waste recycling practices in Khulna city. The willingness of E-waste recycling practices of the people in Khulna city can reduce the effects of heavy metals containing in E-waste and hence reduce soil pollution and can increase environmental, financial and economic development of this city.

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