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Regional Waste Paper Recycling Inventory Study in Turkey and Distribution of Recycling Quality Classes

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Abstract

Although the paper recycling rate in Europe is 70-90% in some countries, its overall average is around 72%. The waste recycling and recycling rate in Turkey has remained unchanged for the last decade and has been fixed at 50%. This lead to has unprecedented levels of paper imports. The average amount of imports in the previous years was 50,000 - 60,000 tons/year, however, this rate has reached 183,000 tons/year in 2014. Approached to 250,000 tons in 2015. And, in 2016, the imported scrap paper tonnage has reached to 500,000 tons by an almost 80% increase. Therefore, by the end of 2017, import tonnage is expected to exceed 700-800 thousand tons. While the current paper recycling tonnage of Turkey is 2.6 million tons on average recently, the industry has reached a size of 3 million tons as a result of capacity increases and new machines introduced. Together with new investments made and to be made, it is expected to reach a size of 3.2 million tons by the end of 2017. The paper types were divided into 3 main classes in this study conducted in 2016 under the coordination of Waste Paper and Recyclers Association (AGED), which is the most important sectoral association representing the scrap paper recycling factories regarding the meeting paper need of the rapidly growing industry from domestic sources in Turkey. These main classes were also divided into sub-classes according to the quality classes. In the next stage, each paper factory were asked to enter the supply information about the quality and amount and region of paper into the inventory system for each month. The data collected were presented in graphs with factors such as the population of the region, the amount of waste to be produced, and the number of facilities in the region. As a result, the regional distribution of 2.123.786 tons waste paper was achieved in this study. In this regard, the highest percentage of waste paper recycling was in the Marmara region by 44%, whereas the lowest recycling was in the Black Sea region by 1%. Within the context of engineering, these results obtained quantitatively will contribute the feasibility studies for future investments.

Keywords: Recycling, Regional inventory, Waste management, Waste paper recycling

INTRODUCTION

Despite the 72% wastepaper recycling rate in Europe on the average, the waste recycling rate in Turkey remains unchanged at 50% over the last decade. The recycling has not increased at the same rate, in spite of the increased paper recycling capacity in Turkey. The average amount of imports in the previous years was 50,000 - 60,000 tons/year, however, this rate has reached 183,000 tons/year in 2014. The same tonnage approached to 250,000 tons in 2015. And, in 2016, the imported scrap paper tonnage has reached to 500,000 tons with an almost 80% increase. Turkey scrap paper import and export figures are shown in Table 1. Therefore, by the end of 2017, import tonnage is expected to exceed 700-800 thousand tons. As the paper consumption capacity of 6-7 million tonnes/year shows, this is not sustainable when the costs are taken into account. Therefore, the only viable option for the industry is to increase current recycling rate of 50% to at least 70% as in Europe.

As shown in Table 2, the current paper recycling tonnage of Turkey was 2.6 million tons on average recently. And, the industry has reached a size of 3 million tons as a result of capacity increases and new machines introduced. Together with the current and new investments to be made, it is expected to reach a size of 3.2 million tons in the following years.

The results obtained in a waste characterization study conducted in 2009 by Istanbul Environmental Protection and Waste Material Evaluation Industry and Trade Inc. (İSTAÇ) are shown in the Figure 1, and despite all the efforts of industry stakeholders and despite the collection of package waste through street collectors, albeit not quite desirable, the percentage of recyclable paper sent to depot areas is 13%. The annual amount of garbage in Turkey is approximately 29 million tons according to Turkish Statistical Institute (TSI) 2014 data, as shown in Table 3 below. Assuming that there is a 13% recyclable paper-cardboard in this tonnage, it turns out that 3,900,000 tons of recyclable paper tonnage is buried in depot areas every year.

The economic size of the paper buried in depot areas is estimated to be €721 million as of 2017. Due to the failure in the collection of the scrap paper, which is the raw material needed by the industry, the quality of paper is decreasing as well as costing more than its counterparts in the world. If the paper waste collection ratios reaches 80% as in Europe, it will be possible for the industry to purchase scrap paper at an actual value and the current account deficit will be decreased by exporting the surplus tonnage.

Table 1. Turkey scrap paper import and export figures (Source: TSI scrap (recycled) paper import and export data)

	IMPORT (tons)	EXPORT (tons)
2011	71,922	119,695
2012	52,500	40,210
2013	80,068	39,541
2014	183,833	43,329
2015	248,288	57,418
2016	450,912	46,096

Table 2. Production Tonnages in Turkey and Estimated (Source: SKSV)

	Actual production			**Estimates**		
	2014 (tons)	2015 (tons)	2016 (tons)	2017 (tons)	2018 (tons)	2019 (tons)
Corrugated cardboard papers	1,997,500	2,189,709	2,279,011	2,482,500	2,525,000	2,580,000
Cardboards	569,000	577,291	614989	643,500	677,000	677,500
Total	**2,566,500**	**2,767,000**	**2,894,000**	**3,126,000**	**3,202,000**	**3,257,500**

Table 3. Collected Domestic Waste Tonnage (Source: TSI 2014 Turkey Domestic Waste Tonnage Collected)

TOTAL (tons/year)	SUMMER (tons/year)	WINTER (tons/year)
28,844,572	16,615,181	12,229,392

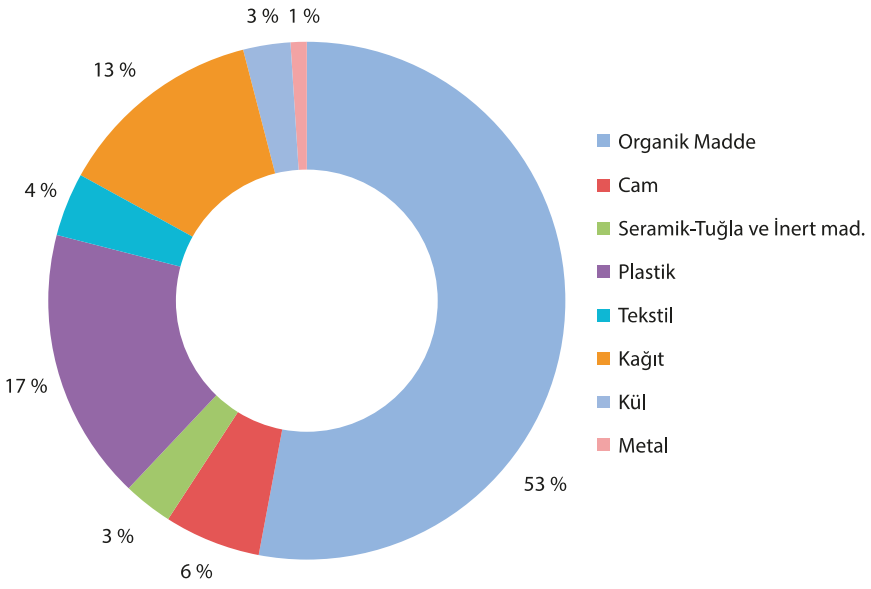

Figure 1. Scrap paper tonnage and economic size buried indepot areas (Source: İSTAÇ Waste Characterization)[1]

Considering these figures, it is a necessity to identify the characteristics of the paper in Turkey as well as identifying the regional quality characteristics of the papers collected. In line with the data to be obtained, it is aimed to plan future investments according to regional waste paper potentials.

MATERIALS AND METHODS

In this study, a table of quality classification according to paper types was created with the participation of technical teams of paper mills due to the differences in the waste paper standards between EU and Turkey. The purpose of this standard is to establish a common quality terminology between suppliers and recycling facilities that produce recycled paper in Turkey. The terminology in question aims to ensure that the trade between the buyer and the seller is carried out more efficiently for standardized classes of recycled paper and cardboard as well as providing a more systematic way for the inventory work.

Recycled paper and cardboard are classified as follows:

- Group A: Corrugated (brown)
- Group B: High-grade (white)
- Group G: Newsprint Paper

These groups were also divided into sub-classes according to their qualities. 3 separate tables were created. The quality classes are determined as shown in the following tables. And, these are shown in Table 4.Since there is no study in Turkey about the quality, amount, and region of the collected paper, a recycling information system was

Table 4. Paper Quality Classes

CORRUGATED PAPER PURCHASE EVALUATION			
Code Number	**Name of Paper**	**Corrugated Quantity (Min %)**	**DESCRIPTION**
A08	Craft	100	Used or not used various craft bags
A07	Corrugated cardboard fragments	100	Craft or testliner surface corrugated cardboard box scrap or unused corrugated cardboard boxes and sheets.
A06	Corrugated market cardboards	99	Used corrugated cardboard boxes and sheets (Without coating)
A05	Collected corrugated cardboard	90	Paper and cardboards with 90% corrugated + 10% other grades
A04	Collected corrugated cardboard	70	Package paper and cardboards with 70% corrugated + 30% other grades
A03	Gray-chrome cardboard	0	Used textile spools, gray cardboard cuts, etc. - Cardboards with at least one white or colored finish and the other side is gray.
A02	Corrugated mixed	< 40	Paper and cardboard with a maximum of 40% corrugated + 60% mix of other grades

HIGH-GRADE PAPER PURCHASE EVALUATION		
Code Number	**Name of Paper**	**DESCRIPTION**
B08	High-grade extra	Sorted, unprinted, wood pulp-free, wax-free, glue-free high-grade printing papers and edge cuts
B07	High-grade high-quality papers	Sorted, lightly printed, wood pulp-free, wax-free, glue-free, high-grade printed papers, sheets, edge cuts, and shredded office papers
B06	High-grade 2nd quality paper	Sorted, printed, wood pulp-free, wax-free, glue-free, high-grade printed papers, sheets, edge cuts, and shredded office papers
B04	High-grade high-quality papers	Sorted, lightly printed, wood pulp-free, wax-free, glued, high-grade printed papers, sheets, edge cuts, and cover-free books and notebooks
B05	High-grade glued papers	Sorted, printed or non-printed, wood pulp-free, wax-free, glued, high-grade printed papers, sheets, edge cuts, and cover-free books and notebooks
B04	Enamel printed papers	Sorted, printed in clear tones, glue-free, high-grade (wood pulp-free), enamel/glossy printed papers
B03	White multi-ply cardboards	Cardboards made from bleached sulphate cellulose
B02	White multi-ply cardboards	White, multi-layer cartons without gray layer, unprinted or printed in clear tones
B01	White, printed multi-ply cartons	Printed, white, multi-layer cardboards without gray layer

NEWSPAPER AND MIXED SCRAP PAPER PURCHASE EVALUATION	
Code Number	Content of Paper
G03	Returned newsprints
G02	Collected newsprints
G01	Mixed waste paper

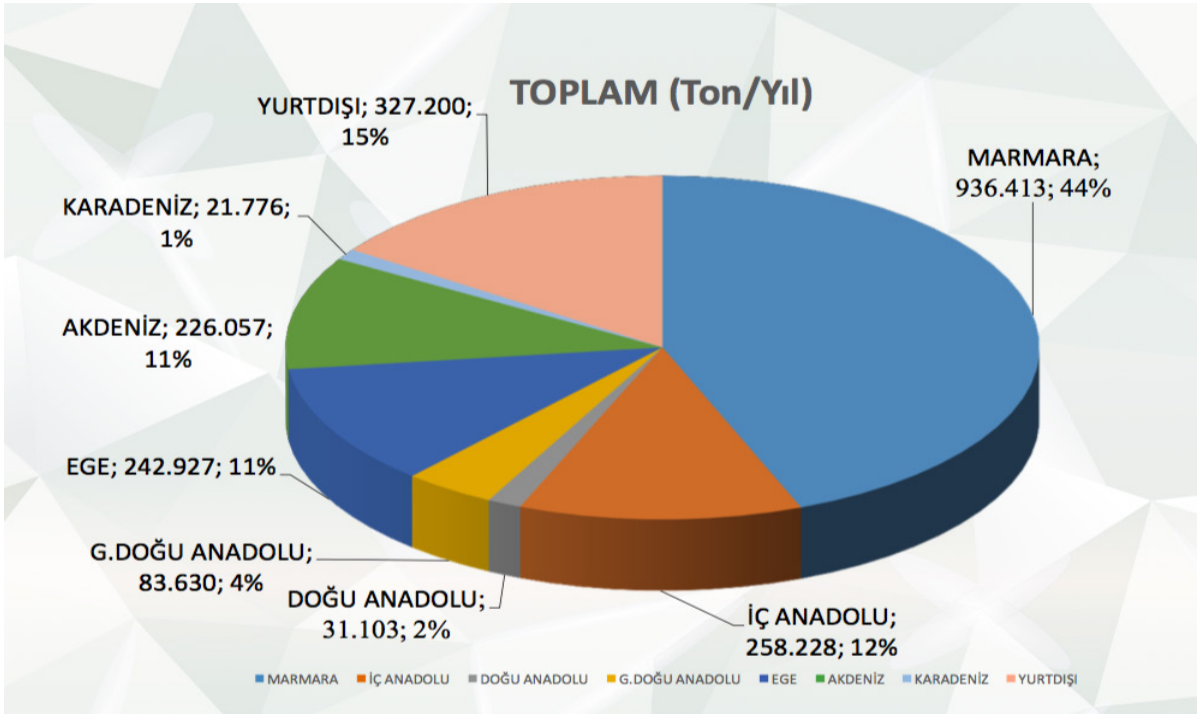

Figure 2. Inventory study results: Regional distribution results

established under the leadership of the Waste Paper and Recyclers Association. Due to the numerous organizations and institutions involved in the collection of recycled paper, many countries do not have a reliable collection data. Normally, collection volumes are calculated by means of recycled paper consumption and trade statistics [2]. The system established has an information security that ensures confidentiality of the data entered through username and password specifically generated for the paper mills in Turkey.

Each paper mill has entered monthly information into the system on the amounts and regions of the waste paper according to its accepted classes of waste paper. A total of 2,132,786 tons of waste paper was added into the system according to this study conducted in 2016. A regional paper inventory report was created by analyzing these wastes according to geographical regions and their qualities.

RESULTS AND DISCUSSION

Today, paper recycling is one of the oldest forms of recycling applied to waste. Recycled paper is an integral part of paper and pulp production and its estimated recycling rate in EU is 72% (20% increase from 2000) in 2012 (CEPI, 2013a) [3]. The paper recycling rate in Turkey was calculated to be 46% according to the 2014 report of the Pulp and Paper Industry Foundation (SKSV) 2014 based on the data from above-mentioned study and the annual capacity of the paper mills (SKSV 2014)[4]. In the current situation, the difference between the waste paper collection rates in Turkey and Europe is due to the ineffective operation of the household waste collection system. It was also found that the quality of the collected paper is below the waste paper standards in Europe. The fact that the collected paper is mainly corrugated cardboard in Turkey also indicates that industrial waste can be collected effectively.As shown in Figure 2, 44% of Turkey's waste paper is collected in the

Marmara region according top the data obtained by the inventory study. This ratio indicates an industry-based collection. The percentage of collected waste paper is low in regions where industrialization is also low.

Today, waste is considered as an inexpensive source of raw material. Recycled paper pulp mills should purchase more waste paper to maintain their production output. When combined with increased global competition, these challenges lead to increased waste paper demand and volatile market prices and availability. Therefore, pulp producers should evaluate and optimize their procurement strategies [5]. Paper is imported from abroad since waste paper production capacity in Turkey cannot be fully utilized. It is known that the amount of waste paper buried in depot areas in Turkey is largely domestic waste papers. It is necessary to collect waste paper from households in order to meet 15% of imported waste paper from domestic sources. To meet this need, the collection rate of waste paper in the domestic market must be increased to 70%.

CONCLUSION

ThisWithin the scope of the studies conducted and literature reviewed, it is necessary for Turkey to achieve a recycling rate in the EU standards. Raw materials can be obtained from domestic sources by making necessary investments and collection systems in areas with low recycling rates. And, the scrap paper surplus can be exported for a positive contribution to the current account deficit. The scrap paper price will reach its actual price by increasing the collection capability to the maximum. Within the scope of the regional studies, waste paper businesses were provided with the opportunity to forecast and an infrastructure was set up for the industry to invest for the current volume of recycling and other reasons. According to the quality assessments made, however, the quality of the waste paper, which includes 20% scrap, should be increased.

It was observed that the amount of paper collected is high in industrialized areas. It was also shown in this study that further research is needed on the variation in the paper

collection according to the income groups and land and regional conditions.

It was observed in the study that recycling awareness, collection systems and recycling investments are especially needed in the Black Sea, Eastern Anatolia and Southeastern Anatolia regions

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