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PRODUCT RECYCLING AND ITS IMPACT ON CLEAN ENVIRONMENT IN PAKISTAN

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Abstract

The objective of this research paper is to analyze the product recycling and its impact on clean environment in Pakistan. The secondary time series data for period 1990-2012 was used in this study. Clean environment was taken as dependent variable while Recycled Products, Energy Generation and Emissions were selected as independent variables. We used econometric techniques such as Descriptive statistics, Correlation analysis and Regression analysis were used to draw the results. Our findings show that recycled products have positive relationship with clean environment because it reduces the need of less natural resources and also reduces minimizes pollution. Energy generation through fusel fuels and vehicle emission have negative relationship with clean environment. Thus, it is suggested that policy makers should devise the polices to generate energy through renewable resources and encourage recycling of used products to conserve natural resources.

Keywords: Waste recycling; Plastic; Aluminum; Environmental impact.
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1.Introduction

1.1. Background of study

Recycling is widely considered as an effective method to mitigate environmental pressures on society. This can be made through conserving renewable energy, decreasing pollution and minimizing cost of solid waste. In case of other products, recycling is also a significant economic activity that creates jobs and attracts investment (Shi et al., 2020). There are two aspects of the word "recycling" denotes regeneration and reutilization. Recovery applies to the treatment and processing of waste from sources with landfills, incinerators, or other recycling systems. Usage applies to waste recycling of fresh and usable items.

Pakistan has become a disposable country where most of the products are sold in disposable forms. However, it is a bitter reality that use of these products are led to increase volume of plastic pollution in Pakistan. Plastic is not a good object as it is composed of major toxic pollutants that have the potential to cause significant harm to the environment in the form of air, water, and land pollution. Besides, it has started to impact natural ecosystem negatively while creating problems for wildlife and human population, such as killing of plant life and posing hazards to animals. It is estimated that about 8 million tons of plastics are deliberately dumped into the oceans globally due to wind and flow of rivers and release of urban overflow into water channels. It is shocking to know that the simplest plastic normally used in grocery store bags takes over 100 years to collapse, though the complex ones take between 100 and 600 years or even beyond that to be decomposed. It is estimated that food wrappers and containers produce 31.15% of pollution while bottles and containers cap produce 15.5% of pollution. Plastic bags cause 11.18% of environmental pollution, straw and stirrers produce 8.13%, beverage bottles produce 7.27% environmental pollution (Eneh and Oluigbo, 2012).

Pakistan is facing many environmental challenges which pose severe threats to human health and life. First, climate change is a non-traditional threat to Pakistan. Pakistan has been declared among the top ten countries mostly affected by climate change. Climate change has negative impact on health, agriculture, and overall economy of the country. The main reasons for climate change are carbon emission, deforestation, population explosion, and lack of finances to mitigate and reduce the effects of climate change. At the same time, recycling is essential if we want to preserve this planet for our future generations. It is suitable for environment since we are making new products from the old products which are of no use to us. (Riedel, 2011).

1.2 Recycling Products

1.2.1 PET Plastic

Plastic bottles are commonly produced from PET plastic, such as water bottles, beer bottles and juice bottles. It is sad to say that all of these bottles wind up in waste landfills. If it is reused/recycled, the energy needs of the manufacture of fresh bottles will be lowered by three quarters. This decreases the decomposition of plastic wastes, as well as the environmental cost generated during processing. Every plastic product has an Identifying Label – typically on the bottom of every plastic container, a triangle with numbers 1 to 7 describing the grade of the plastic item. Many recycling programs provide plastics with codes 1 or 2, including water bottles and containers used for milk, juice, and skincare items.

1.2.2 Aluminum Can

Aluminum containers are simple to recycle and have a significant effect. These frequently used aluminum containers are 100% recyclable without harming the environment. If you recycle aluminum cans, a lot less energy is used to bring them out again. If one can use recycled cans, greater than 90 per cent of the resources used to produce aluminum cans can be saved. These cans are CRV products in California, but you can get credit for the disposal of them. This is an extra benefit.

1.2.3 Paper Products

Almost all paper products are recyclable, but one can consult with the nearest recycle network operator before collecting the paper items like milk and juice cartons. These cartons are composed of cardboard intercalated between the layers of plastic. Therefore, not all products are recyclable, and not all facilities support them. One can recycle his own consumed paper products if having a yard. The environmental protection agency (EPA) notes that 1/3 of urban waste consists of paper. Set up a paper recycling basket at home and bring in your magazines and another outdated document for recycling. It is also necessary to carry corrugated cartons in a different pile. Otherwise, these things will wind up in the garbage. Instead, we conserve valuable money by sending them to recycle.

1.2.4 Metals-Steel

Cutting down the need to extract iron ore by recycling and reusing the scrap steel and other steel containers decrease the mining burden. Mining is an operation of very large resources, not to mention that drilling will also disturb natural ecosystems and environments. Everything we can do to improve the recycling of this essential metal is also beneficial. We can notice steel containers that normally come along with our canned goods. We can also find steel cans in our garment, also known as tin cans, including condensed broth, tomato paste, onions, and more.

1.3 Effect of recycling on environment

Recycling is important, and even the smallest step can have substantial environmental benefits. Greater knowledge about the value of recycling will render it a routine and essential aspect of our lives. This is a complicated question to tackle the health issue with landfills. The more waste ends in sites, the higher the problems we face. Products not biodegradable or slow to decompose, such as plastics, may remain intact on sites of waste for centuries, often releasing polluting gasses (Su et al., 2020). The recycling campaign also reduces pollution and benefit to the ecosystem. The benefits of recycling are as under:

- Conserve natural resources
- Save forests and other habitats
- Reduce energy consumption
- Decrease environmental pollution.

1.4 Recycling Challenges to Pakistan

Recycling in Pakistan undergoes several Challenges. Some of them are as follows: -

► Waste Agriculture Biomass (WAB) management capacities need to be developed mainly within the agricultural sector.

- ► Knowledge and appreciation of the usage of WAB is feeble, provided that many farmers are illiterate and environmental education is non-existent.
- ► Unregulated e-waste trade is an important Issue.
- ► The construction of a functioning SWM device needs a large expenditure and it could be challenging to assign it priority over resource issues like electricity. Support by funding institutions to take the lead in waste reduction will usher a replicable moment among communities.
- ► The developing Strategy or taking Policy initiatives for developing recycling plants including financial and structural frameworks need to be focused.
- ► The promotion of Public-Private Partnerships (PPP) and numerous opportunities (providing property at a low rate, Tax refund, quick distribution of waste to the recycling plants, etc.) need to be understood to encourage private investments.

1.5 Per Capita waste generation

Waste per capita is a term used to measure the quantity of waste generated per day by a person in a specific area. It is measured in the amount of kg/capita/day. A high waste generation per capita harms the environment, especially when the waste is not recycled properly. Here we have noticed a direct proportional dependence of waste generation and energy potential whether it is in the form of biogas or heat etc. It is also directly proportional to population density. Denser the population greater will be the waste generation and hence higher will be the energy potential. population of Pakistan is almost 216.6 million as per 2019 census. The daily waste generation is in the range of 0.283 to 0.612 kg/capita/day and the waste generation growth rate is 2.4% per year. The detail of waste generation in different cities of Pakistan has shown in Table 1.

Table 1: Cities of Pakistan and waste generated in a day

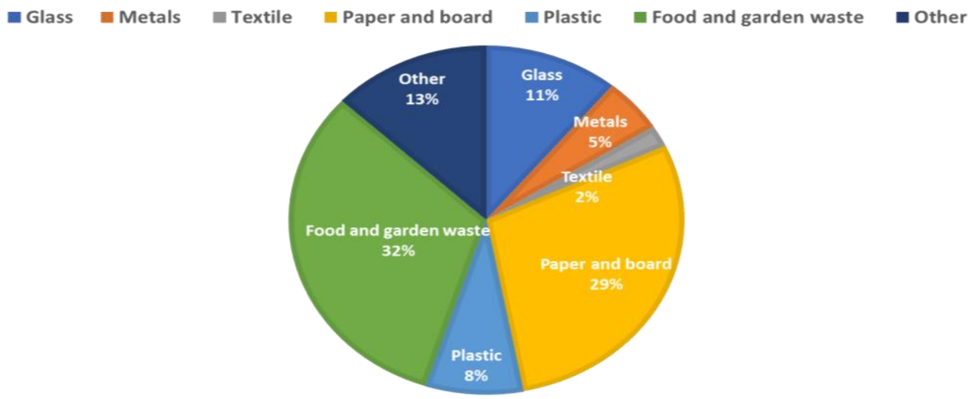
S. No	**Major cities in Pakistan**	**Population**	**Waste generation in tons/day**
1	Karachi	20500000	9440
2	Lahore	10000000	6510
3	Faisalabad	7500000	4883
4	Rawalpindi	5900000	3841
5	Hyderabad	5500000	3581
6	Multan	5200000	3385
7	Gujranwala	4800000	3125
8	Sargodha	4500000	2930
9	Peshawar	2900000	1888
10	Quetta	600000	326

Source: Shirazi and Kazmi. (2014).

1.6 Waste Classification

Waste classification or segregation is a term used to classify waste based on its source and composition. This practice not only helps to better manage the waste but also eases a lot when it comes to re-use or recycle of the waste according to its nature. Waste segregation is an important factor to consider that gives a better understanding of the composition of waste qualitatively as well. For this purpose, we have incorporated waste characterization that can be divided into 12 classes, which are then further classified into 2 main classes. Organic (biodegradable) waste comprises 58 percent of total waste while 33 percent is the combustible waste that can be utilized in various energy generation processes. The Figure 1 shows the composition materials present in waste products. The quantification of the products is based on the general consumption of these products.

Figure 1: Share of climate pollutant products



Source: Majeed et al.(2018)

1.7 Composition of Waste

Approximately 60-70% of solid waste is collected in cities. The fleet of waste collections typically consists of hand carts and the main collection is carried out by the open vans, tractor/trolley systems, and secondary collection/transportation arm roll containers. Table 2 show the detail of municipal waste in Pakistan.

Table 2 Daily Municipal Waste collected in Pakistan

Physical composition of municipality waste collected in Pakistan	
Ash, Bricks and Dirt	18%
Glass	2%
Textile	6%
Cardboard	7%
Food Waste	30%
Leather	1%
Paper	6%
Plastic	9%
Rubber	1%
Metal	4%

Wood	2%
Yard Waste	14%

Source: Mahar et al., (2007b)

1.7 Objectives of study

The objectives of study are stated in the following: -

- To study the state of environmental pollution in Pakistan
- To explore how product recycling affects Pakistan's clean environment.
- To assess the impact of product recycling on Pakistan's socio-economic development and conservation of natural resources.
- To analyze relationship between recycling and healthy climate.
- To assess recycling benefits in saving natural resources.

1.8. Scope of study

Every country and its people are facing climatic change and its effects on human being, animal and plants. Companies are engaged in producing organic and green products to save human life from environmental diseases. Even Global institutions including G-20 member countries are also working on environmental issues and allocating funds for this purpose. The policy makers are forcing business firms to abandon manufacturing products that produce environmental hazards. These brief explanation highlights scope of this study, which is not only useful for all countries but also beneficial for academicians and researchers all over the world.

2. Literature Review

Rapid economic development, urban sprawl, and unplanned industrialization have improved socio-economic status, but have lowered air quality in developing countries of South Asia. Air emissions has become a challenge to the local community in terms of health status, viability, and quality of life. Shi et al., (2020) carried out an analysis on the Spatiotemporal Land Use Regression (LUR) model to optimize global air quality data on national atmospheric PM 2.5 pollutions in a high-density country like Pakistan. They concluded that in conjunction with the transportation system, land use trends, local meteorological conditions, regional characteristics, landscape characteristics, and satellite-based evidence, resulting 54.5 percent of the atmospheric PM2.5 concentration variance. Shi et al., (2020) stressed on numerous facets of plastic waste in coastal and marine ecosystems. Plastic contaminants of varying shapes and types, such as mega plastic, macro plastic, meso-plastic, and micro plastic, are distributed in the environment. Primary and secondary micro plastics show the extensive distribution in aquatic and coastal ecosystems in water, soil, and biota. Shen et al., (2020) have stated that biodegradable plastics (BPs) have been the subject of recent studies owing to their capacity for biodegradability and harmlessness, which will be the most successful solution to handle global deposition of plastic waste. In the long term, though it is unclear if BPs will be a promising option for waste management and global contamination of plastics. Therefore, all aspects of the conflict should be addressed in the research. Grimaud, Perry and Laratte, (2018) investigated environmental impact of recycling aluminum cables by using Life Cycle Assessment (LCA) methodology, following standards of the International Organization for Standardization. The environmental evaluation of the cable recycling pathway is investigated in this analysis by using the LCA approach. The data were gathered from a recycling plant (MTB

Recycling) in France. The MTB recycling method depends only on mechanical isolation and optical sorting measures on shredder cables to produce high-purity aluminum (above 99.6 percent). The findings of the life-cycle review confirm the tremendous environmental advantages of recycled aluminum as compared to primary aluminum. Besides this, the research shows the advantages of product-centric cable recycling pathways. Moreover, it was also noted that mechanical separation is an effective solution to the recycling of metal smelting. Eneh and Oluigbo (2012) studied the effect of liquid and substantial waste pollution on the climate and release of Greenhouse Gas (GHG) into the atmosphere. They trap the atmosphere's re-ray solar heat energy and then overheat the planet. They suggested that all policymakers at local, state, and national levels to support the introduction of waste disposal activities including reuse, recycling, and usage of recycled contents that would, in turn, improve energy efficiency. Mahar et al., (2007a) evaluated condition of solid waste in urban areas of Pakistan. Their study was mainly based on current SWM practices in five major cities of Pakistan. This study attempted to provide a detailed analysis of the total amount of municipal solid waste produced, storage, collection, physical composition, transition, processing, and disposal of SW. By completing overall evaluation, they defined important issues with an analytical assessment of the condition of operation and suggested significant steps to strengthen existing procedures.

2.1 Distinction of the study

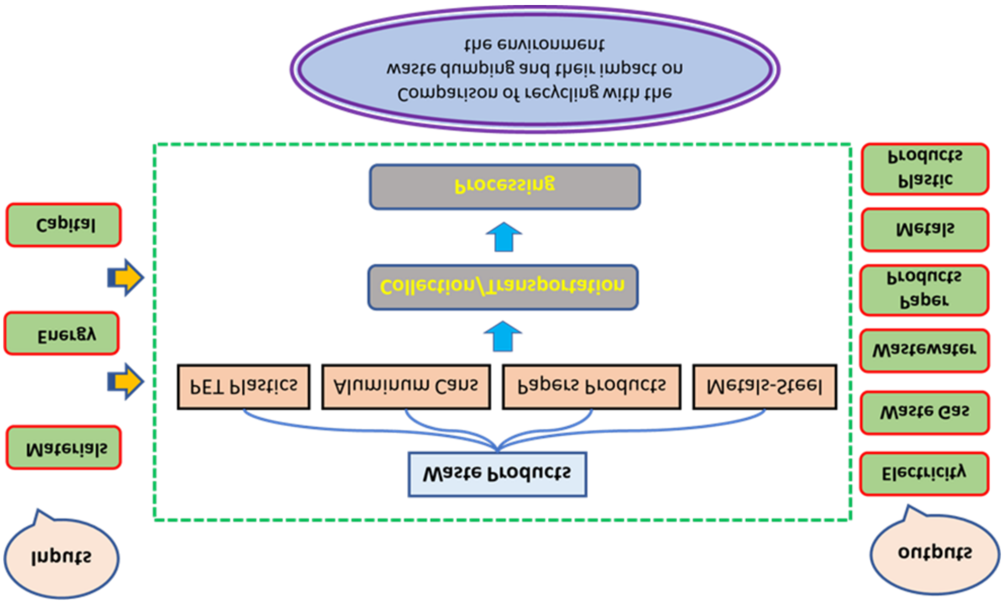
Recycling is a critical component of modern waste reduction and is the third component of the “Reduce, Reuse and Recycle” waste hierarchy. Recycling and waste minimization are a prerequisite for sustainable development and green environment. Also, the environmental challenges due to climate change are expected to directly effect Pakistan's economy, which results in a loss of 6% of GDP (Pakistan Strategic Environmental Assessment Report, 2006). Aluminum Cans, PET plastics, paper products, and steel are the most widely used products in Pakistan. Several studies reported the recycling of these products individually and used different models to study their life cycle. To date, no research has so far been conducted in Pakistan or elsewhere, which can explain in depth the environmental impact of polluting products. There is no quantitative data available in terms of production systems and environmental issues. There are no reports available that can summarize the environmental potential of these products reuse and recycling. Our study on recycling products and their impact on clean environment in Pakistan is different from the above quoted studies in terms of methodology, data, procedure and geographical location.

3 Conceptual Framework

Recycling affects the environment indirectly as less energy is utilized, and least waste is produced through recycling than in producing completely new products. Figure 2 shows the comprehensive flow chart which depicts the overall process involved in waste recycling. and its impact on the environment. Various inputs like waste or used materials, energy, and capital are considered important component of recycling process. The recycling process includes processing of materials to produce new materials which are considered as an output or the products of the recycling process.

During the process of recycling various bi-products and undesirable products are also produced. Moreover, the primary benefit of recycling is the reduction in the resources utilized by reusing the waste products after processing them. The environmental impact of the recycling process and their products in the output will be compared with the dumped waste products. Various aspects of recycling (positive and negative impact, electricity generation, cost, hazardous byproducts) will also be studied through above proposed model statistically and collecting data from real life.

Figure 2: Inputs and outputs of waste products



4.Research Methodology

4.1 Area and population

Area of the study chosen for this study is the whole Pakistan. According to 2019 census, Pakistan total population is 216.0 million. According to a recent survey, Pakistan is cumulatively producing a sum of an average of 87,000 tons of municipal waste per day. It has also been witnessed that waste generation and its management are dependent on population density. On a generic basis, the densely populated province like Punjab and KPK produce more solid waste as compared to the other province. Karachi is the most densely populated city, contributing 9,900 tons of waste per day.

4.2 Type of data

We used secondary data in this research paper. The data was collected from Waster Management Companies reports operating Pakistan. The collected data has two types: Demographic data and Statistical data. *Statistical data contains* daily monthly and yearly waste collections. The waste once picked from the bins is collectively taken to dumpsites where it is weighted, and data is recorded. The data recorded in area/UC wise provides a better understanding of the generation of waste quantities UC wise. *Demographic data* includes population data that is derived from the latest census. Waste per capita is also derived from population and waste collection data. Land use information was also taken into account and recorded

4.3 Selected Variables

Clean environment is dependent variable while independent variables are as under: -

- Recycling products.
- Energy Generation
- Emission
- Economic values
- Hygienic environment

4.4 Hypothesis of study

The hypotheses of this study are enlisted below: -

H_0: Recycling products have no impact on clean environment in Pakistan.

H_1: Recycling products have substantial impact on clean environment in Pakistan.

4.5 Econometric Model

The econometric model of the study is engraved in the following equation: Environmental effect = f (recycling products + energy generation+ emissions+ Error term). The model is shown in the following equation: -

$$CE = \beta 0 + \beta 1(RP) + \beta 2(EG) + \beta 3(E) + \varepsilon \ldots \quad . \quad (1)$$

Where:

CE= Clean environment,

RP= Recycled Products.

EG= Energy Generation,

E= Emissions,

Ɛ= Error term

5. Data Analysis

Statistical data has been presented in the form of tables and graphs to illustrate the impact of recycling and dumping of waste on the environment. This study was conducted to explain the life cycle of the waste recycling process in Pakistan. The details of the results are discussed in the below: -.

5.1 Positive aspects of recycling products

5.1.1 Energy Waste Analysis

Waste-to-energy (WTE) is the process of generating energy in the form of electricity and/or heat from the primary treatment of waste or the processing of waste into a fuel source. WTE is a form of energy recovery. Most WTE processes generate electricity and/or heat directly through combustion, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels."

5.1.2 Biogas

Biogas is very similar to natural gas and is composed of methane, carbon dioxide, and other gases. The energy value of the biogas is 600-950 Kilo-cal/m3 (Keanoi et al., 2014). It can be burned in boilers as natural gas. It can be burned with the purpose of electric and heat power production and as fuel for vehicles after proper treatment. A biogas plant is the most efficient cleaning system. Typical composition of biogas is given in Table 3.

Table 3**:** Typical composition of biogas

S. No	Compound	Percentage
1	Methane CH_4	50–75
2	Carbon dioxide CO_2	25–50
3	Nitrogen N_2	0–10
4	Hydrogen H_2	0–1
5	Hydrogen sulfide H_2S	H_2S 0–3
6	Oxygen O_2	0–0

Source: Pakistan Economic Survey,2019

5.1.3 Biogas Generation from Waste

The most extracted gas is methane or commonly called biogas. We call this biogas as it has been generated by the biological treatment of waste. According to the case study done on Medina city for waste to energy, it was estimated that the typical value of Biogas generation is 180.6 m3 per 1 ton of general waste treatment (Rehan et al., 2017).

Typically for biogas calculation, following equation is used:

Biogas = M x E.F Equation ……… (2)

Where,

E.F = emission factor

M = the percentage weight of organic waste in the total tonnage.

The results of biogas generation wastes are given in Table 4.

Table 4**:** Results for Biogas generation from the waste in Pakistan

Biogas = M * E. F (2)			
Total waste (tons/day)	**M (tons/day)**	**E.F (m^3/ton)**	**Biogas m^3/day**
111456	64644.4	180.6	11,674,793.08

Source: Rehan et al., (2017).

5.1.4 Emissions as a by-product of Energy Generation

All waste treatment procedures are associated with a small or large number of by-products in form of gaseous or particulate pollutants. Simple procedures like composting or AD emits gases that are hazardous if not controlled (Clemens et al., 2006). For example, the process for biogas generation also emits gaseous byproducts like CO_2 and NO_2, etc. Even the burning of biogas which is used for electricity and heat generation, has its side-effects in terms of uncontrolled emissions. Estimation of these by-products is necessary to be calculated and monitored so that we can have a clear statistical picture of any environmentally damaging gases if being generated. Calculation of emissions is usually based on emission factors for each procedure specific to each emitting component.

5.1.5 CH_4 Emission

The equation for methane generation would be like other emissions where the Ef would be multiplied by the waste. In our case, we are considering that we are charging a complete mass of MSW in the incinerator or any other burning facility. Also, we are considering only the wet weight because MSW collected from our site area are always wet or moistened due to leachates and food wastes. Hence the equation is:

$$CH_4 \text{ emission} = EF \times W$$ Equation ……….. (3)

Table 5 shows the results.

Table 5: CH_4 Emissions from the waste

CH_4 Emissions = EF * W (4)			
Waste W (tons)	EF (g/Kg of W)	Waste in Kg (1 ton = 1000kg)	CH_4 emission (g/Day)
111456	4	111,456,000	445,824,000

Source: Rehan et al., (2017).

5.1.6. NO_2 Emission

Similarly, the NO_2 is also emitted sideways with any biological treatment of waste. The value is 0.24 g per KG of MSW for a wet weight of waste considering the general method of composting. The emission obtained will be according to the following equation.

NO_2 emission: Ef x M Equation ……… … . (4)

The results are highlighted in Table 6.

Table 6: NO_2 Emissions from the recycled waste

NO_2 Emissions = EF * W (5)			
Waste W (tons)	EF (g/Kg of W)	Waste in Kg (1 ton = 1000kg)	NO_2 emission (g/Day)
111456	0.24	111,456,000	26,749,440

Source: Rehan et al., (2017).

5.1.7 CO_2 Emission

The leading cause of CO_2 emissions in terms of waste treatments is the open burning of waste at dumping sites and incinerators where waste is burned under a controlled environment to utilize it for energy. According to the estimate, incineration of a single Mg of MSW can release up to 0.7 to 1.2 Mg of CO_2 (Chen and Lin, 2008). This carbon dioxide is directly released into the atmosphere and contributes to greenhouse effect. Since municipal waste is a mixture of liquid and dry wastes i.e., biogenic (food) or fossil (plastic). Different sources contribute differently to CO_2 production; For instance, fossil fuel accounts for s about 33 to 50 per cent of the total CO_2 production. As per calculations, the average value of emissions is estimated to be 0.415 Mg of CO_2 per Mg of waste (Chen and Lin, 2008). The results are shown in Table 7.

CO_2 Emission = Ms x EF Equation …… . (5)

The results of CO2 emission are reflected in Table 7.

Table **7:** CO_2 Emissions from various waste products recycling

CO_2 Emissions = Ms * EF (6)			
Waste W (tons)	EF (Mg/Mg of waste)	Waste Ms in Mg (1 megagram = 1.10 US tons)	CO_2 emission (Mg/Day)
111456	0.415	122,601.6	50,879.664

Source: Rehan et al., (2017).

Moreover, energy generated through waste products also lowers the energy burden of Pakistan by providing an extra option rather than exploiting natural resources such as hydropower, coal, and thermal power stations for electricity generation. However, emissions are observed in recycling the waste with a minimum value of 22000 kg per day.

6. Empirical Analysis

6.1 Descriptive statistics.

The results of descriptive statistics are shown in Table 8.

Table 8: Descriptive statistics of the variables

	RP	RWE	CO2
Mean	63.05000	36.01932	32.14750
Median	62.25000	34.59910	31.90144
Maximum	67.50000	43.74630	35.88995
Minimum	59.60000	32.72499	28.60972
Std. Dev.	2.408896	3.459460	1.980525
Skewness	0.581657	1.325592	0.141535
Kurtosis	2.333474	3.491667	2.968906
Jarque-Bera	0.748982	3.029379	0.033790

Probability	0.687639	0.219876	0.983247
Sum	630.5000	360.1932	321.4750
Sum Sq. Dev.	52.22500	107.7108	35.30230

Table 8 shows descriptive statistics of variables mean of y (dependent variable) is 63.05 median is 62.25 maximum is67.50 and minimum is 59.60 and skewness is 0.58.std.dev is 2.40. mean of recycle waste energy (RWE) is 36.01 median is 34.59 maximum is 43.74 minimum is32.72.std.dev is1.32. skewness is1.32 mean of co is 32,14. median is 31.90. maximum is 35.88 minimum is 28.60.std.dev is 1.98. skewness is 0.14. While the mean value of recycling products is 63.05 and median value is 62.2 and its maximum and minimum values are 67.50 and 59.6 respectively. The value of standard deviation is 2.40 and skewness is 0.58. Kurtosis is 2.33. The value of Jarque-Bera iso.74 and Probability value is 0.68. The mean and median value of CO2 is 32.14 and 31.09 and its maximum and minimum values are 35.88 and 28.60 respectively. The standard deviation and skewness values are 1.98 and 0.14 respectively. The value of Kurtosis is 2.96 and Jarque Bera is 0,03. The probability value is 0.98.

6.2 Correlation Analysis

Correlation analysis show strength of relationship between variables. If the value of correlation is positive one, it shows strong relationship and if the value of correlation is negative it shows strong negative correlation. If the value of correlation is less than 050 it shows weak relationship. The results of correlation analysis are shown in Table 9.

Table 9 Results of Correlations analysis

Correlation	RP	RWE	CO2
RP	1.000000		
RWE	0.733042	1.000000	
CO	0.356183	0.225242	1.000000

The results show there is positive relationship between product recycling and clean environment because it reduces emission and helps reduce environmental pollution. However, there is negative relationship between renewable waste energy recycling and clean environment because recycling of energy waste reduce emission and make the use of energy resources more efficient. While CO2 has negative relationship between clean energy and clean environment because CO2 spoils clean environment.

4.3 Regression Analysis

Regression analysis show the degree of dependence of dependent variable on the independent variables. The results of regression analysis are given in Table 10.

Table 10: Results of Regression analysis

Dependent Variable: Y (clean Environment)		
Method: Least Squares		
Sample: 1990 2012		
Included observations: 10		

Variables	Coefficient	Std. Error	t-Statistic	Prob.
RWE	0.596562	0.113446	5.258554	0.0012
CO2	0.667933	0.198161	3.370661	0.0119
C	20.08986	8.314879	2.416134	0.0464
R-squared	0.823621	Mean dependent var		63.05000
Adjusted R-squared	0.773228	S.D. dependent var		2.408896
S.E. of regression	1.147131	Akaike info criterion		3.355731
Sum squared resid	9.211370	Schwarz criterion		3.446506
Log likelihood	-13.77865	Hannan-Quinn criter.		3.256150
F-statistic	16.34368	Durbin-Watson stat		1.693375
Prob(F-statistic)	0.002304			

Table 10 highlights regression analysis where y (Clean environment) is dependent variable and Independent variable is RWE (renewable waste to energy) and co (co2 emission) the coefficient of RWE shows that if 1unit increases in renewable waste energy the clean environment will likely to increase by 0.59 percent, keeping other factors constant and coefficient value of CO_2 shows that if one unit increases in environmental pollution it will decrease clean environment by 66 percent keeping other factors constant. The .t values are greater than 2 which shows variables are significant and p values are less than 0.05 which also shows that variables are significant. The value of R^2 is 0.82 which is near to 1 which shows that independent variables will cause

82 percent in dependent variable. Prob. value of f-statistics is less than 0.05 which shows combine effect of independent variables is significant. This value also shows that the model of the study is goodness of fit.

5.Conclusions

Efficient, economical, and reliable disposal and recycling of waste products is the top priority of all the developed and developing countries. The handling of recycling products is always associated with the environmental impacts, which arise due to the energy required for collection and sorting and the utilization of recovered materials in producing new products. However, these impacts are much lower than those associated with uncontrolled waste generation that have negative effects on the environment, and handling and disposal. Recycling in a developing country like Pakistan generates substantial economic benefits for the communities. It contributes positively to the environmental impact by reducing the use of energy for manufacturing new products. In can be concluded from the life cycle assessment of waste product recycling and its contribution to the environment of Pakistan that recycling the waste products can reduce the use of energy by utilizing the already used products; moreover, the emission and disposal of the waste products can be reduced by utilizing the practice of recycling process which in turn improve the quality of the environment. The recycling has a positive impact on the economy of Pakistan by producing extra energy resources and reducing the need for energy utilized in manufacturing and other sectors of economy.

6. Policy recommendations

The recommendations of this study are given for policy makers: -

● An initiative named Clean Green Pakistan was taken by Government of Pakistan in 1990. The idea of initiative was to hold a competition between cities of Pakistan in Cleanliness and Greenery. A web portal was launched where citizens can get registered and report their activities to earn points. Citizens would also be awarded medals when they reach a certain threshold of points. Such more policies are needed to address the environmental problems and promote the waste recycling in Pakistan.

● The Billion Tree Tsunami (Program) was launched by the Provincial Government of Khyber Pakhtunkhwa (KPK) in Pakistan in 2014, as a response to the challenge of global warming. Pakistan's Billion Tree Tsunami has so far restored 350,000 hectares of forests and degraded land to surpass its Bonn Challenge commitment. The project aimed at improving the ecosystems of classified forests, as well as privately owned waste and farmlands, and therefore entails working in close collaboration with concerned communities and stakeholders to ensure their meaningful participation through making project promotion and extension services more effective. In just a year it has added three-quarters of a billion new trees, as part of a "tree tsunami" aimed at reversing worsening forest loss. The project was completed in August 2017, ahead of schedule. Such kind of policies will always make our environments free from pollution and the toxic gasses produce in result of recycling products. Therefore, it is recommended that such a projects will continue in future to keep the environment clean and expand area of forest.

● The National Conservation Strategy Report recommends fourteen program areas for priority implementation: maintaining soils in croplands, increasing efficiency of irrigation, protecting watersheds, supporting forestry and plantations, restoring rangelands and improving livestock, protecting water bodies and sustaining fisheries, conserving biodiversity, increasing energy efficiency, developing and deploying renewable resources, preventing or decreasing pollution, managing urban wastes, supporting institutions to manage common resources, integrating population and environmental programs, and preserving the cultural heritage. This conservation strategy must be implemented strictly because it is multi-benefit strategy and it very important for the people and environment.

7 Contribution of study

This study contributes in the literature in the following ways.

An interesting change happened after the industrial revolution as a transition from hand-made towards machine-made goods boosted the efficiency and flow of profits, resulting in a higher quality of life for individuals and the community. However, industrial development was unplanned and unaccountable, and there were several defects in the production and use mechanism contributing to the indiscriminate usage of capital, electricity, and materials. Because of the reckless management of production and use, air, water, and soil are being highly contaminated, and a growing volume of garbage accumulates in the water, posing serious threat to human life and animals. The policy makers of Pakistan in particular and of developing countries in general pay attention to introduce technology for cleaning industrial polluted water.

As the public becomes increasingly involved in our climate change, environmentally friendly production has become most common approach to preserve environmental sustainability for the future generation.

Environmentally aware packaging is associated with manufacturing innovative goods with the utmost caution in terms of conceptual design through actual supply and end-of-life disposal of the commodity so that it matches the criteria prescribed to meet environmental expectations and requirements. Product recycling helps to increase the volume of content that is processed, reused, and composted. Life-cycle research is needed while environmentally sustainable goods are being developed. Life-cycle research includes the design, production, usage, and disposal processes of a commodity and green courses of action are important in the cycle of manufacture. “Design for reuse,” “design for disassembly,” and “design for recycling” are several primary design-related words. The end-of-life phase of goods is essential and must be accomplished by disassembling and recycling. DE manufacturing is a method of manufacturing goods into smaller pieces for more application and further value addition. Disassembly includes the deconstruction of a component and the rationalization of the constituent parts. Dismantling is regarded as an essential aspect of DE manufacturing. Rebuilding restores everything to its initial state. The product is refurbished where worn pieces are transferred to a new use. The theoretical and empirical analysis of de-manufacturing and dissembling will invite further research from global researchers who are interested in this subject. As climate change has been affecting about all countries including Pakistan, the policy makers of all countries may reap benefits from the results of this study.

8. Implication of study

Recycling is a method by which valuable resources may be produced from waste and used products. Many policymakers can opt legislation increasing producers' obligations to handle goods at the final stage. This needs a lot of attention in research how energy and materials movement is influenced by product improvements as well as designing desirable adjustments in the industrial environment. These would significantly affect how societies consume resources and how consumers are coping. There is more pressure on the community in coping with environmental consumer products. There are many obstacles to suppliers and retailers who try to succeed in today's competitive globalized market in which they have to adjust according to changing environment and their desire to maximize their profit. They give less importance to health or costly health-related products.

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Contribution of Authors

Both authors jointly carried out this research study and collaborated each other. The author 1 collected data, conducted its statistical analysis. She prepared initial draft of manuscript. The Author 2 helped Author 1 in selected of title of research, guided in statistical analysis and formatted final draft of manuscript. Both authors carefully read final draft of manuscript and find it fit for publishing.

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