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2. Economic and Environmental Benefits Wastepaper Recycling in Lagos State, Nigeria

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Abstract

The study assessed the economic and environmental benefits of paper waste recycling in Lagos State, Nigeria. Data was gathered by administering 100 copies of structured questionnaires to companies and individuals involved in wastepaper collection for sales. Principal components analysis (PCA), simple percentages, and averages were used to analyze the data. PCA results identified an increase in job opportunities (21.57%), an increase in economic development opportunities (21.15%), and sustaining local manufacturing firms (19.4%) as significant dimensions of the economic benefits of wastepaper recycling. It also revealed that most of the respondents stated that wastepaper recycling reduces pollution (97%), saves energy needed to manufacture new paper (95%), and protects the environment from destruction (75%). Based on the findings, the study recommended a public-private partnership in wastepaper recycling.

Keywords: Wastepaper recycling, environmental benefits, Perceived economic benefits, Lagos State

Introduction

Paper undeniably exists in human civilizations because it enhances saving information and passes it to the next generations. Globally, paper is used in everyday life for immeasurable purposes, so its consumption has increased. The demand for paper has increased with the increase in human population and the need to save and pass on information. This has increased the demand for raw materials (Ferrara and De Feo, 2021; Yilmaz and Gumuskaya, 2015). To solve the problem of sourcing raw materials for paper production, technologies over the years have been developed for sustainable recycling rather than sustainable forestry. Through this process, all waste-paper components are separated except for fibers using the most economical and environmentally friendly methods and recycling is crucially important (Yilmaz and Gumuskaya, 2015; Karademir et al., 2012). Cellulose is the base material of paper production. Plant sources such as trees and other kinds of perennial and annual plants are consumed if the cellulose is obtained solely from raw fibers.

For centuries, forests as well as other ecosystems where such plant sources are found have been exploited as sources for raw fibers to produce paper. Such exploitation puts the sustainability of natural resources in danger (Sultan and Gulnur, 2017). To sustainably manage plant resources for future generations and meet the increasing

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demands for papers, recycling waste papers has been the focal source of raw materials for paper production. As the demand for paper has increased, paper producers are now forced to use wastepaper as raw material. Because there is a decrease in the number of natural resources such as wood, hay, and cotton (which are used as raw materials to produce cellulose, and cellulose is the raw material of paper), reforestation takes a long time and environmental pollution and cost of energy have increased (Yakut, 2012). The recycling of wastepaper has countless economic and environmental benefits. In line with this, Van Beukering and Duraiappah (1998) stated that recycling may generally be considered a key strategy for alleviating the pressures of society on the environment. They opined that recycling reduces the demand for energy and finite resources, results in less water pollution and air emissions, and mitigates the problem of solid waste disposal.

Recycling paper reduces the pressure on natural resources such as forests. Moreover, recycling may be considered economically beneficial in developing countries. First, it provides significant employment opportunities to a large informal sector. The high degree of the labour intensity of certain reclamation processes enables numerous people to amass some income. Second, recycling can reduce the costs for raw materials in the production process and thereby may increase the supply of cheaper products. Third, it can reduce dependence on foreign resources and thereby save on expenditure on imports in developing countries. In the literature, several studies have been carried out on the economic benefits of wastepaper recycling (Chukwuemeka, 2019; Sultan and Gulnur, 2017; Ferrara C., and De Feo, G., 2014); others looked at the environmental benefits of wastepaper recycling (Čabalová et al., 2011), while the several others examined the economic and environmental benefits (Van Beukering and Duraiappah, 1998). A good number of these studies largely looked at the recycling of waste papers from a descriptive perspective as they did not make use of empirical data. Also, most studies did not show the main economic and environmental benefit (s) of wastepaper recycling. Identifying specific benefits of substantial levels will enable interventions to be channeled towards expanding the observed benefits of wastepaper recycling. It is on this noticeable research gap that the present study is carried out. The study examines the perceived economic and environmental benefits of wastepaper recycling in Lagos State.

A brief review of the literature

UNEP (2021) stated that expanding wastepaper recycling in Kenya would result in additional jobs in collecting, separating, and processing recycled paper. The recycled paper would substitute imported paper and conserve foreign exchange earnings. The report also stated that paper recycling plants are major investments that require large capital outlays. However, as the demand for paper in the country remains unsatisfied, the investment will be recovered in the long term. In addition, Paper Recycling Coalition (2021) stated that the recycled paper industry is a major contributor to the U.S. economy and that during the 1990s alone, U.S. papermakers invested an estimated $10 billion in new recycling capacity. That recycled paper, paperboard, and deinked market pulp mills employ nearly 140,000 people directly and influence another 615,000 jobs, for a total of nearly 755,000 jobs nationwide. The annual payroll of recycled paper, paperboard, and deinked market pulp mills is $6.9 billion. The report further stated that through taxes and other receipts; recycled paper, paperboard, and deinked market pulp mills contribute $9.6 billion to federal, state, and local government revenues.

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Similarly, the Environmental and Energy Study Institute (2014) stated that recycling is an easy way for individuals to protect the Earth and help the economy. The report revealed that America's recycling industry accounted for more than one million jobs and over $236 billion in annual revenue in 2001 when the last extensive study was carried out. In 2010, the U.S. recycling industry sold 44 million metric tons of recycled materials valued at almost $30 billion to over 154 countries around the world. In addition to generating income, recycling saves money by reducing spending on landfills (which charge tipping fees and require significant amounts of land). Recycling also produces substantial energy savings of up to 87 per cent for mixed plastics and 92 percent for aluminum cans. Recycling has important environmental benefits: it limits the need to extract new resources and reduces greenhouse gas emissions. In 2012 alone, recycling prevented the equivalent of 168 million metric tons of carbon dioxide emissions, which is comparable to taking 33 million passenger vehicles off the road.

The Montana Department of Environmental Quality (2004) stated that throughout the United States, recycling has resulted in economic growth, income growth, net job increases, long-term investment, energy savings, waste reduction, lower production costs for many industries, and an extension of the life of landfills. While referring to the California Environmental Protection Agency, the report revealed that waste diversion of any type, including recycling, tends to create twice the economic activity per ton of conventional waste disposal. The United States Environmental Protection Agency (2020) reported that recycling has economic and community benefits which include increasing economic security by tapping a domestic source of materials, supporting American manufacturing, and creating jobs in the recycling and manufacturing industries. The report showed that recycling and reuse of materials creates jobs, while also generating local and state tax revenues. In 2012, the report stated that recycling and reuse activities in the United States accounted for 681,000 jobs, $37.8 billion in wages; and $5.5 billion in tax revenues which equates to 1.17 jobs for every 1,000 tons of materials recycled.

The United States Environmental Protection Agency (2020) stated that also recycling conserves resources and protects the environment. Environmental benefits include reducing the amount of waste sent to landfills and combustion facilities; conserving natural resources, such as timber, water, and minerals; and preventing pollution by reducing the need to collect new raw materials. More so, Michigan Recycling Coalition (2001) cited in Miller et al., (2008) reported that recyclable materials processing has a significant impact on Michigan's economy. Respondents to a survey of recyclable materials processors conducted by the Michigan Recycling Coalition reported $437 million in annual revenue, 1,920 jobs, and over $52 million in annual payroll attributable directly to processing activities. When extrapolated from the 51 percent of entities who responded to the survey to the entire processing industry in Michigan, this implies total annual revenues of over $1.9 billion, total employment of 5,028, and a total annual payroll of more than $137 million.

The United States Environmental Protection Agency (2016) stated that paper recycling reduces greenhouse gas emissions that can contribute to climate change by avoiding methane emissions and reducing the energy required for some paper products; extends the fiber supply and contributes to carbon sequestration; saves considerable landfill space; reduces energy and water consumption and decreases the need for disposal (i.e.,

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landfill or incineration which decreases the amount of CO_2 produced). The report further stated that recycling one ton of paper would save enough energy to power the average American home for six months; save 7,000 gallons of water; save 3.3 cubic yards of landfill space and reduce greenhouse gas emissions by one metric ton of carbon equivalent (MTCE). Similarly, the Green America Report (2021) stated that recycled paper use saves resources and reduces the paper industry's impact on the planet. Using 100% recycled copy paper instead of 100% virgin fiber paper saves 100% of the trees; saves 31% of the energy; saves 53% of the water and produces 39% less solid waste. It also reported that recycled paper production emits 40% fewer greenhouse gases and uses 26% less energy.

University of Southern Indiana (2021) reported that to produce each week's Sunday newspapers, 500,000 trees must be cut down and that recycling a single run of the Sunday New York Times would save 75,000 trees. If all newspapers were recycled, about 250,000,000 trees would be saved each year. The report showed that the average American uses seven trees a year in paper, wood, and other products made from trees. This amounts to about 2,000,000,000 trees per year and the amount of wood and paper thrown away each year is enough to heat 50,000,000 homes for 20 years. The report also stated that each ton (2000 pounds) of recycled paper can save 17 trees, 380 gallons of oil, three cubic yards of landfill space, 4000 kilowatts of energy, and 7000 gallons of water. This represents 64% energy savings, 58.0% water savings, and 60 pounds less of air pollution. The 17 trees saved can absorb a total of 250 pounds of carbon dioxide from the air each year. Blue (2024) stated that paper makes up about 28 percent of solid trash in landfills and one ton of paper takes up about 3.3 cubic yards of landfill space. Therefore, recycling paper and cardboard saves space in landfills for trash that cannot be recycled, and saving space in landfills reduces the need to build more landfills.

Yilmaz and Gumuskaya (2015) stated that one tree is saved every time 54 kg of newspaper is recycled and that each ton of recycled paper saves 17 trees. The study further showed that photocopy papers, kitchen rolls and tissues, corrugated cardboard, and newspapers can be made from recycled paper. Also, every saved tree produces the amount of oxygen that 3 people consume as well and recycled paper consumes 64% less energy compared to producing paper from cellulose. The study further revealed that when producing 1 ton of recycled paper, 2.5 tons of petroleum and 26 tons of water are saved. Also, UNEP (2021) stated that recycled paper reduces the amount of waste that would go to landfills thus prolonging the life of landfill sites. And that recycling of wastepaper avoids the production of methane gas that would have resulted from the anaerobic decomposition of wastepaper therefore contributing to climate change mitigation. In addition, wastepaper recycling significantly reduces energy use as the recovered pulp uses more energy than virgin pulp therefore conserving energy.

Paper Recycling Coalition (2021) stated that rigorous scientific research has demonstrated that manufacturing paper with recycled content is good for the environment and that producing recycled paper requires less energy than making paper from trees. By recycling paper, we prevent it from being landfilled where it degrades, producing methane, and a greenhouse gas. According to the U.S. EPA, landfills are the largest U.S. source of methane emissions to the atmosphere, and degrading paper 24 times as potent as carbon dioxide is a primary

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cause. The report also revealed that manufacturing with recovered paperboard reduces air pollutants such as nitrogen oxides that contribute to smog and particulate emissions that cause respiratory problems. Producing recycled paperboard and containerboard also requires less water and energy. In line with this, the Montana Department of Environmental Quality (2004) stated that recycling also reduces pollution and conserves natural resources, which leads to cleaner air and water, and it increases open space and reduces greenhouse gases.

Materials and methods

Study area

Data collection procedure and analysis

Random and accidental sampling techniques were employed. The random sampling technique was used to select three (3) wastepaper recycling companies in Lagos State. The accidental sampling technique was employed to administer 100 copies of the structured questionnaire to the staff of the selected companies as well as individuals involved in the wastepaper collection for sales. This technique was deemed suitable because of the difficulties in accessing the staff of the recycling companies as well as wastepaper scavengers. As such, respondents were approached in landfill areas and other areas. The questionnaire was administered by the researcher. The questionnaire was divided into three sections. Section A had questions that measured the socioeconomic characteristics of respondents; Section B measured the economic benefits of wastepaper recycling; Section C measured the environmental benefits of paper battery recycling. The items in Sections B and C were measured using 4-point ordinal scales with responses ranging from Totally agree, Agree, Disagree and Totally disagree.

Data analysis

Data obtained were analyzed using simple percentages, averages (mean), and principal components analysis (PCA). The statistical analyses were performed with the aid of SPSS (Statistical Package for Social Sciences) Version 21.0 and Microsoft Excel Spreadsheet.

Results

Socioeconomic and demographic characteristics of respondents

The socioeconomic and demographic characteristics of respondents substantially influence respondents' perception of wastepaper recycling and their involvement in wastepaper scavenging or collection. The sex of respondents showed that there were more males than women implying that males dominated the survey (Table 1). This is because 82% of the respondents surveyed were males, while 18% were females. The dominance of males is anticipated as males are heads of families and tend to be more involved in scavenging jobs than their female counterparts. Information on the age of respondents showed that respondents between the ages of 25 to 30 years dominated the survey (51%), followed by those between the ages of 31 to 36 years (Fig 1). The observed pattern therefore shows that most of the respondents (87%) fall between the ages of 25 to 36 years. It therefore means that the recycling business is largely dominated by young adults.

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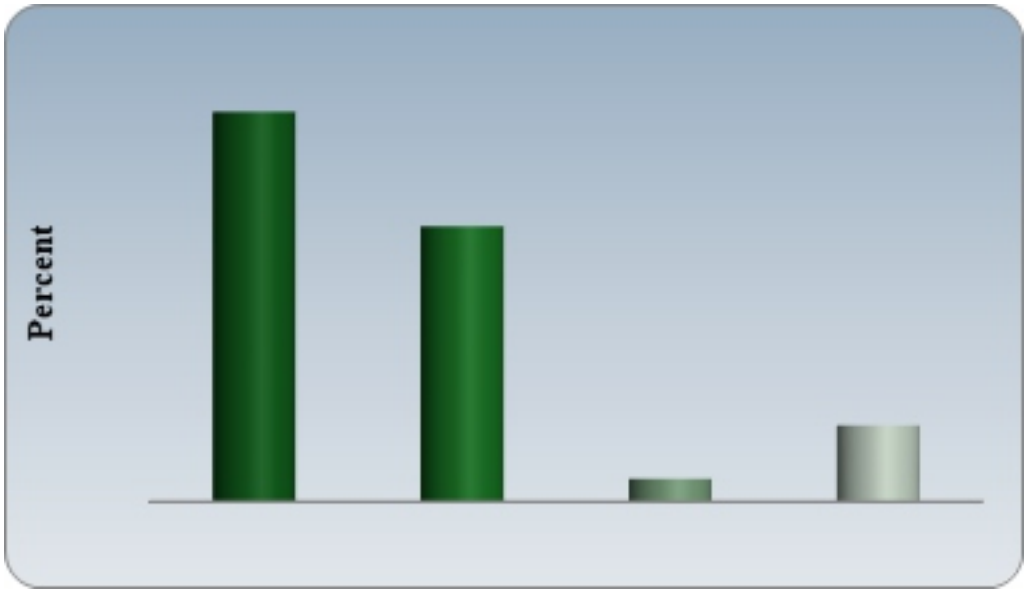

Figure 1: Ages of respondents

The educational status showed that the respondents had varied qualifications ranging from primary education to tertiary education (Table 1). It showed that a significant proportion (74%) of the respondents had secondary education, followed closely by primary education and tertiary education with 19% and 7% respectively. From the results obtained, it is apparent that a good number of respondents precisely 93% have primary and secondary education. The result nevertheless suggests a high literacy level which can influence the people's level of understanding and knowledge of land use land cover in the area. In a similar study, Munthali et al., (2019) reported that 77.8% of the respondents were literate. The educational qualifications of respondents could also influence the way households in the area manage land use land cover changes that are inevitable.

Table 1: Socioeconomic and demographic profile of respondents

Variables	Categories	Freq	Percent
Sex	Male	82	82.0
	Female	18	18.0
Age	25 – 30yrs	51	51.0
	31 – 36yrs	36	36.0
	36 – 41yrs	3	3.0
	36 – 41yrs	10	10.0
Education	Primary	19	19.0
	Secondary	74	74.0
	Tertiary	7	7.0

Perceived economic benefits

Perception of respondents on the perceived economic benefits of wastepaper recycling was determined using principal components analysis (PCA). The statistical tool was employed due to the number of variables used to measure the perceived economic benefits of wastepaper recycling. PCA result of 8 variables resulted in the extraction of three (3) components that accounted for 62.1% of the variation in the data set (Table 2).

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Employing component loadings ±≥0.8, PC_1 (principal component one) had strong and positive loadings on *recycling wastepaper creating job opportunities* (0.884). The positive loading simply means an increase in job opportunities with the increase in wastepaper recycling. PC_1 was responsible for 21.57% of the total variance in the data set and represented an increase in job opportunities. On PC_2, only one variable loaded on it; the variable was *wastepaper recycling promotes economic development opportunities* (0.899). PC_2 was responsible for 21.2% of the total variance in the data set and represented an increase in economic development opportunities. Likewise, PC_3 had one variable that positively loaded on it; the variable was *recycling helps in maintaining local manufacturing firms* (0.821). PC_3 was responsible for 19.4% of the total variance in the variable set and represented sustaining local manufacturing firms.

The result in Table 2 identifies an increase in job opportunities, increase in economic development opportunities, and sustaining local manufacturing firms as the significant dimensions of perceived economic benefits of wastepaper recycling. These three dimensions or factors largely explain the inherent perceived economic benefits of wastepaper recycling. The first extracted component, which has a large explanation clearly shows that recycling creates job opportunities. Through recycling, many recycling plants will be set up leading to a long chain of collection and delivery. All these activities are performed by humans, which will also trigger an explosion of opportunities. Recycling is an integrated process that begins with recyclable material collection from locations such as households, drop-off points, construction, and demolition centers, and businesses. After collecting, these recyclable materials go through a thorough sorting process to separate various materials as well as different quality goods. All these processes create jobs for different groups of people. From the collection of materials to sales, recycling businesses need varying degrees of skilled and semi-skilled employees. This agrees with the findings of UNEP (2021) that the expansion of wastepaper recycling in Kenya would result in the creation of additional jobs in the collection, separation, and processing of recycled paper. The recycled paper would substitute imported paper and conserve foreign exchange earnings. The report also stated that paper recycling plants are major investments that require large capital outlays. However, as the demand for paper in the country remains unsatisfied, the investment will be recovered in the long term. In addition, Paper Recycling Coalition (2021) stated that the recycled paper industry is a major contributor to the U.S. economy and that during the 1990s alone, U.S. papermakers invested an estimated $10 billion in new recycling capacity. That recycled paper, paperboard, and deinked market pulp mills employ nearly 140,000 people directly and influence another 615,000 jobs, for a total of nearly 755,000 jobs nationwide.

The second extracted component shows that wastepaper recycling promotes economic development opportunities. The recycling of waste papers creates an avenue for local businesses to flourish. The availability of raw materials will attract local and foreign industries which will foster economic growth. In this way, large quantities of paper will be locally produced and sold to other countries. The growth of recycling is being driven by increasing demand for recyclables which helps make the economy thrive by pushing up the price of materials. It also boosts the economy by increasing the number of recyclables sorted and placed on the market. Recycling promotes economic development opportunities by creating more jobs at higher income levels and by being able to meet a large proportion of the economy's resource demand, alleviating pressure on ecosystems to provide

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resources and assimilate waste cans. This agrees with the submission of Miller et al., (2008) that recyclable materials processing has a significant impact on Michigan's economy. Respondents to a survey of recyclable materials processors conducted by the Michigan Recycling Coalition reported $437 million in annual revenue, 1,920 jobs, and over $52 million in annual payroll attributable directly to processing activities. When extrapolated from the 51 percent of entities who responded to the survey to the entire processing industry in Michigan, this implies total annual revenues of over $1.9 billion, total employment of 5,028, and a total annual payroll of more than $137 million.

The third extracted component reveals that recycling helps in maintaining local manufacturing firms. Recycling paper waste can help sustain local firms because the process helps save money and improve the firm's bottom-line production. Recycling can create cost avoidance and free up funding for other sustainable initiatives. This process enables local industries to thrive and optimally utilize resources within their reach without much economic cost. Through recycling activities, local firms can remain in production and be high in the competitive market. Since raw materials are readily available, the local firms make good use of available resources for their growth. This is because paper is easy to convert into a new one and resold in large quantities. Paper recycling makes it possible for local manufacturing firms to remain in business and their ability to remain in business enables them to attract new customers, enhance their chances of winning contracts, and improve customer loyalty. The result in Table 2 therefore identifies an increase in job opportunities, an increase in economic development opportunities, and sustaining local manufacturing firms are the principal perceived economic benefits of wastepaper recycling.

Table 2: PCA result of economic benefits of wastepaper recycling

Variables	Components		
	PC_1	**PC_2**	**PC_3**
Recycling of wastepaper creates job opportunities	.884	-.028	-.052
Recycling helps satisfy the increasing demand for paper products and raw materials	.718	-.040	.283
Wastepaper recycling saves industries the costs of sourcing material and energy production	.604	.160	-.029
Wastepaper recycling promotes economic development opportunities	-.146	.899	.121
Wastepaper recycling reduces importation	.112	.764	-.346
Wastepaper recycling generates revenue for the government via taxes	.381	.663	.309
Recycling helps in maintaining local manufacturing firms	-.084	-.011	.821
Recycling helps in the provision of household income	.206	.052	.751
Eigenvalues	**1.73**	**1.69**	**1.55**
% variance	**21.57**	**21.15**	**19.4**
Cumulative exp.	**21.57**	**42.72**	**62.11**

[a]the underlined with coefficients ±≥0.8 are considered significant

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Environmental benefits

The environmental benefits of wastepaper recycling are presented in Table 3. As shown in Table 4.9, only the first three items with high mean values and responses were used to establish the perceived environment of wastepaper recycling. The first ranked item revealed that the majority (97%) of the respondents stated that wastepaper recycling reduces air, water, and soil pollution. This is expected as recycling substantially reduces the need to grow and extract new raw materials from the earth's crust. This in turn lessens the harmful disruption and damage that would have done to the natural world. The extraction of latex would have resulted in the falling of trees or clearing of forests, rivers would be diverted, wild animals would have been harmed or displaced, and there would have been pollution of water, soil, and air. Recycling wastepaper helps to keep the environment clean without which used papers would be blown down or washed into rivers and seas and end up hundreds or thousands of miles away, polluting coastlines and waterways and becoming a problem to the environment. Indeed, wastepaper recycling goes a long way towards considerably cutting back on the levels of pollution because these waste products are reused rather than being thrown away recklessly. In a related study, the United States Environmental Protection Agency (2016) stated that paper recycling reduces greenhouse gas emissions that can contribute to climate change by avoiding methane emissions and reducing the energy required for several paper products; extends the fiber supply, and contributes to carbon sequestration; saves considerable landfill space; reduces energy and water consumption and decreases the need for disposal.

The second-ranked item revealed that 95% of the respondents stated that wastepaper recycling saves energy (saves the amount of energy needed to manufacture new cans or products). This is expected as the amount of energy needed to extract ore is preserved, and this saves the industry a huge amount of money. The recycling of paper can save precious natural resources, energy, time, and money which will benefit the earth, the economy, and local communities. Making products from recycled materials requires less energy than making them from new raw materials. Sometimes there is a huge difference in energy. Belinda (2006) asserted that manufacturing with recycled materials saves energy and water and produces less air and water pollution than manufacturing with raw materials. Recycling reduces mining and drilling, which produces air and water pollution. By saving energy, recycling reduces the air pollution caused by burning fossil fuels such as coal, natural gas, and oil which contributes to the largest amount of energy generated. The Green America Report (2021) stated that recycled paper use saves resources and reduces the paper industry's impact on the planet. Using 100% recycled copy paper instead of 100% virgin fiber paper saves 100% of the trees; saves 31% of the energy; saves 53% of the water and produces 39% less solid waste. It also reported that recycled paper production emits 40% fewer greenhouse gases and uses 26% less energy.

The third-ranked item revealed that 75% of the respondents stated that recycling protects the environment from damage (Table 3). This perhaps is vital as recycling plays a big part in protecting the earth in the most balanced way. While many trees are felled every day, recycled waste cans reduce deforestation. The recycling process involves minimal combustion, and waste is transformed into reusable materials with zero or minimal harmful impact on the environment. The whole process of processing and manufacturing products from wastepaper emits few greenhouse gases because the waste recycling industries burn little fossil fuels. If the process of

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recycling used and old materials is not there, it means new products will be manufactured by the extraction of fresh raw materials. For this reason, recycling conserves existing raw materials and protects them for future use which ensures sustainable and optimal use. In a related study, UNEP (2021) stated that recycled paper reduces the amount of waste that would go to landfills thus prolonging the life of landfill sites. And that recycling of wastepaper avoids the production of methane gas that would have resulted from the anaerobic decomposition of wastepaper thus contributing to climate change mitigation. In addition, wastepaper recycling significantly reduces energy use as the recovered pulp uses more energy than virgin pulp thus conserving energy. The result in Table 3 shows that many respondents stated that recycling wastepaper reduces air, water, and soil pollution; saves the energy needed to manufacture new paper, and protects the environment from damage.

Table 3: Environmental benefits of wastepaper recycling

Variables	Total % response		Mean	Rank
	TA	TD		
Reduce air, water, and soil pollution	97.0	3.0	3.61	1
Saves energy needed to manufacture new paper	95.0	5.0	3.34	2
Protect the environment from damage	75.0	15.0	3.29	3

TA = totally agree and TD = totally disagree

Conclusion

The study has shown that wastepaper recycling impacts positively on the environment. The outcome of the study shows that wastepaper recycling has several benefits to the environment and human well-being. The study clearly shows that an increase in job opportunities, an increase in economic development opportunities, and sustaining local manufacturing firms are significant dimensions or perceived economic benefits of wastepaper recycling. It further reveals that reduction of air, water, and soil pollution; energy saving or conservation, and protection of the environment from damage are the perceived environmental benefits of wastepaper recycling. The study shows that wastepaper recycling does not significantly impact the environment.

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