

An-Najah National University

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"Assessing Palestinian Community Knowledge and Awareness Towards Waste to Energy"

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List of Nomenclatures

<u>Symbol</u>	Description
PCBs, HCB	Chemical compounds
CFB	Circulating fluidized bed
WTE	West to energy
MSWM	Municipal solid waste management

Abstract

This project discusses the Palestinians local citizens awareness regarding problems of household waste, wrong ways of disposal and its impact on environment and health, and it helps decision makers in better understanding of how to find solutions to benefit from it in the field of energy production.

The project took An-Najah National University students as its targeted population. Where representative sample was designed based on 95% level of significance and 5% margin of error. Under these conditions, sample size was 385. Survey was designed based on Likert scale. In which 21 questions were included, targeting the establishment of waste to energy plant environmental and economic citizens awareness, waste disposal methods (current and proposed) knowledge.

The World Bank report says that 70% of the waste collected is disposed of 10% in an environmentally correct manner. For Palestine, it produces 1.387 million tons of waste per year. This rate is increasing by 1% per capita, The waste is associated with the physical situation of the countries.

We found a very low percentage of awareness of dealing with the subject of waste and the correct methods to get rid of them. The right solutions need an integrated cooperation between all segments of society. The goal of this project is to assess awareness of the local community and finding out the efficient possible ways to increase awareness of waste management and possibility to build a plant to convert waste and produce electric energy from it.

The findings of the survey showed that the percentage of lack of awareness in the community is high.

1. Introduction

Waste is one of the inevitable outputs in the society and dealing with waste is one of the biggest challenges now and in the future. The awareness and knowledge of the different aspects of society is a great challenge because the best solution to dealing with waste cannot be successful by one person. It requires integrated cooperation from all aspects of society. Waste depends on the economic, political, social and environmental aspects of the area. The increase in population and continuous growth is a major challenge, which leads to increased production in waste. Consequently, a greater effort is needed to get rid of them.

The World Bank report states that 70% of the waste is collected and almost 10% of the waste is disposed of in an environmentally acceptable manner and the remainder is disposed of. This is a danger to the health of the living organisms as a whole. This process of burning is emitted by dioxins so that the dioxins are highly toxic environmental pollutants where they are deposited on the leaves of green plants and thus enter into the food chain through eating. Animals such as cattle and sheep are stored in the fatty tissues of these animals and therefore when humans eat meat and dairy products for those animals it becomes dangerous as well as air pollution leading to problems in the lungs and other carcinogens such as PCBs, HCB and many other substances threatening the life of organisms. [1,2]

The evaluation of a new waste disposal site is very complex, requiring great experience in all fields such as economic, environmental and engineering fields, Take into account many things such as the distance from the places of residence and natural nature of the land as well as the proportion of the groundwater of that area and the proportion of filter nomination of pollutants these things is very important for the present time and future .The waste is classified according to its uses such as domestic waste, medical waste and agricultural waste. Solid household waste is one of the most important sources of energy production. The main parts of solid waste include plastics, organic materials, glass, paper and textiles. The following table (1) shows the different sources of the recognized waste and its composition [3].

Source/ type		composition	
	Residential	Food wastes, paper. Cardboard, plastics. Textiles, leather, Yard wastes, Wood, glass, metals. Ashes, special wastes. (e.g. bulky items, consumer electronics. White goods, batteries, Oil, tyres). Household hazardous wastes, e- wastes.	
Municipal solid	industrial	Housekeeping wastes, Packaging, food wastes, wood, steel, concrete, bricks, ashes, hazardous wastes.	
waste (MSW)	Commercial & institutional	Paper, cardboard, plastics, wood, food wastes, glass metals, special wastes, hazardous wastes, e-wastes.	
	Construction & demolition	Wood, steel, concrete, soil, bricks, tiles, glass, plastics, insulation, hazardous wastes.	
	Municipal services	Street sweepings, landscape & tree trimmings, sludge, wastes form recreational areas.	
Process waste		Scrap materials, off-specification products, slag, tailings, top soil, wastes rock, process water & chemicals.	
Medical waste		Infections wastes (bandages, gloves, cultures, swabs, blood & bodily fluids). Hazardous wastes (sharps, instruments, chemicals). Radioactive wastes, pharmaceutical wastes.	
Agricultural waste		Spoiled food wastes. Rice husks, cotton stalks, coconut shells, pesticides, animal excreta, soiled water, silage affluent, plastic, scrap machinery, veterinary medicines.	

Table 1: the different sources of the recognized waste and its composition.

In the past two decades, managing and raising the general level of environmental awareness on all levels of society has become one of the main social goals that has reached a level of social and political assent. [4] the measuring of environmental awareness based on scientific criteria is becoming increasingly interesting to scientists working in different Specializations.

Environmental awareness can be defined as the attitude concerning environmental consequences of human behavior. he publics' support for the protection of the environment depends on its level of environmental awareness. [5] Despite the wealth of information which exists concerning environmental behavior, it is not known which variable or variables appear to be most influential in motivating individuals to take responsible environmental action.



Figure 1:The three elements of environmental awareness [6]

The term "awareness" is a milestone and is defined in the Cambridge Dictionary as "knowing something, or understanding a position or subject at the present time based on information or experience" Awareness has been discussed in many previous contributions. Basically, it is not possible to generalize its definition but it is one of the ways in which individuals develop their beliefs and values towards the environment. Most people intuitively but environmental behavior may not result from environmental awareness [7]

According to **Dembkowski** and **Hanmer-Lloyd**, environmental awareness can be viewed as a multidimensional concept with three main cognitive components that form individual awareness–knowledge, memory, intelligence and decision making when investigating many studies for his knowledge of the relationship between knowledge and consciousness, **Wagner** suggested that knowledge is the main engine of consciousness. **Makower and Pike** considered that knowledge is an independent value through education and considered to be the motivation for values that humans maintain and develop in their own knowledge of the environment. In this context, Jumbo and Switzky defined knowledge as "the ability to understand the impact of society on ecosystems". Here are pro-environmental behaviors in ways of human interaction with the environment, ways of dealing with it, such as recycling, ways of conserving energy and renewable energy resources. However, awareness does not represent pro-environmental methods.

Stern proposed that environmentally significant behavior may be classified from an intentoriented or an impact-oriented perspective; it can be driven by a person's values and beliefs or controlled and motivated by other forces. Values are considered a component of pro-environmental behaviors as they serve to guide people or limit their behaviors. In 1997, Sagiv suggested that behavior occurs when individuals believe in personal standards or principals, Environmental responsibility is awareness (attitude) supported by actual pro-environmental behaviors. In other words, environmental awareness consists of a positive attitude towards the environment and appropriate environmentally relevant behaviors. Intentions are sometimes considered to be habits. However, habits are formulated through repeated experiences, but intentions are supposed to be produced automatically in forms of behavior.

Based on a review of the literature we have conducted, we have found a paucity of studies that measure the level of awareness of the Palestinian society about environmental issues in general and global warming in particular. Moreover, none of the studies examined the relationship between the level of awareness and environmentally friendly behavior of people in Palestinian society. However, a great deal of international studies has been conducted to measure perceptions, ideas and understand the impact of climate change and GHG and GW [8].

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America is the large sources of waste production has reached about of waste in the world Millions of tons of waste are exported annually to the external market, even with tight restrictions, but they can be circumvented in the surrounding area. in 2015, these exports were estimated at 86 billion dollars. International trade in waste is mainly based on reusable waste as raw materials. The bulk of the exports are estimated at 87 million tons, followed by paper, 1 million tons, followed by non-ferrous metals, 16.9 tons, and finally plastic, 11.8 million tons, these wastes are either exported in their raw state or after a preliminary phase of screening or treatment in the country of origin. As for China, it is the world's largest importer of waste to be used in the industrial sector. Waste is a growing concern in China, as in many emerging countries Economies. The country generates about 300 million tons of solid waste annually [9].

However, even this is not so directly. Solid waste contains a high percentage of waste food, which leads to their rise Moisture content and net thermal value is relatively low (3-5 MJ / kg average, Compared with 8-11 MJ / kg in Europe). Waste also contains seasonal variations, Gives them complex heating properties. The combustion technology that originated in Europe is not quite suitable for waste treatment. Therefore, research in China has developed new Copy terminals rely on CFB to restore technology Energy from their waste. CFB proved to be more convenient, Moisture content of the waste, making it attractive for implementation in other emerging economies. The levels of dioxin reported from these new plants are Under EU standards. Plants are also able to treat wastewater Sludge and other waste sludge, of which China produces 40 million tons General, once the waste is dried. The current research aims at minimizing the amount of ash caused by burning, fusion Dried ash with MSW to produce more fuel for the plant. There are currently 28 CFB WTE plants in China, the largest It was built in 2012 and handles 800 tons of waste per day [10].

Germany has declared that it is free of garbage after If there is a big treasure in it has reached the volume of profits 100 billion dollars a year, Germany imports imported garbage from neighboring countries, Germany either recycled to be primary materials or burning garbage in places equipped and closed and generate energy from them [11].

MSWM is one of the most important health and environmental problems facing the authorities in the Arabian Gulf. Recent studies have been conducted on the current solid waste management (SWM) in Qatar and a focused study to provide a review of the total amount of municipal solid waste produced, stored, collected and disposed of as well as waste components.

The analysis showed that Qatar produced about 2,000,000 tons of municipal solid waste per year, equivalent to a daily production of 2.5 kg per capita. About 60% of the local solid waste is organic, and landfill and composting are the best way to get rid of the country.

Umm Al-Afi mill has an area of about 80% of solid waste. Due to increased migration in Qatar, there is a sharp rise in volume as well as in a variety of solid waste. It is important to reduce societal concerns about increased resource consumption and waste production; thus, policy makers have encouraged recycling and reuse of strategies to reduce demand for raw materials and reduce the amount of waste destined for the landfill. An example of the usefulness of mechanical recycling of plastic materials is presented. Recycling is the preferred solution for waste plastic management because it is less environmentally friendly compared to converting it as fertilizer and its use in the soil. The United Arab Emirates produces about 15 thousand tons daily and Kuwait produces about 12 thousand tons daily, The richest countries in the Arab region [12].

For Palestine, it is more complicated than other countries because of the lack of material resources and the lack of awareness among the majority of citizens about the danger of this issue and the existence of occupation and the division of existing areas of areas and each area is under the control of one of the parties either the Palestinian Authority or the occupation and not to act independently. In addition to the high cost of separation, collection and processing of incoming, as well as prefer to use raw materials in order to conduct waste management there must be standards and statistics to assess the situation. There should be laws to deter violators and provide the competent authorities with the application of penalties.

The household sector in the West Bank produces about 1.387 million tons / year of waste, equivalent to 4% annually, 1% annually, and the economic sector produces about 2527.5 tons per day. But there are existing policies to deal with waste, including the Oslo Accords, which provided for an agreement indicating that there would be transfer of powers and environmental responsibilities to PA in the field of environment, including licensing of handicrafts, industry, and solid Wastes, including hazardous wastes. However, this transfer is restricted to Areas A and B,

and does not Including Area C where the transfer of powers takes place only after their final agreement the two parties.

Most of the West Bank is Area C, and therefore the sites of any waste plant are subject to waste Of Israeli regulations and approvals, the standards that must be applied by Palestinians and Israelis are in accordance with recognized international standards [13].

Article 23 of the Palestinian Law 23 (2003) provides for the right of the Palestinian environment to clean up, the importance of sustainable development and the importance of maintaining environmental protection in the present and future. The Palestinian Environmental Law No. 24 provides the general legal framework for the management of solid waste in Palestine [14].

There are institutions responsible for solid waste management including:

- 1. **Ministry of Local Government (MOLG)**: The Ministry plays a role of monitoring and inspection at the local level
- 2. **Ministry of Planning**: Ensure the management of solid waste between national development Plans.
- 3. Environmental Quality Authority (EQA): Develop national plans and strategies for solid waste management, Specification of solid waste dumps and identification of hazardous waste regulations.
- 4. **Ministry of Health (MOH):** The Ministry is licensed to build solid waste Management facilities such as landfills. They also have the role of applying public health standards Solid waste management activities. According to the Public Health Act, the Ministry has a role Issuance of conditions relating to the transportation, storage, treatment and disposal of hazardous wastes. That is contrary to the role of EQA in this regard because environmental law gives EQA the same Job.
- 5. Palestinian Institute of Standards (PSI): PSI has the role of developing and approving national Standards or implementation of international standards. Criteria for solid waste management PCBS: The PCBS is a PC Of national figures. Solid waste management is one of the areas addressed by the Palestinian Central Bureau of Statistics, since it has Conduct periodic surveys on household environmental surveys and eco-economic surveys

(Including industrial installations), and environmental surveys Solid waste is the main issue.

 Local authorities: They have the responsibility to manage wastes within their jurisdiction, in terms of conditions from collection, transport, transportation and final disposal The Local Authorities Act is responsible for the collection, transportation and disposal of solid waste [15].

The absence of oil in the territory of the West Bank is a problem that requires us to search for the other source to generate energy in addition to the existence of occupation and lack of political independence caused another dilemma, it is a long period of use of solar baths, a useful and useful way because of the period of radiation has been proposed using solar cells as well, which Used in power generation, they are also useful, but the ideal and renewable idea is to use waste to produce energy [16,17].

2. Literature Review

This chapter provides background information on the technologies used to address waste, namely incineration, conventional gasification, Landfill with Gas Capture and pyrolysis.

2.1.1 Incineration

Is one of the oldest methods used in the treatment of waste, all of which shows the method of burning solid waste in an environment rich in oxygen directly, Combustion of MSW is the complete oxidation of the combustible materials contained in the solid waste fuel, and the process is highly exothermic. During combustion of solid waste, several complex processes happen simultaneously. consisting of several types of incinerators such as single stage, two stage, grate and fluidized bed incinerators [18,19,20]. ordinarily at temperatures between 700°C and 1,350°C. In this process an exhaust gas is produced consisting mainly of carbon dioxide and water, which flows through a boiler to produce steam to drive a steam turbine generator, producing electricity. Inorganic materials are converted to bottom ash and fly ash in the MSW. These byproducts must be disposed in controlled landfills to prevent water pollution. It is important to note that the bottom

and fly ashes that are formed by the inorganic constitutes of the waste affects the energy balance through its mean heat capacity, even though it is not particularly participated in the combustion process. Depending on the bottom ash treatment options, ferrous and non-ferrous metals can also be recovered and the remaining ash can be further enhanced to be used for road construction and buildings. however, incineration does not eliminate the need for landfills, it reduces the amount that is sent to the landfill by 90% by volume [21]. Over 90% in Europe use incineration technology which treating approximately 750,000 ton per year [22]. Typical systems in North America treat up to 3,000 tons/day of MSW, producing about 605 kWh/ton of MSW [23].



Figure 2: illuminates an example of a single stage incinerator [24].

2.1.2 Conventional Gasification

This operation has also been used since ancient times, but it was mainly only used for coal gasification. It is in recent years that this technology has been developed for MSW gasification .in this process a synthetic gas (syngas) is produced from heating of MSW with a controlled amount of air or oxygen. ordinarily at temperatures between760 to 1,500°C [25]. The syngas is processed to remove and water vapor and other contaminants before using it to generate power generation or heating. The largest MSW gasification plant is in Kawaguchi, Japan, processing 400 tons/day of MSW using three gasifier chains [26].



Figure 3:gasifier plant [27].

2.1.3 Pyrolysis

Pyrolysis Is the pyrolysis of raw materials at a range of temperatures from 650 to 1,200°C in the absence of oxygen [28]. The products can vary from solids, liquids, to gas(syngas) depends on the temperature of the system. The syngas can be used directly as boiler fuel for higher quality uses such as engine fuels, chemicals, and other products, the remaining solids Is a mixture of non-combustible inorganic materials and carbon. However, the pyrolysis process is very sensitive to the presence of air. Exposure to air may result to increase the risk of explosive reactions, it is possible to use the pyrolysis technology to produce nearly 770 net kWh/ton of MSW [29]. The largest MSW pyrolysis plant in operation is the Toyohashi City facility in Japan, processing a total of 400 tons/day of MSW. Currently, there is no facility in the world produced above 9MW. no formation of dioxins and furans since no oxygen is present in the process.



Figure 4:pyrolysis process [30]

2.1.4 Landfill with Gas Capture

Landfills can be useful, but not in the currently used methods. Methane gas is released from the landfill, which can be used for energy. The decomposed organic matter in the landfill produces 50% methane and 50% carbon dioxide. Methane affects global warming more than a 25 Time of the CO₂. Capturing methane emissions from landfills is not only beneficial for the environment as it helps mitigate climate change, but also for the energy sector and the community [31,32].

Pyrolysis	Gasification	Combustion	
Normally no air	Sub stoichiometric air Exothermic/Endothermic	Excess air Very Exothermic	
Only heat (external or internal)	Lower total volumetric flow	Higher Volumetric flowrate	
Want liquid, gases not desired	Lower fly ash carries over	Fly ash carry over	
Pollutants in reduced from (H ₂ S, Cos)	Pollutants in reduced from (H ₂ S, Cos)	Pollutants in oxidized from (Sox, NOx etc.)	
Higher char	Char at low temperatures Vitrified slag at high	Bottom ash	

Table 2:comparison between pyrolysis, gasification and combustion [33]

2.2 Success Stories of Waste to Energy

it imports waste from neighbors to waste-to-energy program. Sweden largely successful in the recycling of solid waste. Just 4% of household waste in Sweden goes into landfills. The rest are recycled or used to generate energy. Burning the rubbish in the incinerators generates 20 % of Sweden's central heating, it also supplies electricity for a 1/4 of a million homes. Sweden's waste recycling is too successful.

Sweden has recently begun to import about800000 tons of garbage from the rest of Europe per year to use in its power plants. The majority of the imported waste comes from Norway because it's more expensive to burn the garbage there and cheaper for the Norwegians to export their waste to Sweden. Norway pays Sweden to take the waste off their hands and Sweden also gets heat and electricity.

With technological development at a rapid pace, it is not surprising that waste disposal waste can now be used to manufacture electricity. Major concerns for developing countries, including waste disposal and power generation, can now be combined with the invention of this new technology. This will have two advantages: it can help us to take advantage of the huge space occupied by rubbish disposal in productive land use and secondly reduce our reliance on non-renewable energy sources. Engineering involves the operation of 1000 tons of solid waste and other waste disposal to generate approximately 60 megawatts of electricity and 40 megawatt hours of steam [34].

2.3 Recycling of waste to generate electricity

We are all familiar with the "Minimize, Reuse and Recycle" exhortation, but we add an additional R system called Recovery. Yes, this involves having to do with previous reduction, recycle and reuse we can progress to recover the energy from this waste. The operation involves the dumping of garbage by the truck in the Holocaust. Waste can be heated to convert stored chemical energy into useful electrical energy. The metals are separated by this process and thus ensure the recycling of 400,000 tons of minerals each year. The restoration of electricity through this process ensures that we reduce our emissions of methane. Although this process releases carbon dioxide, it is less effective than the methane that is produced when rubbish is disposed of in the landfill.

2.4 Waste to energy process

The basic principle of electricity generation involves the use of thermal energy to generate electricity. Municipal solid waste can be burned, for thermal power generation. Thermal energy can be used to convert water into boilers to pure vapor. Steam can then be used to convert turbines. The turbine connected to the generator is eventually used to produce electricity. Steam produced during combustion of waste can be condensed into water in the boiler. The secondary product produced during the waste burning process includes ash, which represents approximately 10% of the original waste mass.

But there are concerns about the release of harmful toxic gases into the atmosphere during solid waste combustion. But because of the straight rules that the authorities have committed to the concern, there are no significant emissions of toxic gases or heavy metals in the surrounding area during the process. the recycling of metals that can be severely affected by the introduction of this technology. This problem can be solved by separating the metal before process it. Magnetic and non-magnetic materials can also be separated from ash residues, which are produced as a byproduct.

Waste to energy is a good approach because it will promote many local areas to draw inspiration from this project and take individual initiatives to build a waste plant into its own large to small capacity. This will reduce reliance on non-renewable fossil fuels for electricity generation, while at the same time helping to create an alternative to more efficient waste disposal [35].



Figure 5: illuminates how to convert waste to energy [36].



Figure 6: illuminates waste to energy process [37]

2.5 Likert scale

The Likert scale was used in this project. the purpose of the Likert scale is to understand about the opinions or perceptions of participants related with single variable (phenomenon of interest). This variable is expressed by several manifested (present) items in the questionnaire [38].

The analytical treatment and interpretation with Likert scale largely depends upon these diversities. -Symmetric versus asymmetric Likert scale- If the position of neutrality (don't know) lies exactly in between two extremes of strongly disagree. to strongly agree, it provides independence to a participant to choose any response in a balanced and symmetric way in either direction. This construction is known as symmetric scale. On the other hand, asymmetric Likert scale offer less choices on one side of neutrality (average) as compared to other side. [39]

Likert scales may meet your needs when you have attitude, belief, or behavior items. For example, you would not use a Likert scale to assess attributes, such as age, race, and income, but you may use a Likert scale to assess someone's attitude about a particular topic [40,41].

2.6 Scope

University students was assumed as the population of this study. In order to assess the knowledge and awareness of Palestinian community, AL-Najah National University was considered as the study sample. Online survey was developed using google online questionnaires. The questionnaire was distributed on social media. About 385 surveys were distributed according to the table below

	Confidence level=95%			C	onfidence level	=99%
	Margin of error			Margin of error		
Population size	5%	2.5%	1%	5%	2.5%	1%
100	80	94	99	87	96	99
500	217	377	475	285	421	485
1000	278	606	906	399	727	943
10000	370	1.332	4.899	622	2.098	6.239
100000	383	1.513	8.762	659	2.585	14.227
500000	384	1.532	9.423	663	2.640	16.055
1000000	384	1.534	9.512	663	16.317	2.647

Table 3: illuminates how to choose a sample size [42]

2.6.1 Sample size

Sample size varies as function of the confidence level and the margin of error. Equation 1 [43] was used to calculate the sample size:

$$n = \frac{\left(\frac{z}{d}\right)^2 * 0.5^2}{\left(1 + \left(\frac{1}{n}\right)\right) * \left(\left(\frac{z}{d}\right)^2 * 0.5^2 - 1\right)}$$

In Equation 1, N is the population size (385), Z is the standardized from of normal distribution equivalent to $p \ge 95\%$ level of confidence, and d is the predefined acceptable error (0.05).

2.7 Minitab program

Minitab is a software product that helps you to analyze the data. It provides a simple, effective way to input the statistical data, manipulate that data, identify trends and patterns, and then extrapolate answers to the current issues. Minitab helps companies and institutions to spot trends, solve problems and discover valuable insights in data by delivering a comprehensive and best-inclass suite of machine learning, statistical analysis and process improvement tools. Combined with unparalleled ease-of-use, Minitab makes it simpler than ever to get deep insights from data [44].

3. Methodology

We have started this project with a simple explanation of Waste to Energy as a definition and methods of dealing with it common in most countries, especially in Palestine, and was also mentioned by a simple awareness of the awareness and understanding of the level of consciousness in the societies to know the correct ways to solve this matter, finally a simplified explanation about survey designed and lakert scale. After that, we determined the number of people to be dealt with. The census was a sample of the student An-Najah National University for designing the questions and we designed the form based on the elementary sample to verify the validity of the questions, and then we distributed 50 forms and then we took the results and analyzed them. We have

modified the form and change and added some questions to solve the problem of the work and we specified the size of the sample, of course, considering (95%Confidence level ,5%Margin error and 20%responce rate) and the distribution of the Questionnaire online. Finally collected the data and the process of cleaning the data, hypothesis, design to know the relations between the questions and answers to them then do a comprehensive statistical analysis.

4. Discussion and Results

Awareness, knowledge of the community towards solid waste management, the questionnaire survey used 108 respondents from Faculty of Engineering ,37 respondents from Faculty of Management and Economics, 22 respondents from Faculty of Law, Arts and Public Relations, 23 respondents from Faculty of Medicine and Health Sciences, and 34 respondents from Faculty of Science and Information Technology.

The chi-square test provides a method for testing the association between the row and column variables in a two-way table. The null hypothesis H_0 assumes that there is no association between the variables (in other words, one variable does not vary according to the other variable), while the alternative hypothesis H_a claims that some association does exist. The alternative hypothesis does not specify the type of association, so close attention to the data is required to interpret the information provided by the test.

Age Vs. Q ₂₁	p-value=0.008 < 0.05

There is a relation between Age and establishing the plant next to the communities is a viable idea. Because of p-value =0.008 which is smaller than 0.05 due to this relation we reject H_0 and accept H_a .

Specialization Vs. Q1	p-value=0.169 >0.05
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There is no relation between Specialization and if the Household waste can be classified as solid waste. Because of p-value =0.179 which is bigger than 0.05 due to this relation we accepted H_0 and reject H_a .

Table 4: results based on p-value

Hypotheses	If there is a relation or not according to p-value
Specialization Vs. Q ₁	Due to p-value=0.169 there's no relation between specialization and do you think Household waste can be classified as solid waste.
Educational level Vs. Q1	Due to p-value=0.342 there's no relation between educational level and If the Household waste can be classified as solid waste.
Educational level Vs. Q ^v	Due to p-value=0.047 there's a relation between educational level and if the Industrial waste can be classified as solid waste
Specialization Vs. Qr	Due to p-value=0.898 there's no relation between specialization and if the Industrial waste can be classified as solid waste
Specialization Vs. Qr	Due to p-value=0.834 there's no relation between specialization and if the amount of solid waste commensurate with the population
Educational level Vs. Qr	Due to p-value=0.053 there's no relation between educational level and if the amount of solid waste commensurate with the population
Specialization Vs. Q	Due to p-value=0.034 there's a relation between specialization and if the amount of solid waste commensurate with the population

Educational level Vs. Q ⁱ	Due to p-value=0.581 there's no relation between educational level and if the amount of solid waste commensurate with the population
Specialization Vs. Q.	Due to p-value=0.975 there's no relation between specialization and if the amount of solid waste is commensurate with the standard of living
Educational level Vs. Q°	Due to p-value=0.852 there's no relation between educational level and if the amount of solid waste is commensurate with the standard of living
Specialization Vs. Q	Due to p-value=0.572 there's no relation between specialization and if the Traditional methods (landfill and / or incineration) for disposal of solid waste have an impact on environmental pollution.
Educational level Vs. Q1	Due to p-value=0.2 there's no relation between educational level and if the Traditional methods (landfill and / or incineration) for disposal of solid waste have an impact on environmental pollution.
Specialization Vs. Qv	Due to p-value=0.469 there's no relation between specialization and if the Conventional methods (landfill and / or incineration) for the disposal of solid waste have an impact on air pollution.
Educational level Vs. Q ^v	Due to p-value=0.530 there's no relation between educational level and if the Conventional methods (landfill and / or incineration) for the disposal of solid waste have an impact on air pollution.
Specialization Vs. QA	Due to p-value=0.842 there's no relation between specialization and if the Conventional methods (landfill and / or incineration) for disposal of solid waste have an impact on increasing the impact of global warming.
Educational level Vs. Q [^]	Due to p-value=0.551 there's no relation between educational level and if the Conventional methods (landfill and / or incineration) for disposal of solid waste have an impact on increasing the impact of global warming.

Specialization Vs. Qa	Due to p-value=0.411 there's no relation between specialization and if the process of converting waste to energy is economically feasible
Educational level Vs. Q1	Due to p-value=0.670 there's no relation between educational level and if the process of converting waste to energy is economically feasible
Specialization Vs. Q1.	Due to p-value=0.148 there's no relation between specialization and If The process of converting waste into energy is healthy and environmentally feasible.
Educational level Vs. Q1.	Due to p-value=0.054 there's no relation between educational level and If The process of converting waste into energy is healthy and environmentally feasible.
Specialization Vs. Q11	Due to p-value=0.066 there's no relation between specialization and If we applying the idea of converting waste to energy, it will reduce the volume of waste generated by 30% below the original size
Educational level Vs. Q1v	Due to p-value=0.955 there's no relation between educational level and If we applying the idea of converting waste to energy, it will reduce the volume of waste generated by 30% below the original size
Specialization Vs. Q ₁ ^y	Due to p-value=0.395 there's no relation between specialization and the rate of production of your household of solid waste per day is almost 1-3 kg
Educational level Vs. Q1 ^y	Due to p-value=0.935 there's no relation between educational level and the rate of production of your household of solid waste per day is almost 1-3 kg
Specialization Vs. Q ₁ r	Due to p-value=0.957 there's no relation between specialization and the most household solid waste consists of organic matter (food residues)
Educational level Vs. Q1r	Due to p-value=0.450 there's no relation between educational level and the most household solid waste consists of organic matter (food residues)

Specialization Vs. Q11	Due to p-value=0.460 there's no relation between specialization and if the burning is one of the most commonly used methods of solid waste disposal
Educational level Vs. Q1:	Due to p-value=0.130 there's no relation between educational level and if the burning is one of the most commonly used methods of solid waste disposal
Specialization Vs. Q1°	Due to p-value=0.808 there's no relation between specialization and if recycling is the best way to get rid of household solid waste
Educational level Vs. Q1°	Due to p-value=0.873 there's no relation between educational level and if recycling is the best way to get rid of household solid waste
Specialization Vs. Q ₁ ,	Due to p-value=0.581 there's no relation between specialization and if we can recycle household solid waste by 100%
Educational level Vs. Q17	Due to p-value=0.531 there's no relation between educational level and if we can recycle household solid waste by 100%
Specialization Vs. $Q_{1^{\vee}}$	Due to p-value=0.556 there's no relation between specialization and if the strategy of recycling household solid waste is economically feasible
Educational level Vs. $Q_{1^{\vee}}$	Due to p-value=0.065there's no relation between educational level and if the strategy of recycling household solid waste is economically feasible.
Specialization Vs. Q ₁ ^A	Due to p-value=0.424 there's no relation between specialization and if the thermal and / or electrical energy can be produced from household solid waste
Educational level Vs. Q1A	Due to p-value=0.424 there's no relation between educational level and if the thermal and / or electrical energy can be produced from household solid waste
Specialization Vs. Q19	Due to p-value=0.086 there's no relation between specialization and if the rural areas are the best place to establish a plant to convert waste into energy economically

Educational level Vs. Q19	Due to p-value=0.267 there's no relation between educational level and if the rural areas are the best place to establish a plant to convert waste into energy economically
Age Vs. Q19	Due to p-value=0.077 there's no relation between age and if the rural areas are the best place to establish a plant to convert waste into energy economically
Gender Vs. Q ₁₃	Due to p-value=0.391 there's no relation between gender and if the rural areas are the best place to establish a plant to convert waste into energy economically
Specialization Vs. Qv.	Due to p-value=0.654 there's no relation between specialization and if the Rural areas are the best place to set up a plant to convert waste into energy from a health and environmental perspective
Educational level Vs. Qr.	Due to p-value=0.123 there's no relation between educational level and if the Rural areas are the best place to set up a plant to convert waste into energy from a health and environmental perspective
Gender Vs. Qv.	Due to p-value=0.483 there's no relation between gender and if the Rural areas are the best place to set up a plant to convert waste into energy from a health and environmental perspective
Age Vs. Qr.	Due to p-value=0.153 there's no relation between age specialization and if the Rural areas are the best place to set up a plant to convert waste into energy from a health and environmental perspective
Specialization Vs. Qr	Due to p-value=0.496 there's no relation between specialization and if establishing this station next to the communities is a viable idea
Educational level Vs. Qry	Due to p-value=0.957 there's no relation between educational level and if establishing this station next to the communities is a viable idea

Gender Vs. Qv1	Due to p-value=0.743 there's no relation between gender and if establishing this station next to the communities is a viable idea
Age Vs. Qr1	Due to p-value=0.008 there's a relation between age and if establishing this station next to the communities is a viable idea

Pearson correlation coefficient

The Pearson product-moment correlation coefficient (PPMCC) or the bivariate correlation is a measure of the linear correlation between two variables X and Y. According to the Cauchy–Schwarz inequality it has a value between +1 and -1, where 1 is total positive linear correlation, 0 is no linear correlation, and -1 is total negative linear correlation.

Table 5:Statistical analysis based on Pearson

Question number	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Educational level	0.06372	0.1328	0.12946	0.03712	0.01254	0.08585	0.04222
Specialization	0.09232	-0.0087	0.01404	0.14172	-0.0021	-0.038	0.04863

Question number	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Educational level	-0.04	0.0286	-0.1288	-0.0038	0.00552	0.05075	-0.1016
Specialization	0.01337	-0.0552	-0.097	-0.123	-0.0571	0.0036	0.04959

Question number	Q15	Q16	Q17	Q18	Q19	Q20	Q21
Educational level	-0.0107	0.04208	0.12343	-0.0526	0.07445	0.1033	0.00365
Specialization	-0.0164	-0.0434	0.03957	0.05366	0.11494	0.03011	0.04569
Gender					0.05759	0.04714	-0.022
Age					-0.1184	-0.0957	-0.1761

We have noticed from the above table that the relationship between the fourth question and the educational level is that no linear correlation.





This curve shows the relation between Educational level and questions.

Table 7:relation between Specialization and questions



This curve shows the relation between Specialization and questions.

The findings of the survey showed that the percentage of lack of awareness in the community is high

5. Conclusion

There are wide variations in the size of solid waste management problems among cities with similar income levels. A well-managed, middle-income or low-income city may differ significantly from a similar city with urban management of small villages. The analysis of waste flow, material balance assessment and life cycle assessment may be useful in the sustainable management of landfills. Sustainable waste management may not be possible in the absence of full understanding and enhancement of the required capacities, along with financial support. Efforts should also be made to break the link between prosperity and waste generation.

In conclusion giving social duty awareness along with waste management awareness may improve the practice of waste management. Awareness program of waste management is greatly needed for parents also. This can be given in the university during parent teacher meetings or in community based programs.

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To our friends, all the doctors who helped us in our educational journey,

Our husbands specially" Diaa Braik"

To the beautiful girl "Rawan tayeh"

We dedicate this second graduation project

7. Recommendations for future work

Because of the above results, we would like to offer a course at the university to increase student awareness about waste to energy, do awareness campaigns to raise awareness about waste to energy technologies. Government and every individuals of country should take Active step to protect our environment.

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9. Appendices



جامعة النجاح الوطنية، كلية الهندسة وتكنولوجيا المعلومات، تخصص هندسة الطاقة

السلام عليكم ورحمة الله، بين أيديكم هذه الاستبانة والتي نود أن نتعرف من خلال إجاباتكم عن أمكانية إعادة تدوير النفايات الصلبة ومدى فائدتها إقتصادياً وصحياً وبيئياً، فأرجوا لكم الإجابة عن الأسئلة التي وردت في هذه الاستبانة وذلك بوضع علامة (/) أمام ما ترونه مناسباً مع العلم بأنها ستوظف لأغراض مشروع التخرج فقط. ولكم كل الشكر والتقدير

> الجنس: O ذكر O أنثى العمر: O أقل من ٢٠ O من ٢٠ - ٢٧ ٢٥ ٢٩ مما فوق المستوى التعليمي:O دبلوم فما دون O بكالوريوس O دراسات عليا مجال التخصص: O إدارة واقتصاد O هندسة O طب، وعلوم صحية O قانون وفنون وإعلام O علوم وتكنولوجيا المعلومات

	صلبة	النفايات المنزلية كنفايات	۱. یمکن تصنیف
0 معارض 🕥 معارض بشدة	0 محايد	O موافق	0موافق بشدة
	ت صلبة	النفايات الصناعية كنفاياه	۲. يمكن تصنيف
0 معارض 🕥 معارض بشدة	0 محايد	O موافق	O موافق بشدة
	ن صلبة	النفايات الزراعية كنفايان	٣. يمكن تصنيف
0 معارض 🔿 معارض بشدة	0 محايد	O موافق	O موافق بشدة
	سكان طردياً	لنفايات الصلبة مع عدد ال	٤. تتناسب كمية ا
0 معارض 🔿 معارض بشدة	0 محايد	O موافق	O موافق بشدة
	ى المعيشة طردياً	لنفايات الصلبة مع مستوي	 ٥. تتناسب كمية ا
0 معارض 🛛 معارض بشدة	0 محايد	O موافق	O موافق بشدة
النفايات الصلبة لها أثر في تلويث مياه	لحرق) للتخلص من	ة (الطمر الصحي و/ أو ا	 ٦. الطرق التقليدي البيئة
0 معارض 🔿 معارض بشدة	0 محايد	O موافق	O موافق بشدة
النفايات الصلبة لها أثر في تلويث الهواء	الحرق) للتخلص من	ة (الطمر الصحي و/ أو ا	 ۷. الطرق التقليدي الجوي
0 معارض 🛛 معارض بشدة	0 محايد	O موافق	O موافق بشدة
النفايات الصلبة لها أثر في زيادة تأثير	الحرق) للتخلص من	ة (الطمر الصحي و/ أو ا _اري	 ٨. الطرق التقليدي الاحتباس الحر
0 معارض 🛛 معارض بشدة	0 محايد	O موافق	O موافق بشدة
	اقتصاديا	النفايات إلى طاقة مجدية ا	٩. عملية تحويل ا
0 معارض 🕥 معارض بشدة	0 محايد	O موافق	O موافق بشدة
	ة صحياً وبيئياً	، النفايات إلى طاقة مجدياً	١٠. عملية تحويل

🔾 معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			
جم النفايات الناتجة إلى	وف تساهم في تقليل ح <u>م</u>	بل النفايات إلى طاقة س أصلي	لل تطبيق فكرة تحوي ما دون من الحجم الأ	۱۱. من خا ۳۰% ف			
) معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			
	باً من ۱-۳ کغم	يات الصلبة يومياً تقري	إنتاج أسرتك من النفا	١٢. معدل			
) معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			
	ضوية (بقايا طعام)	لية مكونة من مواد عد	النفايات الصلبة المنز	۱۳. معظم			
O معارض بشدة	0 معارض	0 محايد	0 موافق	O موافق بشدة			
	من النفايات الصلبة	بتخدمة محليأ للتخلص	من أكثر الطرق المس	١٤. الحرق			
O معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			
	فايات الصلبة المنزلية	الأمثل للتخلص من النف	التدوير هي الطريقة ا	١٥. إعادة			
O معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			
	ية ١٠٠%	ت الصلبة المنزلية بنس	ع إعادة تدوير النفايان	١٦. تستطير			
O معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			
	إقتصادياً	صلبة المنزلية مُجدية	جية تدوير النفايات ال	۱۷. إستراتي			
O معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			
	ات الصلبة المنزلية	, أو كهربائية من النفايا	تاج طاقة حرارية و/	۱۸ ـ یمکن ان			
O معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			
١٩. المناطق الريفية هي أفضل مكان لإقامة محطة لتحويل النفايات إلى طاقة من الناحية الاقتصادية							
0 معارض بشدة	0 معارض	0 محايد	O موافق	O موافق بشدة			

٢٠. المناطق الريفية هي أفضل مكان لإقامة محطة لتحويل النفايات إلى طاقة من الناحية الصحية والبيئية

O موافق بشدة O موافق O محايد O معارض O معارض O معارض بشدة ٢١. إقامة مثل هذه المحطة بجانب التجمعات السكانية فكرة قابلة للتطبيق

O موافق بشدة O موافق O محايد O معارض O معارض ف

نتائج الإستبيان















































