An-Najah National University

Faculty of Graduate Studies

Estimation of Household Electrical and Electronic Waste Generation And its Management Scenarios in Nablus city during 2017

By

Tasneem Nehad Abu-Hijleh

Supervisor

Dr. Hamzeh Al Zabadi

This Thesis is Submitted in partial Fulfillment of the Requirements for The Degree of Master of Public Health, Faculty of Graduate Studies, An-Najah National University, Nablus-Palestine.

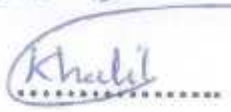
2018

Estimation of Household Electrical and Electronic Waste Generation And its Management Scenarios in Nablus city during 2017

By

Tasneem Nehad Abuhijleh

This thesis was defended successfully on 18 / 7 /2018 and approved by:

Defense Committee Members	signature
- Dr. Hamzeh Alzabadi / Supervisor	
- Prof. Khalil Thabayneh / External Examiner	
- Dr. Abdalsalam Alkhayat / Internal Examiner	

Dedication

This thesis dedicated to:

The soul of my grandmother Roqaia may GOD let her rest in peace

My beloved parents Tamam and Nehad and to my parents in-law,

To my darling husband Ahmad,

To my precious brothers Naeem, Yahia, Naseem and Issam,

And most of all to my lovely sons Saifaldein and Mohammed whose smiles helped as my motivation through my hard times,

To all the people in my life who touch my heart,

I dedicate this dissertation

With all respect

Tasneem Nehad AbuHijleh

Acknowledgment

First and foremost, I praise God, the almighty for providing me this opportunity and granting me the capability to proceed successfully. Thank you God

I would like to express great thanks and sincere gratitude to my supervisor **Dr. Hamzeh Al Zabadi** for his guidance, suggestions and assistance during preparing this thesis.

Acknowledgments for all my teachers in the Public Health department at the University of An-Najah for teaching me Public Health.

الإقرار

أنا الموقعة أدناه مقدمة الرسالة التي تحمل العنوان:

Estimation of Household Electrical and Electronic Waste Generation And its Management Scenarios in Nablus city, 2017

أقر بأن ما اشتملت عليه هذه الرسالة أنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة اليه حيثما ورد، وأن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researchers own work, and has not been submitted elsewhere for any other degree or qualification.

Students name: **اسم الطالبة:**

Signature: **التوقيع:**

Date: **التاريخ:**

Table of Content

List of Tables

List of Figures

List of Appendixes

List of Abbreviations

CEDARE	Centre for Environment and Development for the Arab Region and Europe
EEE	Electrical and Electronic Equipment
e-waste	Electronic waste
EMPA	the Swiss Federal Laboratories for Materials Science and Technology
MSW	Municipal Solid Waste
NIS	New Israeli Shekel
OPT	Occupied Palestinian Territory
StEP	Solving the E-waste Problem (an international initiative, created to develop solutions to address issues associated with Waste Electrical and Electronic Equipment WEEE)
SWM	Solid Waste Management
USA	United States of America
UNIDO	, nited Nations Industrial Development Organization
UNU	United Nations University
US EPA	United States Environmental Protection Agency
WEEE	Waste Electrical and Electronic Equipment

Estimation of Household Electrical and Electronic Waste Generation And its Management Scenarios in Nablus city, 2017

By

Tasneem Nehad Abu-Hijleh

Supervisor

Dr. Hamzeh Al Zabadi

Abstract

Background

The development of new technologies and the increasing consumption of electronic and electrical equipment have led to increased amounts of generated e-waste.

This waste due to the presence of hazardous substances in its composition needs specific attention and management. The necessary regulations regarding e-waste are not yet in place. Therefore, a reliable estimation of e-waste generation is crucial to policymakers. Considering the limited available data, this study estimates the household e-waste generation during 2017 in Nablus city –Palestine , namely washing machines, refrigerators, air conditioners, lab tops/tablets, mobiles ,screens both CRT and LCD/LED, and TV's both CRT and LCD/LED. Also the current status of household e-waste management and citizen's awareness and behaviors toward e-waste has been investigated.

Materials and methods

This study is a questionnaier based study were 400 households in Nablus city have been assessed in terms of in use EEE, stored EEE and generated EEE (e-waste).

The sample size of 400 have been calculated depending on the number of housing units in the city 35,864 (PCBS, 2017) with confidence level 95% .The questionnaires distributed on 40 blocks 10 for each to ensure total coverage of the city. Then the questionnaires results has been analyzed and popularized on Nablus city households.

Results

Nablus city generated about 265.22 tons of E-waste during the year 2017. The average amount of E-waste produced per capita is 1.69 kg/capita. Over a span of 5 years, from 2017to 2022, a total of 2537.4 tons of the currently in use EEE will reach its end of life.

Nearly 64% of the household generated e-waste goes to scrap and second hand dealers, the rest is thrown in the streets or disposed with MSW and near 9% of the unwanted EEE goes for donation.

The most welcomed management method for the study participant was creating special places for e-waste dumping and developing the work of scrap dealer

Conclusions and recommendations

To conclude, the amount generated e.waste from Nablus city households during 2017is 265.2tons (1.69 kg/capita) , 64.22% of it goes to scrap dealer and second hand dealers, so it is worthy for researchers to conduct further investigations on the fate of e-waste after being in those dealers hands.

On the other hand 18.95% of it discarded with MSW and 7.37% thrown in streets, these two behaviors are related to hazardous materials reaching directly to the environment, and here the need for awareness campaign arises to warn the citizens about the danger behind this kind of behaviors.

Chapter one
Introduction

1.1 Background

e-waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention of re-use. (StEP, 2014)

Stored EEE could also considered as e-waste especially if it has reached its end of life according to Organization for Economic Co-operation and Development (OECD) definition as "any appliance using an electric power supply that has reached its end-of-life."

The Palestinian Environmental Law of 1999 did not address, in any of its clauses, a definition for the e-waste and did not mention the process of generation, treatment or management of hazardous wastes except in a marginal form and in the context of its intent to manage solid waste in general.

It is estimated that the total amount of e-waste generated in 2014 was 41.8 million metric tons. It is forecasted to increase to 50 million metric tons in 2018 (Balde, Wang, Kuehr, & Huisman, 2015)

Of those tons of electronic wastes only 13% is recycled mostly in developing countries (UNEP, 2009).

Another studies claimed that the amount of e-waste is expected to increase to 52.2 million metric tons by 2021 with 6.8 kg /capita. An annual growth rate of 3 to 4 percent is expected. In terms of both more sustainable

approaches and recovered value, there is a clearly defined hierarchy that can be applied when treating WEEE and this include (refurbish and re-use, repurpose, recover and reuse functional modules, recover and reuse components, recover materials, produce raw material feed stocks and recover energy) (Hester & Harrison, 2009)

While the health implications of e-waste are difficult to isolate due to the informal working conditions, poverty, and poor sanitation, several studies in Guiyu, a city in southeastern China, offer insight. Guiyu is known as the largest e-waste recycling site in the world, and the city's resident's exhibit substantial digestive, neurological, respiratory, and bone problems, studies showed that 80% of Guiyu's children experience respiratory ailments, and are especially at risk of lead poisoning (Leung, 2008)

In Palestine, to the best of our knowledge, there are no estimations about the e-waste quantities or ways of disposal. However, there is one study conducted in Idhna town in Hebron showed that this town is the most affected areas by e-waste illegal dumping and trading. The study concluded that Idhna has essentially turned into an electronic graveyard with 200-500 tons of e-waste every day. (TCCR, 2012)

1.2 Significance and rationality of the study

This study answered some questions in the field of solid waste management in Nablus city. To the best of our knowledge, there is no study in Palestine that had the same objectives as this study which makes it original and ingenuous. The study also is quantitative in nature and conclusion as it

estimated the amount of e-waste generated in certain population by studying a representative sample of the population in Nablus city. This study provide a guidance for conducting more assessment studies in the field in whole Palestine.

According to a recently released report, Global e-waste Monitor 2017 (Balde, Forti, Gray, Kuher, & Stegman, 2017) there is only 61 countries comprising of world's 66 percent population have legislations for e-waste management. Of these 61, only 41 countries have official e-waste statistics.

Other researcher emphasize that the route to manage e-waste is through data (Agarwal, 2018) so what we conclude is that, all the remaining countries in the world should form legislation for e-waste which would lead to better data on the generation and processing of e-waste.

Better data will help improve track the amount of e-waste generated, reduce e-waste, promote recycling, and prevent illegal dumping and emissions. It will also help create jobs, set and assess targets and policies, identify best practices. (Agarwal, 2018)

And that is exactly what we are trying to start doing in our study trying to have better data on the generation of e-waste.

1.3 Study Questions

- What is the amount of e-waste generated from Nablus city households during 2017?

- What is the future projections of household discarded EEE?

- What is the amount of stockpiled EEE?

- What is the amount of currently in use EEE?

- What are Nablus citizen behaviors and perspectives regarding e-waste?

- What is the best management solution based on the study results?

1.4 Study Objectives

- General objective:

To estimate the generated e-waste for Nablus city households during 2017 and to assess citizens behaviors and perspectives regarding e-waste.

-Specific objectives:

- To estimate the amount of e-waste generated from Nablus city households during 2017.

- To predict future amount of e-waste generated from Nablus city households

- To assess the awareness and current behavior toward e -waste in Nablus city.

- To investigate possible future management scenarios considering the management practices.

- To provide a method to be suitable when assessing the e-waste in other cities.

Chapter two
Literature review

2.1 Palestine

-Country report on solid waste management (GIZ german ccoperation, 2014). This report mentioned that according to the definition of hazardous waste in the Palestinian environmental Law 1999, e-waste is hazardous waste. Hence, all aspects addressed in the legal and institutional framework of hazardous waste applies to the e-waste. No special articles on e-waste.

The Arab countries has been classified based on their E-Waste management into five categories: level I – low, Level II, Level III, Level IV, Level V – High, where Level I is the least developed and Level V is the most developed with regards to e-waste. The Palestine situation with regards to management of e-waste was not classified during this initial assessment. Utilizing the same classification of CEDARE (Centre for Environment and Development for the Arab Region and Europe) it can be found that Palestine is at level I in all aspects, legal framework, inventory, collection, recycling and reuse. Furthermore, it is important to include another item in the evaluation relevant to monitoring and tracking of waste. This is missing in Palestine, even for the items that are collected to be sold and exported.

The country profile published on the Sweep.net (sweep.net, 2011) addressed that the municipal solid waste (MSW) generation in Palestinian territory was estimated to be around 1.387 million ton/yr. in 2012, the profile mentioned estimations for medical waste generation, industrial waste gen-

eration, Hazardous waste generation and agricultural waste generation. BUT no estimation for e-waste generation in Palestine although it has been reported for Tunisia 90.000 ton/yr., Morocco 30,300 ton/yr. and Jordan 30,000 piece/year.

-On Al-Quds TV a reportage under the title of “electronic waste، Hidden threat to humans and the environment" (AlqudsTV, 2011)، the journalist highlighted the e-waste problem in Palestine، he interviewed the head of the solid waste department in Ramallah municipality who confirmed that e-waste despite its danger it's been handled as the ordinary waste in Ramallah dump. The journalist comments that environmental quality authority and the municipalities did not monitor this problem because there is no statistical measures for it and because it is mixed with other kinds of waste.

-Press report on Wattan News agency under the title of “the household electronic waste in dumpster without processing" (Wattan, 2012)، mentioned the sources of danger in this kind of waste and demanded for formal and popular actions and stressed that the educational dimension about the consumption patterns that generate such large amounts of waste is the most important at the long term .

-The impacts of electronic waste disposal on the environment and public health in the occupied Palestinian territory: a case study from Idhna, Hebron Governorate (ARIJ, 2014). One of the a live hazardous consequences is Idhna town in Hebron, in this town burning of the e-waste make an environmental crisis, most of those e-wastes came from Israel it includes old

military equipment such as tanks and jeeps which are concealed upon entry into the West Bank and while contained in the workshops .

-The assessment report on sustainable consumption and production policies in Palestine (EQA, 2015) this report mentioned that private sector has minimal participation in sol-id waste collection and has no participation yet in disposal facilities. It is mainly active in transfer and transport of solid waste in some areas in the west Bank, such as Nablus and recycling of special streams such as construction and demolition waste in Gaza strip, recycling of e-waste illegally imported from Israel, few companies with small size active in recycling of plastic.

-A project to promote sustainable growth in Palestine through an environmentally safe, innovative and economically valuable treatment of WEEE implemented by three partners; North Hebron Chamber of Commerce NHCCI (as the main applicant), Green Land Society for Health Development GLSHD and Cesvi. It is funded by the EU with 1,622,452.60 euro. The project started since 1/3/2017, and will be finalized with the end of February 2020. The expected outputs of the project are:

1- A WEEE treatment factory as a center for the pre-treatment of WEEE is created and managed by a formalized entity set up by informal and formal recyclers.

2- The awareness and skills of strategic private actors on inclusive economy and green entrepreneurship of WEEE value chain is raised.

3- The behavior of the population concerning dangers and risks of uncontrolled WEEE treatment is changed.

2.2 48 lands and Jordan

- Article in the Jerusalem post "Special Needs Workers Open e-waste Recycling Spot" (Udasin, 2013)the report showed that, in Israel 5% of household waste is e-waste.

- "Households Awareness، Behaviors، and Willingness to Participate in E-waste Management in Jordan" (Tarawneh & Saidan, 2013)

This research finding showed that a significant percentage of the responding sample has poor awareness and knowledge about the e-waste. However, more than 50% of the responding sample was aware about the importance of recovering of e-waste precious components. The prevailing public opinion (more than 90%) showed enthusiastic willingness for managing the e-waste. While, the percentages of responses of people who are willing-to-pay to manage the E-waste is relatively low, but it increases with the household income.

-" Estimation of Potential E-waste Generation in Jordan" (Saidan & Tarawneh, 2015)

This paper describes the current and future estimation of e-waste generation in Jordan, namely cell phones, personal computers, TVs, refrigerators, and washing machines. Jordan is estimated to generate about 16,874 tons of e-waste in the year 2015, as compared to the present generation of 15,211

tones, accounting for about 0.7% of all municipal solid wastes dumped in the country. The average amount of e-waste produced per capita indicates it is estimated to grow from 2.38 kg/capita in 2012 to 2.48 kg/capita in 2015.

2.3 Europe

-The e-waste assessment methodology (training and reference manual) (EMPA, 2012) That manual talked about the first step of the three steps approach about e-waste management which has been adopted by several development cooperation projects, those steps are:

1. Performing a country assessment in order to understand the current framework conditions.

2. Developing a structured strategy in a multi-stakeholder approach.

3. Implementing the strategy through a roadmap with assigned responsibilities and a timeframe.

Some countries with available e-waste country assessment studies which have been developed according to the methodology described in that document include (Morocco, South Africa, Colombia, Brazil, Nigeria, Ghana, Kenya and Chile).

-The Global Partnership on Waste Management (GPWM) (UNIDO, 2012)

This plan was established to help in coordinating activities related to e-waste management in the desired countries, they made a seven steps plan to be followed, the founder of this plan put (establishing a national e-waste

strategy including regulations on governmental level) as the first step, inconsistence with my methodology where I put this step as the last step, and their second step (Inventory of the current situation regarding e-waste. The type, quantity, source, existing collection system, existing treatment methods) was my first.

2.4 United states

- U.S. EPA (United States environmental protection agency) study (Santa Clara, 2004). According to this study 40 % of the lead in U.S. landfills is from discarded electrical and electronic products. The majority of this waste consisted of cathode ray tubes (CRT) in televisions and monitors. The lead in CRTs and the lead solder in printed circuit boards can migrate to groundwater and accumulates in the environment.

-The story of stuff project, the story of electronic. (free range studios, 2010)

This YouTube video talked about the extended producer responsibility (EPR) as an ultimate solution for the e-waste problem in our plant.

EPR or producer take back is a product and e-waste management system where manufacturers take the responsibility for the environmentally safe management of their products when it is no longer useful or discarded.

2.5 Africa

- (Schluep, 2010) Study focused on Africa talked about activities related to e-waste sector that is made in 6 African countries until 2010 the only Arabic country that have activities in was morocco also the same study mentioned that in 2005Africa generated .2 % of the world e waste.

Chapter Three
Methodology

3.1 Introduction

This chapter discusses the methodology of the study. It includes the methodological approach, research design, selection of the study population, sample size, methods of data collection. Consideration is also given to the methods of data analysis. Ethical and administrative issues were also described in this chapter including consent for conducting the study.

3.2 Study design

Cross sectional study was conducted.

3.3 Study population

The study population was all households at Nablus city as potential e-waste generators.

3.4 Study setting

The study questionnaires were required to be geographically distributed on Nablus city in the West Bank, Palestine.

A total of 400 questionnaires distributed in 40 blocks that cover Nablus city (10 questionnaires for each block). And those blocks gathered in 6 regions (use in the analysis) .The list of blocks and regions shown in Appendix B

3.5 Sample size

Estimating the needed number of household depended on Nablus number of housing units which is 35,864 (PCBS, 2017) With a confidence level 95%, and a confidence interval of 4.87 the needed sample of household is 400 household which implies the need for 400 questionnaire one for each housing unit.

3.6 Sampling methods or techniques

Nablus city blocks and regions map used to define the 40 blocks borders then the researcher started collecting data randomly from distributed houses within the block borders until filling the required 10 questionnaire from each block.

It was a tow- way cluster sampling which implied using simple random sampling technique on each block to choose the 10 houses from each of the 40 blocks.

3.7 Ethical and administrative considerations

The study has been approved by the Institutional Review Board (IRB) (Appendix A) and the scientific research committee of the Public Health Department as well as the faculty of graduate studies scientific research board at An-Najah National University.

An explanatory letter for all participants attached to each questionnaire which explains the aim, importance, confidentiality and anonymity of the

information with optional participation (voluntary). A written and signed informed consent obtained from each participant (Appendix C).

3.8 Data collection tool

A special questionnaire designed to accommodate the study objectives Appendix D. The used questionnaire designed with the guidance of another questionnaier from the e-waste assessment methodology (training and reference manual), by EMPA (The Swiss Federal Laboratories for Materials Science and Technology).

The questionnaires filled by the researcher and two other trained persons through face to face interview with the stakeholder and taking the written consent from that person.

The environmental relevance, weight, size, and material composition differ considerably for each electrical or electronic product. Taking these differences into account, categorization can be grouped into roughly 54 homogeneous product types, referred to as the UNU-keys. (Balde, Forti, Gray, Kuher, & Stegman, 2017) In the figure below the 9 equipment's targeted in this study questionnaier along with their UNU-KEYS.

Table 3.1: targeted equipment's along with their UNU-keys

Equipment	UNU-Key
washing machine	104
Refrigerators	108
air conditioner	111
laptop/tablet	303
Mobile	306
CRT screen	308
LCD/LED screen	309
CRT TV	407
LCD/LED TV	408

3.8 Data analysis

EXCEL software and statistical package for social sciences (SPSS) software version 22 has been used for data entry and analysis (IBM SPSS, 2013).

Depending on the questionnaire, study results could be in units or in tons, the average weight for selected electrical and electronic devices has been taken from (Appendix E), composition table from the Swiss Federal Laboratories for Materials Science and Technology EMPA manual (EMPA, 2012).used to estimate e-waste composition from the hazardous and nom-hazardous materials (Appendix F).average lifespans has been taken from (Appendix G).

Chapter four
Results

4.1 Introduction

This chapter introduces the study results including the characteristics of the participants and the average percentages of the responses for each item in the questionnaier. A reliability test conducted on the data and the resulted Cronbach Alpha is 0.72.

4.2 Socio-demographic characteristics of the study population

In this study, we have met 400 participants who live in different 400 households distributed on 6 regions in Nablus city as shown in table 4.1.

The percentage of females and males among participants where 55.75% and 44.25% respectively. The relation between the participant and the household owner shown in table 4.1 most of the questionnaires filled with help of the wives 40.25 %.

Households which has 4-6 members living in represents 58.8 % of the sample, and 32.8 % of it have an average monthly income of 3001-5000 NIS (table 4.1).

Table 4.1: Socio-demographic characteristics of the study participants N (%) =400*

Variable	N (%) =400
Description of the participants	
Sex	
Male	177(44.3)
Female	223(55.8)
Relative relation	
Husband	102(25.5)
Wife	161(40.3)
Daughter	55(13.8)
Son	72(18.0)
Other	10(2.5)
Description of the studied households	
Region distribution	
Rafedia and Makhfeyyah	70(17.5)
Ebal	91(22.8)
Jirzim	59(14.8)
Middle	70(17.5)
East	60(15.0)
Industrial	50(12.5)
Family size	
(1-3)members	96(24.0)
(4-6)members	235(58.8)
(7-9)members	66(16.5)
10 and more members	3(.8)
Total monthly income	
Less than or equal 1500	44(11.0)
1501-3000	118(29.5)
3001-5000	131(32.8)
5001-10000	85(21.3)
More than 10000	22(5.5)

*data expressed as number (percent) of each group

4.4 Participants awareness, behaviors and perspective for management regarding e-waste

4.4.1 Participants level of awareness regarding e-waste

Among the respondents 67% knew what we mean with e-waste (figure 4.1), but after the term has been explained, 81.8% of the 400 participants knew that e-waste parts might need special treatment before safe disposal, 89% knew that e-waste has an impact on the environment and 84.3% knew that e-waste contains precious and heavy metals (table 4.2).

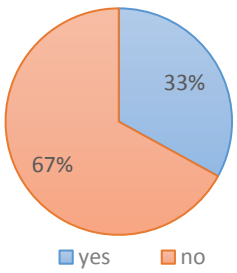


Figure 4.1: the percent of participants who were able to tell what is e-waste.

Table 4.2: participant's awareness regarding e-waste N=400

Question	Participant response
Do waste collectors come and pick up waste at your door? Do they pick up e-waste too?	1.Yes, for all 0% 2.Yes,no for e-waste 100% 3.No 0%
Type of waste collection?	1.Informal 0% 2.Private 0% 3.Municipal 100%
Is the current e-waste collection convenient to you?	1.Yes 14.2% 2.No 85.8%
Are you willing to give your e-waste for free if you guaranteed that it will managed in an environmentally sound methods?	1.yes 92.3% 2.No7.8%

4.4.2 Participant's management perspective regarding e-waste

Nearly, 85.8% of the participants see that the current collection method is inappropriate (Table 4.3) and their suggestions for new ways of e-waste management shown in figure 4.2.

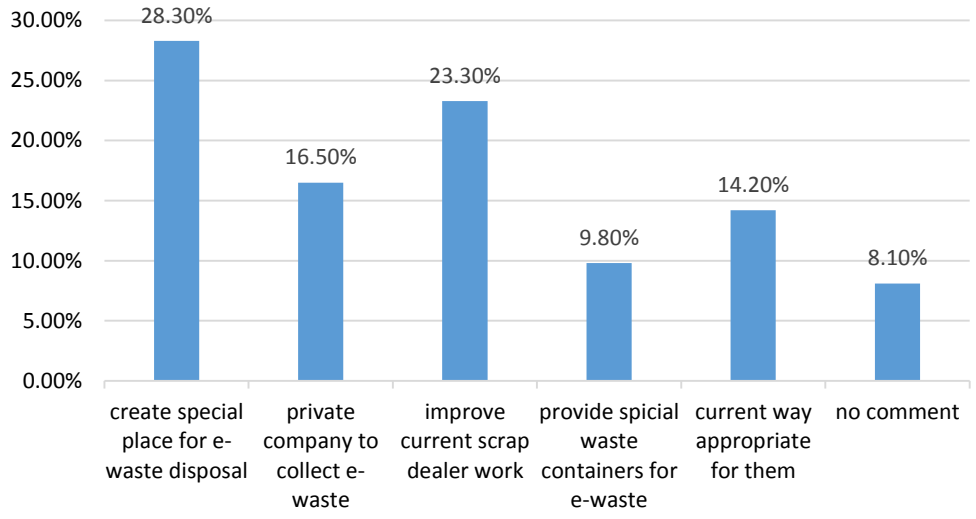


Figure 4.2: suggested management method for e –waste.

Table 4.3: participant's perspective regarding e-waste management

Question	Yes	No
Are you aware that parts of e-waste parts needs special treatment to be disposed safely?	81.8%	18.3%
Are you aware about the environmental impact for e-waste?	89%	11%
Do you know that e-waste could contain precious and heavy metals?	84.3%	15.8%

4.4.3 Purchasing habits for in use equipment

Participants answers reveal that Nablus household owners lean toward purchasing new devices from the market and they expect it to live many years beyond its expected life as shown in table 4.4

Table 4.4: Participants answers regarding purchasing habits for in use equipment

Question	**Possible answers**
Place of purchase	1. Market 93.48% 2. Second hand 6% 3. Friend .52%
Condition at the purchase time	1. New 93.43% 2. Used and working 6.54% 3. Broken .03%
Years the owner intend to use the device	1. Until it is broke 96.47% 2. Years specified 3.53%

4.4.4 Behaviors regarding stored e-waste

The average storing years , condition when decided to stop using and reason for stop using for each equipment shown in table 4.5.

Table 4.5: Participants answers regarding storing habits

Equipment	Storing years average (year)
washing machine	3.0
Refrigerators	3.7
air conditioner	1.5
laptop/tablet	3.3
Mobile	3.9
CRT screen	5.9
LCD/LED screen	4.7
CRT TV	4.7
LCD/LED TV	2.5

Table 4.6: Participants answers regarding storing habits (N=400)

Question	Participants answers (%)
Condition when stored	1. working 38% 2. broken 62%
Reason for stop using	1.permenantly broken 42.23% 2. old model 22.71% 3.repeated fixing 27.89% 4.dont need anymore 7.17%

4.4.5 Behaviors regarding discarded EEE

The 5 main ways of disposal that used at the 400 houses are shown in table 4.7 along with their popularization on Nablus total households count.

Table 4.7: e–waste disposal ways that chosen

Disposal way	n=95	n=35.864(%)*
Selling to second hand dealer	21	1882.86(22.11%)
Give or sell to scrap dealer	40	3586.4(42.11%)
Dispose with households waste	18	1613.88(18.95%)
Thrown on the street	7	627.62(7.37%)
Donation	9	806.94(9.47%)

*results shown as weight in kg (%)

4.5 Quantities and composition of generated e-waste during 2017

4.5.1 e-waste generated during 2017

The total amount of discarded devices at the 400 households were 95 device as shown at table 4.8 when popularization this number we conclude that the estimated household e-waste generation at Nablus city during 2017 is about 265.2 tons.

Table 4.8: household e.waste during 2017 (sum of units and weights)

Device	Sum-of units	Weights-kg (%) n=400	Weights-tons n=35864
Washing machine	18	1287(43.5%)	115.4
Refrigerators	19	1027.9(34.7%)	92.2
Air conditioner	4	100.8(3.4%)	9
laptop/tablet	11	33(1.1%)	2.96
mobile	18	1.8(.1%)	.16
CRT screen	5	65(2.2%)	5.8
LCD/LED screen	3	16.2(.5%)	1.5
CRT TV	13	369.2(12.5%)	33.1
LCD/LED TV	4	57.2(1.9%)	5.13
Total	**95**	**2958.1(100.0%)**	**265.25**

4.5.2 Estimation of hazardous materials in generated e-waste

Among the 265.25 generated tons there is 2.24 tons thrown in the streets or disposed with other household solid waste, this amount represents (26.32%) of the total of the disposed devices.

Table 4.9: the percentages of each component in 2 types of discarded equipment

Material	Amount thrown in street(kg)	Percentage of total thrown	Amount disposed with household waste (kg)	Percentage of total disposed with house-holds
Iron	9852.5	41%	2088.36072	39%
Aluminum	2661.8	11%	471.43228	9%
Copper	2258.4	9%	395.22128	7%
Lead	281.3	1%	45.1473964	1%
Cadmium	3.7	0%	0.87472296	0%
Mercury	0.0	0%	0.003030149	0%
Gold	0.0	0%	0.007460505	0%
Silver	0.1	0%	0.037400808	0%
Palladium	0.0	0%	0.00186812	0%
Indium	0.0	0%	0.01551118	0%
Plastics with BFR	1508.9	6%	564.9548328	11%
Plastics	4036.0	17%	801.5604	15%
Lead glass	1543.4	6%	589.42484	11%
Glass	27.1	0%	9.69081144	0%
Other	2074.2	9%	402.770652	8%
Total	24247.6		5369.503206	

4.6 Quantities in-use devices

the total weight of In use devices at the 400 households is 73923.6 (kg) , this weight for a total of 3994 device ,Table 4.10 show the exact amounts for each kind of the studied devices at 400 households and its expectation for Nablus city**.**

Table 4.10: In use devices at studied households (sum of units and weights)*.

equipment	sum of units	**Weights kg (%) n=400	***weights kg n=35864
washing machine	423	30244.5(40.9)	2711721.87
refrigerators	427	23100.7(31.2)	2071208.762
air conditioner	331	8341.2(11.3)	747871.992
laptop/tablet	559	1677(2.3)	150359.82
Mobile	1562	156.2(.2)	14004.892
CRT screen	38	494(.7)	44292.04
LCD/LED screen	91	491.4(.7)	44058.924
CRT TV	97	2754.8(3.7)	246995.368
LCD/LED TV	466	6663.8(9.0)	597476.308
Total weights (kg)		**73923.6**	**6627989.976**
Total weights (tons)		**73.9236**	**6627.989976**

*Data expressed as number (percent) of each group

**device weight= unit average weight (Appendix E) ×sum of units

*** 35864 is the number of housing units at Nablus city according to PCBS, 2017.

4.6.1 Projections for e-waste generation

Two types of devices excluded from the total of in use devices before conducting the prediction calculations (Table 4.11).

Table 4.11: Devices excluded from the e-waste predictions

Kind of device	Number of devices	Percentage (number/total in use)
Total devices purchased as used	203	6.6%
Total devices exceeded its lifespan and still working	387	12.6%
Total devices used in the prediction calculations	2488	80.8%
Total devices entered the predictions calculations	**3078**	**100%**

Table 4.12 shows the average ages for in use devices that entered the predictions calculations in addition to specific amount and percentages for devices that exceeded its expected lifespan and still in use.

Table 4.12: in use devices average ages*

Device	average years in use
Washing-machine	5.15
Refrigerators	8.18
Air conditioner	8.99
Laptops/tablets	2.04
Mobiles	2.33
CRT screen	4.71
LCD/LED screen	3.82
CRT TV	0.52
LCD/LED TV	5.72

*the prediction calculation conducted using the specific age for each device not the shown aver ages.

Table 4.13: EEE that exceeded its lifespan but still working

Equipment	n(%)=387
washing machine	70(18.1)
Refrigerators	48(12.4)
air conditioner	8(2.1)
laptops/tablets	95(24.5)
Mobiles	87(22.5)
CRT screen	11(2.8)
LCD/LED screen	17(4.4)
CRT TV	37(9.6)
LCD/LED TV	14(3.6)

After excluding the mentioned devices table 4.11 and based on the expected life expectancy for the targeted devices at the study and its current age the expected quantities has been calculated table 4.14.

Table 4.14: Estimated amounts of in use EEE will reach its end of life during the coming years.

Year	**Amount in units**	**Percentage year/total for 14 years**
2017(devices reached its expected end of life time during 2017)	411	15%
2018	272	10%
2019	276	10%
2020	386	14%
2021	301	11%
2022	185	7%
2023	181	6%
2024	139	5%
2025	147	5%
2026	189	7%
2027	139	5%
2028	80	3%
2029	72	3%
2030	32	1%

4.7 Quantities of stored EEE

Table 4.15 show the amounts of stored e-waste at the 400 households and its expectation for the whole city, total weight is 301 tons.

Table 4.15: Household stored e-waste (sum of units and Weights)

	sum of units	Weights kg (%) N=400	Weights kg N=35864
washing machine	23	1644.5(49%)	147445.87
Refrigerators	12	649.2(19.3%)	58207.272
Air conditioner	2	50.4(1.5%)	4518.864
Laptop/tablet	53	159(4.7%)	14255.94
Mobile	223	22.3(.7%)	1999.418
CRT screen	9	117(3.5%)	10490.22
LCD/LED screen	6	32.4(1.0%)	2904.984
CRT TV	21	596.4(17.8%)	53473.224
LCD/LED TV	6	85.8(2.6%)	7692.828
Totals	355	3357(100%)	300988.62

Chapter five
Discussion

5.1 Main study findings

5.1.1 e-waste generation

The aim of this study was to estimate the generated household e-waste during 2017 at Nablus city, and to assess the behaviors and perspectives of citizens related to e-waste.

The main study findings showed that the amount of e-waste generated from Nablus city households during 2017 is 265.2 tons, and the e-waste per inhabitant is about 1.69kg/capita.

In Jordan it is estimated that it is 2.23kg /capita not forgetting that this study considered only 5 types of equipment's and it is done on a national level not on a household level (Saidan and Tarawneh, 2015). Europeans produce e-waste at a rate of 14 kg / person 121per year (Goosy, 2004) and Switzerland produces 9 kg / person per year (Sinha-Khetriwal et al., 2005).WEEE generated in Belgium was 22.4 kg/resident (Huisman and Balde, 2013) in 2011.

These differences in per capita calculation might be attributed to differences in the methods used to come up with these results. for example most of the developed countries do their inventory on a national level, that include the institutions, companies and organizations, which mostly generate

e-waste in amounts that exceeds the households amounts and this might affect the per/capita result.

As it can be seen in table 4.8 in the results chapter, the highest category that supports the e-waste generation in Nablus households is washing machines whereas refrigerators and CRT TV's are the other major categories that generate high amount of e-waste. Due to the advancement of technology, introduction of energy efficient and lightweight LED/LCD display devices, the CRT technology is on the verge of extinction globally.

Mobile phones generate high number of wastes in terms of quantity, but as the average weight of a mobile phone is only about (0.1kg/unit), quantifying in terms of weight sees them being the least producer of electronic waste, in addition to that the general trend found within participant is storing the obsolete mobiles not discarding it.

5.1.2 Disposal of generated e-waste

Based on the questionnaier responses, the following consumer's behavior options regarding EEE disposal can be generalized:

- 42.11% of the samples preferred to sell or give the obsolete electronic product to a scrap dealer followed by 22.11% of the samples who preferred to sell it to a Second hand dealer, in Jordan both options percentage were 56% (Saidan and Tarawneh, 2015).

- 18.9% of the samples preferred to dispose their obsolete electronics with municipal solid waste compared to Jordan the percentage were 33% (Saidan and Tarawneh, 2015).

- The lower percentages of responses goes to throwing on the street (7.37%), and Donation (9.47%).

5.1.3 The composition of generated e-waste

The composition for thrown in the streets and disposed with households waste has a special meaning cause it reach the environment directly through the streets and open areas, or through the dumpsites when thrown with regular MSW.

The estimation of the average composition of EEE Appendix F, used to calculate the discarded e-waste composition. Of the total of 24247.6 kg discarded in the streets, 41% were iron followed by 17% plastics and 11% of aluminum. For the disposed with household's e-waste iron percent was 39% followed by plastics 15%.

Plastic with BFR and lead glass have the same percent of 11% in disposed with household e-waste and 6% in thrown in the streets e-waste, the term brominated flame retardants (BFRs) refers a wide range of brominated chemicals added to materials to both inhibit their ignition and slow their rate of combustion, BFR's are highly resistant to degradation in the environment and are able to bio accumulate (build up in animals and humans). (Greenpeace, 2010)

The lead glass mainly found in CRT funnel glass, the lead content ranges from 22% to 28%. In other words, 1.2 kg lead is approximately distributed in one CRT monitor.

Lead compromise 1% of the total weight of both discarded with households or thrown in the streets e-waste. 40 % of the lead in U.S. landfills is from discarded electrical and electronic products. The lead in CRTs and the lead solder in printed circuit boards can migrate to groundwater and accumulates in the environment. (Santa Clara, 2004) .According to EPA, the excessive amount of lead in e-waste, if released into the environment, could cause severe damage to human blood and kidneys, as well as central and peripheral nervous systems.

5.1.4 Projections for e-waste generation

Before starting the e-waste projections calculations two types of EEE excluded from the predictions calculations, and it is as follow:

1- All the devices that purchased as used which represents 6.6% of the total in use equipment's has been excluded since we cannot determine its current age.

2- All the devices exceeded their expected age but still working and used by the current owner this kind of equipment's represents 12.6% of the total of in use devices , refer to (table 4.13) for further details about this kind of EEE.

Using an electrical or electronic device, more than its expected life is quite common in our community and this behavior have two main negative impacts.

The first one is the only negative environmental effect, which comes from the delay in using more resource-efficient products during the use phase (Montalvo et al., 2016)

For example, "The average washing machine used to use 35 to 50 gallons per load, but the high efficiency ones today use only 12 to 15." The need for less water is not only environmentally beneficial but can also save some of your money by reducing the costs of water consumption. (Lemire, 2017)

The second one is the potential hazard that caused by electrical components aging which happens in any distribution system. After the expected useful life, the failure of electrical equipment is unpredictable. Electrical equipment failures have been the most common cause of fires in buildings and facilities. (Peeran et al., 2011)

The prediction of the quantities of in use devices that will turn into e-waste during the coming years conducted depending on the studied in use devices (current ages) and the (average lifespans, Appendix G) for those devices.

At the study year 2017 15% of the in use devices has reached it is end of life, by the end of 201710% of it will reach its end of life and by the end of 2018 another10% will be included in the category of EEE reached end of life by the end of 2019.

This percentage continue decreasing until 2030 when the last 1% of the currently in use EEE will reach its end of life.

In order to be more precise when predicting the total generated e-waste in coming years the expected amount of e-waste that is going to be generated from not yet purchased EEE have to be added , this percentage taken from expected put on market and sales scenarios for the intended year.

This kind of scenarios could not be found currently in Paltrade documents so we could use worldwide estimations that is made especially to meet countries different conditions in e-waste generation and apply them on our current results.

Countries like Palestine with GDP (PPP) Gross Domestic Product-Purchasing Power Party of 4300$ (CIA, 2014) is ranked as low PPP and have an average annual growth rate of 23% in EEE according to global e-waste monitor 2017 (Balde,et al., 2017).

So if the generated e-waste from Nablus city households during 2017 where 265.2 tons (according to the study results) then it is expected to be 326.2 tons during 2018.

The responses of 100% in the first two questions (Table 4.3) at the table were because in the city of Nablus, there is one governmental body responsible for garbage collection in general, which is the municipality and municipalities in Palestine does not have a special collection service for electronic waste.

5.2 In use EEE (quantities and citizens behaviors)

In terms of weight the highest contributors to EEE in households are washing machines (40.9%) followed by refrigerators (31.2%).

In terms of units in use mobiles, laptops and tablets have the highest contribution with about 1562 mobile and 559 laptop and tablets in the studied 400 households, table 4.7 show the exact studied amounts with their corresponding weight.

During the interview, people were asked about the purchasing habits regarding in use devices the results revealed that Nablus household owners lean toward purchasing new devices from the market (93.43%) and they expect it to live many years beyond its expected life 96.47% of participants intended to use their EEE until it is permanently broken.

5.3 Stored e-waste (quantities and citizens behaviors)

The total weight of stored devices at the studied 400 households was 3357 kg which represents (4%) of the 77280.6 kg (sum of in use devices and stored devices). According to a study on 396 in Nepal this percent were 24% (PACE Nepal, 2017).

Participant were asked about the number of years the device spent stored in their houses and the average years for storing were the highest for CRT screens 5.9 years followed by CRT TVs and LCD/LED TVs 4.7 years.

In terms of quantities the total number of stored items was 355 (table 4.15), mobiles contributes to the highest percentage of stored EEE with 223 mo-

biles stored in the 400 households studied but in terms of weights washing machines is the highest contributor with 23 item representing 49% of the total weight of stored items.

The overriding opinion of the participants when asked about the reason for stop using the stored device with 42.23% of the answers was that the device is permanently broken. Followed by 27.89% of participants who admitted that the reason for stop using the device is repeated fixing.

Among the 400 participants 29.88% kept their devices stored not used although they are working either because its old model (mostly for mobiles) 22.71% or because they don't need the device anymore(mostly for laptops and computer screens).

According to a study in Malaysia (Perunding good earth, 2007) citizens who kept their WEEE are keeping them for one of the next reasons:

1- Some of the internal parts of the equipment's can still be used

2- The owners are not certain that the WEEE is irreparable and believe that it might work again if sent to repair shops.

3- The owners are reluctant to throw away their WEEE, which was bought at a high price.

4- The owners are waiting for collectors to buy from them to dispose the discarded WEEE rather than having to pay someone to collect the WEEE.

The average family size in 58.8 % of the houses we filled the questionnaier about was 4-6 members and the average monthly total income in those houses was 3001-5000 NIS 32.8 %.

5.4 Participants' awareness and management perspectives regarding e-waste

Regarding the participants familiarity with the term e-waste only 35% of the participants knew what e-waste is. A study in Jordan showed that 49.5% of study participants were to certain extent knowledgeable about e-waste (Tarawneh and Saidan, 2013). It is worth mentioning that the knowledge of the term was highly influenced by lack of public awareness campaigns.

After an appropriate explanation of the term, 81.8% of the participants were aware about the need for special treatments for some e-waste parts to be disposed of safely, and 89% knew that e-waste have an impact on the environment.

As to responses concerning the existence of precious and heavy metals in the e-waste 84.3% of the participants acknowledge such awareness while in Jordan the percent was 71.3%.

The level of public satisfaction about the current way of collection (through scrap dealer) was low 85.8% of the participants admit that this way is not appropriate for them. The remaining participants when asked about their suggestion for methods for e-waste management also answered that the

current way is appropriate for them this percent along with participants who don't have any suggestions replied by no comment represent a total of 16.3% of the participants answers regarding suggested methods of management.

While the most suggested e-waste management methods which got welcomed by the participants is creating a special place for e-waste disposal 28.3% followed by improving the current scrap dealer work 23.3%.

About 16.5% of the participant goes with creating a private company to collect e-waste as the best choice regarding e-waste management and 9.8% claimed for special waste containers for e-waste.

The willingness of participant to be part of environmentally sound management e-waste disposal ways measured by asking about their readiness to give their e-waste for free if they guaranteed that it will be managed in an environmentally sound ways ,surprisingly 92.3% of the participants answered with yes.

5.5 Socio-demographic characteristics of the study participants

A total of 400 questionnaier has been distributed on 6 regions which divided into 40 blocks 10 questionnaier per block this distribution ensured adequate coverage for the city households. 55.8% of the participant were female and 40.3% of them were the wives this percentages justified by the cultural habits that women deal with women and the researcher is a women,

a good percentage of the questionnaires filled with the help of the husband 25.5%.

As to households the average number of persons live in the household were 4-6 persons (58.8%), in rate of total income in the household those who earn 3001-5000NIS represents (32.8%) of the sample.

5.6 Indicators related to e-waste

According to (Global e-waste monitor 2017), there is indicators that we could use to assess e-waste condition in certain country. The indicators that could be estimated from our study are:

1-Total EEE put on market (unit kg/inh): this represents the size of the national e-goods market. The imported amounts for targeted equipment's in the study has been taken from Pal-trade documents, and the results shown in the followed table.

Table 5.1: Imported quantities for targeted equipment's (Tons)

UNU-key	Total	2009	2010	2011	2012	2013	2014	2015
104	22909	1806	1954	3111	3399	5093	3659	3887
108	23216	2174	3151	3284	3483	3518	3467	4139
111	9972	843	1169	1558	2060	1557	1323	1462
303	493	28	47	81	79	78	91	89
306	805	87	80	174	89	133	105	137
308	missed raw data							
309	295	31	43	41	40	45	48	47
407	missed raw data							
408	missed raw data							

The total population of Palestinian according to 2017 census is 4,780,978 and the result after taking it in consideration and converting tons to kg shown in table 5.2.

Table 5.2: put on market for targeted equipment

The product	**104**	**108**	**111**	**303**	**306**	**308**	**309**	**407**	**408**	**Total**
Put on market (kg/inh)	0.81	0.87	0.31	0.02	0.03	No data	0.01	No data	No data	**2.04**

2-Total e-waste generated (unit kg/inh) this represents the size of the national e-waste market. For Nablus city it is 1.69 kg/inh according to the study results.

3-e-waste collection rate = e-waste collected / e-waste generated * 100 % this indicator represents the performance of the formal collection systems.

But in Nablus case where no formal collection it will represent the informal system performance, which represented by the scrap dealer who collected 42.11% of the total household generated e-waste during 2017 and the second hand dealer who take another 22.11% of that total according to our results.

By applying the previous formula, we get:

(1882.86+3586.4)/8517.7*100=64%

4- e-waste in waste bin: the amount of e-waste that ends up in non-separately collected waste. For Nablus city households this

amount =1613.88 (kg) represent 18.95% of the total generated e-waste (in the questionnaier referred to as disposed with household waste).

5.7 Study limitations

-General public apathy: Individuals were not concerned enough about e-waste to give us the time to fill in the questionnaier.

- Individuals were sometimes reluctant to disclose their ownership level of electrical/ electronic appliance.

- Many people do not keep track of the various electrical/electronic appliances that they dispose or own and were reluctant to spend the time to recall the information.

5.8 Conclusions and recommendations

To conclude, the amount of 265.2 tons of generated e.waste from Nablus city households during 2017 is subjected to continuous increase as a natural result of the global trend towards increasing the consumption of electronic devices.

As 67% of participant couldn’t recognize the term of e-waste, it is important for environmental associations and media in Palestine to consider start working on awareness campaigns to increase public knowledge about this kind of hazardous waste.

Moreover and In the light of the lack of any governmental projects that quantify the e-waste in Palestine it is highly recommended for future re-

searcher to conduct similar researches regarding electronic waste inventory. The cumulative results of these researches will be used in creating a national e-waste inventory which will help decision makers in establishing an efficient e-waste management policy that is suitable for Palestinian conditions.

The method used in this study is suitable for conducting similar studies that target other Palestinian cities on the level of households and it could be modified to suit researches on the level of institutions and organizations investigation.

It is also worthy for private sector holders in partnership with relevant governmental agencies to start thinking about creating special places for e-waste disposal as this idea have been suggested by 28.3% of the study participants.

As for the scrap dealers who are currently taking the lead in e-waste collection from households with 42.11% of generated e-waste goes to them according to our result, further investigations is required to know the fate of e-waste after being in their hands and to work side by side with municipalities to start formalizing their work as a first step toward creating an effective collection system.

References

- Agarwal, R. (2018, 1 17). **down to earth periodical**. Retrieved 4 18, 2018, from down to earth organizaton website: http://www.downtoearth.org.in

- Allam, H. (2014). **E-waste Management in the Arab Region: Status and Opportunities.** CEDAR(Centre for Environment and Development for the Arab Region and Europe).

- AlqudsTV. (2011). **electronic waste .Hidden threat to humans and the environment.**

- ARIJ. (2014). **The impacts of electronic waste disposal on the environment and public health in the occupied Palestinian territory: a case study from Idhna, Hebron Governorate**. Applied Research Institute – Jerusalem.

- Balde, C., Fondeur Gill, S., Kern, M., P. Micheli, E., & Blumenthal, K. (2015). **e-waste statistics (guidelines on classification reporting and indicatores 2015***)*. bonn,Germany: united nations university.

- Balde, C., Forti, V., Gray, V., Kuher, R., & Stegman, P. (2017). **The global e-waste monitor 2017**. Bonn/Geneva/Vienna: United Nations.

- Balde, C., Wang, F., Kuehr, R., & Huisman, J. (2015). **The global e-waste monitor 2014**. Bonn, Germany: United Nations University.

- CEDARE. (2010). **e-waste forum 2010**. Retrieved from e-waste forum 2010 webpage:

http://ewasteforum2010.cedare.int/Presentations/Session_VI/2_CEDARE.pdf

- CIA. (2014). **central intelligence agency**. Retrieved from central intelligence agency website:

https://www.cia.gov/library/publications/resources/the-world-factbook/geos/we.html

- EMPA. (2012). **The e-waste assessment methodology (training and reference manual)'.** the Swiss Federal Laboratories for Material Science and Technology.

- EQA, e. q. (2015). **assessmant report onsustainable consumpion and production policies in palestine**. SwitchMed Programme.

- free range studios, A. L. (Director). (2010). **the story of electronics** [Motion Picture].

- GIZ german ccoperation. (2014, 4). **Country report on the solid waste management.** Bonn and Eschborn,Germany: Deutsche Gesellschaft für. Retrieved from

http://www.environment.pna.ps/ar/files/Country%20report%20on%20the%20solid%20waste%20management.pdf

- Goosy, M. (2004). **end of life electronics legislation-an industry perspictive**. circuit world.

- Greenpeace. (2010). **greenpeace organization**. Retrieved 4 19, 2018, from https://www.greenpeace.org/archive-

international/en/campaigns/detox/electronics/the-e-waste-problem/what-s-in-electronic-devices/bfr-pvc-toxic/

- Hester, R. E., & Harrison, R. M. (2009). **Issues in Environmental Science and Technology** (Vol. 27 electronic waste management). Royal Society of Chemistry.

- Huisman, J., & Balde, K. (2013). ***(*W)EEE mass balance and market structure in Belgium.*** united nations university,istitute for sustainable and peace . Retrieved from www.FFact.nl

- IBM SPSS, v. 2. (2013). **Statistical package for social sciences. IBM SPSS Statistics for Windows, Version 22.0.** Armonk, NY: IBM Corp.

- lemire, s. w. (2017, 1). Retrieved from courant Website: http://www.courant.com/features/home-garden/hc-cthome-lifespan-of-household-appliances-20170112-story.html

- Leung, A. O. (2008). **"Heavy Metals Concentrations of Surface Dust From E-Waste Recycling and its Human Health Implications in Southeast China,**". Environmental Science and Technology, p. 42.

- Montalvo, c., peck, d., & Rietveld, E. (2016, 6). **europian parliment,A Longer Lifetime for Products:Benefits for Consumers and Companies.** Retrieved 2017, from http://www.europarl.europa.eu: http://www.europarl.europa.eu/RegData/etudes/STUD/2016/579000/IPOL_STU(2016)579000_EN.pdf

- PACE Nepal. (2017). **inventory preparation of E-waste and its management in Kathmandu Vally**. Nepal: department of environment Kupondol,Laliitpur,Nepal. Retrieved 4 2018, from www.doenv.gov.np

- PCBS. (2017). **Preliminary results of the General Population, Housing and Establishment Census 2017.** Nablus: Palestinian Central Bureau of Statistics.

- Peeran, S., Vecchiarello, M., & Romeo, J. (2011, 9 5). r**enovating electrical distribution systems,how to decied what to keep and what to discard in an electrical distribution system.** consulting specifying engineer, p. 42.

- perunding good earth. (2007). *t***he e-waste inventory project in Malysia**. Malaysia: depaartment of environment (DOE) Malaysia.

- Saidan, M., & Tarawneh, A. (2015). **Estimation of Potential E-waste Generation in.** Ekoloji.

- saidan, m., & tarawneh, a. (2015, april). e**stimation of potential E-waste generation in Jordan.** Ekoloji, p. 63.

- Santa Clara, C. D. (2004). **Best Management Practices For Electronic Waste.** san jose: the California Integrated Waste Management Board.

- Schluep, D. M. (2010). **E-Waste Management in Developing Countries – with a focus on Africa. ITU Symposium on ICTs and the Environment & Climate Change.** cairo: EMPA (The Swiss Federal Laboratories for Materials Science and Technology) .

- Sinha-Khetriwal , D., Kraeuchi, P., & Schwaninger, M. (2005). **A comparison of electronic waste recycling in Switzerland and in india.** environ impact assess.

- StEP. (2014). . '**StEP Initiative: Solving the E-waste Problem (StEP)'.** white paper, one global definition of e-waste.

- Sweep.net. (2011). *s***weep net (the regional solid waste exchange of information and expertise network in Mashreq and Maghreb countries).** Retrieved from Palestine country profile.

- Tarawneh, A., & Saidan, M. (2013). ***Households Awareness, Behaviors, and Willingness to Participate in E-waste Management in Jordan.*** **international journal of ecosystem,** 127.

- TCCR. (2012). **'Burning of copper and toxic waste in Idhna town**. Idhna: Ta'awn Center for Conflict Resolution.

- Udasin, S. (2013). **Special Needs Workers Open E-Waste Recycling Spot.** Jerusalem Pos*t*. Retrieved from http://www.jpost.com/Enviro-Tech/Special-needs-workers-open-e-waste-recycling-spot-314651

- UNEP. (2009). **recycling fro e-waste to resources**. Newyork. Retrieved 3 2018

- UNIDO. (2012). **global partnership sponsered focal area/business plan :UNIDO – E-waste working plan.**

- Wattan, N. (2012). **the household electronic waste in dumpster without processing.**

Appendix A

Institutional Review Board approval letter

An-Najah
National University
Faculty of medicine
&Health Sciences
Department of Graduate
Studies

جامعة النجاح
الوطنية
كلية الطب وعلوم الصحة
دائرة الدراسات العليا

IRB Approval Letter

Study Title:

Estimation of Household Electrical and Electronic Waste Generation and its Management Scenarios in Nablus city, 2017)

تقديرالكمية الناتجة من النفايات الالكترونية و الكهربائية المنزلية و طرق ادارتها في

مدينة نابلس, 2017

Submitted by:
Tasneem Abu-Hijleh, Dr.Hamzeh Al Zabadi

Date Reviewed:

16h November,2017

Date Approved:
19h November, 2017

Your Study titled "**Estimation of Household Electrical and Electronic Waste Generation and its Management Scenarios in Nablus city, 2017)**
تقديرالكمية الناتجة من النفايات الالكترونية و الكهربائية المنزلية و طرق ادارتها في مدينة نابلس, 2017" with achieved number (15) November 2017 was reviewed by An-Najah National University IRB committee and was approved on 19th November 2017.

Hasan Fitian, MD

IRB Committee Chairman
An-Najah National University

نابلس - ص.ب 7 أو 707 || هاتف 2342902/4/7/8/14(09) (970) || فاكسميل 2342910 (09) (970)

Nablus - P.O Box :7 or 707 | Tel (970) (09) 2342902/4/7/8/14 | Faximile (970) (09) 2342910 | E-mail : hgs@najah.edu

Appendix B

list of blocks and regions at Nablus city*

Region	Blocks*
1.Rafedia and Makhfeyyah	(Muhandesen Ganobi, Andalus, Qayrawan, jameah Jadeed, Junaid, Taybah)
2.Ebal	(Maageen,muhandeseen shamali,mujeer dein,blebos,zaytoon basha,watani,set islemeieh,sham,khalet ruhban)
3.Jirzim	(Kfr qalil,dahyieh,khalet amood. Ras aleen,hijaz, balad qadimeh)
4.Middle	Taawon,Nablus aljadedah, Jameah qadim, Khulafa rashedeen, Shuhada, Muntazah, Mreej
5.East	Kahruba, Iraq tayeh, Balatah albalad, Orobah, Aserah shamalyeh, Askar albalad)
6.Industrial	(Sahel roujeeb, Barakeh, Souq alkhodar, Taqadum, Iskan mouazafeen)

*the blocks and regions names and borders taken from Nablus municipality map for blocks and regions

Blocks names in Arabic:

1: حي المهندسين الشمالي	11: حي بليبوس	21: حي البلدة القديمة	31: حي الضاحية
2: حي المعاجين	12: حي المنتزه	22: حي زيتون الباشا	32: حي عسكر البلد
3: حي الوادي	13: حي الخلفاء الراشدين	23: حي مستشفى الوطني	33: حي البركة
4: حي الحرم الجامعي الجديد	14: حي جامعة النجاح الوطنية	24: حي محطة الغاز	34: حي العروبة
5: حي الجنيد	15: حي التعاون	25: حي الشام	35: حي عصيرة الشمالية
6: حي طيبة	16: حي راس العين	26: حي خلة الرهبان	36: حي سوق الخضار
7: حي المهندسين الجنوبي	17: حي خلة العامود	27: حي محطة الكهرباء	37: حي التقدم
8: حي الأندلس	18: حي المريج	28: حي الست اسليمية	38: حي كفر قليل
9: حي القيروان	19: حي الشهداء	29: حي عراق التايه	39: حي سهل روجيب
10: حي مجير الدين	20: حي نابلس الجديدة	30: حي بلاطة البلد	40: حي إسكان الموظفين
41: حي المنطقة الزراعية (مستثنى لعدم وجود بيوت سكنية) 42: حي بيت فوريك (مستثنى لعدم وجود بيوت سكنية)			

Appendix C

Consent letter (attached to each questionnaier)

بسم الله الرحمن الرحيم

جامعة النجاح الوطنية – كلية الدراسات العليا

هذه الاستبانة مخصصة لغرض جمع معلومات لمحاولة تقدير كمية النفايات الالكترونية الناتجة من مدينة نابلس، حيث أن الطالبة: تسنيم نهاد عصام ابوحجلة تقوم بجمع هذه المعلومات لمساعدتها في إتمام رسالتها بعنوان " تقييم وضع النفايات الالكترونية في مدينة نابلس" بإشراف الدكتور: حمزة الزبدي كمتطلب لنيل درجة الماجستير في الصحة العامة من جامعة النجاح الوطنية.

نرجو الإجابة عن الأسئلة بصدق والتأكد بأن أي معلومات يتم تزويدنا بها لن تستخدم لغير أغراض البحث مع العلم بأن مشاركتك في تعبئة هذه الاستبانة طوعية بالكامل.

الاسم الرباعي:

التوقيع:

نشكر لكم تعاونكم

Appendix D

Study questionnaier

استبانة مخصصة للبيوت السكنية التاريخ

الجزء الأول: معلومات الشخص الذي تمت مقابلته

1.الرقم .....

2.رقم الهاتف أو المحمول: .....

3. ايميل (ان وجد): .....

4. الجنس: 1.ذكر 2.أنثى

5. صلة القرابة برب الأسرة: 1.الزوج 2.الزوجة 3.ابنة 4. ابن 5.أخرى

6. العنوان: الحي**.....**

المنطقة 1- رفيديا و المخفية 2- عيبال 3-جرزيم 4- الوسطى 5- الشرقية 6- الصناعية

7. عدد الأشخاص في المنزل: .....

8. مجموع الدخل في المنزل: 1. ≤1500 2. 3000-1501 3. 5000-3001
4. 10000-5001 5.›10000

الجزء الثاني: مستوى الوعي وطرق التعامل الحالية

1. **هل تعلم ما هي النفايات الالكترونية؟** (وضح للشخص الذي تتم مقابلته مفهوم النفايات الالكترونية عند الحاجة)
   0.نعم 1.لا
2. **هل تعي أن بعض أجزاء النفايات الالكترونية بحاجة لمعالجة خاصة حتى يصبح التخلص منها آمن؟**
   0.نعم 1.لا
3. **هل تعي التأثير البيئي للنفايات الالكترونية؟**
   0.نعم 1.لا
4. **هل تعلم أن النفايات الالكترونية تحتوي معادن ثقيلة ومعادن ثمينة؟**
   0.نعم 1.لا
5. **هل يتم جمع النفايات من منزلك وهل يتم جمع النفايات الالكترونية معها؟**
   1.نعم للكل 2.نعم. لا للنفايات الالكترونية 3. لا
6. **ما نوع الأسلوب المتبع في جمع النفايات؟**
   1. غير رسمي 2. خاص 3.بلدية

7. هل تناسبك طريقة جمع النفايات الالكترونية الحالية؟

0.نعم 1.لا

8. هل لديك أي اقتراح أو تعليق حول موضوع إدارة النفايات الالكترونية؟

1.ايجاد مكان مخصص لرميها

2. شركة خاصة لجمعها

3.تحسين عمل جامعي الخردة الحاليين

4.وضع حاويات خاصة لها ولكل نوع نفايات (حاويات فصل النفايات)

5.لا تعليق

9. هل ستعطي النفايات الالكترونية مجانا إذا تأكدت أنه سيتم التخلص منها بطريقة مفيدة ولا تلوث البيئة؟

0.نعم 1.لا

الجزء الثالث: الأجهزة قيد الاستخدام

1.كم قطعة من المنتجات الالكترونية والكهربائية التالية يوجد في منزلك قيد الاستخدام؟		
الرمز	الجهاز	العدد
104	غسالة	
108	ثلاجة	
111	مكيف	
303	لا بتوب أو تابلت	
306	هاتف محمول	
308	شاشة CRT	
309	شاشة LCDأو LED	
407	تلفزيون CRT	
408	تلفزيون LCDأو LED	

2.شراء واستخدام المنتج				
الجهاز	من أين اشتريته؟ 1.سوق 2. يد ثانية 3. صديق	في أي حالة اشتريته؟ 1.جديد 2. مستعمل وشغال 3. معطل	كم سنة والجهاز لديك قيد الاستخدام؟	كم سنة تنوي أن تستمر في استخدامه؟

الجزء الرابع: الأجهزة المخزنة في المنزل

1.كم قطعة من المنتجات الالكترونية والكهربائية التالية يوجد في منزلك مخزنة غير مستخدمة؟		
الرمز	الجهاز	العدد
104	غسالة	
108	ثلاجة	
111	مكيف	
303	لا بتوب أو تابلت	
306	هاتف محمول	
308	شاشة CRT	
309	شاشة LCDأو LED	
407	تلفزيون CRT	
408	تلفزيون LCDأو LED	

معلومات تخزين المنتج			
المنتج	كم سنة والجهاز قيد التخزين في المنزل؟	ما كانت حالة الجهاز عندما قررت أن تتوقف عن استخدامه؟ 1.شغال 2.معطل	سبب التوقف عن الاستخدام؟ 1.تعطل بشكل نهائي 2.انتهاء زمنه (الموديل قديم) 3.كثر تصليحه 4.لم نعد بحاجة له (لم يتم استخدامه طوال فترة التخزين المذكورة)

الجزء الخامس: الأجهزة التي تم التخلص منها خلال 2017

1.كم قطعة من المنتجات الالكترونية والكهربائية التالية تم التخلص منها خلال 2017؟		
الرمز	الجهاز	العدد
104	غسالة	
108	ثلاجة	
111	مكيف	
303	لا بتوب أو تابلت	
306	هاتف محمول	
308	شاشة CRT	
309	شاشة LCDأو LED	
407	تلفزيون CRT	
408	تلفزيون LCDأو LED	

معلومات التخلص من المنتج		
المنتج	سبب التخلص من المنتج؟ 1.تعطل بشكل نهائي 2.انتهاء زمنه (الموديل قديم) 3.كثر تصليحه	كيف تم التخلص من المنتج؟ 1.بيع لتاجر مستعمل 2.بيع أو إعطاء لتاجر خردة 3.مع النفايات المنزلية 4.تسليم لجامعي النفايات 5.القاؤه في الشارع 6.تخزين في المنزل 7.بيع لأفراد 8.التبرع

شكرا لمشاركتك في تعبئة هذه الاستبانة

Appendix E

weights /unit for selected electrical and electronic equipment's

(Balde, Fondeur Gill, Kern, P. Micheli, & Blumenthal, 2015)

UNU key	Equipment	Wight Kg/Unit
104	Washing machine	71.5
108	Fridge	54.1
111	Air conditioner	25.2
303	Laptop/tablet	3
306	Mobile	0.1
308	CRT screen	13
309	LCD/LED screen	5.4
407	CRT TV	28.4
408	LCD/LED TV	14.3

Appendix F

Composition

The following table presents an estimation of the average composition of two categories in weight %. (EMPA, 2012)

Material	Large household appliances	ICT and consumer electronics
Iron	43	36
Aluminum	14	5.0
Copper	12	4.0
Lead	1.6	0.29
Cadmium	0.014	0.018
Mercury	3.8E-05	7.0E-05
Gold	6.7E-07	2.4E-04
Silver	7.7E-06	1.2E-03
Palladium	3.0E-07	6.0E-05
Indium	0	5.0E-04
Plastic with brominated flame retardants	0.29	18
Plastics	19	12
Lead glass	0	19
Glass	0.017	0.30
Other	10	5.7

Appendix G

lifespans

(Huisman & Balde, 2013)

UNU key	product	years
104	washing machine	10.3
108	refrigerator	14
111	air conditioner	12.8
303	laptop/tablet	5.3
306	mobile	5
308	CRT screen	11
309	LCD/LED screen	7.4
407	CRT TV	11.1
408	LCD/LED TV	10

جامعة النجاح الوطنية

كلية الدراسات العليا

تقدير الكمية الناتجة من النفايات الالكترونية والكهربائية المنزلية وطرق ادارتها في مدينة نابلس، 2017

إعداد

تسنيم نهاد أبو حجلة

إشراف

د. حمزة الزبدي

قدمت هذه الاطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في الصحة العامة، بكلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس- فلسطين.

2018

تقدير الكمية الناتجة من النفايات الالكترونية والكهربائية المنزلية وطرق ادارتها في مدينة نابلس، 2017

إعداد

تسنيم نهاد أبو حجلة

إشراف

د.حمزة الزبدي

الملخص

مقدمة

لقد أدى تطوير التكنولوجيات الجديدة والاستهلاك المتزايد للمعدات الإلكترونية والكهربائية إلى زيادة الكمية الناتجة من النفايات الإلكترونية. هذه النفايات وبسبب وجود مواد خطرة في تركيبها تحتاج إلى مزيد من الاهتمام وادارتها بشكل خاص.

لم يتم بعد وضع اللوائح اللازمة بشأن النفايات الإلكترونية في فلسطين، ولذلك فإن تقدير موثوق للكمية الناتجة من النفايات الإلكترونية أمر حاسم بالنسبة لصانعي السياسات.

بالنظر إلى البيانات المتوفرة المحدودة، تقدر هذه الدراسة الكمية الناتجة من النفايات المنزلية خلال عام 2017 في مدينة نابلس –فلسطين، وهي الغسالات والثلاجات ومكيفات الهواء وأجهزة الكمبيوتر المحمولة / الأجهزة اللوحية والهواتف المحمولة وشاشات CRT و LCD / LED وتلفزيونات CRT وLCD / LED، بالإضافة الى دراسة الوضع الحالي لإدارة النفايات الإلكترونية المنزلية ووعي المواطن وسلوكياته تجاه النفايات الإلكترونية.

المواد والأساليب

هذه الدراسة عبارة عن دراسة مستندة إلى استبيان تم تقييم 400 أسرة في مدينة نابلس من حيث استخدام المعدات الكهربائية والإلكترونية، وتخزينها وإنتاج النفايات الإلكترونية.

تم حساب حجم العينة 400 بناءً على عدد الوحدات السكنية في المدينة 35،864 (الجهاز المركزي للإحصاء الفلسطيني، 2017) بمستوى ثقة 95٪. الاستبيانات موزعة على 40 حي، 10 لكل منها لضمان التغطية الكاملة للمدينة. ثم تم تحليل نتائج الاستبانة وتعميمها على العدد الكلي للمساكن في مدينة نابلس.

النتائج

أنتجت مدينة نابلس حوالي 265.22 طن من النفايات الإلكترونية خلال عام 2017. متوسط كمية النفايات الإلكترونية المنتجة للفرد الواحد هو 1.69 كجم / فرد. على مدى 5 سنوات، من 2017 إلى 2022، سيصل إجمالي 2537.4 طن من الاجهزة الكهربائية والإلكترونية المستخدمة حاليا إلى نهاية عمرها الافتراضي.

حوالي 64% من النفايات الالكترونية الناتجة من المنازل تذهب لتجار الخردة وتجار المستعمل والباقي يتم رميها في الشوارع او مع النفايات البلدية وحوالي 9% يتم التبرع بها. بالنسبة للمشاركين في الدراس فأن انشاء مكان خاص للتخلص من النفايات الالكترونية وتطوير وتحسين عمل جامعي الخردة هي أكثر الأساليب التي لاقت استحسانا.

الاستنتاجات والتوصيات

بلغ إجمالي النفايات الناتجة من الوحدات السكنية في مدينة نابلس 265.2 طن خلال 2017، منها 64.22٪ تذهب الى تجار الخردة وتجار المستعمل، لذا من المفيد للباحثين إجراء مزيد من التحقيقات في مصير النفايات الإلكترونية بعد الوصول لأيدي هؤلاء التجار.

من ناحية أخرى، تم التخلص من 18.95٪ منه مع النفايات البلدية، وتم طرح 7.37٪ في الشوارع، هذين السلوكين مرتبطين بوصول المواد الخطرة المتسربة من النفايات الالكترونية مباشرة إلى البيئة، وهنا تظهر الحاجة لحملات توعية لتحذير المواطنين من الخطر المترتب على هذه السلوكيات.