

Waste Recycling Awareness in Saudi Arabia and Barrier Analysis Using ISM

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Abstract

Organization, individuals, and families in Saudi Arabia need more attention on recycling in their daily waste. The average generated daily rate of municipal solid waste is 1.72 kg per capita and the yearly kingdom waste recycling is around 15 million tons. Saudi government set a goal to reach 30million tons per year by 2033. This study examines the awareness level of paper recycling for university students in Saudi Arabia. A survey model consists of 26 measures that concentrated in attitudes, actions, and beliefs, is used. Seventy students in college of engineering at University of Jeddah responded to the survey. Moreover, barriers of adopting recycling paper in Saudi Arabia is analyzed and prioritized using Interpretive Structure Modeling (ISM) software. The findings indicates that the current state level of paper recycling awareness in Saudi Arabia is considered low, the education system does not support this issue, and there is a strong agreement that recycling for individuals and families in Saudi is not easy due to the absence of facilities such as containers and poor infrastructure. Furthermore, it indicates that the barrier “lack of laws that support recycling paper” is considered as the most critical barrier and it influences the rest of barriers.

Keywords

Paper Recycling, Awareness, Sustainability, ISM and Waste Management.

1. Introduction

Waste recycling in Saudi Arabia needs more attention from the government and the private sector. Moreover, it is crucial that personal people and families be engaged in waste recycling. In 2015, the total rate for recovery of paper and cardboard in Saudi Arabia was around 32% (Ouda et al., 2017). This low rate in addition to, the average daily high rate of municipal solid waste generation is 1.72 kg per capita (General Authority of Statistic 2018) is raising environmental and economic issues for our country. Therefore, the government set up a goal to recycle 30 million tons of municipal solid waste per year by 2033 (Nizami 2017). Ouda et al. (2017) maintain that “it is estimated that by 2030, 5.05 million ton of waste paper would be recovered in the country.”

The idea of this research came from a unique initiative for recycling paper by King Abdul Aziz University Research Endowment, Jeddah, Saudi Arabia. The initiative is to help organizations and household in Jeddah to donate their recycling paper to the endowment. For five years (2014 – 2018) the total collected paper is about 3,000 Tons. This experience was not easy and it faced many difficulties such as lack of awareness, lack of facilities, no clear procedures, and storage issue. This was an inspiration to conduct a research about recycling awareness in Saudi Arabia. Research in this area is not covered enough and needs more attention from researchers.

This work aims to examine the awareness level of paper recycling for university students in Saudi Arabia. A survey is conducted for college of engineering students at University of Jeddah to assess the current state level of awareness about paper recycling. In addition, it aims to explore and analyze the barriers to achieve a reasonable level of awareness using Interpretive Structure Modeling (ISM) software.

2. Literature Review

2.1 Recycling paper in Saudi Arabia

In 2011, Saudi Arabia recorded one of the highest countries in Gulf Cooperation Council (GCC) in solid waste generation (1.16 Kg/capita). The paper and cardboard waste represent high percentage of (17.09%) compared to the other materials such as glass (10.82%), plastic (13.81%), etc. (Gharaibeh et al., 2011). As one of the GCC countries,

Bahrain is facing challenges about the current municipal solid waste management. These worries are serious by the increased municipal solid waste generated per capita in addition to the current recycling rate in Bahrain of 1% (Freije et al. 2015).

Nizami et al., (2017) claims that Municipal Solid Waste (MSW) quantities in Saudi Arabia become enormous. City landfills receive about 2.4 thousand tons of MSW daily, while during holy seasons such as Hajj these quantities become almost double. Zafar (2020a) maintains that Middle Eastern countries like Saudi Arabia are counted as one of the highest countries in waste producers and the government needs investment plans to improve waste management scenarios that help the country to convert the MSW to energy.

The issues of recycling paper and solid waste management in Saudi Arabia need to be addressed from the researchers. The kingdom's vision 2030 comprises three ambitious goals: making the country a vibrant society, a thriving economy and an ambitious nation. Thus, the estimation of recycling 5.05 million tons of waste paper would attain an income of 11.3 billion SAR (equivalent to 3.01 billion USD) in addition to the countless environmental benefits (Ouda et al. 2017). Dhawi (2020) claims that "if recycling industry targeted only plastic and paper and metals they can meet the need of the Saudi market efficiently."

A short survey of three questions conducted for university students to understand their sense of recycling attitude. The outcomes showed that (11%) of the respondents recycle their house waste. Most of the students (93%) think that recycling is very important. List of barriers are stated as follows: no recycling containers nearby, no places to recycle, recycling is not important, and sorting house waste is very difficult (Dhawi 2020).

2.2 Awareness Assessment Tools

The survey model based is the most tool used in many studies that concentrated in measuring the awareness level. Nevertheless, there is absence of studies that discover level of awareness about recycling paper in Saudi Arabia. Table 1 expresses a short summary of the studies that focus on assessing awareness level of recycling.

Table 1. Summary of the studies that focus on assessing awareness level of recycling

Author	Country	Methodology
(Dhawi, 2020)	Saudi Arabia	Short survey of 3 questions only was used to get a sense of young generation recycling attitude in Saudi Arabia. The survey was for university student with age group of 18-24 years old.
(Aksan et al., 2019)	Turkey	Survey model based on <i>The Scale of Recycling Awareness</i> developed by Aksan and Çelikler (2017) was implemented. The sample consisted of (81) students in the Faculty of Education, Department of Science Teaching in Northern Turkey.
(Dung et al., 2017)	Nigeria	Cross-sectional survey research design was employed in the North Central Zone of Nigeria. The participants (1800) were students in the College of Education.
(Freije et al., 2015)	Bahrain	A primary survey using a questionnaire distributed to (300) household representatives from different governorates of Bahrain.
(Al-Moosa et al., 2015)	Saudi Arabia	The study aims to understand of the variables influencing household recycling behavior. Survey that consisted of 56 questions divided into six parts: waste composition, waste management behavior, recycling knowledge, environmental attitudes, improving waste management and recycling, and personal data. Saudi Aramco's residential camp with total of 205 responded to the survey.
(Ittiravivongs, 2012)	Thailand	Personal interviews based on a structured questionnaire. Total of (381) households in Bangkok city were selected randomly to participate in this study.

2.3 Barriers of adapting recycling paper in Saudi Arabia

Although, most of publications about recycling in Saudi Arabia considered the issue of the challenges and barriers, still there is shortage of studies that focus on the barriers for adopting paper recycling. Table 2 identifies seven barriers that adopted from different sources.

Table 2. Barriers of adapting recycling paper in Saudi Arabia

B#	Barriers	Barriers description	Supporting references
B1	Lack of awareness about recycling paper benefits	This includes the economic and environmental benefits.	(Zafar, 2020b; Mani, 2020; Ouda et al., 2017; Anjum et al., 2016)
B2	Lack of organizations that deal with paper recycling	Result of google search for paper recycling companies in Saudi Arabia shows 5 companies.	(Dhawi, 2020; Gharaibeh et al., 2017; Alsebaei, 2014).
B3	Lack of expertise in the recycling field	Short human and organizational capacities and capabilities	(Zafar, 2020b; Mani, 2020; Ouda et al., 2017)
B4	Poor infrastructure that supports recycling paper process	Lack of accurate information about solid waste. Absence of recycling facilities. There is no clear instructions for household regarding recycling procedures.	(Dhawi, 2020; Zafar, 2020b; Mani, 2020; Gharaibeh et al., 2017; Ouda et al., 2017)
B5	Lack of demand for recycled products	The modest demand for recycled products in the local market is one of the reasons that hindered the growth of the waste recycling industry.	(Mani, 2020; Ouda et al., 2017)
B6	Lack of motivation for recycling paper	Due to the oil dependent in Saudi Arabia, the alternative for recycling was not highly considered. Motivation from government and companies toward recycling paper is vital.	(Mani, 2020; Ouda et al., 2017)
B7	Lack of laws that support recycling paper	People are not required to separate solid waste. The operational companies that collecting waste are not obligated to manage recycling paper.	(Zafar, 2020b; Mani, 2020; Alsebaei, 2014; Alhumoud 2005)

3. Methodology

3.1 Survey

Due to lack of standard measures or techniques to evaluate the awareness level, a survey technique is implemented. Moreover, survey technique is appropriate to study attitudes, actions, ideas and beliefs of the individuals and cross-sectional research design that requires collecting data in a short time (Kumar 2019). The survey design adopted from *The Scale of Recycling Awareness* developed by Aksan and Çelikler (2017) which contains 10 factors as follows: environmental, educational, economic, administrative, legal, susceptibility, media, protection of resources, features of recycled products, and biological (Aksan et al. 2019). In this study, the survey included 26 questions that concentrated in attitudes, actions, and beliefs. The survey is designed using Microsoft Forms and conducted to College of Engineering students in University of Jeddah.

3.2 Interpretive Structure Molding (ISM)

ISM is an extensively used model to approach decision problems, proposed firstly by J. Warfield in 1973. It is a well-established methodology for identifying and summarizing relationships among specific elements, which define an issue or a problem. ISM transforms unclear, poorly articulated mental models of a system into visible well-defined, hierarchal models (Andejany et al. 2019). For barrier analysis, ISM software is used. Dr. Benjamin Broome and Dr. Michael Hogan upgraded the software to Windows. Using the software for the case requires understanding interactive management (IM) that is a thought and action mapping strategy used to aid groups in developing outcomes which integrate contributions from individuals with diverse views, backgrounds and perspectives. It involves the nominal group technique (NGT) and ISM (Dwyer et al. 2014). The following steps are applied for the barrier analysis using the software: (a) Barriers (ideas) identification from the literature and from the survey. NGT is adopted by interviewing three experts working for recycling paper projects. (b) Use the voting system to clarify and determine the relationships between the barriers as it shown below in figure1. (c) Develop the structural model. (d) Discuss and validate the model with the experts.

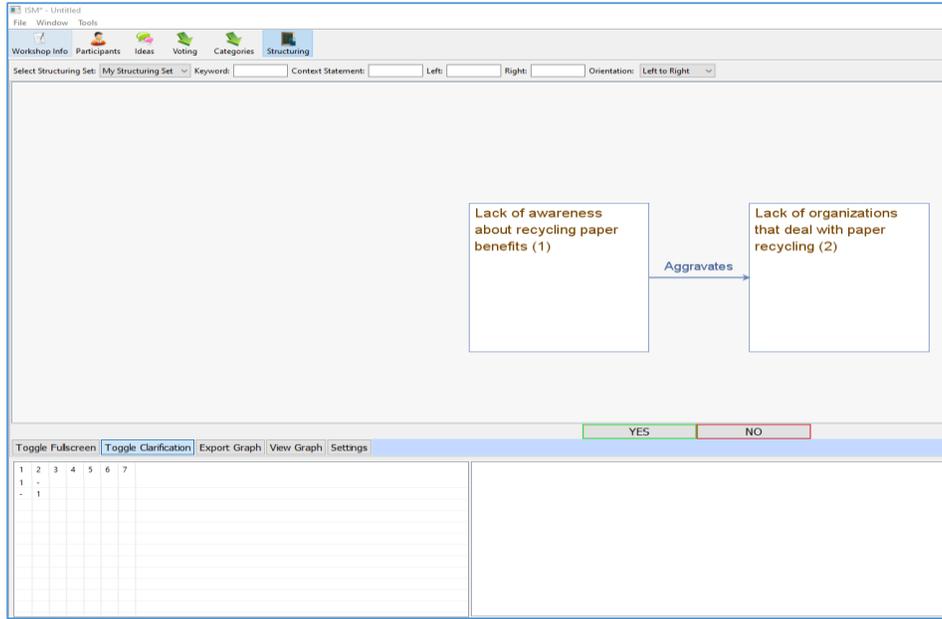
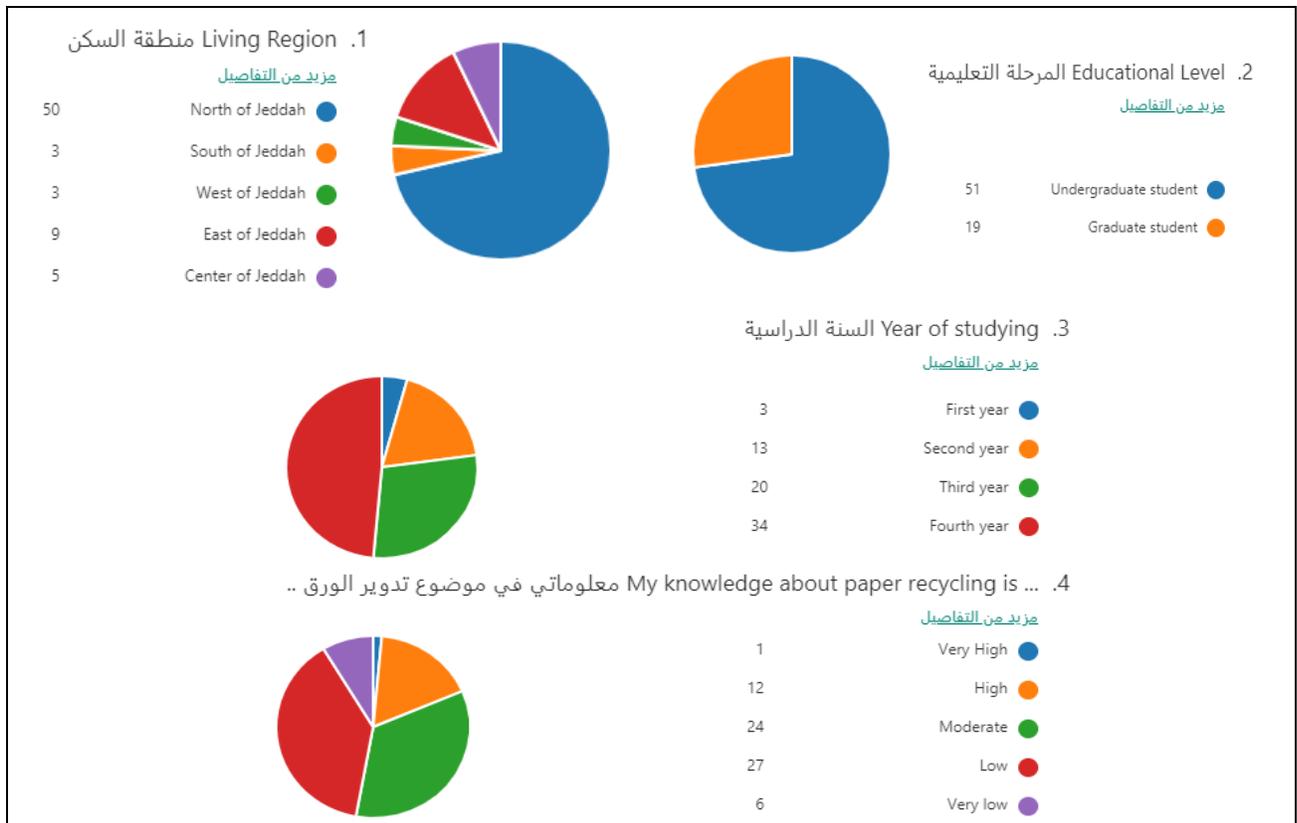


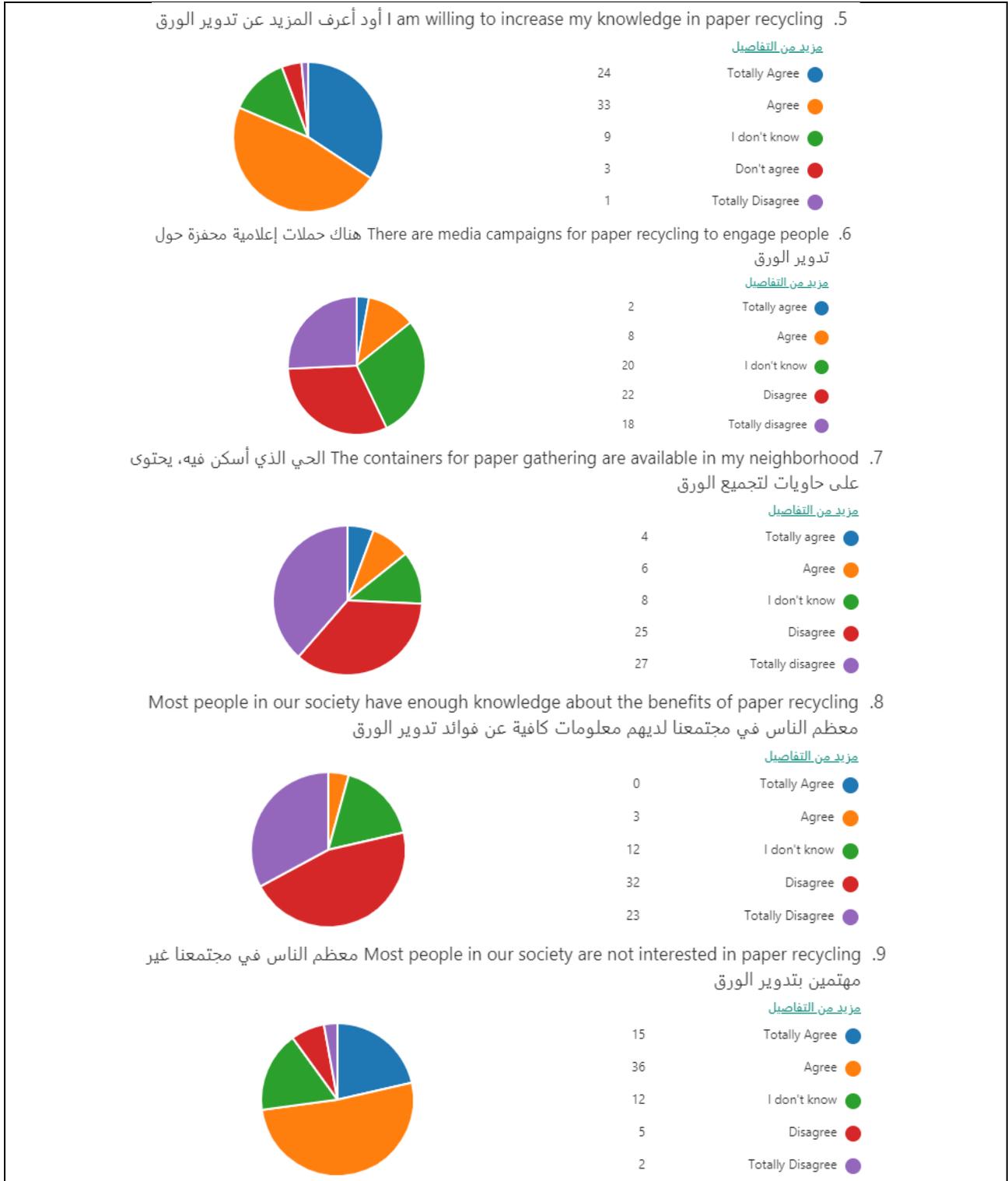
Figure 1. Screen from the ISM Software Application

Data Analysis and Results

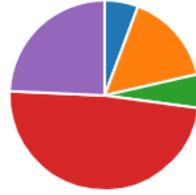
4.1 Survey Result and Discussion

The following contexts and graphs illustrate the survey outcomes of 70 students from college of engineering at university of Jeddah.





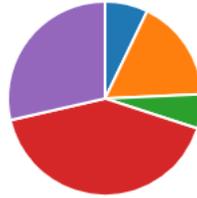
10. In my home and college I collect paper for recycling
 أقوم بتجميع الورق في البيت والكلية لغرض التدوير



مزيد من التفاصيل

- Totally Agree
- Agree
- I don't know
- Disagree
- Totally Disagree

11. During my study, I have attended courses or lectures in recycling
 محاضرات أو دورات أو درست مواد عن التدوير خلال رحلتي الدراسية حضرت



مزيد من التفاصيل

- Totally Agree
- Agree
- I don't know
- Disagree
- Totally Disagree

12. I am interested in participating or working in the paper recycling field
 العمل في مجال تدوير الورق مستقبلا انا مهتم للمشاركة أو



مزيد من التفاصيل

- Totally Agree
- Agree
- I don't know
- Disagree
- Totally Disagree

13. I have no problem using recycled products
 لا أجد مشكلة في استخدام منتجات معاد تدويرها



مزيد من التفاصيل

- Totally Agree
- Agree
- I don't know
- Disagree
- Totally Disagree

14. Recycled products have a good level quality
 المنتجات المعاد تدويرها تتمتع بجودة جيدة



مزيد من التفاصيل

- Totally Agree
- Agree
- I don't know
- Disagree
- Totally Disagree

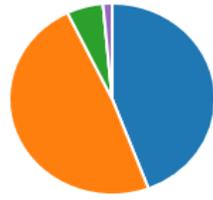
15. Using recycled paper can save money
 استعمال الورق المعاد تدويره يؤدي إلى تقليل التكاليف



مزيد من التفاصيل

- Totally Agree
- Agree
- I don't know
- Disagree
- Totally Disagree

16. Recycling paper industry can create jobs for people
 صناعة تدوير الورق توفر وظائف للناس



مزيد من التفاصيل

31	Certainly Agree
34	Agree
4	I don't know
0	Disagree
1	Totally Disagree

17. Investing in a recycling paper industry is a promising investment
 الورق استثمار واعد
 الاستثمار في صناعة تدوير



مزيد من التفاصيل

24	Totally Agree
28	Agree
16	I don't know
2	Disagree
0	Totally Disagree

18. People can earn money from recycling their paper
 الورق الخاص بهم
 الناس تستطيع الحصول على نقود عبر تدوير



مزيد من التفاصيل

23	Totally Agree
27	Agree
18	I don't know
2	Disagree
0	Totally Disagree

19. Recycling paper process is expensive
 إعادة تدوير الورق مكلفة



مزيد من التفاصيل

1	Totally Agree
6	Agree
45	I don't know
13	Disagree
5	Totally Disagree

20. Paper recycling is supported by the authorities
 الجهات ذات العلاقة
 هناك جهود داعمة لتحفيز الناس لتدوير الورق من



مزيد من التفاصيل

2	Totally Agree
3	Agree
27	I don't know
26	Disagree
12	Totally Disagree

21. Our society needs several kind of campaigns to raise awareness about the benefits of recycling paper
 recycling paper المجتمع بحاجة إلى حملات دعائية مختلفة لزيادة الوعي بفوائد تدوير الورق



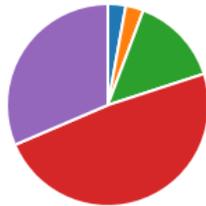
مزيد من التفاصيل
 44 Totally Agree
 24 Agree
 2 I don't know
 0 Disagree
 0 Totally Disagree

22. Social media can raise awareness for recycling paper
 زيادة الوعي في المجتمع حول تدوير الورق باستخدام وسائل التواصل الاجتماعي تؤدي إلى



مزيد من التفاصيل
 36 Totally Agree
 28 Agree
 6 I don't know
 0 Disagree
 0 Totally Disagree

23. Centers for recycling paper containers are easy to locate
 مراكز تدوير الورق من السهل معرفة اماكن حاويات تدوير



مزيد من التفاصيل
 2 Totally Agree
 2 Agree
 10 I don't know
 34 Disagree
 22 Totally Disagree

24. Finding organizations that buy paper for recycling are easy to locate
 التي تشتري الورق المجهز للتدوير من السهل معرفة الأماكن

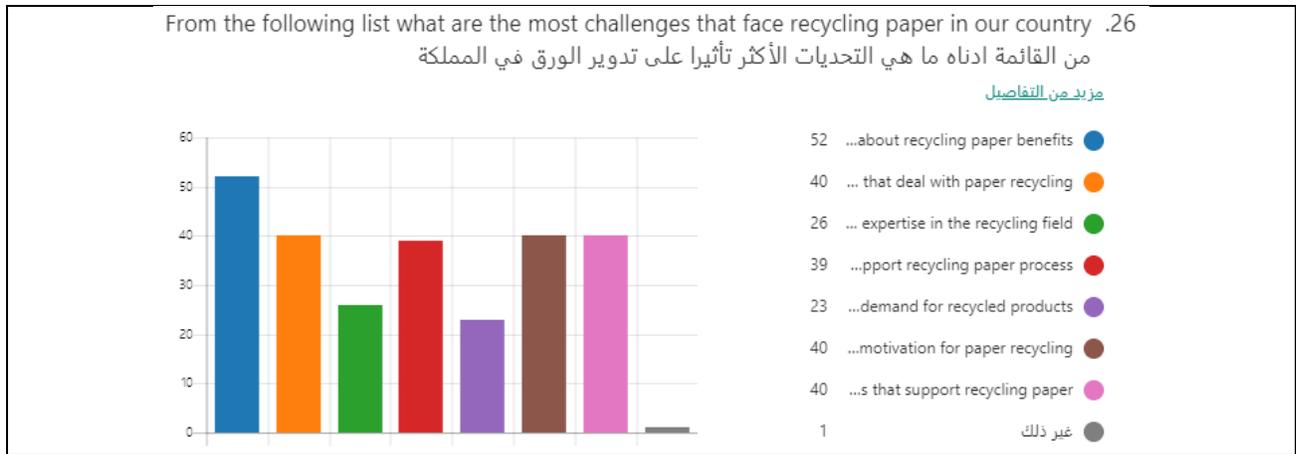


مزيد من التفاصيل
 0 Totally Agree
 3 Agree
 20 I don't know
 28 Disagree
 19 Totally Disagree

25. There is a need to legislate rules to encourage recycling paper
 لتشجيع تدوير الورق هناك حاجة إلى تشريع قوانين



مزيد من التفاصيل
 28 Totally agree
 30 Agree
 7 I don't know
 4 Disagree
 1 Totally disagree



The results indicated that large percentage of respondents were undergraduates (73%) and specifically in their fourth year (49%), third year (29%), second year (19%), and first year (4%). Moreover, most of the respondents were from North of Jeddah (71%). This might be a sign to apply the result of this study to north Jeddah region.

It is noticed from the survey results that large percentage of respondents (79%) believe that most of the people in Jeddah do not have enough knowledge about paper recycling. Meanwhile, the largest percentage of respondents had low and moderate level of knowledge (39% for low, and 34% for moderate).

Due to the low and moderate level of knowledge explained in the previous paragraph, the large percentage of respondents (81%) have a high level of willingness to increase their knowledge in paper recycling (34% totally agree, and 47% agree). However, most of the respondents (70%) did not attend lectures or courses in recycling during their study (29% totally did not attend, and 41% did not attend). In the respondents' opinion, most of Jeddah public (72%) are not interested in paper recycling. More than half of the respondents (64%) showed their interest in participating in paper recycling field. However, 27% of them were hesitated to do that. For using recycled products, the respondent showed a high level of agreement (90%).

For media efforts in paper recycling, (57%) of the respondents agreed that there are no media campaigns for paper recycling. While (29%) of the respondents did not know about that. The respondents are mostly in a consensus (97%) direction for the statement of "our society needs several kind of campaigns to raise awareness about the benefits of recycling paper". Most likely (91%) of the students believes that "social media can raise awareness for recycling paper".

Regarding economic benefits of paper recycling, almost three-quarters (74%) of the respondents agreed that investment in paper recycling industry is promising and (23%) out of them did not know about that. Most of the respondents (93%) showed that using recycled paper could save money. In addition, (93%) of the sample agreed that paper recycling industry can create jobs for people and (72%) from the respondents believe that people can earn money from recycling their paper. Most of the respondents (64%) do not know whether recycling paper process is expensive or not.

For the question regarding containers availability in students' neighborhood most of them (75%) answered that our neighborhood has no containers. More than half of the sample (54%) do not agree that the authorities is supporting paper recycling. Four-fifth of the sample (80%) believed that finding paper containers or centers for recycling is not easy. Two-third of the sample (67%) revealed that finding organizations that buy paper for recycling is not easy. Practically, (83%) of the respondents believed that there is a need to legislate rules in order to encourage recycling paper.

The students' ranked nearly three levels for the concern about the most challenges that face recycling paper in our country as follows:

- Level 1
 - Lack of awareness about recycling paper benefits (52)

- Level 2
 - Lack of laws that support recycling paper (40)
 - Lack of organizations that deal with paper recycling (40)
 - Lack of motivation for paper recycling (40)
 - Poor infrastructure that support recycling paper process (39)
- Level 3
 - Lack of expertise in the recycling field (26)
 - Lack of demand for recycled products (23)

4.2 ISM Software Result and Discussion

The structural model shown in figure 2 classifies and prioritizes that the seven barriers to four stages. Stage 1 considers barrier (B7: Lack of laws that support recycling paper) as the most crucial barrier and it influences the rest of barriers directly for (B1, B3 and B4) and indirectly for (B2, B5, and B6). Stage 2 includes (B4: Poor infrastructure that supports recycling paper process) which influenced by (B7) and has no influence to any other barriers. In addition, it contains (B1: Lack of awareness about recycling paper benefits and B3: Lack of expertise in the recycling field) which also influenced by (B7); but it influences (B2 and B5). The interrelationship between (B1 and B3) is considered high since they are merged in one group. Stage 3 consists of (B2: Lack of organizations that deal with paper recycling and B5: Lack of demand for recycled products) which influenced by (B1 and B3); but it influences (B7). Similar to (B1 and B3), the interrelationship between (B2 and B5) is considered high. Stage 4 includes (B6: Lack of motivation for recycling paper) which is considered the least barrier that highly influenced by the other barriers except B4.

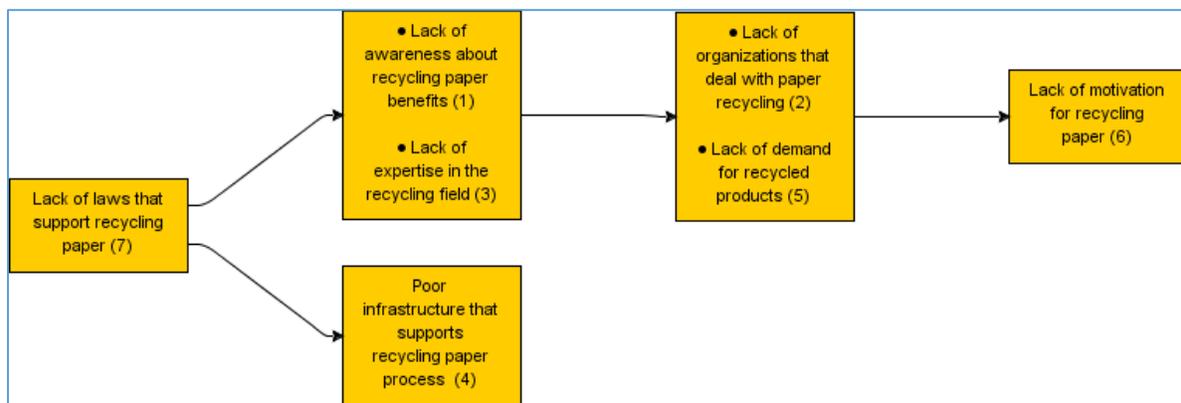


Figure 2. ISM based hierarchical model for barriers of adopting recycling paper in Saudi Arabia using the ISM Software

4. Conclusion

Although, the current state level of paper recycling awareness in Saudi Arabia is considered low, large percentage of people in Jeddah have a high level of willingness to increase their knowledge in paper recycling. The education system in Saudi Arabia is not supporting this issue and there is lack of training courses that cover it. There is a clear evidence that most of people in Jeddah currently are not recycling their waste but they are interested in participating and practicing recycling in the future. There is a strong agreement that recycling for individuals and families in Saudi Arabia is not easy due to the absence of facilities such as containers and poor infrastructure. In order to achieve our kingdom’s goal regarding recycling paper, it is crucial to address the roadblocks and set up long term plans that assist to treat them.

ISM is a very useful tool to analyze and prioritize the barriers. The hierarchical model for barriers of adopting recycling paper showed a practical framework with four stages which can be followed by decision makers in our country. “lack of laws that support recycling paper” is considered as the most critical barrier and it significantly influences the rest of barriers. The second critical barriers are “poor infrastructure that supports recycling paper process, lack of awareness about recycling paper benefits, lack of expertise in the recycling field”. There are solid interrelationships between the barriers; for instance, in the third stage the interrelationships between barriers of “lack of organizations that deal with paper recycling and lack of demand for recycled products” is considered strong.

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Biography

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