Sudan University of Science & Technology

College of Graduate Studies

The impact of environmental awareness and consumer style of the citizen in solving the problem of waste plastic bags

Case Study: Khartoum State, Sudan

أثر الوعي البيئي و النمط الاستهلاكي للمواطن في حل مشكلة نفايات الأكياس البلاستيكية

دراسة حالة,ولاية الخرطوم

A thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Environmental Engineering

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APPROVAL PAGE

الآية

بسم الله الرحمن الرحيم

قال تعالى :

﴿ ظَهَرَ الْفَسَادُ فِي الْبَرِّ وَالْبَحْرِ بِمَا كَسَبَتْ أَيْدِي النَّاسِ لِيُذِيقَهُمْ بَعْضَ الَّذِي عَمِلُوا لَعَلَّهُمْ يَرْجِعُونَ ﴾

صدق الله العظيم

سورة الروم الآية 41

Dedication

TO …

My beloved parents (mother and father)

TO …

My husband, daughter and Son.

TO…

My sisters, brothers and their sons and daughters…

TO …

The Sudan University …

TO …

All My teachers…

TO …

My friends and all whom

I love for their encouragement

& support.

ACKNOWLEDGMENT

Initially thanks my God for this conciliate

I wish to acknowledge all the support, encouragement and assistance given throughout this research by **Dr. Abduelatif Mokhtar Ahmed bilal** for being a friend and a supervisor This work would not have been possible without the generous support from him, sincere thanks.

Special thanks to The Supreme Council for the Environment Department of Supervision, Inspection and Violations team. I am very grateful for their sponsorship.

I would like also to express my gratitude to my beloved family; for their understanding & endless love.

ABSTRACT

This research discusses the problem of the negative environmental effects of plastic bags waste and its relationship to the environmental awareness of citizens and the pattern of production and consumption of plastic bags in the state of Khartoum. Where plastic bag waste appears in a very small percentage of the total municipal solid waste in the state of Khartoum, but it causes chronic environmental problems due to its light weight, its transmission by wind, and the difficulty of recycling it compared to other types of plastic waste.

The theoretical background of the problem was investigated from previous references by studying the experiences of other countries, and a detailed questionnaire was conducted in the state of Khartoum to determine the consumer behavior of citizens and the extent of their awareness of the environmental impacts of waste plastic bags. Some interviews were also conducted with government officials to determine the extent of the problem, its root causes, and the technical and legal remedies that have already been taken in the state.

The results of the research and the analysis of the questionnaire concluded that the aggravation of the problem of the spread of waste plastic bags in the state is caused by factors related to production and consumption together. In addition to the weak coordination between the legislators and the enforcers of laws related to this industry. And solutions were recommended in the form of economic, social and legal packages of treatments to control this problem in all its stages, starting from the stage of production and distribution, through consumption, to the stage of proper disposal of waste plastic bags.

المستخلص

المستخلص

يناقش هذا البحث مشكلة الآثار البيئية السلبية لمخلفات الأكياس البلاستيكية و علاقتها بالوعي البيئي للمواطنين و نمط الإنتاج و الاستهلاك للأكياس البلاستيكية بولاية الخرطوم. حيث تظهر نفايات الأكياس البلاستيكية بنسبة قليلة جدًا من إجمالي النفايات الصلبة البلدية في ولاية الخرطوم و لكنها تسبب مشاكل بيئية مزمنة بسبب خفة وزنها و انتقالها عن طريق الرياح و صعوبة إعادة تدويرها بالمقارنة مع الأنواع الأخرى من النفايات البلاستيكية.

تم التحقيق في الخلفية النظرية للمشكلة من المراجع السابقة عبر دراسة تجارب الدول الأخرى , كما تم عمل استبيان تفصيلي بولاية الخرطوم لتحديد السلوك الاستهلاكي للمواطنين ومدى وعيهم بالتأثيرات البيئية لمخلفات للأكياس البلاستيكية. كما تم إجراء بعض المقابلات مع المسؤولين الحكوميين لتحديد حجم المشكلة وأسبابها الجذرية وما تم القيام به فعلا من معالجات فنية و قانونية في الولاية.

و خلصت نتائج البحث و تحليل الإستبيان إلى أن تفاقم مشكلة انتشار نفايات الأكياس البلاستيكية في الولاية ناتج عن عوامل متعلقة بالإنتاج والاستهلاك معا. بالإضافة إلى ضعف التنسيق بين الجهات المشرعة و المنفذة للقوانين المتعلقة بهذه الصناعة. و تمت التوصية بحلول تتمثل في حزم معالجات اقتصادية و اجتماعية و قانونية للسيطرة على هذه المشكلة في كل مراحلها بدءاً من مرحلة الانتاج و التوزيع مروراً بالاستهلاك وصولاً إلى مرحلة التخلص بصورة سليمة من نفايات الأكياس البلاستيكية.

List of Abbreviations

A	**Agree**
CO	**Carbon Monoxide**
CO2	**Carbon Dioxide**
D	**Disagree**
EPHC	**Environment Protection Heritage Council**
EPS	**Expanded Polystyrene**
EU	**European Union**
FDA	**united states Food and Drug Administration**
FGD	**Focused Group Discussion**
GDP	**Gross Domestic Product**
GHG	**Green House Gases**
HDPE	**High-Density Polyethylene**
IETC	**International Environment Technology Centre**
ITDG	**Intermediate Technology Development Group**
LDPE	**Low Density Polyethylene**
LLDPE	**Low Density Polyethylene**
M	**Moderate**
Mt	**Metric ton**
MSW	**Municipal Solid Waste**
NEMA	**National Environment Management Authority**
NGO	**Non-Governmental Organization**
PE	**Polyethylene or polythene**
PET	**Polyethylene Terephthalate**
PHA	**Poly hydroxyl alkanoates**
PLA	**Poly-lactic Acid**
PP	**Polypropylene**
PS	**Polystyrene**
PVC	**Polyvinylchloride**
SA	**Strongly Agree**
SD	**Strongly Disagree**
UNEP	**United Nation Environment Program**
USA	**United States of America**
USDA	**United States Department of Agriculture**
WHO	**World Health Organization**
WTP	**Willingness to Pay**

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Chapter One

Introduction

CHAPTER ONE

Introduction

1 .1 General

Plastic bags in all their forms are wide spread in use, provide useful packing benefits and offer a convenient transport solution for many Sudanese people. Plastic shopping bags are given away for free in large numbers and are generally designed to be single use. In comparison, re-usable alternatives such as green bags, generally come at a cost to the consumer. In Sudan. plastic shopping bag consumption appears to be steadily increasing.

What makes plastic so convenient in our day-to-day lives – it's cheap and easy to find and use, resulting in one of our planet's greatest environmental challenges. Our oceans have been used as a dumping ground, choking marine life and transforming some marine areas into a plastic soup. In cities around the world, plastic waste clogs drains, causing floods and breeding disease. Consumed by livestock, it also finds its way into the food chain.

Plastic packaging accounts for nearly half of all plastic waste globally, and much of it is thrown away within just a few minutes of its first use. Much plastic may be single-use, but that does not mean it is easily disposable. When discarded in landfills or in the environment, plastic can take up to a thousand years to decompose.

a growing number of governments are taking action and demonstrating that all nations, whether rich or poor, can become global environmental leaders. Rwanda, a pioneer in banning single-use plastic bags, is now one of the cleanest nations on earth. Kenya has followed suit, helping clear its iconic national parks and save its cows from an unhealthy diet.

Learning from the experience of countries that have introduced bans and regulations on single-use plastics, this assessment analyses what has worked well, what hasn't, and why. This research is aimed to work as a tool to evaluate the Sudanese experience in single-use light plastic bags (less than 60microns) banning three years after the ban, taking Khartoum State as a case study area.

Plastic isn't the problem. It's what we do with it. And that means the responsibility is on us to be far smarter in how we use this miracle material.

1.2 Research Problem

The plastic bags waste littering cause health, environmental and esthetic problems. And it is significantly increasing in Sudan and becomes a pressing issue, especially with the increasing trend of using plastic bags.

However, no comprehensive policy has been so far advanced to obtain sustainable management system to control the life cycle of plastic bags or to minimize its effect on the health and environment.

1.3 Objectives of the research

The main Objectives of the research including: -

1. To assess the current situation in Khartoum state about the light weight bags bans.
2. To evaluate the Sudanese public environmental awareness about the plastic bags litter issue.
3. To identify appropriate steps to form a policy packages and technical approaches for sustainable management of plastic shopping bag waste.

1.4 Research questions

1. What is the current status of plastic bag waste pollution in Khartoum state?
2. What are the associated undesirable environmental impacts caused by plastic bags littering?
3. What are the factors responsible for increasing trend of the usage of plastic bags?
4. What are the applicable solutions for long term?
5. What are the recommended scenarios to obtain a sustainable use of plastic bags?

1.5 Research Methodology

The research adopted a descriptive design. This approach allowed the researcher to gather information, summarize, present and interpret it for the purpose of clarification. This study will be conducted on the ground of data collected from Khartoum state via interviews and questionnaires with key representatives of the plastic bags industry, the academic, governmental, and municipal sectors. The study used questionnaires to collect empirical data from the obtained sample size. Each item in the questionnaire was developed to fulfill a specific objective and research questions. The analysis was done as per questionnaires and all the empirical data that were collected. The results presented in tables and figures to highlight the major findings. They are also presented sequentially according to the research questions of the study. This information will be analyzed to determine the status of the problem, its root causes, major stakeholders and what has already been done in response to the issue. The experiences of other countries on the issue will be studied also to support in establishing sustainable plastic bags usage polices in Sudan. Finally, a comprehensive scenario will propose to provide the best plastic bags sustainable management system that suite with Sudan environment.

1.6 Research structural

This Research is divided in to five chapters as follow: -

- Chapter 1: introduction and objective of the research.
- Chapter 2: The literature review of related previous researches.
- Chapter 3: Including the experimental study.
- Chapter4: Show result of experiment and discussion.
- Chapter5: Including conclusion and recommendations.

Chapter Two

Literature review

Chapter Two

Literature review and background

2.1 Introduction

The middle of the last century witnessed a great development in the manufacture of some compounds and materials that were not known to man before, one of the most important of which was the production of plastic, which was used in all aspects of working life, due to the many advantages that it enjoys, the most important of which is the ease of formation and manufacture to suit with human daily and life needs.

The plastic industry in Sudan started in the seventies and has been continuously evolving until it now plays an important and significant role in the development process through the added value of agricultural, animal and industrial production, which represents the reality of modern and industrial life.

Plastic industries have become the complementary aspect of other industries and this in turn reflected on the growth of demand for industries plastics have led to the development of the plastics industries in terms of technology used, product quality and productivity. It is estimated that between one26 to five27 trillion plastic bags are consumed worldwide each year. Five trillion is almost 10 million plastic bags a minute. If tied together, they would go around the world seven times every hour and cover an area twice the size of France.

2.2 Plastic

Plastic is a lightweight, hygienic and resistant material which can be molded in a variety of ways and utilized in a wide range of applications. Unlike metals, plastics do not rust or corrode. Plasticity is the general property of all materials which can deform irreversibly without breaking but, in the class of moldable polymers, this occurs to such a degree that their actual name derives from this specific ability. Most plastics do not biodegrade, but instead photodegrade, meaning that they slowly break down into small fragments known as micro plastics. The fragmentation of large plastic items into micro-plastics is common on land such as beaches because of high ultra violet irradiation and abrasion by waves, while the degradation process is much slower in the ocean due to cooler temperatures and reduced ultraviolet exposure. The main categories of

plastic are thermosets and thermoplastics. The table (2.1) shows every category and its common types (Hana Mahmoud Abdel Qader , 2016).

Table (2.1): types of plastic

plastic	**Thermosets**	Thermosets are a family of plastics that undergo a chemical change when heated, creating a three dimensional network. After they are heated and formed, these plastics cannot be re-melted and reformed.	Polyurethane (PUR)
			Phenolic resins
			Epoxy resins
			Silicone
			Vinyl ester
			Acrylic resins
			Urea formaldehyde (UF) resins.
	Thermoplastics	Thermoplastics are a family of plastics that can be melted when heated and hardened when cooled. These characteristics, which lend the material its name, are reversible. That is, it can be reheated, reshaped and frozen repeatedly	Polyethylene Terephtalate (PET)
			Polypropylene (PE)
			Low Density Polyethylene (LDPE)
			High Density Polyethylene (HDPE)
			Polystyrene (PS)
			Expanded polystyrene (EPS)
			Polyvinyl-chloride (PVC)
			Polycarbonate Polypropylene (PP)
			Polylactic acid (PLA)
			Poly hydroxy alkanoates (PHA)

2.2.1 Single-use plastic

Single-use plastics or disposal plastics are the items intended for use only once before they are thrown away such as cotton-bud sticks, cutlery, plates, bottles, grocery bags, straws and sticks for balloons, cups, food, beverage containers made of polystyrene (EPA,2016), the main polymers used in the production of single-use plastics are shown in table (2.2).

Table (2.2) Main polymers used in the production of single-use plastics

Polymer type	Single use product
LDPE	Bags, trays, containers, food packaging film
HDPE	Milk bottles, freezer bags, shampoo bottles, ice cream containers
PET	Bottles for water and other drinks, dispensing containers for cleaning fluids, biscuit trays
PS	Cutlery, plates and cups
EPS	Hot drink cups, insulated food packaging, protective packaging for fragile items
PP	Microwave dishes, ice cream tubs, potato chip bags, bottle caps

2.2.2 Plastic bags

Plastic bag is type of container made of thin, flexible, plastic film used for containing and transporting goods such as foods, powders, ice, magazines, chemicals, and waste. It is a common form of packaging. plastic bags are made from different materials and each of these materials offers users specific characteristics. They also come in various mixed shapes and colors. The main types of plastic bags are shown in table (2.3).

Table (2.3): types of plastic bags and their uses.

Type of bag	Main characteristics	uses
High Density Poly Ethylene (HDPE) bags	-lightweight -relatively transparent. -water resistant. -temperature resistant -has high tensile strength	in restaurants, grocery stores in homes for storing and packaging purposes, garbage bags, utility bags, T-shirt bags, and laundry bags.
Low Density Poly Ethylene (LDPE) bags	-not as strong as HDPE bags. -capable of storing bulk items like food and meat products. -clear and easy to identify the contents. -highly versatile - low melting point.	-food bags. -bread bags -bags with moderate strength and stretch properties -use with heat sealing
Liner Low Density Poly Ethylene (LLDPE)	moderate degree of clarity	-newspaper bags. -shopping bags. -garbage bags. -food storage in freezers and refrigerators in commercial kitchens.
Medium Density Polyethylene (MDPE)	-low degree of strength. -low degree of stretch. -not preferred for the carrying or storing of bulk products	-garbage bags. -packaging for toilet paper or paper towels.
Poly propylene (PP)	- high strength. - chemical resistance. - not breathable - ideal for retail situations due to their longer shelf life. - clarity and visibility. - high melting point. -USDA and FDA approved for food handling	- food packaging like candies, nuts, herbs and other confectionaries. - for heat-sealing packaging.

2.3 The Environmental Impacts of Single-use thin Plastic Bags

Scientific research has shown that plastic materials cause a large number of health problems on living organisms, and it is one of the complex environmental problems. This risk is due to their basic components and to the additives added to them during the manufacturing and forming process to gain the required hardness, elasticity, color, or to make them resistant to the effects of light and heat. In addition, the disposal of plastic materials by conventional methods such as burning and landfilling results in a large number of gases and toxic substances, particularly dioxins, which directly affect living organisms and aquatic organisms.

The volume of that waste is increasing, and studies also show that more than 100 billion plastic bags are produced in the world annually, and that these bags end up in landfills which is one of the most dangerous types of waste because it does not decompose until after one thousand years according to scientific studies, it also represents a danger to the animal when it eats, and prevents photosynthesis of the plant by blocking sunlight, they also form numerous distortions of the environment as the properties of the chemical compounds of polyethylene are harmful to the soil. When burned, they become carcinogens materials. (Hafez Makki Muhammad Muhammad Abuh,2011).

Table (2.4): The Environmental Impacts of Single-use thin Plastic Bags

The impact	Affected	Description
Biological diversity	-woodland animals. -domestic animals such as sheep, goats, cows and fowls	-animals die through the taking in of plastic waste along as they graze in the fields. plastic bags are responsible for suffocation deaths as well as inhibiting soil nutrients.
Agriculture	Farm lands	- preventing crops to grow by cover the soil, preventing air penetration into it. -killing the soil organisms that help to tilt the farmlands. -a spark has the potential to hit a piece of litter like a paper bag which could start a fire.
Water bodies	-marine animals -marine plants	- polluting the water. -The plastics float on the surface of the water bodies preventing direct sunlight from the water organisms. - Marine animals are killed by plastic bags as they mistakenly eat them as food as Shown in the figures (2.1), (2.2) and (2.3) respectively. - the ingested plastic is freed back to the environment again to continue causing problems. - the residue left behind can harm the soil and leach into groundwater.
General health of human	- respiratory illnesses -cancer -food poisoning -hormonal imbalance. -disorders of the nervous system. -weak mental capabilities. -weakened immunity	- a breeding ground for insect vectors. -Mosquitoes, which breed in stagnant water, can transmit West Nile virus and malaria as shown in fig (2.6). - When burned they smolder for long periods of time emitting hundreds of chemical and compounds that pollute the air as shown in fig (2.5). -urea formaldehyde decomposes when exposed to sunlight or heat due to contact with hot foods and drinks. -the use of plastic containers in microwave ovens. especially food containing fats, since under high temperatures, emission of plastic dioxins occurs, mixing with food, which leads to the poisoning. -placing water in plastic bottles and cooling or freezing them in the refrigerator
Air pollution	Human animals and plants	-The smoke that comes out as a results of burning plastic litter contain (CO) and (CO2) gases
Visual pollution	Human	- disruptions to environmental quality and affect tourism (fig 2.7). - The blocking of the gutters and drains by plastic bags causes flooding whenever it rains, because the rain water cannot get access to flow away, fig (2.4).

The effect of plastic bags waste on aquatic organisms

Figure (2.1): a turtle eating plastic bag by mistake

Figure (2.2): whale's stomach full of plastic parts in Philippines

Figure (2.2): dead whale found with 40 kilograms of plastic bags inside

The effect of plastic bags waste on environment quality

Figure (2.4): plastic bags waste causing blockage of drains.

Figure (2.5): burning plastic waste emit toxic gases.

2.4 Status of plastic bag pollution in Khartoum and root cause

Problem in Khartoum State is only an indication of what has become a national problem. Most the major roads out of Khartoum as being lined with plastic bags more than grass, and all major shopping areas in the country covered in plastic. Bahri locality with its six sectors produces about 456 tons per day, 70% of them represents the waste of the population sector, and about 30% are industrial waste (Makki Abdullah 2011). More than 20 billion bags are consumed in Sudan every year, according to the report of the public opinion newspaper.

Environmentalists, top politicians, members of parliament, and ordinary people have repeatedly complained about the problem. These bags are not disposed in a way that ensure a clean environment. Littering of plastic bags is associated with a number of environmental problems in Sudan, most of which are also common to other countries.

A discussion with governmental officials indicated that the bags most responsible for littering are carrier bags of 60 microns. Although a shift has been made to 100 microns as per the Sudanese standard, littering still continues owing to lack of effective collection and recycling infrastructure.

Once disposed in the open environment, plastic bags tend to scatter with the help of wind due to their light weight, which also makes them difficult to collect. As a result, they have now littered road sides, open spaces and rivers in Sudan. In the Nail River, they are the major causes of blockage and stagnation. The accumulation of plastic bag waste increases year after year due to their poor degradability.

The manner in which people dispose plastic wastes is worrying. There is no well-organized way of disposal of solid wastes. People dispose the wastes in their own ways, wherever they find it necessary to dispose them. In some cases, people gather the plastics waste and set fire on the waste to burn the plastic waste which they pollute the air in the neighborhoods. consumer attitudes towards single-use and reusable bags are very important to study.

The effect of plastic bags waste on local markets vision

Figure (2.6): littering plastic bags in waste water

Figure (2.7): plastic bags waste scattering everywhere in local markets

2.5 Municipal Solid Waste in Khartoum

The volume of waste in the state of Khartoum is about 3500 tons per day, the proportion of plastic, an estimated 12.7%. As a result, the landfills are not sufficient to accommodate the different contents. The components of the waste are shown in the table (2.5).

The spread of plastic waste and its presence in the environment, as well as deal with this type of waste without a scientific manner is cause the increasing volume of domestic consumption in Khartoum State. That's needs a useful economic solution method for disposal or reuse. The most important of these methods is recycling and multiple purposes of use.

According to table (2.5), the proportion of plastic volume of the total volume of waste is 12.7%, and this is shown in fig (2.8).

Table (2.5): components of solid waste in Khartoum state

(MSW) TYPE	PERCENTAGE
card board	11.8
plastic	12.7
organic materials	49.5
dust & ash	13.4
Metals	1.7
Wood	0.2
Leather	0.4
Glass	3.5
cotton & hessian	4.6
Rubber	0.3
Other	1.9

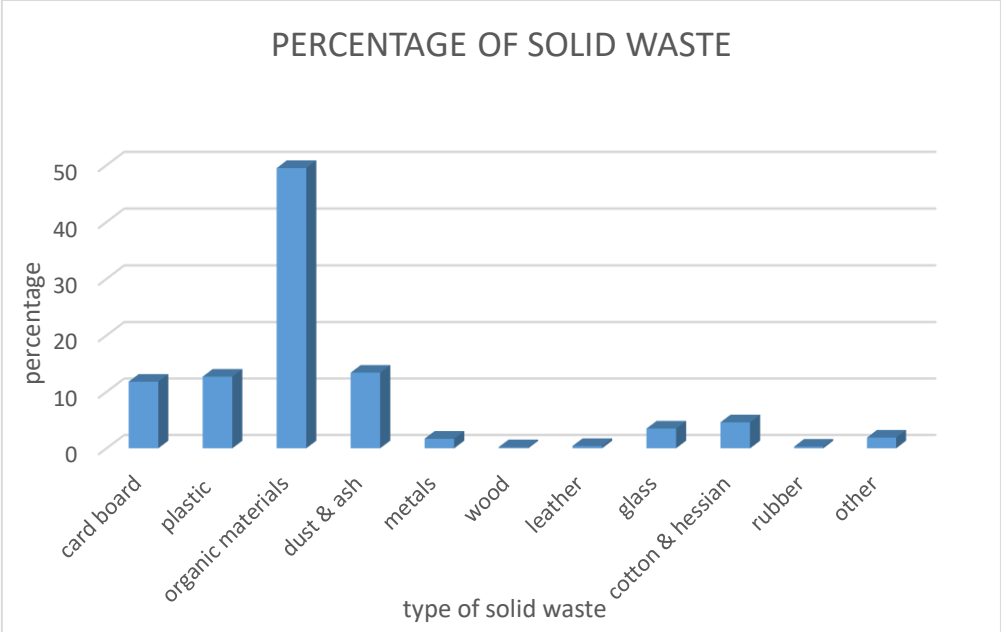


Fig (2.8): The percentage of plastic waste from the total (MSW) in Khartoum state

2.6 plastic industry in Khartoum

The plastic bags industry is considered one of the most important plastic industries in Sudan, because it covers many domestic, commercial and industrial uses. It indirectly contributes to completing the production cycle of many projects that need packaging operations. One of the important industries that use single use plastic bags are food industries, by means of packaging and garbage collection operations.

Currently in Sudan there are about 300 factories operating in the plastic industry sector, of which 155 factories currently operate with a design capacity of 625 thousand tons annually and operate at actual capacity 244 thousand tons annually equivalent to 39% of the design capacity, and these factories operate about 9320 workers, more than 90% of them are concentrated in The state of Khartoum and the rest in various states. These factories produce many products shown in table (2.6).

The plastic industry is based on raw material produced by Khartoum Petrochemical Company in Al-Jili area, which has a production capacity of 1500 tons per month of granules (ppt-pvc) of which monthly sugar factories use 300 tons

for touring, and rope factories 300 tons annually, while 900 tons are distributed to other industries. Since the local production is not enough for these factories, plastic factories resort to import polyethylene granules from abroad throughout the year , especially from Saudi Arabia.

The number of plastic bags factories located in Khartoum state is about 29 of the total factories operating in this industrial sector with a design capacity of about 200,000 tons and the volume of employment there is about 1500 workers and the presence of these factories is mostly concentrated in Omdurman as the number of factories has about twenty-two factories, as for Khartoum, there are about five factories, and there are two factories in Khartoum North all are shown in table (2.7).

Table (2.6): plastic factories in Sudan

no	product	No. of factories	Design capacity (ton)	Actual capacity (ton)	Productivity	labor
1	robe	26	45,000	23,000	50,000,000 cord	1500
2	Woven bag	7	13,244	6,244	62,440,000 bag	500
3	Pipe	8	90,000	40,000	12,000,000 pipe	871
4	Packaging	16	100,000	25,000	10,000,000 package	1500
5	Household utensils	20	75,000	18,000	120,000,000 piece	1500
6	Water bottles	10	50,000	12,500	30,000,000 bottle	700
7	Furniture	10	20,000	12,500	10,000,000 piece	700
8	Cartridge	10	175,000	5,000	5,000 ton	249
9	Bags	30	200,000	100,000	100,000 ton	1500
10	Cables	3	5,000	250	250 ton	40
11	Plastic mat	4	5,000	1,250	1,250 ton	40
12	Water puts	6	500	125	125 ton	35
13	Water tanks	5	1,000	250	250 ton	30

Table (2.7): plastic bags factories in Khartoum

No.	Name of the factory	location
1	Aboul Gheit factory for plastic packaging, advertising bags, and publications	Omm durman
2	Balbaid factory for plastic bags products	Omm durman
3	Tawil Star Plastic Factory	Omm durman
4	Rana Plastic Products Factory	Omm durman
5	Al-Fanoub Factory for the manufacture of plastic shoes, waste bags and sponges	Omm durman
6	Kampal Sponge and Plastic Products Factory	Omm durman
7	Man Plastic Factory	Omm durman
8	Al Sharifain Industrial Factory	Khartoum
9	Alwaedain factory for plastic products	Khartoum
10	Yes Plastic Factory	Omm durman
11	Al Bayariq Products Factory	Omm durman
12	Al-Safa Plastic & Sponge Factory	Omm durman
13	Abdul Majid Plastic Factory	Omm durman
14	Ibn Sina Plastic Bags Factory	Khartoum
15	Golden Arrow Factory for Plastic and Medical Packaging	Omm durman
16	Bright Light Plastic Products Factory	Omm durman
17	Al-Kaaki Factory for the manufacture of plastic bags	Omm durman
18	Moon Plastic Packaging Factory	Omm durman
19	Iltzam Plastic Factory	Omm durman
20	Al Astorah Plastic Products Factory	Khartoum
21	Sun Plastic Packaging Factory	Omm durman
22	Sahab Plastic Factory	Omm durman
23	Al-Jamed Factory for Paper Packs, Tissue Paper and PE Packs. Which . T. and plastic bags	Khartoum
24	Howaida Plastic Products Factory	Omm durman
25	Gilani Radwan Plastic Factory	Bahri
26	Express Plastic Products Factory	Omm durman
27	Al-Zaher Plastic Factory	Bahri
28	Jawa Plastic Products Factory	Omm durman
29	Al Wadi Plastic Factory	Omm durman

2.7 Plastic bag waste policy: experiences of others.

Several measures are being employed to reduce the negative impacts of plastic bags all over the world. These measures include recycling and ban of the production and distribution of these products. For economic and quality reasons, recycling has been found to be impractical. This results in the build-up of plastic bag wastes in environment, and has mounted the concern of many governments and environmentalists. The problem also prompted many countries to pass legislations to ban or impose economic instruments such as levies and taxes to restrict the use and production of plastic bags, Though, they are not as such effective, voluntary initiatives have also been attempted in some countries to reduce plastic bag use and/or plastic bag problems in environment (UNEP, 2005b) as shown in table (2.8) the wide spectrum of laws and tools to control the problem, figure (2.9) shows the national level plastic bag bans and Styrofoam regulations around the world. Sudan is one of the African countries that partially have banned plastic bags by setting a minimum thickness of the bags to be manufactured in the country. Also figure (2.10) and shows the usage of the polices by continent.

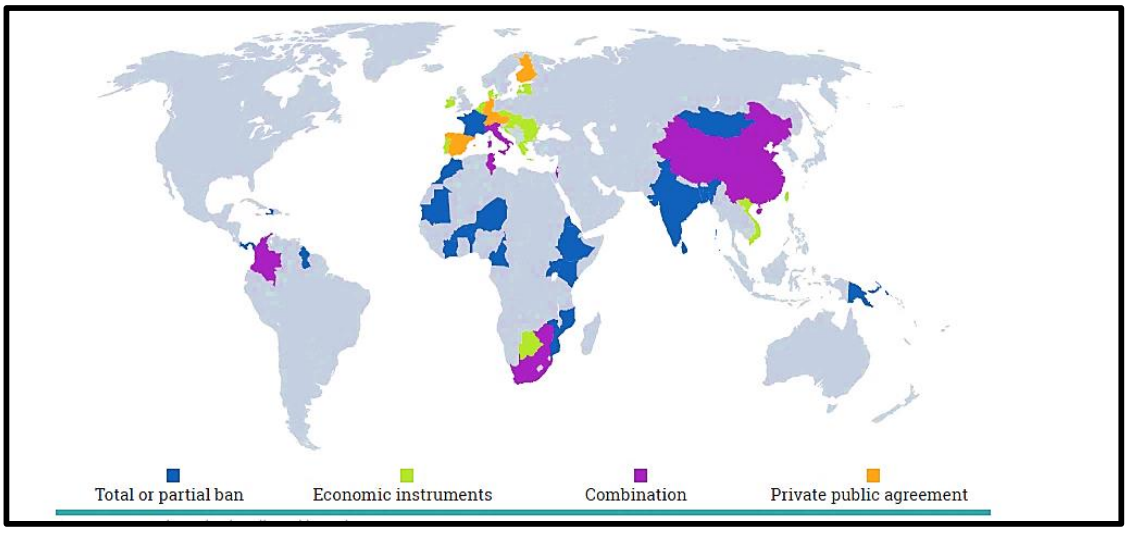


Figure (2.9): national level plastic bag bans and Styrofoam regulations

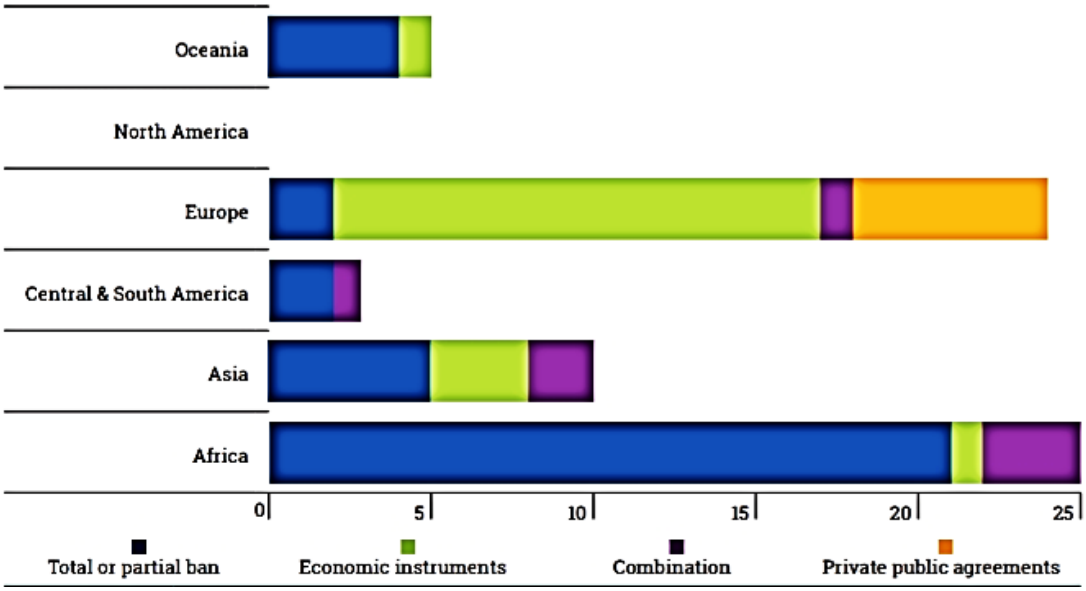


Figure (2.10): Types of national policies on plastic bags, by continent

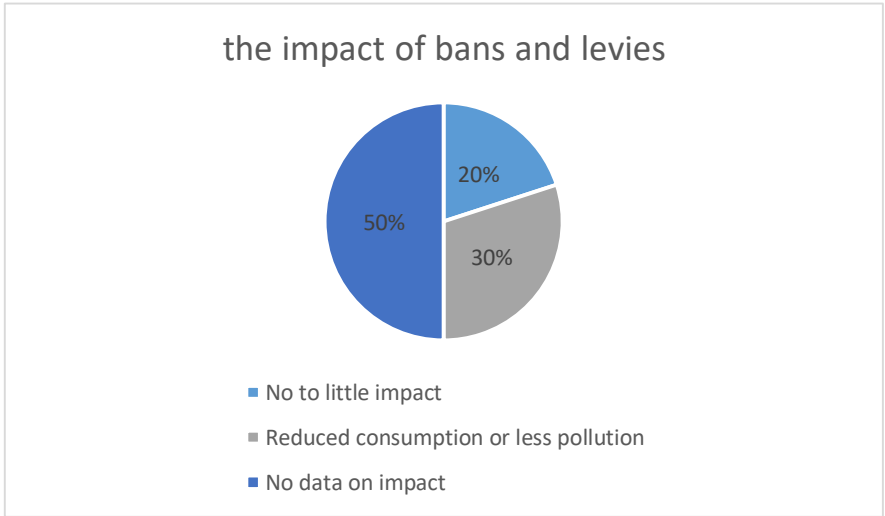


Figure (2.11): Impact of national bans and levies on plastic bag usage (based on more than 60 countries experience)

Table (2.8.): Policy tools to limit the use of plastic bags

Policy tools		Feature
Regulatory instruments	Ban	Prohibition of a particular Type or combination of single-use plastics (including plastic bags, foamed plastic products, etc.). The ban can be total or partial (for those of certain specifications, e.g. plastic bags <30µ thickness).
Economic instruments	Levy on suppliers	Levy paid by suppliers of plastic bags (domestic producers or importers). For such a tax to be effective in inducing behavioural change, it should be fully passed on from suppliers to retailers, enticing the latter to (i) charge consumers for plastic bags or (ii) offer a rebate/reward to consumers who do not ask for plastic bags, promoting the use of reusable ones.
	Levy on retailers	Levy to be paid by the retailer when purchasing plastic bags. The retailers are not obligated to convey the tax to the consumers
	Levy on consumers	Charge on each bag sold at the point of sale; standard price defined by law.
Combination of regulatory and economic instruments	Ban and levy	Combination of ban and levy (for instance a ban on thin plastic bags and a levy on thicker ones)

Table (2.9): Summary of some countries that have introduced regulations on plastic bags and Styrofoam products

Area	Country	Year	Action	Type	Features
Asia	Indonesia	2017	Government commitment	Memorandum of understanding	campaign organized by citizens to get plastic bags banned in Bali, the governor signed a memorandum of understanding to phase out plastic bags by January 2018. Impact: Information not available
	Thailand	2009	Public private campaign	Discount to consumers	Type: Local authorities initiated a 45-day campaign in Bangkok to reduce the consumption of plastic bags. Many supermarket chains, local markets and other stores took part in the campaign and offered a one-baht (around $0.03) discount for every purchase if they brought their own cloth bags. In 2009, the campaign targeted a cutback of 4.4 million plastic bags (Corporal, 2010). Impact: Information not available
Europe	Luxembourg	2004	Public private agreement	Levy	85 brands participate in the "Eco-sac" initiative, a cooperate project between the Ministry of the Environment, the Trade Confederation and the non-profit association to reduce the consumption of lightweight plastic bags by replacing them with a reusable bag. Impact: Plastic bag consumption dropped by 85% in nine years and the Eco-sac has replaced most free plastic bags at supermarkets.
	Switzerland	2016	Public private agreement	Levy	largest supermarket chains introduced a plastic bag levy based on a voluntary agreement, which was approved by the parliament as an alternative to a total ban. Impact: Demand for plastic bags dropped by 80-85%
North America	Canada	2016	Private initiative	Levy	A big supermarket chain announced that it will start charging consumers CAD 0.05 per single-use plastic bag and CAD 0.25 per reusable bag . Impact: Information not available
Oceania	Australia	2017	Private initiative	Ban or levy	Some major supermarkets announced that they will phase out lightweight plastic bags or provide bags but charge AUD 0.15 ($0.12) per bag. Impact: Information not available

Table (2.10): Summary of African countries that have introduced regulations on plastic bags and Styrofoam products

Country	Year	Level	Policy	Features
Chad	2010	Local – N'Djamena	Ban –entered into force	Type: Ban on the importation, sale, and use of plastic bags in the capital city, N'Djamena.65 Impact: Less observable plastic pollution in the city.
Egypt	2009	Local – Hurghada	Ban –entered into force	Type: Ban on the use of plastic bags in Hurghada. Distribution of 50,000 cloth bags for free by the Environmental Protection and Conservation Association, together with letters explaining the health and environmental reasons behind the campaign (Zohny, 2009). Impact: Information not available
Eritrea	2005	National	Ban – entered into force	Type: Ban on the importation, production, sale, and distribution of plastic bags. Impact: Problems associated with plastic bags, such as the blockage of drains and water pipes, dramatically decreased.
Ethiopia	2007	National	Ban – entered into force	Type: Ban on production and importation of non-biodegradable plastic bags <30µ (Ethiopian News Agency, 2016). Impact: Enforcement unclear.
Mali	2012		Ban approved	Type: Ban on the production, importation, possession, sale and use of non bio-degradable plastic bags. Impact: The ban was adopted in 2012, but has not yet entered into force.
Morocco	2009	National	Ban – entered into force	Type: Ban on the production, importation, sale and distribution of black plastic bags. Impact: Although only considered partially successful, the law is considered an important step forward.

	2016	national	Ban entered into force	Type: Ban on the production, importation, sale and distribution of plastic bags. Impact: 421 tons of plastic bags were seized in one year. Citizens have switched to fabric bags. The Moroccan government declared that plastic bags are virtually no longer used in the country.
Somalia	2015	Local – Somaliland	Ban – entered into force	Type: Ban on disposable plastic bags in Somaliland67 (Masai, 2015) Impact: Despite the law, plastic bags are still widely used (Hasan, 2017).
South Africa	2003	National	Ban – entered into force	Type: Ban on plastic bags <30µ and levy on retailer for thicker ones. Impact: In the first phase the consumption of plastic bags fell, but then increased again due to lack of enforcement.
	2006	Local – Zanzibar	Ban – entered into force	Type: Ban on the importation, distribution and sale of plastic bags <30µ. (IRIN, 2006) Impact: Information not available
Tunisia	2017	national	Ban and levy – entered into force	Type: Ban on the production, importation and distribution of single-use plastic bags in major supermarkets and levy on consumers on thicker ones (>50µ)68. Impact: Information not available
	2017	national	Ban – entered into force	Type: Ban on Styrofoam products Impact: Ban temporary lifted shortly after its introduction to allow businesses more time to replace Styrofoam containers with recyclable or biodegradable ones69.

2.7.1 Rwanda the pioneer in Africa total plastic bags ban

In 2004, the Rwandan Ministry of Environment, concerned by the improper disposal of plastic bags, as they were often burned or clogged drainage systems, commissioned a baseline study which revealed that plastic bag litter was threatening agricultural production, contaminating water sources, killing fish and creating visual pollution. In 2008 the Rwandan government banned the manufacturing, use, sale and importation of all plastic bags. Paper bags replaced plastic ones, and citizens also started using reusable bags made of cotton. Along with the new ban, tax incentives were provided to companies willing to invest in plastic recycling equipment or in the manufacturing of environmentally friendly bags.

After the entry into force of the ban, investments in recycling technologies were lacking, as were good and cheap alternatives. As a result, people started smuggling plastic bags from neighboring countries and a lucrative black market emerged. With time, enforcement of the law became stricter, and if caught, offenders would face high fines and even jail. In the long run, citizens became used to the new regulation and, Kigali, the capital of Rwanda, was nominated by UN Habitat in 2008 as the cleanest city in Africa. (UNEP,2018)

2.7.2 Kenya experience

Kenya is also taking firm steps to strictly enforce the ban. David Ongar, director of Kenya's Environmental Affairs Agency, told DW channel that his country is ready to renew the ban again in the future until it reaches its desired outcome.

To further enforce the ban, the Kenyan government has organized awareness campaigns for citizens, whether through the media or NGOs, to achieve the best possible results. Ongar pointed to the ongoing negotiations with the companies producing plastic bags with a view to joining all efforts to make the ban a success.

The Kenyan official said there had been 27 rounds of negotiations since the ban came into force in March. "Kenya is a country of tourism, fishing and livestock. These sectors have suffered as a result of the circulation of plastic bags," Ongar said. (Theuri Donald Wachira, 2013)

2.8 alternatives to reduce single-use plastic bags

There is no way to strictly limit the effects of plastic bags on the environment because there is no disposal method that will really help eliminate the problem. While reusing them is the first step, most people either don't or can't re-use them. Plastic bags are not durable enough to stand up to numerous trips to the store so often the best that citizens can do is reuse them. The biggest problem with this is that once they have been soiled they end up in the trash, which then ends up in the landfill or burned. Either solution is very poor for the environment.

2.8.1 Reusable bags

The terms reusable bags, often called “bags for life”, comprises bags made of any material that are meant to be used from several to hundreds of times. Usually these are commercially produced in materials like cloth, woven, jute, canvas, hemp, synthetics, thicker plastics. When comparing with single-use plastic bags, these require more energy and resources per bag but if used several times, as intended, the environmental footprint becomes lower and lower after each use.(Javier López-Murcia Martín , 2015)

2.8.2 Paper Bags

Paper bags have a higher recycling rate although it takes almost twice the same energy to recycle one pound of paper than a pound of plastic and four times more energy to produce one paper bag compared to a plastic one. In addition, high pressures would be put into forests if all plastic bags were substituted by paper ones. Fuel used for transportation is seven times higher when carrying the same amount of paper bags than plastic ones, and the amount of fresh water used for paper bags is much higher as well.

2.8.3 Biodegradable Bags

Biodegradable bags are produced as an alternative to traditional plastic bags. These are designed to naturally degrade by activity of microorganisms like fungi, algae and bacteria and made from synthetic or biologically produced polyesters like sugarcane, corn or potatoes. There are three types of categories under the term

"biodegradable" regarding plastics: starch-polyester, poly-lactic acid (PLA) and polyethylene with additives that accelerate the degradation.

As shown in Table (2.11) the three categories require certain conditions for an effective degradation. When comparing the different types of single-use bags, independently of which material they are made of, and reusable bags, the latter have proved to cause lower impacts into the environment in case of actually being used several times.

Table (2.11): Descriptions of biodegradable bags categories

Category	Composition	Degradation Pathway	Suitable environments for degradation
Biodegradable Starch-based Polymers	Starch polyester (PCL,PLA,PBAT or AAC) blends	Hydrolysis by hydrolytic scissions of the ester bonds in the chain backbone.	Compostable biodegradable and marine degradable suitable for degradation in controlled composting facilities, activated sludge (sewage treatment). Also degrades in soil.
Biodegradable polyesters	Poly lactic acid (PLA)	As above	As above apart from composting at (˚80C) within time limit for standard.
Controlled degradation master batch additives	Poly ethylene with a prod rant additive	Two stage process in sequence, including oxidative degradation witch is normally a biotic in the first instance.	Insufficient data but appear to be slow to degradation compost and landfill. Fragment into fine residue in open air.

Chapter Three

Research Design and Methodology

Chapter Three

Research Design and Methodology

3.1 Introduction

The objective of this survey was to assess usage of plastic bags and their environmental impacts in Khartoum State of Sudan. In order to reflect the most accurately possible the social perceptions of the Sudanese population regarding single-use plastic consumption, a questionnaire was designed and interviews conducted. A semi-structured questionnaire was used to collect data from 444 randomly selected respondents. This method is appropriate for collecting data with large number of respondents in many locations, when the information required from the respondents is fairly brief.

This research chooses a method that allows the collection of quantitative data at the same time that provides opportunity to gather some qualitative data. Thus, the questionnaire consisted of close-ended questions with some of them containing an open-ended question. The first type provides standardized, pre-coded answers and data accuracy and the second allows for more scope for respondents to give answers that reflect better their real opinion. The questions consisted of multiple choice and scale ones, where considered suitable.

The software Microsoft Word 2010 was used for the creation of the questionnaire and SPSS for the tabulation of data and creation of graphs was considered appropriate.

3.2 Research design

This study employed a descriptive research design that collecting data in order to answer questions concerning the current status of the study subject. Descriptive research designs are used in preliminary and exploratory studies to allow researchers to gather statistical information, summarize, present and interpret it for the purpose of clarification. The steps involved in descriptive research are: formulating the objectives of the study, designing the method of data collection, selecting the sample, data collection and analyzing the results, (Borg ,1989). All the steps of descriptive research in his study in evaluating the problem of plastic

bag littering at Khartoum State Township and the social-economic hazards of plastic bag littering.

The design attempted to describe such things as sample of population in relation to behavior of plastic bag littering, attitudes, values and characteristics as it exists at Khartoum State. The design was concerned with the collection, organization, description and analysis of plastic bag littering data from the sample and making inference to the entire population. Its objective was to get a snapshot view of social-economic hazards of plastic carrier bag litter as it is on the ground at Khartoum State to find the main causes of the problem.

3.3 Description of the Study area

This study is conducted in the State of Khartoum. It is one of the eighteen states of Sudan. Although it is the smallest state by area (22,142 km^2) , it is the most populous (7,152,102 in 2008 census) composed of various tribes of the Sudan. It contains the country's second largest city by population, Omdurman, and the city of Khartoum, which is the capital of the state as well as the national capital of Sudan. The capital city contains offices of the state, governmental and non-governmental organizations, cultural institutions, and the main airport. The city is located in the heart of Sudan at the confluence of the White Nile and the Blue Nile, where the two rivers unite to form the River Nile. The state lies between longitudes 31.5 to 34 °E and latitudes 15 to 16 °N. It is surrounded by River Nile State in the north-east, in the north-west by the Northern State, in the east and southeast by the states of Kassala, Qadarif, Gezira and White Nile State, and in the west by North Kurdufan as shown in figure (3.1) . sabah 'ahmad alsaadiq eabd almanan, 2017-2018

Figure (3.1): Khartoum state location

3.4 Targeted Population

Population refers to an entire group of individuals having common observable characteristics which the researcher wants to generalize the results of the study. In this study targeted population estimated to be 6,014,132 from all ages living in the peri-urban centres of Khartoum State at seven localities shown in figure (3.2)

The population is 79% urban and 74% of the state's population reported their region of origin to be outside Khartoum Most of the population works in government service, the private sector, and banking. There is also a large number of merchants, and migrants and displaced people working in marginal activities. In the countryside most people are engaged in agriculture and grazing and thus supply the capital, Khartoum, with vegetables, fruits, and dairy products. There are also some residents living on the banks of the rivers engaged in the trades dependent on the rivers, such as pottery, brick-making and fishing. Table (3.1) shows the number of population in each state (Hafez Makki Muhammad Abuh,2011).

Table (3.1): localities of Khartoum state

Locality	No. of population
Khartoum	745.938
Jabal Awlia	1.703.950
Omdurman	508.401
Umbada	1.500.000
Karary	750.000
Khartoum North	533.700
East Nile	1.184.000

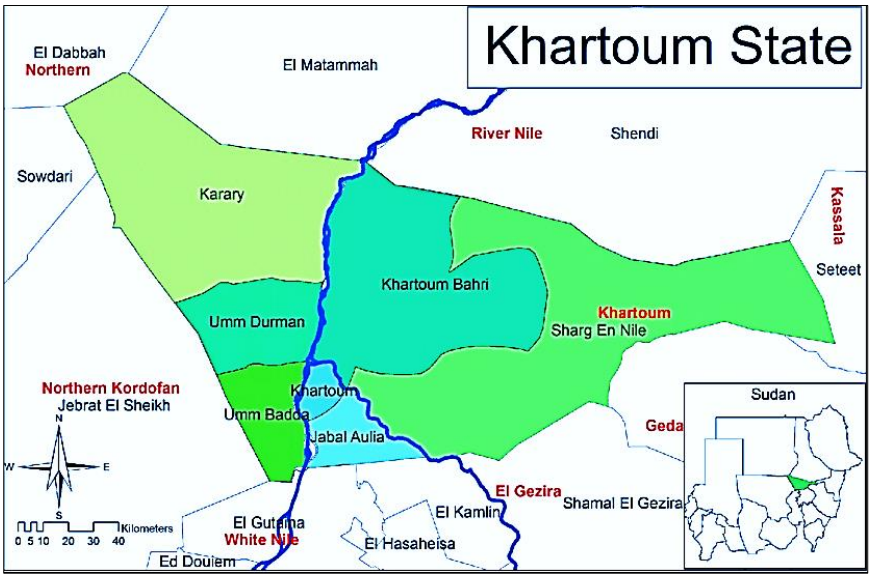


Figure (3.2): localities of Khartoum state

3.5 Sample Size

A sample is a smaller group contained from the accessible population. Each member or case in the sample is called “respondent” or “interviewees”. The researcher conducted his research along the seven localities. The researcher proportionated sampling to select 444 participants. The Researcher also interviewed governmental employees who were key in informing the study about the views of other people about the hazards of plastic bag litter.

3.6 Sampling technique

Data were collected from 444 respondents that consisted of 196 males and 239 females. The study subjects were selected using random sampling technique.

Before handing the final questionnaire among potential respondents, fifteen questionnaires were handed to a test group which, after having filled them up, provided valuable feedback. Corrections were made regarding the overall length of the questionnaire and several questions less relevant to the research were excluded while others were reformulated. The fifteen responses gathered from the test group were not included in the total for the final questionnaire.

To collect the data, semi-structured questionnaires were prepared. (Appendix A). Prior to the administration of the questionnaires, conversations were held with the selected respondents to explain the objective of the research. An electronic questionnaire has been collected also. Those respondents who were willing but not able to attend the questionnaires by themselves were helped by data collectors.

3.7 data collection Procedure

The study used questionnaires to collect empirical data from the obtained sample size. Each item in the questionnaire was developed to address a specific objective and research questions. The kinds of questions contained in the questionnaire was be structured (closed-ended), unstructured (open- ended), or contingency questions. The structured questions had a list of all possible alternatives from which the respondents selected the answer that best described their situation while unstructured questions gave the respondent complete freedom to respond to the question in his or her words. Contingency questions are subsequent questions that the researcher employed to probe for more information. The sample of questions and interview with the group of regulatory bodies governing control of plastic litter in Sudan is attached as Appendix A.

3.8 Questionnaire structure

Instructions at the beginning of the questionnaire were facilitated, which included a short description of the purpose of it and a confidentiality statement. The language used in the survey was easy to understand and questions were formulated as short as possible to avoid loss of interest from the respondents. Arabic was chosen as the most suitable language. The questionnaire consisted of 17 questions divided into four parts:

Part 1: Demographic profile of the respondent.

Part 2: Consumption behavior of the respondent (questions 1-7)

Part 3: Environmental impacts awareness (questions 8-16)

Part 4: self-opinion and suggestions and willingness to reduce consumption (questions 17-23)

Some interviews were also conducted with some governmental employees whom related to the research problem to find out their opinions and get more possible actions from the practical views of them.

3.9 Data analysis

Data analysis is the process of bringing order, structure the mass of information collected. It involves examining what has been collected and making deductions and inferences. This study employed descriptive statistics to analyze the data obtained. The social data included respondents' background, causes of plastic bag littering, the extent of plastic bag litter, effects of plastic bag litter and the possible solutions to plastic bag littering. Descriptive statistics involved the collection, organization and analysis of all data relating to some population or sample under study.

For quantitative data analysis processing and editing ensured that the data collected is free from inconsistencies and any incompleteness. Finally, content analysis which involved identify the main themes, and classify responses under the main themes was to analyze qualitative data.

The results of the descriptive research are represented by use of frequency charts, graphs, and pie charts to tabulate the information gathered appropriately. Analysis of the collected data was carried out using SPSS program.

Chapter Four

Results and discussion

Results and discussion

4.1 General

This chapter presents the data analysis and interpretation of the results. The analysis was done as per questionnaires that were used to the collect data. The study targeted a population of 444 respondents and they all responded giving a response rate of 100% which is sufficient enough for the study. Data collected from the field was sorted and later analyzed using SPSS software. The results are presented in tables and figures to highlight the major findings. They are also presented sequentially according to the research questions of the study. Mean scores and standard deviations analysis was used to analyze the data collected. The raw data was coded, evaluated and tabulated to achieve clearly results.

4.2 Presentation of Result

The respondent demographic profile is shown in tables (4.1) and analyzed in figures (4.1-4.8). the consumption behavior of respondent's information is shown in table (4.2- 4.6) and analyzed graphically in figure (4.9-4.26). table (4.7-4.10) represents the general environmental awareness of respondents and figures (4.27-4.32) shown the statistical analysis graphically. Finally, table (4.11) represent the opinion of respondents about voluntary initiatives, use of plastic bags in the future and decision of ban light bags in achieving goals, while figures (4.33-4.38) explain the information's graphically.

Table (4.1): Demographic profiles of respondents of survey

Variable	Categories	Frequency	Percent
Sex of Participant	Male	196	45.1%
	Female	239	54.9%
Age group	<20 years	25	5.7%
	20 to 29 years	194	44.6%
	30 to 39 years	162	37.2%
	40 to 49 years	47	10.8%
	More than 50 years	7	1.6%
Marital status	single adult	247	56.8%
	adult parent with family	188	43.2%
Educational status	primary education	1	0.2%
	high school education	11	2.5%
	higher education	246	56.6%
	Post Graduate	177	40.7%
Occupation	student	94	21.6%
	government employee	79	18.2%
	private sector	117	26.9%
	private job-daily laborer	43	9.9%
	housewife	51	11.7%
	Other	51	11.7%
Residential area	Khartoum	155	35.6%
	Jabal awlia	46	10.6%
	Omdurman	70	16.1%
	Umbada	16	3.7%
	Karary	23	5.3%
	Khartoum north	77	17.7%
	East Nile	48	11.0%
Location of work	Housewife	9	2.1%
	Khartoum	389	89.4%
	Outside of Khartoum	6	1.4%
	Outside of Sudan	8	1.8%
	Student	4	0.9%
	Unemployed	19	4.4%
Years on Khartoum	Less than 5 years	40	9.2%
	From 5 to 9 years	63	14.5%
	From 10 to 19 years	112	25.7%
	More than 19 years	220	50.6%
Total		**435**	**100.0%**

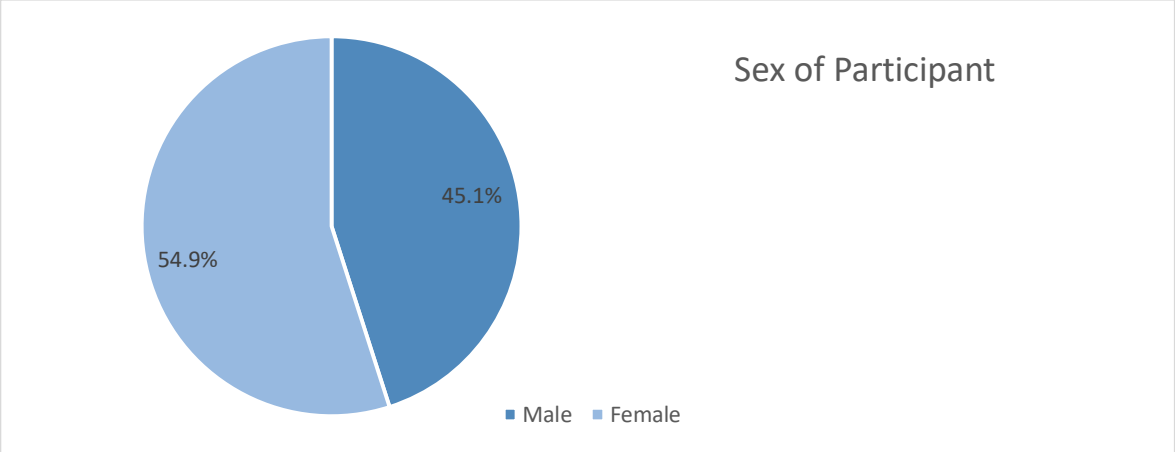


Figure (4.1): Sex of participants

Above table and figure shows that 45.1% of participant are male, and 54.9% of participant are female.

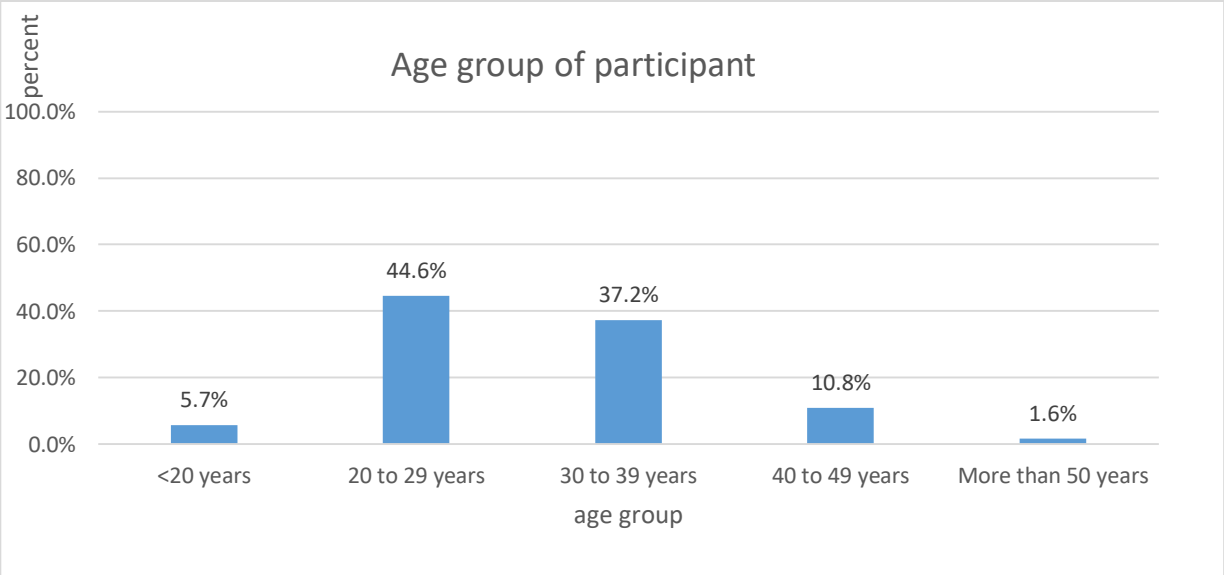


Figure (4.2): Age group of participants

More of age classes of participants between 20 to 29 years with percent 44.6%, 47.2% their ages between 30 to 39 years, 5.7% are less than 20 years, 10.8% from 40 to 49 years, and 1.6% are greater than 50 years.

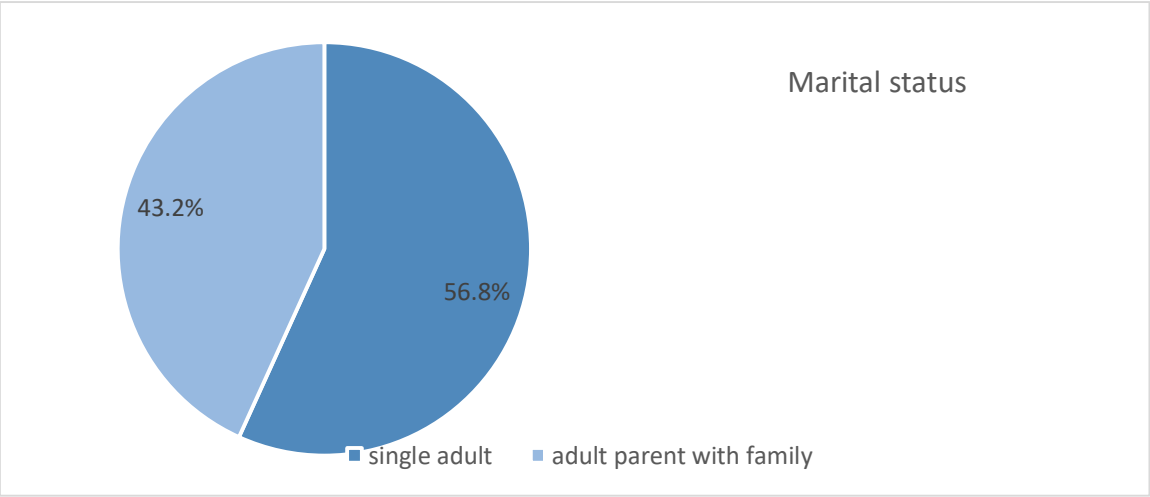


Figure (4.3): Marital status of participants

The above figure shows there is 56.8% of participants are single adult, and 43.2% are adult parent with family.

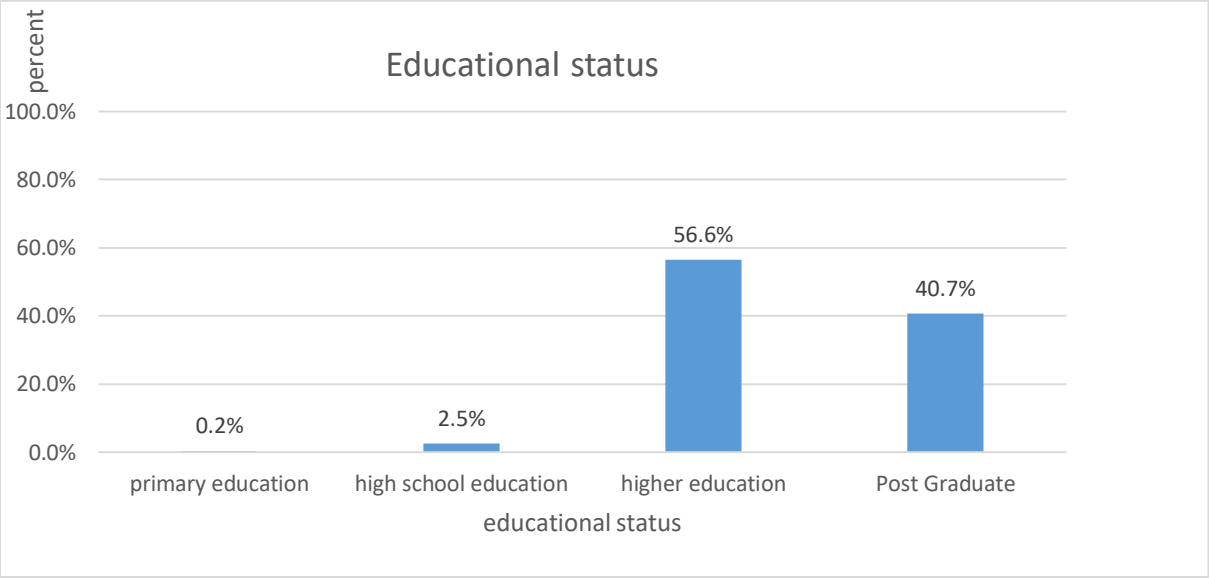


Figure (4.4): Educational status of participants

Figure (4.4) shows there is 56.6% of participants have higher education, 40.7% have a post graduate certificate, 2.5% have high school, and 0.2% have primary school.

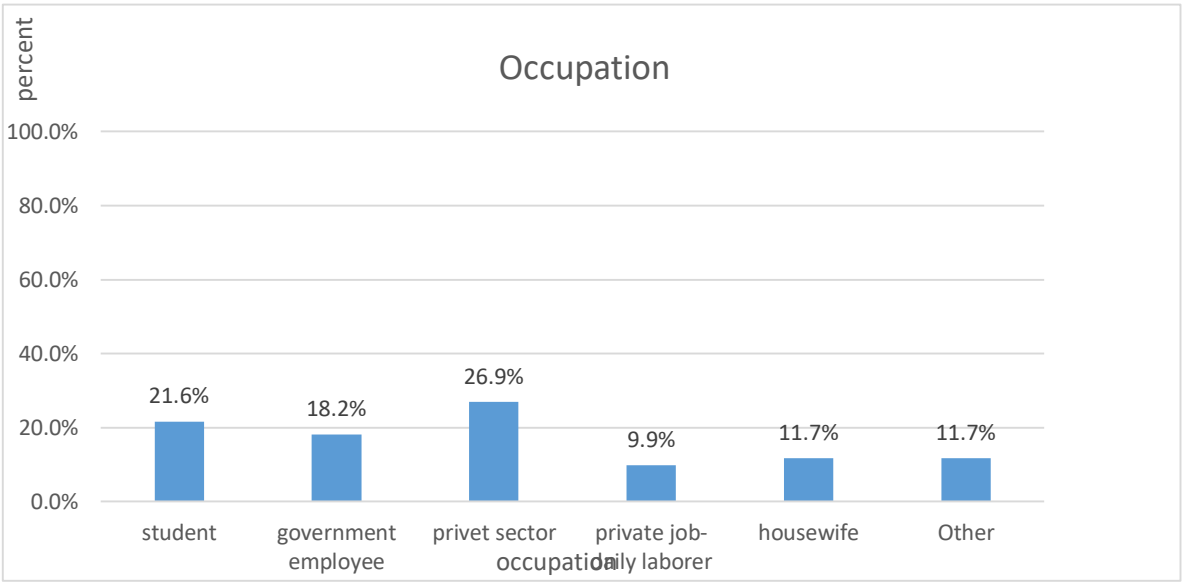


Figure (4.5): Occupation of participants

21.6% of sample are students, 18.2% are working in government sector, 26.9% working in private sector, 9.9% are working in private job or daily laborer, 11.7% are housewife, and 11.7% are working in other job.

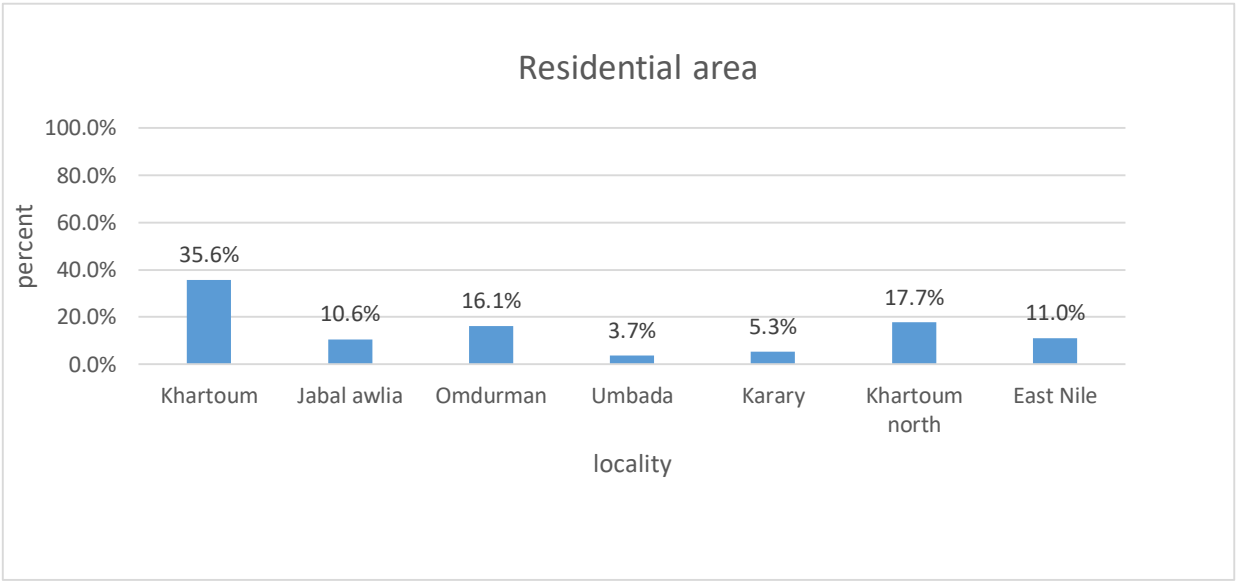


Figure (4.6): Residential area of participants

35.6% of participant are live in Khartoum locality, 10.6% from Jabal awlia, 16.1% from Omdurman, 3.7$ from Umbada locality, 5.3% from Karary locality, 17.7% from Bahri (Khartoum North), and 11% are live in East Nile.

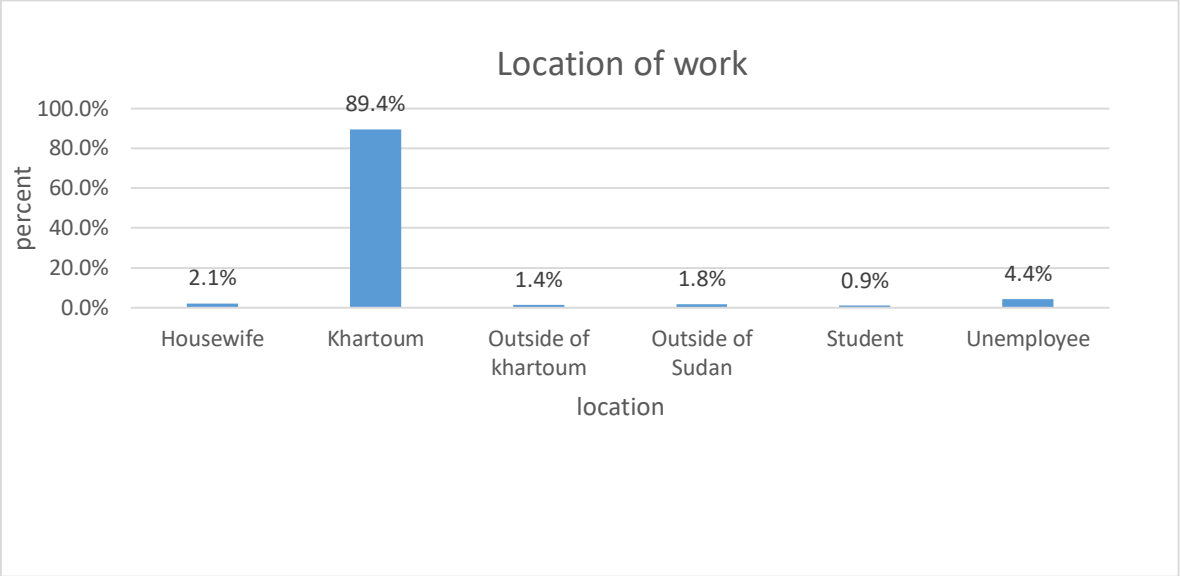


Figure (4.7): Location of work

89.4% of sample are work at Khartoum state, 2.1% are housewife, 1.4% work outside Khartoum, 1.8% work outside of Sudan, 0.9% are student, and 4.4% are unemployed.

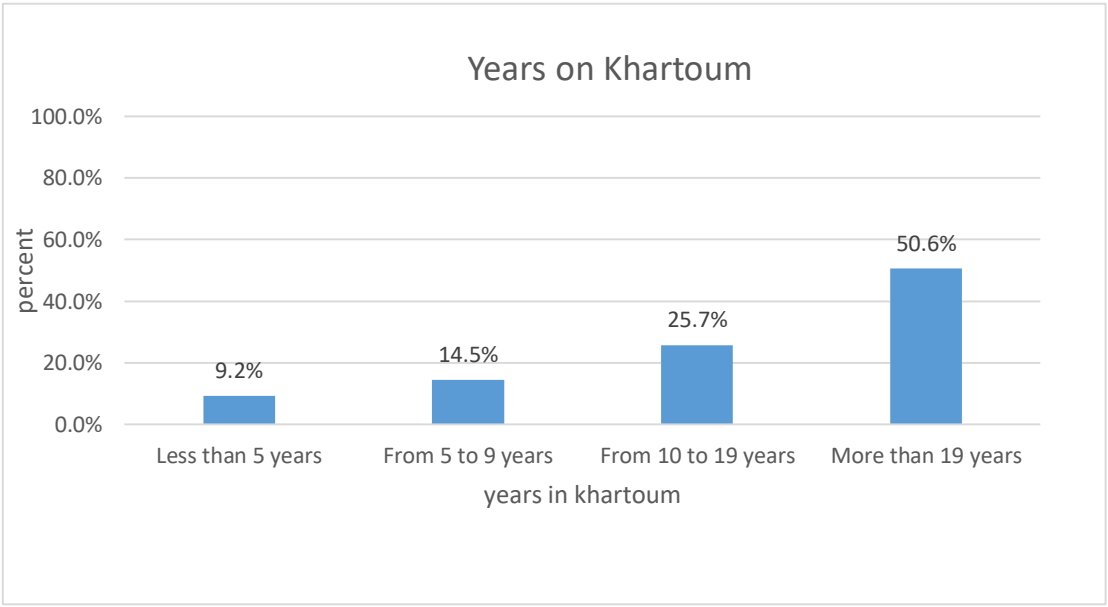


Figure (4.8): Years on Khartoum

More than half participants had years in Khartoum is greater than 19 years with percent 50.6%, 9.2% less than 5 years, 14.5% from 5 to 9 years, 25.7% from 10 to 19 years.

Table (4.2): Types of plastic products commonly used

Category	Frequency	Percent
Bags	418	66.9%
cups & plates	23	3.7%
Bottles	143	22.9%
Packaging	41	6.6%

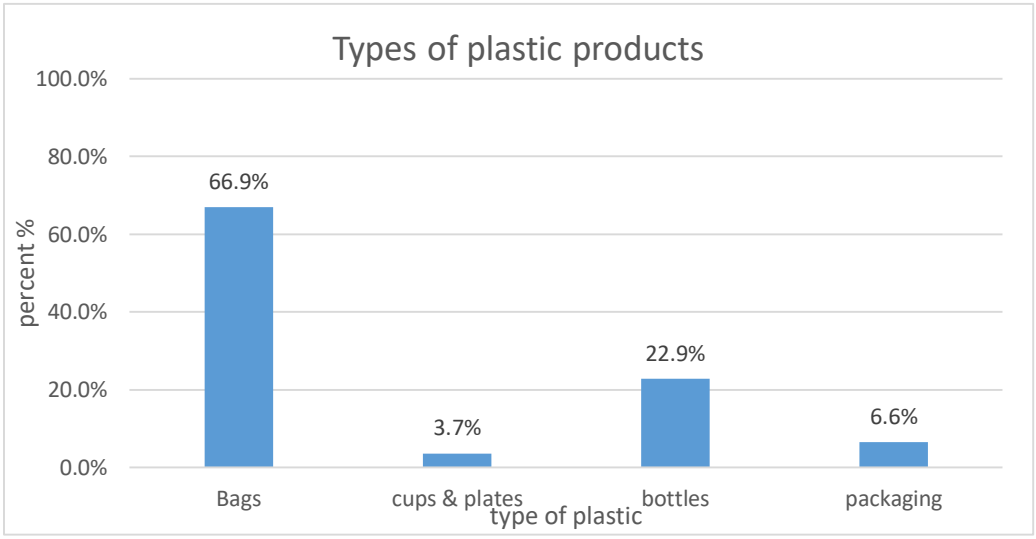


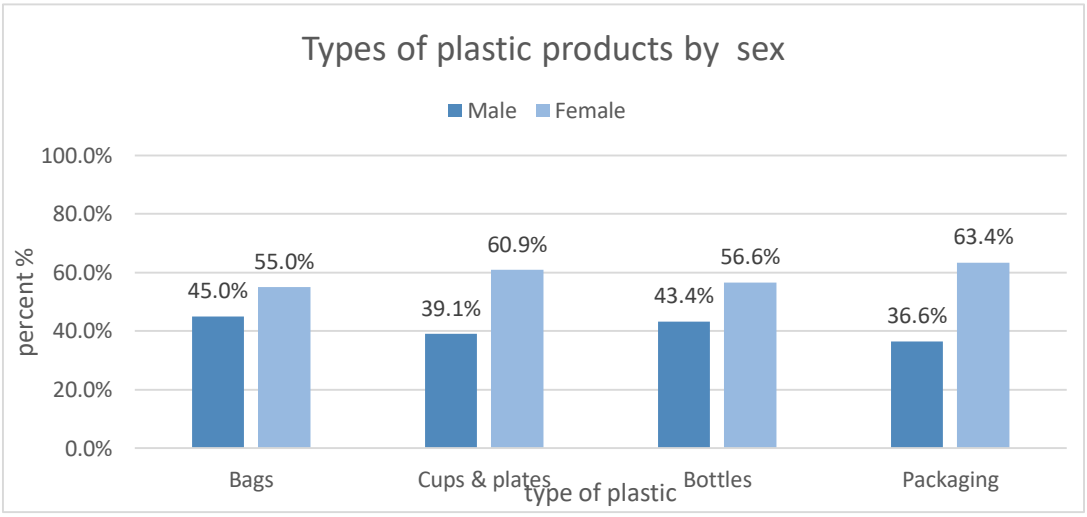
Figure (4.9): Type of plastic product common used

Of the 435 respondents, the largest proportion of them (418, 66.9%) used bags in high frequency as compared to other plastic products, (143, 22.9%) used bottles, (23, 3.7%) used cups & plates, and (41, 6.6%) used packaging.

Table (4.3): Types of plastic products commonly used by demographic variables

Variable	Category	Bags No. (%)	Cups & plates No. (%)	Bottles No. (%)	Packaging No. (%)
Sex of Participant	Male	188(45.0%)	9(39.1%)	62(43.4%)	15(36.6%)
	Female	230(55.0%)	14(60.9%)	81(56.6%)	26(63.4%)
Age group	<20 years	23(5.5%)	1(4.3%)	10(7.0%)	2(4.9%)
	20 to 29 years	186(44.5%)	15(65.2%)	81(56.6%)	17(41.5%)
	30 to 39 years	157(37.6%)	5(21.7%)	40(28.0%)	17(41.5%)
	40 to 49 years	45(10.8%)	2(8.7%)	12(8.4%)	4(9.8%)
	More than 50 years	7(1.7%)	0(0.0%)	0(0.0%)	1(2.4%)
Marital status	single adult	233(55.7%)	15(65.2%)	101(70.6%)	19(46.3%)
	adult parent with family	185(44.3%)	8(34.8%)	42(29.4%)	22(53.7%)
Educational status	primary education	1(.2%)	0(0%)	0(0%)	0(0%)
	high school education	10(2.4%)	0(0%)	2(1.4%)	0(0%)
	higher education	238(56.9%)	12(52.2%)	91(63.6%)	21(51.2%)
	Post graduate	169(40.4%)	11(47.8%)	50(35.0%)	20(48.8%)
Occupation	Student	87(20.8%)	9(39.1%)	44(30.8%)	11(26.8%)
	government employee	77(18.4%)	4(17.4%)	28(19.6%)	4(9.8%)
	privet sector	111(26.6%)	4(17.4%)	35(24.5%)	13(31.7%)
	private job-daily laborer	42(10.0%)	2(8.7%)	13(9.1%)	2(4.9%)
	Housewife	51(12.2%)	3(13.0%)	10(7.0%)	6(14.6%)
	Other	50(12.0%)	1(4.3%)	13(9.1%)	5(12.2%)
Residential area	Khartoum	148(35.4%)	9(39.1%)	55(38.5%)	17(41.5%)
	Jabal awlia	43(10.3%)	4(17.4%)	15(10.5%)	4(9.8%)
	Omdurman	68(16.3%)	2(8.7%)	24(16.8%)	3(7.3%)
	Umbada	15(3.6%)	0(0%)	2(1.4%)	0(0%)
	Karary	22(5.3%)	1(4.3%)	6(4.2%)	2(4.9%)
	Khartoum north	75(17.9%)	4(17.4%)	20(14.0%)	10(24.4%)
	East Nile	47(11.2%)	3(13.0%)	21(14.7%)	5(12.2%)
Location of work	Housewife	9(2.2%)	0(0%)	1(0.7%)	1(2.4%)
	Khartoum	372(89.0%)	21(91.3%)	131(91.6%)	34(82.9%)
	Outside of Khartoum	6(1.4%)	0(0%)	3(2.1%)	0(0%)
	Outside of Sudan	8(1.9%)	0(0%)	2(1.4%)	1(2.4%)
	Student	4(1.0%)	0(0%)	0(0%)	1(2.4%)
	Unemployee	19(4.5%)	2(8.7%)	6(4.2%)	4()
Years on Khartoum	Less than 5 years	38(9.1%)	1(4.3%)	15(10.5%)	1(2.4%)
	From 5 to 9 years	61(14.6%)	4(17.4%)	25(17.5%)	6(14.6%)
	From 10 to 19 years	107(25.6%)	9(39.1%)	35(24.5%)	12(29.3%)
	More than 19 years	212(50.7%)	9(39.1%)	68(47.6%)	22(53.7%)
Total		**418(100%)**	**23(100%)**	**143(100%)**	**41(100%)**

Figure (4.10) Type of plastic product common used by sex



Of 413 was use Bags (55% are female), (45% are male), of 23 was use cups and plates (60.9% are female), (39.1% are male), of 143 was using Bottles (43.4% are male), (56.6% are female), and of 41 was use packaging 36.6% are male, 63.4% are female.

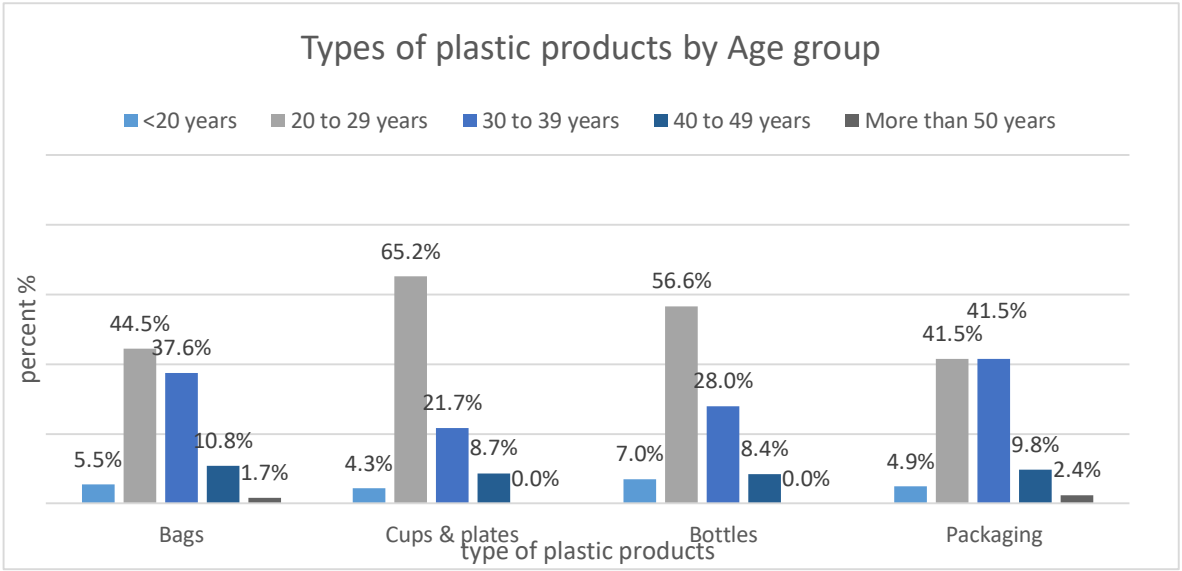


Figure (4.11):Type of plastic product common used by age

Above figure shows that of 413 was use Bags 44.5% their age between 20 to 29 years, 37.6% their age between 30 to 39 years. Of 23 was use cups and plates 65.2% their age between 20 to 29 years, of 143 was using Bottles 56.6% their age between 20 to 29 years, 28% their age between 30 to 39 years, and of 41 was use packaging 41.5% age between 20 to 29 years, 41.5% age between 30 to 39 years.

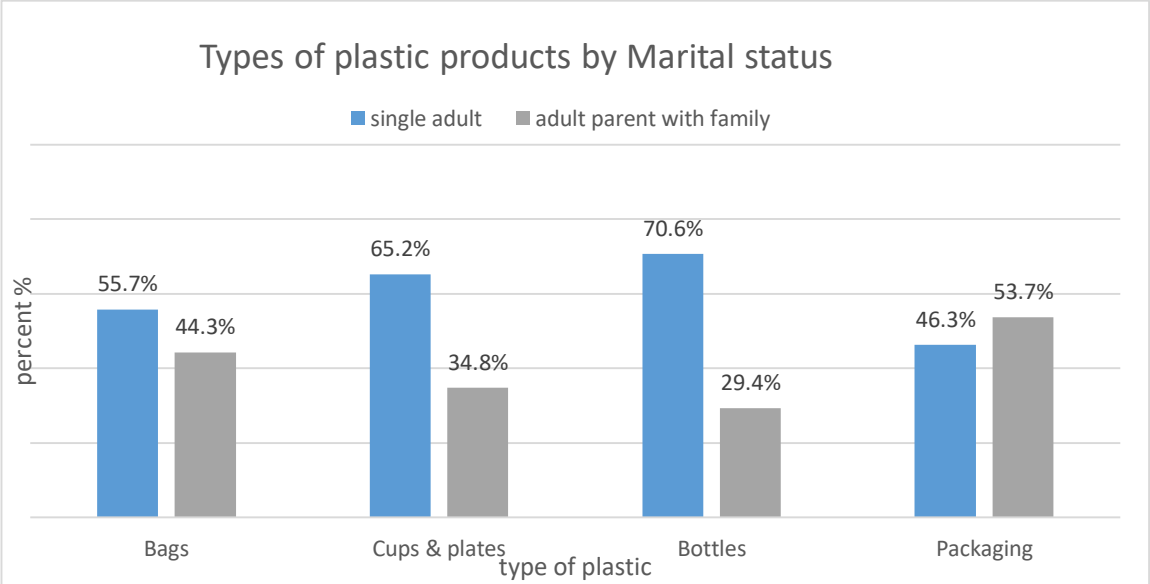


Figure (4.12) Type of plastic product common used by marital status

Above figure shows that of 413 were use Bags 55.7% are single adult, 44.3%are adult parent with family. Of 23 were use cups and plates 65.2% are single adult, 34.8% are adult parent with family, of 143 was using Bottles 70.6% are single adult, 29.4% are adult parent with family, and of 41 was use 46.3% are single adult, 53.7% are adult parent with family.

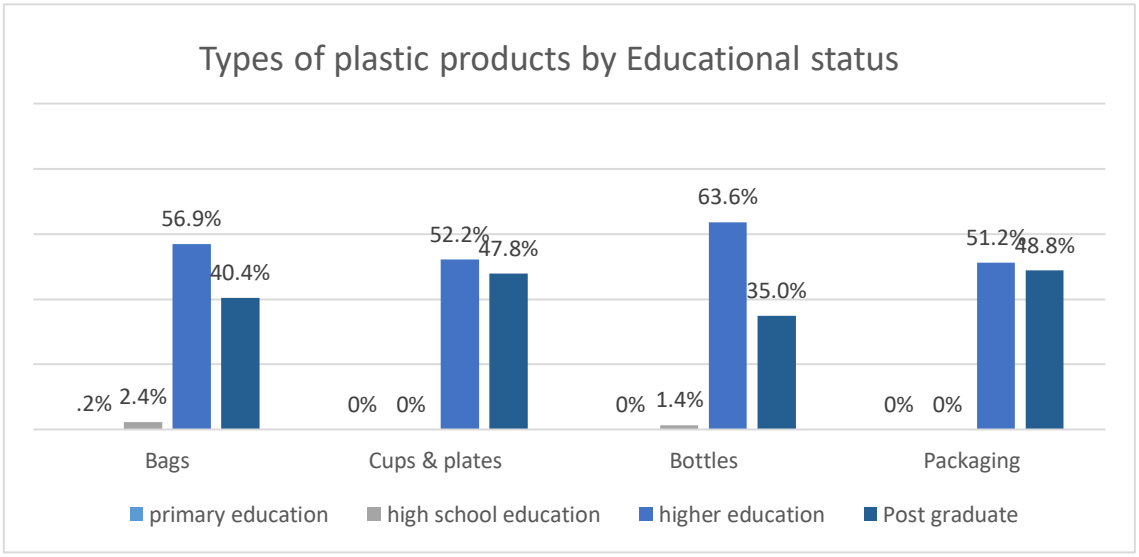


Figure (4.13): Type of plastic product common used by educational status

Of 413 are used Bags 56.9% having higher education, 40.4% have post graduate. Of 23 were use cups and plates 52.2% have higher education, 47.8% have post graduate., of 143 was using Bottles 63.6% have higher education, 35% have post graduate., and of 41 was use 51.2% have higher education, 48.8% have post graduate.

Table (4.4): trend of utilization of plastic bags and possible reasons

Variable	Category	Frequency	Percent
Trend of utilization of plastic bags	Increasing	394	90.6%
	Decreasing	41	9.4%
	Total	**435**	**100%**
If your answer is "Increasing", what are the possible reasons?	low cost	135	34.3%
	Durability	17	4.3%
	Availability wherever and whenever required	305	77.4%
	Lack of awareness of the community	199	50.5%

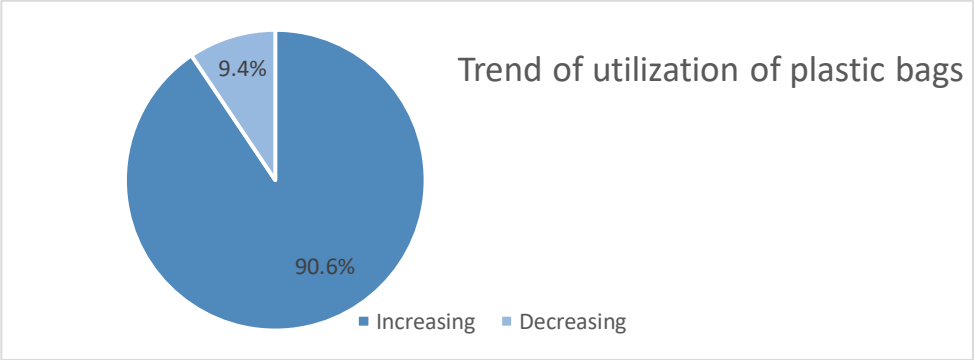


Figure (4.14) : trend of utilization of plastic bags

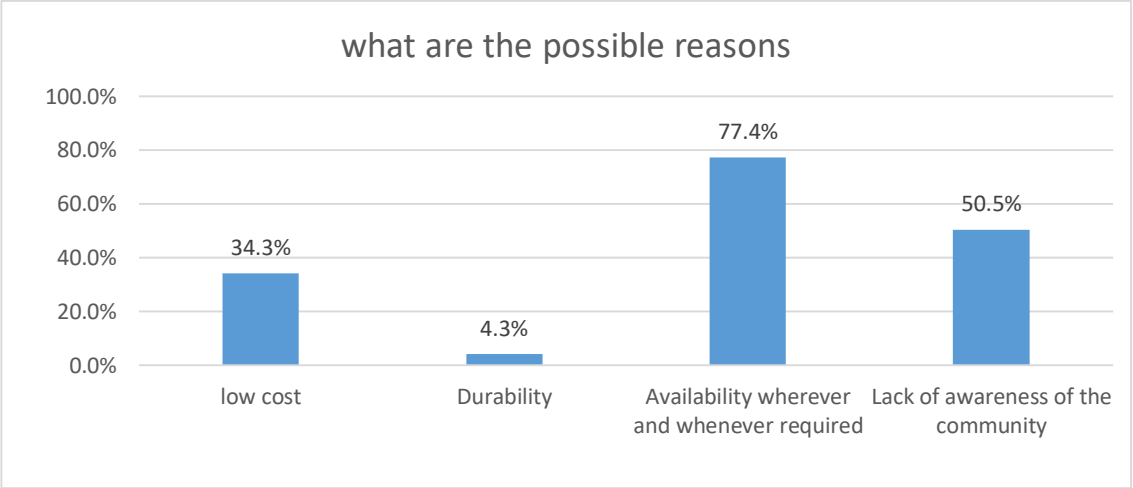


Figure (4.15) If your answer is "Increasing", what are the possible reasons

Figure (14) and (15) shows the trend of utilization of plastic bags is increasing with percent 90.6%, and decreasing with percent 9.4%, of 394 are increasing the possible reasons (135, 34.3% is low cost), (305, 77.4% is easy variability), (199, 50.5% is lack of awareness of the community).

Table (4.5) Factors attributed for widespread utilization of plastic bags

Variable	Category	low cost No. (%)	Durability No. (%)	Availability wherever and whenever required No. (%)	Lack of awareness of the community No. (%)
Sex of Participant	Male	66(48.9%)	8(47.1%)	131(43.0%)	97(48.7%)
	Female	69(51.1%)	9(52.9%)	174(57.0%)	102(51.3%)
Age group	<20 years	7(5.2%)	0(0%)	21(6.9%)	13(6.5%)
	20 to 29 years	64(47.4%)	9(52.9%)	146(47.9%)	99(49.7%)
	30 to 39 years	51(37.8%)	4(23.5%)	99(32.5%)	64(32.2%)
	40 to 49 years	13(9.6%)	4(23.5%)	34(11.1%)	20(10.1%)
	More than 50 years	0(0%)	0(0%)	5(1.6%)	3(1.5%)
Marital status	single adult	84(62.2%)	10(58.8%)	173(56.7%)	120(60.3%)
	adult parent with family	51(37.8%)	7(41.2%)	132(43.3%)	79(39.7%)
Educational status	primary education	0(0%)	0(0%)	0(0%)	1(.5%)
	high school education	1(0.7%)	0(0%)	8(2.6%)	5(2.5%)
	higher education	86(63.7%)	8(47.1%)	174(57.0%)	119(59.8%)
	Post Graduate	48(35.6%)	9(52.9%)	123(40.3%)	74(37.2%)
Occupation	Student	33(24.4%)	5(29.4%)	69(22.6%)	53(26.6%)
	government employee	27(20.0%)	4(23.5%)	55(18.0%)	27(13.6%)
	privet sector	32(23.7%)	2(11.8%)	76(24.9%)	56(28.1%)
	private job-daily laborer	13(9.6%)	1(5.9%)	31(10.2%)	18(9.0%)
	Housewife	12(8.9%)	1(5.9%)	33(10.8%)	22(11.1%)
	Other	18(13.3%)	4(23.5%)	41(13.4%)	23(11.6%)
Total		**135(100%)**	**17(100%)**	**305(100%)**	**199(100%)**

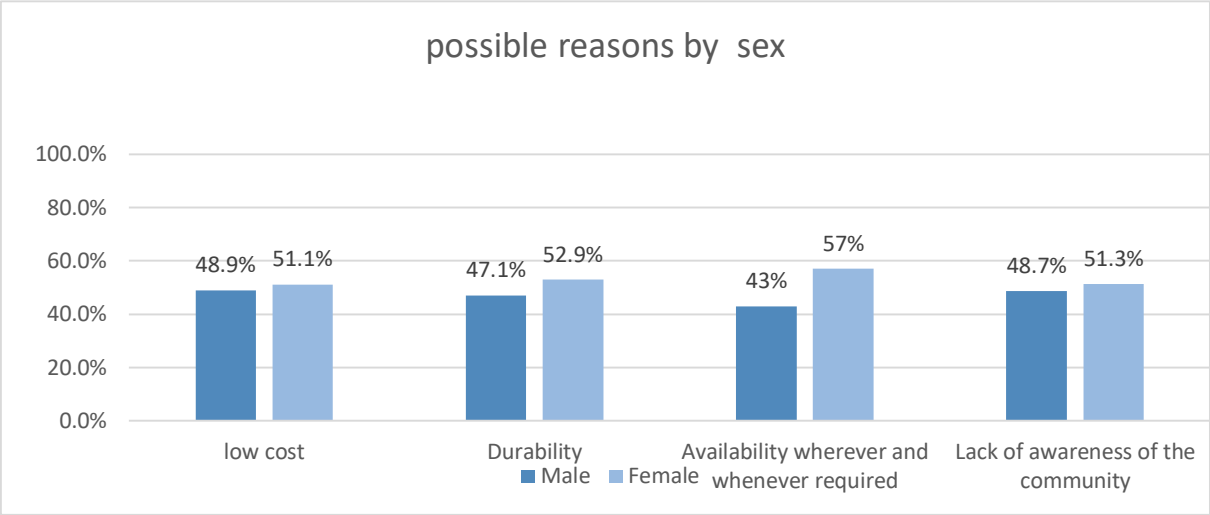


Figure (4.16) possible reasons by sex

The survey results indicated that regardless of sex, majority of the city residents widely used plastic bags in their daily life activities. Some of the main reasons attributed to the widespread usage were availability wherever and whenever required (305, 77.4% of total participants) 47.1% are male, and 52.9% are female, another reason were low cost (135, 34.3%) from those 135 participants (48.9%) are male, (51.1%) are female.

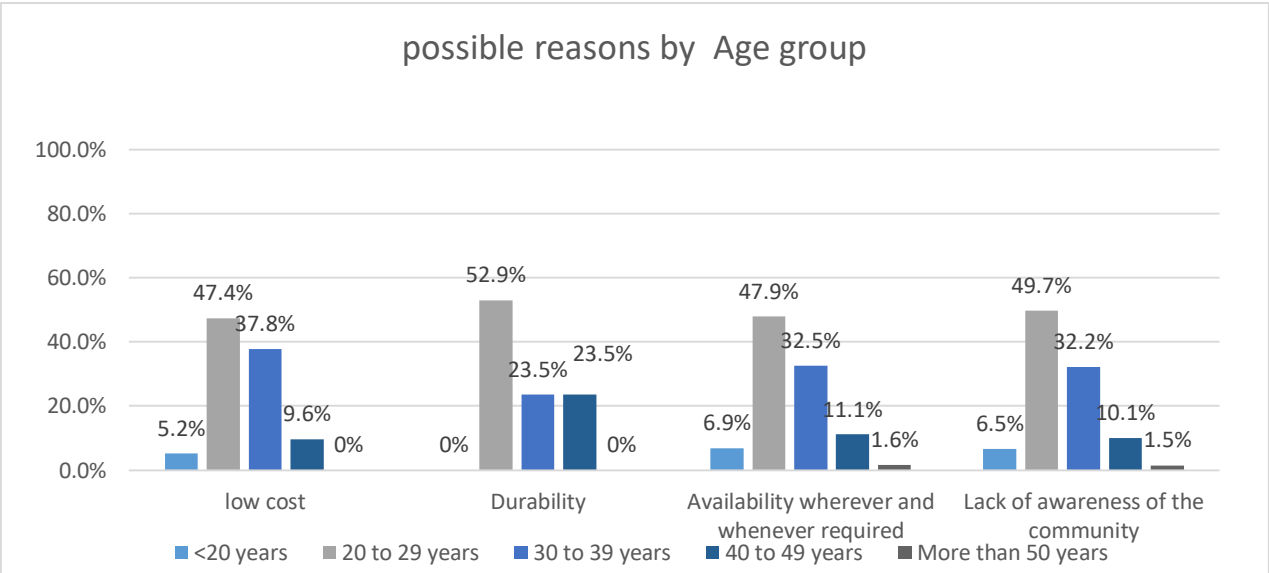


Figure (4.17) possible reasons by age

The highest percentage for reasons above was in age group from 20 to 29, (47.4% of 135) they are saw low cost, (52.9% of 17) durability, (47.9% of 305) availability wherever and whenever required, and (49.7% of 199) lack of awareness of the community.

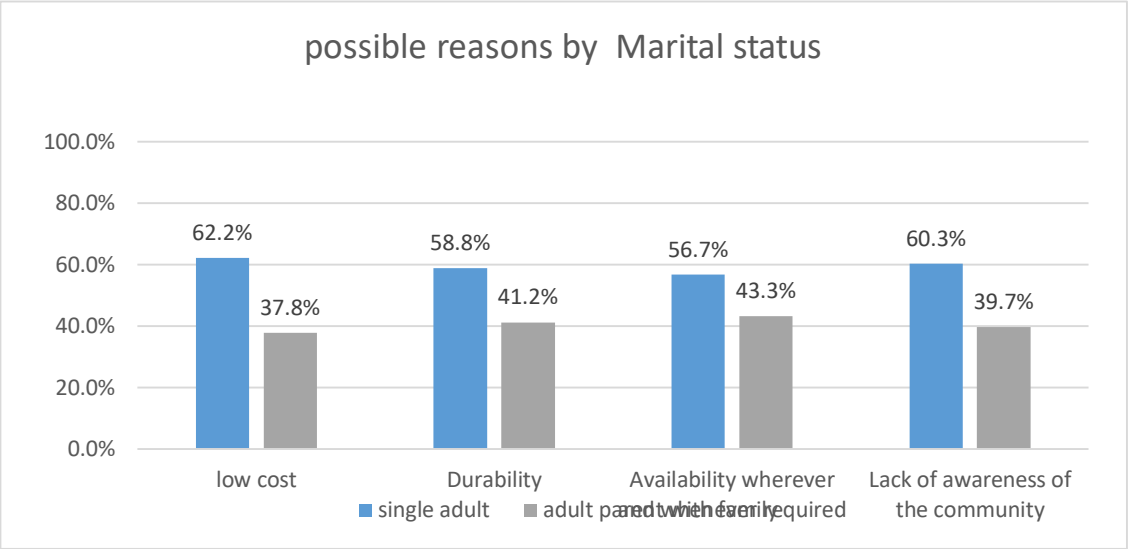


Figure (4.18) possible reasons by marital status

The highest percentage for reasons above was in marital status is single adult, (84, 62.2%) of 135 they are saw low cost, (10, 58.8%) of 17 durability, (173, 56.7%) of 305 availability wherever and whenever required, and (120, 60.3%) of 199 lack of awareness of the community.

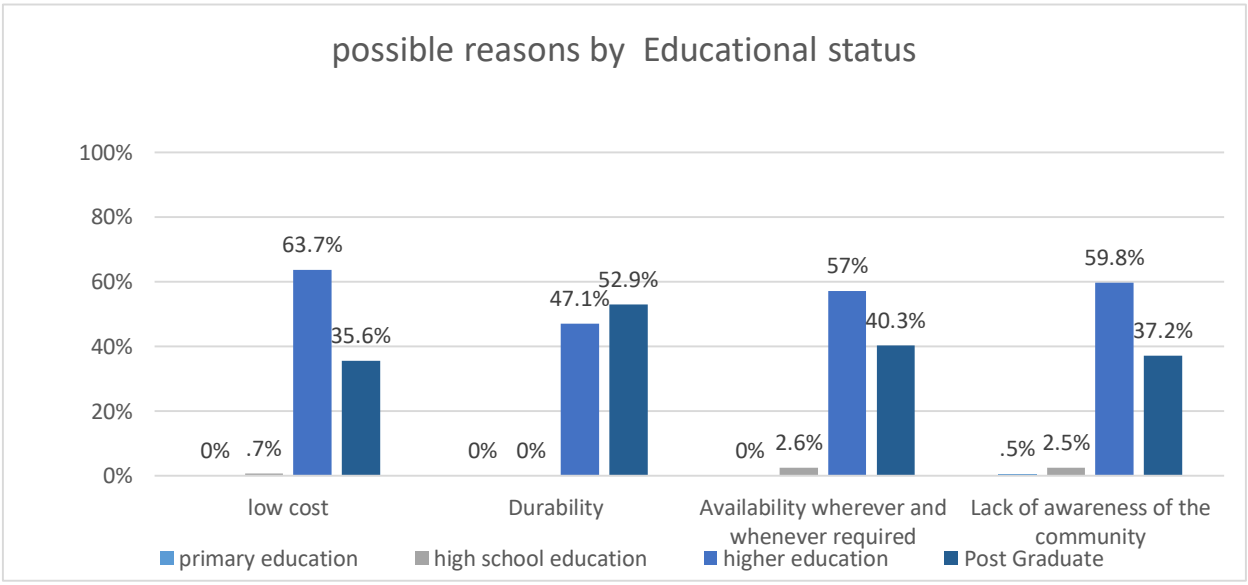
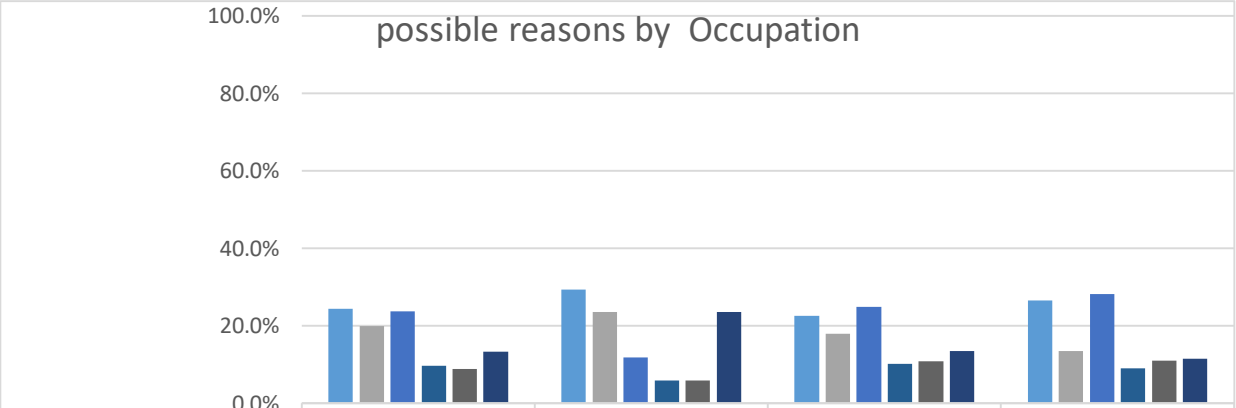


Figure (19) possible reasons by educational status

(86, 63.7%) of 135 they are saw low cost and have a higher education, (8, 47.1%) of 17 durability they have post graduate, (174, 57%) of 305 availability wherever and whenever required they have higher education, and (119, 59.8%) of 199 lack of awareness of the community they have higher education.



	low cost	Durability	Availability wherever and whenever required	Lack of awareness of the community
student	24.4%	29.4%	22.6%	26.6%
government employee	20%	23.5%	18%	13.6%
privet sector	23.7%	11.8%	24.9%	28.1%
private job-daily laborer	9.6%	5.9%	10.2%	9%
housewife	8.9%	5.9%	10.8%	11.1%
Other	13.3%	23.5%	13.4%	11.6%

Figure (4.20): possible reasons by occupation

(33, 24.4%) of 135 they are saw low cost and they are students, (5, 29.4%) of 17 durability they are government employee, (76, 24.4%) of 305 availabilities wherever and whenever required they have are work in private sector, and (56, 28.1%) of 199 lack of awareness of the community they are work in private sector

Table (4.6): Part 2 consumption behavior of the respondent

Variable	Category	Frequency	Percent
How often do you visit commercial stores?	daily	206	47.4%
	weekly	142	32.6%
	monthly	42	9.7%
	occasionally	45	10.3%
How do you plan your daily/weekly shopping?	I decide what to buy in the shop	94	21.6%
	I make a shopping list	315	72.4%
	I make a shopping list and take a shopping bag.	26	6.0%
When you buy baker's goods what kind of bag do you use?	thin plastic bags	393	90.3%
	paper bags	12	2.8%
	fiber bags	14	3.2%
	Other	16	3.7%
When you buy hot foods (milk/beans) what kind of pot do you use?	thin plastic bags	127	29.2%
	plastic pot	59	13.6%
	metallic pot	229	52.6%
	glass pot	9	2.1%
	Other	11	2.5%
Why do you prefer to use the plastic bags?	They are cheap	15	3.4%
	They are light in weight	17	3.9%
	They are easily available	120	27.6%
	Lack of alternative materials	280	64.4%
	other reason	3	0.7%
How long time do you use a shopping bag?	one time	128	29.4%
	a few times	235	54.0%
	for a few years	8	1.8%
	until it is damaged	64	14.7%
Total		**435**	**100%**

47.4% of participant they are visit commercial stores daily, 72.4% make a shopping list in a plan of shopping, 90.3% they are used thin plastic bags, 52.2% use metallic pot when they are buy hot foods, 64.4% they are preferring to use the plastic bags according by reason lack of alternative materials.

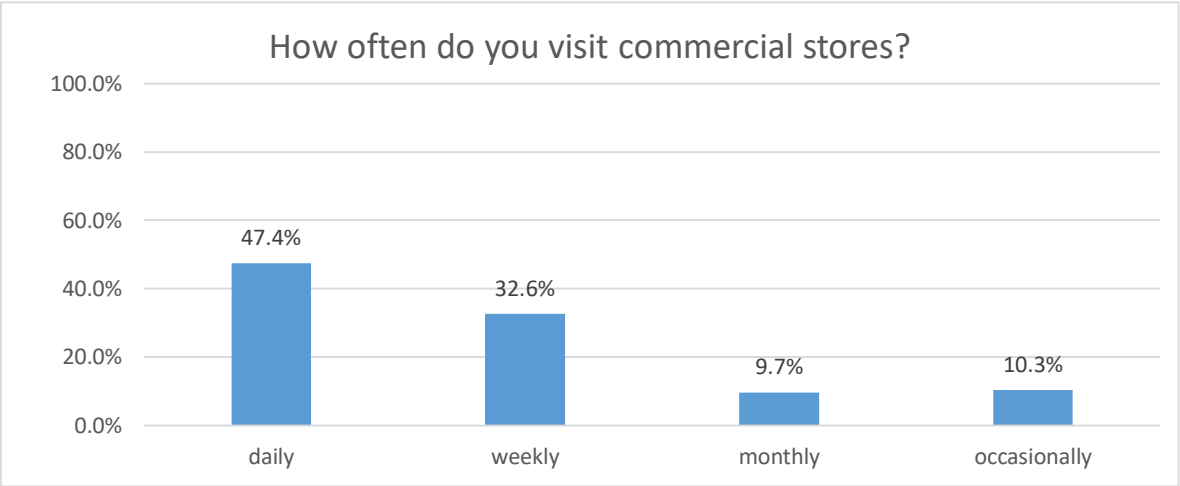


Figure (4.21): often do you visit commercial stores?

47.4% they are visit commercial stores daily, 32.6% they visit weekly, 9.6% they are visit monthly, and 10.3% they are visit occasionally.

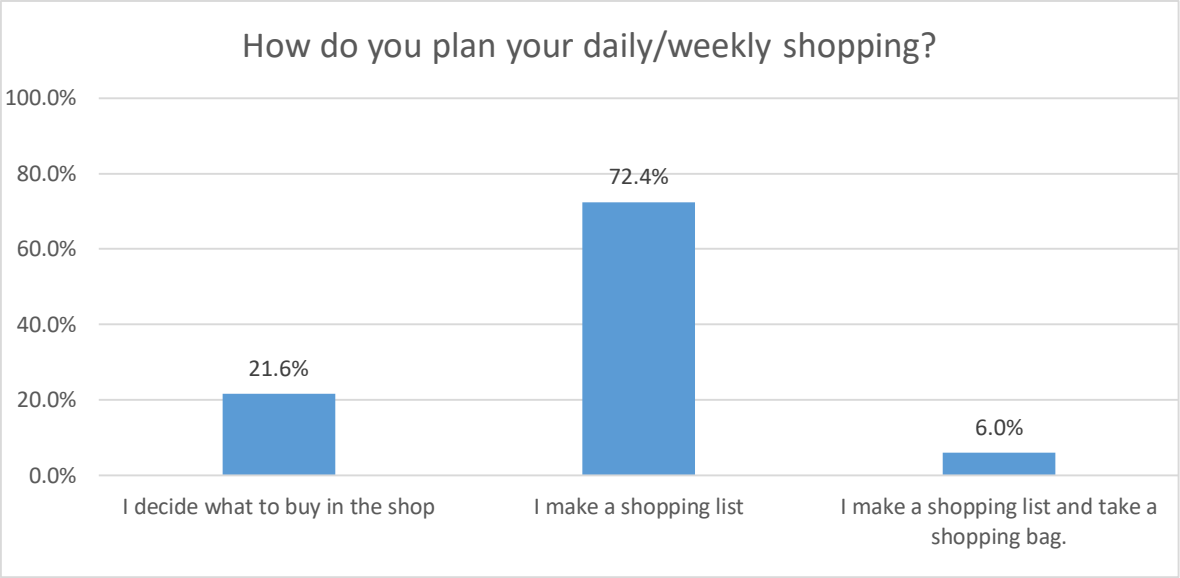


Figure (4.22): how do you plan your daily/weekly shopping?

21.6% they decide what to buy in the shop, 72.4% they make a shopping list, and 6% make a shopping list and take a shopping bag.

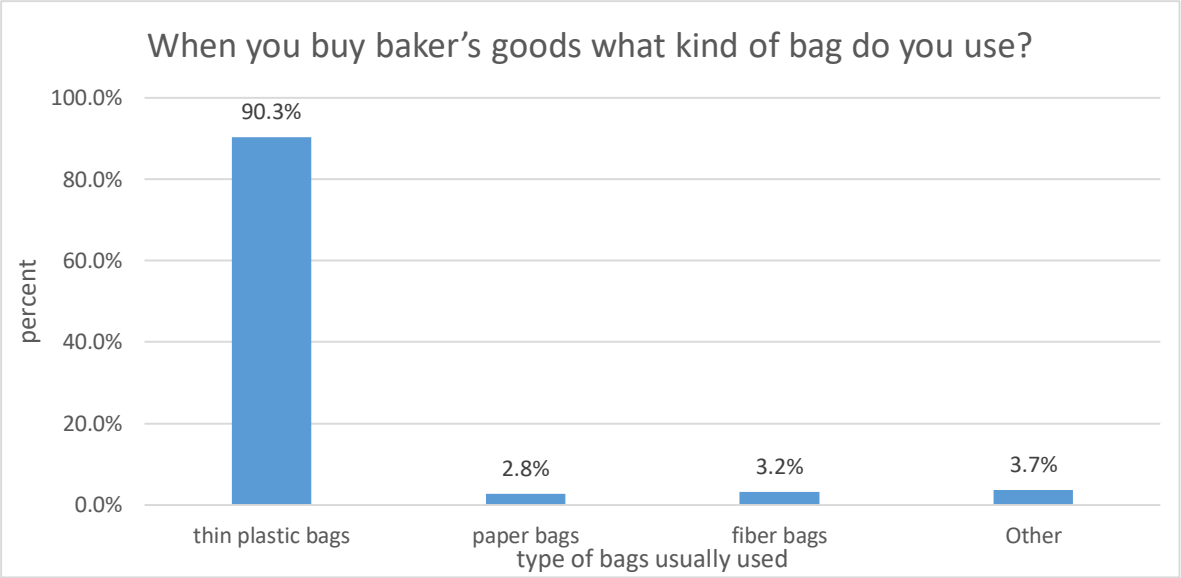


Figure (4.23): when you buy baker's goods what kind of bag do you use?

90.3% they are using thin plastic bags when they buy bakers, 2.8% they are use paper bags, 3.2% they are use fiber bags, 3.7% using other kind of bags.

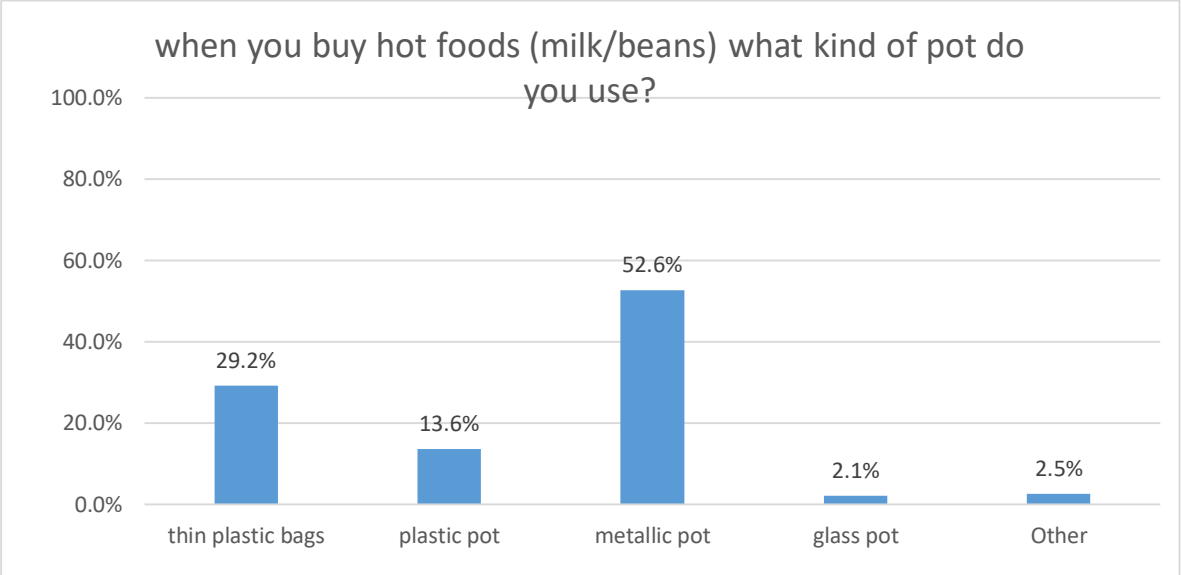


Figure (4.24) when you buy hot foods (milk/beans) what kind of pot do you use?

29.2% they are using thin plastic bags when they buy hot foods, 13.6% they are use plastic pot, 52.6% they are use metallic pot, and 2.1% using a glass pot.

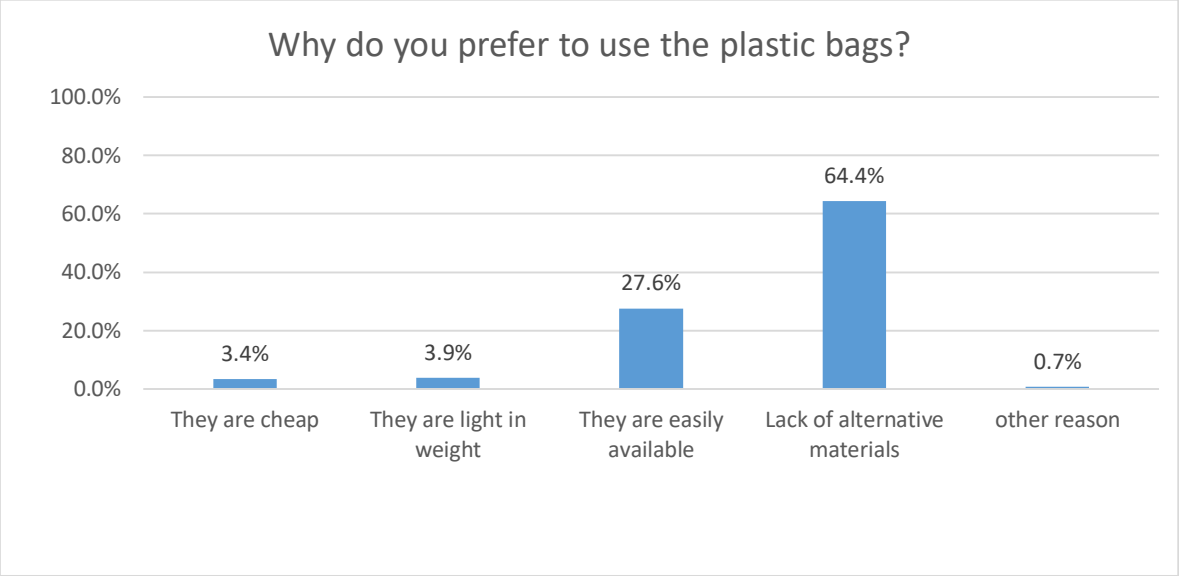


Figure (4.25) why do you prefer to use the plastic bags?

3.4% they are seeing the reason is cheap when they prefer to use plastic bags, 3.9% they are light in weight, 27.6% they are easily available, and 64.4% lack of alternative materials.

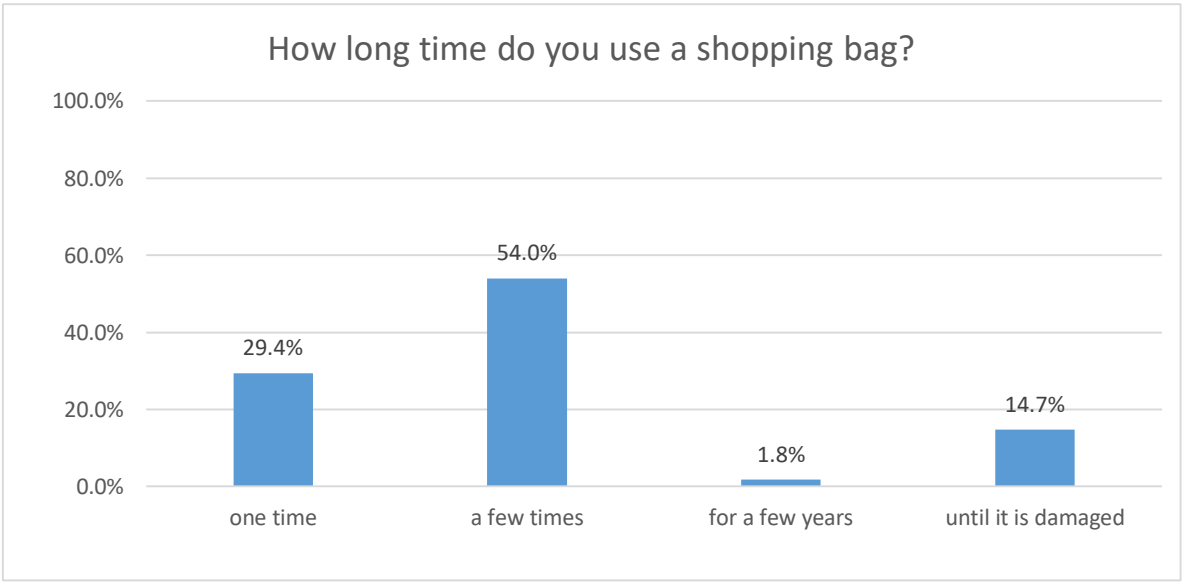


Figure (4.26) how long time do you use a shopping bag?

29.4% of participants they are using a bag for one time, 54% they are using a few times, 1.8% for a few years, and 14.7% until it is damaged.

Table (4.7) :Part 3 environmental awareness of the respondent

Variable	Category	Frequency	Percent
Do you think that plastic bag wastes cause problems?	Yes	421	96.8%
	No	2	0.5%
	No idea	12	2.8%
If your answer to question 8 is 'Yes', what are the problems?	Animal death	2	0.5%
	Human health problem	19	4.5%
	Blockage of sewage (drain) systems	8	1.9%
	Deterioration of natural beauty of environment	10	2.4%
	agricultural problems	5	1.2%
	all above	377	89.5%
Have you heard environmental impacts of plastic bag wastes on environment?	Yes	329	75.6%
	No	106	24.4%
If your answer to question number 9 is "Yes", how or where?	TV/radio	96	29.2%
	School/university	61	18.5%
	From professionals	43	13.1%
	Published materials	30	9.1%
	Internet	203	61.7%
	Other	53	16.1%
After you have finished the use of plastic bag what do you do with it?	Through it to the floor	21	4.8%
	Dust bin	283	65.1%
	reuse	118	27.1%
	burn	1	0.2%
	recycle	5	1.1%
	other	7	1.6%
Which parts of Khartoum state seriously polluted by plastic bag wastes?	Parks	318	73.1%
	Waste dumping sites	339	77.9%
	Market places	378	86.9%
	Crowded residential areas	329	75.6%
	Roadsides	339	77.9%
	open places in the city	324	74.5%
	sewage (drain) lines	373	85.7%
	other	1	0.2%
Total		**435**	**100%**

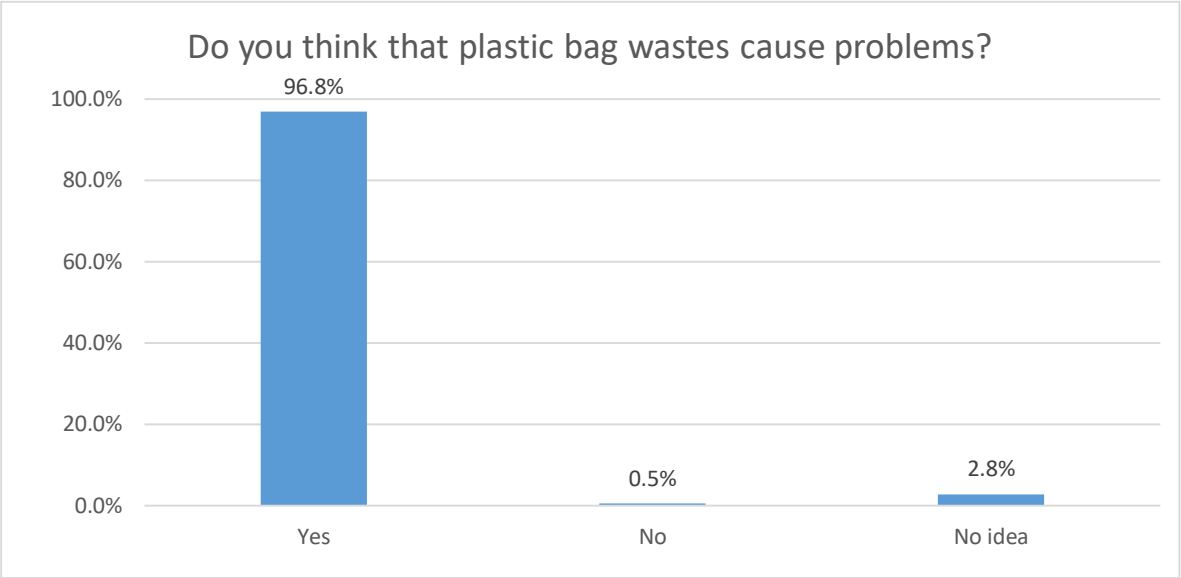


Figure (4.27) do you think that plastic bag wastes cause problems?

96.8% they are thinking that plastic bag wastes cause problem

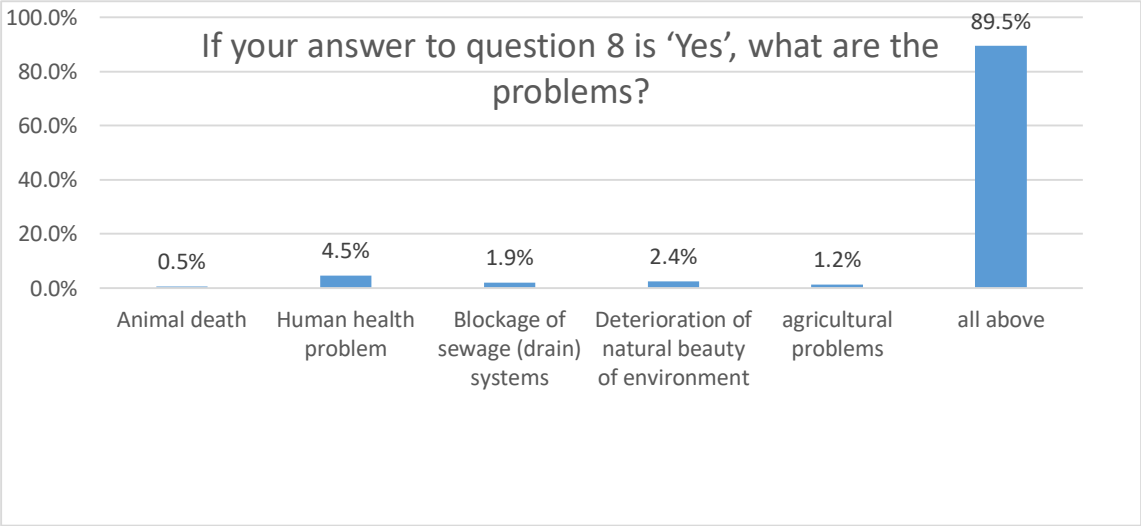


Figure (4.28) if your answer to question 8 is 'Yes', what are the problems?

From (421 participants) 89.5% are seen that plastic bag wastes cause problem for animal death, human health, blockage of sewage, deterioration of natural beauty of environment, agricultural problems

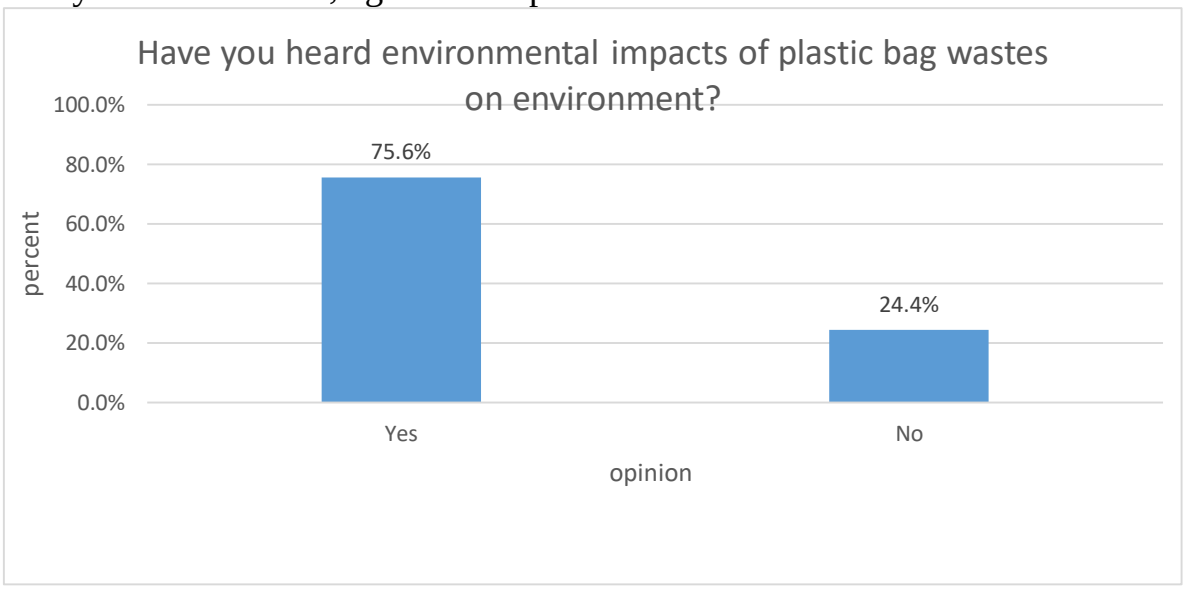


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Figure (4.29): have you heard environmental impacts of plastic bag wastes on environment?

(329, 75.7%) they are heard about environmental impacts of plastic bag wastes on environment, and 24.3% they aren't heard.

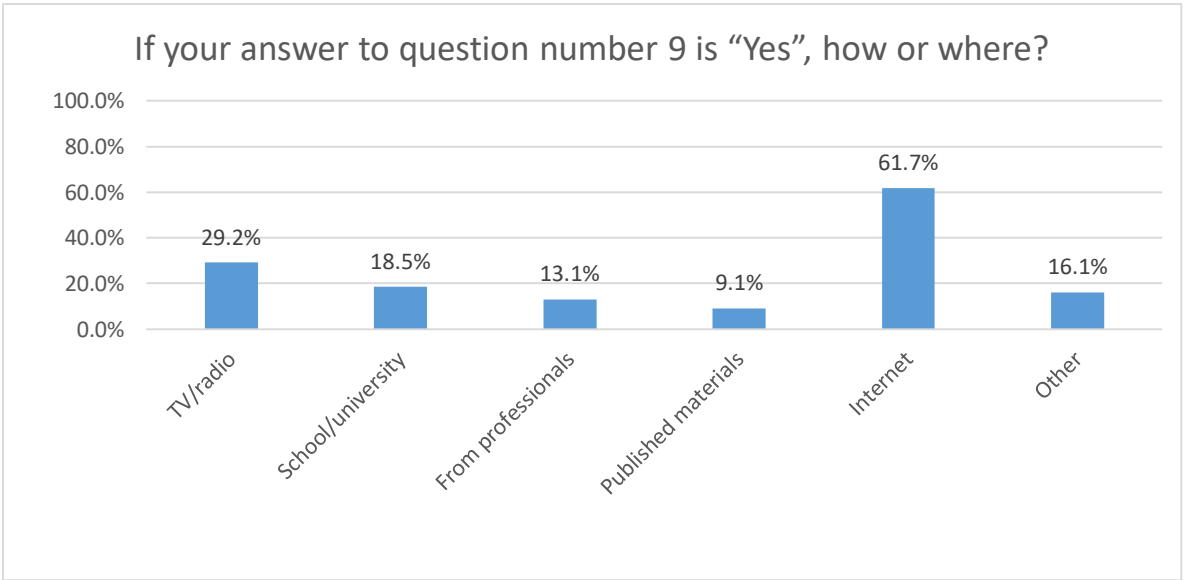

Figure (4.30): if your answer to question number 9 is "Yes", how or where?

From 329 they are heard about environmental impacts of plastic bag wastes on environment from TV/Radio with percent 29.2%, from internet with percent 61.7% from school or university with percent 18.5%, from professionals with percent 13.1%, and from published materials with 9.1%.

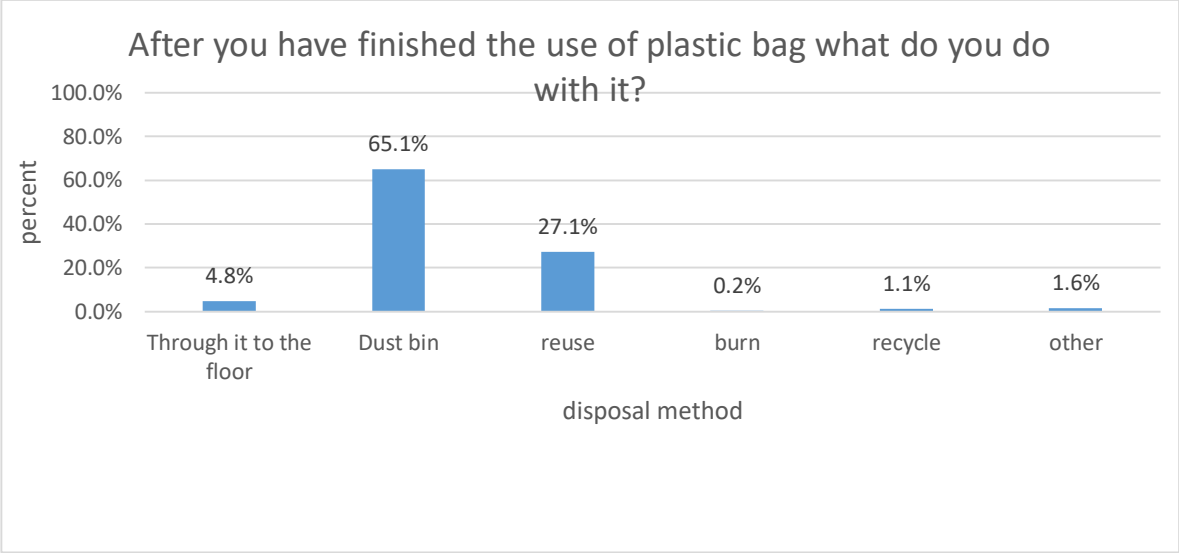

Figure (4.31): after you have finished the use of plastic bag what do you do with it?

After finished the use of plastic bag 4.8% they through it to the floor, 65.1% get it in a dust bin, and 27.2% reuse a plastic bags.

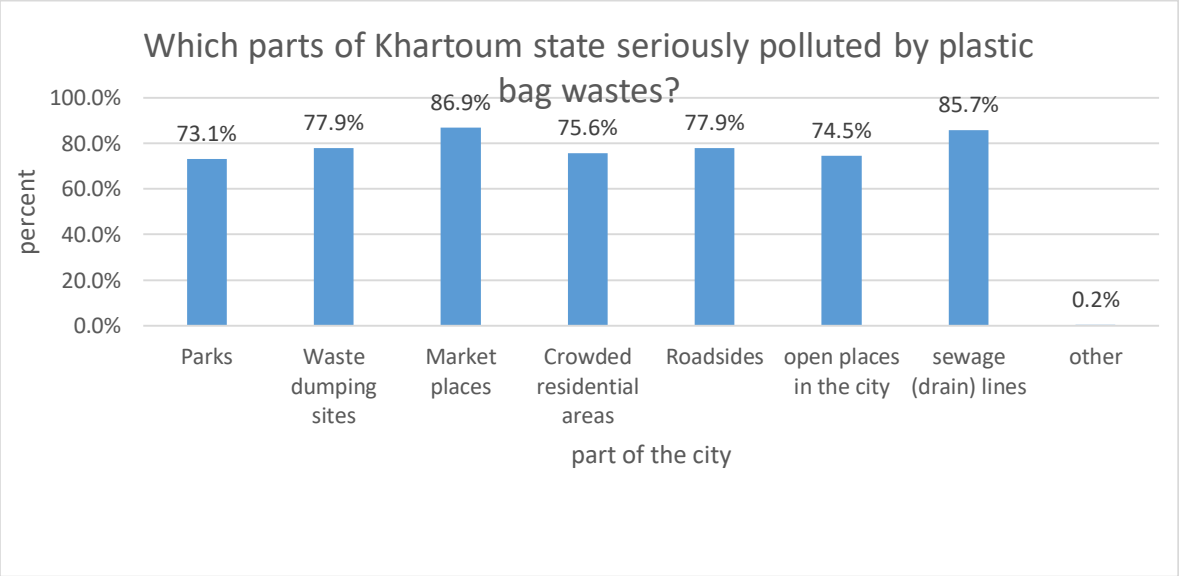

Figure (4.32): which parts of Khartoum state seriously polluted by plastic bag wastes?

The parts of Khartoum state seriously polluted by plastic bag wastes is parks (73.1%), waste dumping sites (77.9%), market places (86.9%), crowded residential areas (75.6%), roadsides (77.9%), open places in the city (74.5%), sewage lines (85.7%).

Table (4.8): Part 4 self-opinion and suggestions and willingness to reduce consumption

Variable	Category	Frequency	Percent
Do you think that all shops should offer plastic and paper bags for their customers?	Yes	293	67.5%
	No	72	16.6%
	Maybe	69	15.9%
Do you think that plastic bags should completely disappear from shops?	Yes	317	73.0%
	No	60	13.8%
	Maybe	57	13.1%
If your answer in above question yes which is the best alternative material?	cloth bag	168	38.7%
	a shopping bag with the logo of the shop	56	12.9%
	with strong handles	74	17.1%
	paper	162	37.3%
Total		**434**	**100%**

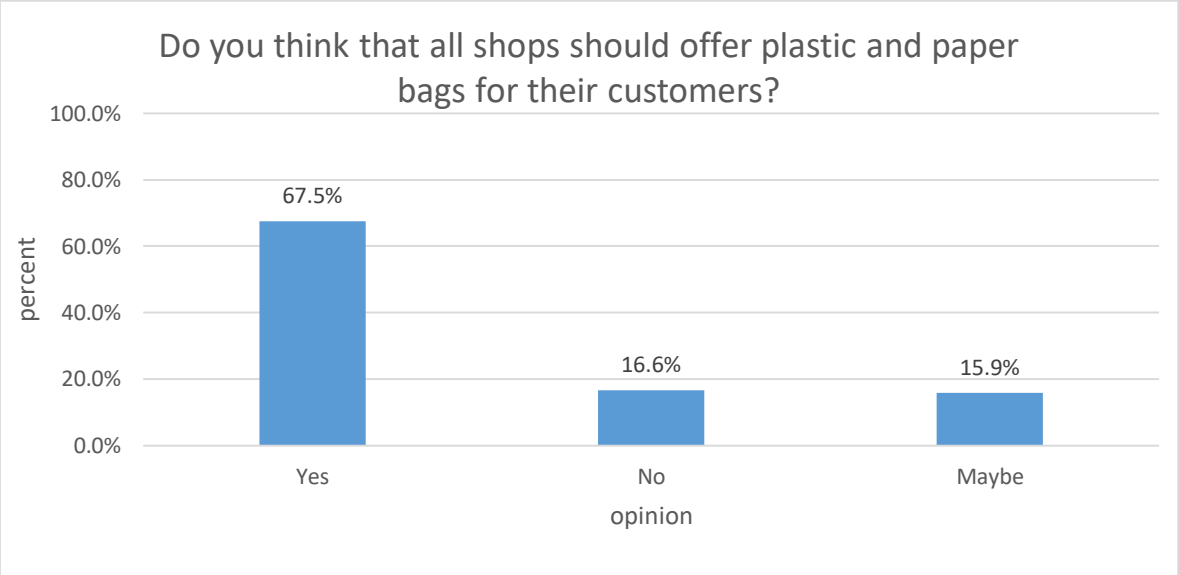

Figure (4.33): Do you think that all shops should offer plastic and paper bags for their customers?

(293, 67.5%) they are think that shops should offer plastic and paper bags for their customers.

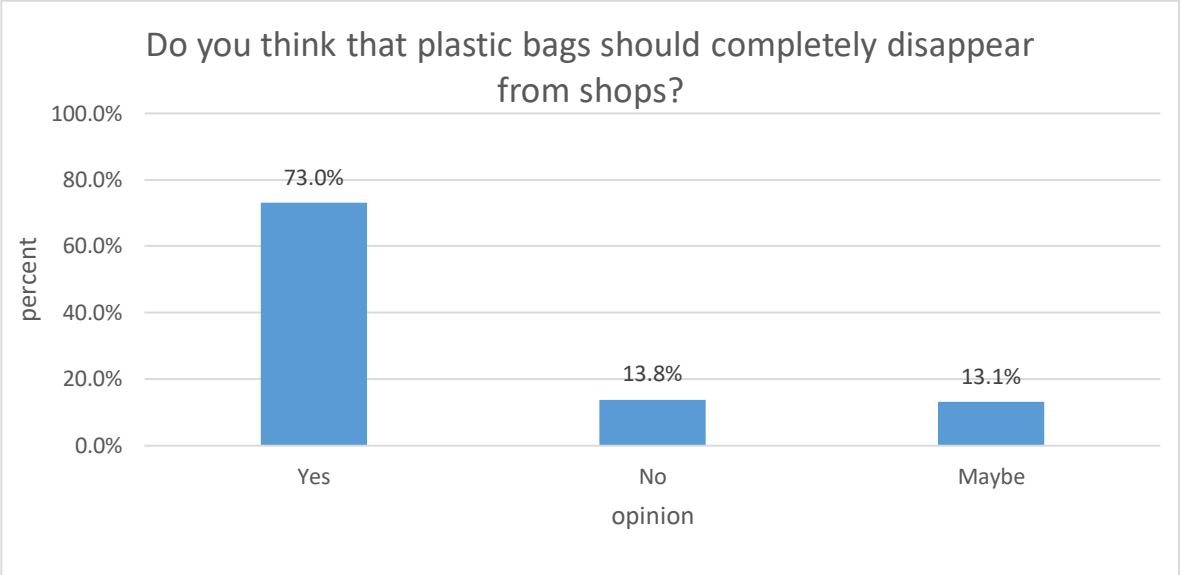

Figure (4.34): Do you think that plastic bags should completely disappear from shops?

(317, 73%) they are think that plastic bags should completely disappear from shops.

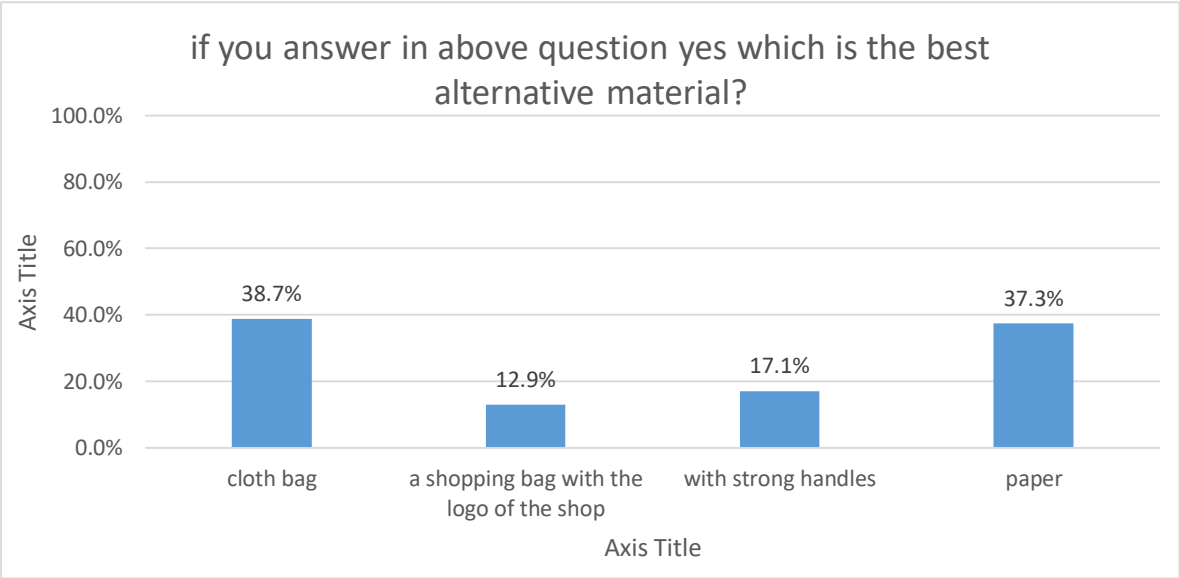

Figure (4.35): If your answer in above question yes which is the best alternative material?

Of 317, (168, 38.7%) they are seen the best alternative material is cloth bag, and (162, 37.3%) they are seen the best alternative material is paper.

Table (4.9): Problems associated with plastic bag wastes

Variable	Category		Animal death	Human health problem	Blockage of sewage (drain) systems	Deterioration of natural beauty of environment	agricultural problems	all above
Sex of Participant	Male	N	2	11	4	5	2	163
		%	100%	57.9%	50%	50%	40%	43.2%
	Female	N	0	8	4	5	3	214
		%	0%	42.1%	50%	50%	60%	56.8%
Age group	<20 years	N	0	1	0	0	1	23
		%	0%	5.3%	0%	0%	20%	6.1%
	20 to 29 years	N	1	10	6	5	0	167
		%	50%	52.6%	75%	50%	0%	44.3%
	30 to 39 years	N	1	4	2	3	2	141
		%	50%	21.1%	25%	30%	40%	37.4%
	40 to 49 years	N	0	4	0	1	2	40
		%	0%	21.1%	0%	10%	40%	10.6%
	More than 50 years	N	0	0	0	1	0	6
		%	0%	0%	0%	10%	0%	1.6%
Marital status	single adult	N	2	11	5	8	1	214
		%	100%	57.9%	62.5%	80%	20%	56.8%
	adult parent with family	N	0	8	3	2	4	163
		%	0%	42.1%	37.5%	20%	80%	43.2%
Educational status	primary education	N	0	0	0	0	0	1
		%	0%	0%	0%	0%	0%	0.3%
	high school education	N	0	0	0	1	0	9
		%	0%	0%	0%	10%	0%	2.4%
	higher education	N	2	14	4	6	2	213
		%	100%	73.7%	50%	60%	40%	56.5%
	Post graduate	N	0	5	4	3	3	154
		%	0%	26.3%	50%	30%	60%	40.8%
Occupation	Student	N	1	5	1	2	1	83
		%	50%	26.3%	12.5%	20%	20%	22%
	government employee	N	0	5	0	0	2	71
		%	0%	26.3%	0%	0%	40%	18.8%
	privet sector	N	1	7	2	6	1	94
		%	50%	36.8%	25%	60%	20%	24.9%
	private job-daily laborer	N	0	1	1	1	0	38
		%	0%	5.3%	12.5%	10%	0%	10.1%
	Housewife	N	0	1	2	1	1	45
		%	0%	5.3%	25%	10%	20%	11.9%
	Other	N	0	0	2	0	0	46
		%	0%	0%	25%	0%	0%	12.2%

(163 male, 43.2%), and (214 female, 56.8%) of 377 participants believe that the problems associated with plastic bag waste are animal death, human health, blockage of sewage, deterioration of natural beauty of environment, agricultural problems.

(167 of participants their age from 20 to 29, 44.3%), and (141 of participants their age from 30 to 39, 37.4%) of 377 participants believe that the problems associated with plastic bag waste are animal death, human health, blockage of sewage, deterioration of natural beauty of environment, agricultural problems.

(214 of participants are single adult, 56.8%), and (163 of participants are adult parent with family, 43.2%) of 377 participants believe that the problems associated with plastic bag waste all above problems.

(213 of participants have higher education, 56.5%), and (154 of participants have a post graduate, 40.8%) of 377 participants believe that the problems associated with plastic bag waste all above problems.

(83 of participants are student, 22%), and (94 of participants are worked at private sector, 24.9%) of 377 participants believe that the problems associated with plastic bag waste all above problems.

Table (4.10): Media exposure of the community to get information about plastic bag wastes

Variable	Category		TV/radio	School/ university	From professionals	Published materials	Internet
Sex of Participant	Male	N	47	27	24	17	89
		%	49.0%	44.3%	55.8%	56.7%	43.8%
	Female	N	49	34	19	13	114
		%	51.0%	55.7%	44.2%	43.3%	56.2%
Age group	<20 years	N	5	6	2	0	13
		%	5.2%	9.8%	4.7%	0.0%	6.4%
	20 to 29 years	N	45	28	19	11	92
		%	46.9%	45.9%	44.2%	36.7%	45.3%
	30 to 39 years	N	33	19	13	10	77
		%	34.4%	31.1%	30.2%	33.3%	37.9%
	40 to 49 years	N	12	8	6	9	20
		%	12.5%	13.1%	14.0%	30.0%	9.9%
	More than 50 years	N	1	0	3	0	1
		%	1.0%	0.0%	7.0%	0.0%	.5%
Marital status	single adult	N	58	38	27	15	121
		%	60.4%	62.3%	62.8%	50.0%	59.6%
	adult parent with family	N	38	23	16	15	82
		%	39.6%	37.7%	37.2%	50.0%	40.4%
Educational status	high school education	N	1	1	0	1	4
		%	1.0%	1.6%	0.0%	3.3%	2.0%
	higher education	N	50	38	19	15	125
		%	52.1%	62.3%	44.2%	50.0%	61.6%
	Post graduate	N	45	22	24	14	74
		%	46.9%	36.1%	55.8%	46.7%	36.5%
Occupation	Student	N	24	18	12	4	47
		%	25.0%	29.5%	27.9%	13.3%	23.2%
	government employee	N	22	10	6	8	36
		%	22.9%	16.4%	14.0%	26.7%	17.7%
	privet sector	N	23	13	14	8	52
		%	24.0%	21.3%	32.6%	26.7%	25.6%
	private job-daily laborer	N	9	4	1	2	21
		%	9.4%	6.6%	2.3%	6.7%	10.3%
	Housewife	N	8	11	3	5	20
		%	8.3%	18.0%	7.0%	16.7%	9.9%
	Other	N	10	5	7	3	27
		%	10.4%	8.2%	16.3%	10.0%	13.3%

Most of female are heard about Media of the community to get information about plastic bag wastes at (TV/radio, School/ university, and Internet) with percent (51%, 55.7%, and 56.2%) respectively, and male heard at (From professionals, and Published materials) with percentage (55.8%, and 56.7%) respectively.

Table (9) shows the complete knowledge of the age groups from 20 to 29 years and age from 30 to 39 that all percentage are greater than 30% for all media of the community to get information about plastic bag wastes.

Single adults are more familiar with media of the community to get information about plastic bag wastes (all percentage greater than 50%).

The people who have it higher education and post graduate are more familiar with media of the community to get information about plastic bag wastes with percent more that 90% for two groups.

The students are heard about media of the community to get information about plastic bag wastes at (TV/radio, and School/university) with percent (25%, and 29.5%) respectively. government employee heard from Published materials with percent 26.7%. and private sector employee they are heard at (From professionals, Published materials, and Internet) with percent (32.6%, 26.7%. and 25.6%) respectively.

Table (4.11): voluntary initiatives, use of plastic bags in the future, decision of ban light bags in achieving goals

Variable	Category	Frequency	Percent
Would you like to participate in voluntary initiatives?	Yes	226	52.1%
	No	49	11.3%
	Maybe	159	36.6%
Do you intend to reduce your use of plastic bags in the future?	Yes	331	76.3%
	No	23	5.3%
	Maybe	80	18.4%
How would you describe the success of the decision to ban light bags in achieving its goals?	successful	66	15.2%
	Partial successful	191	44.0%
	Unsuccessful	177	40.8%
Total		**434**	**100%**

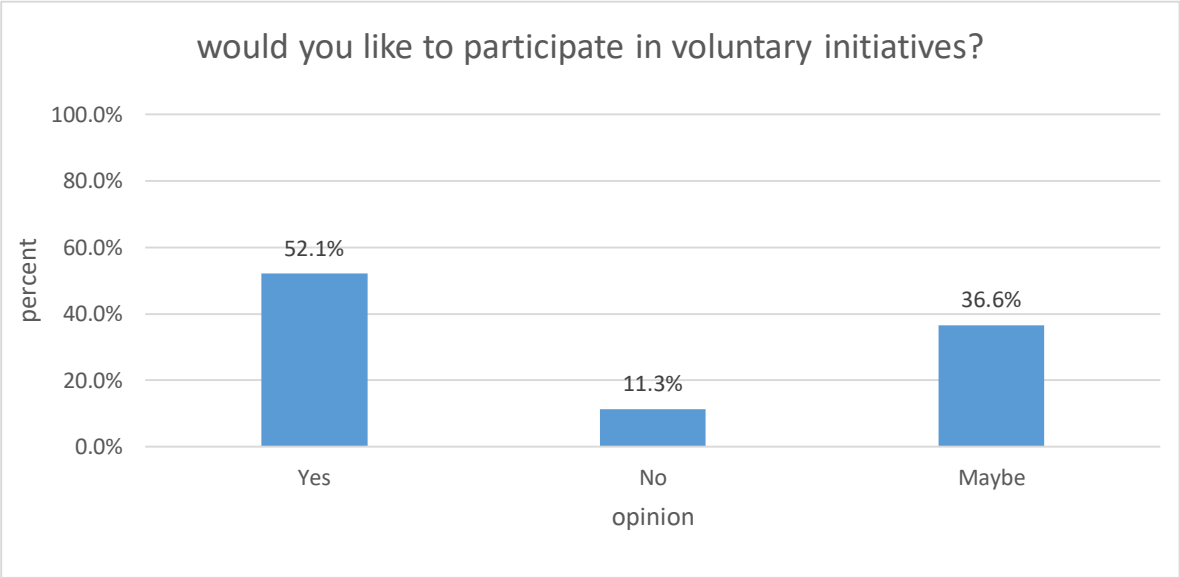

Figure (4.36): participate in voluntary initiatives

52.1% of participant are like to participate in voluntary initiatives.

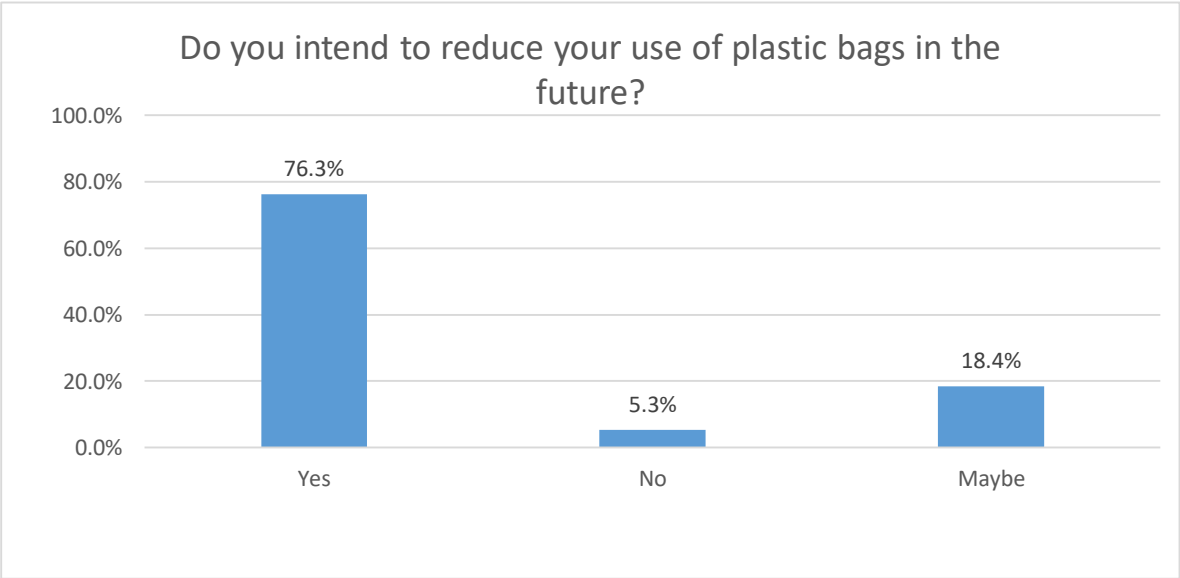

Figure (4.37) reducing of use plastic bags in the future

76.3% from participant they are intending to reduce their use of plastic bags in the future,5.3% aren't intending to reduce their use and 18.4% may be try to reduce their consumption rate.

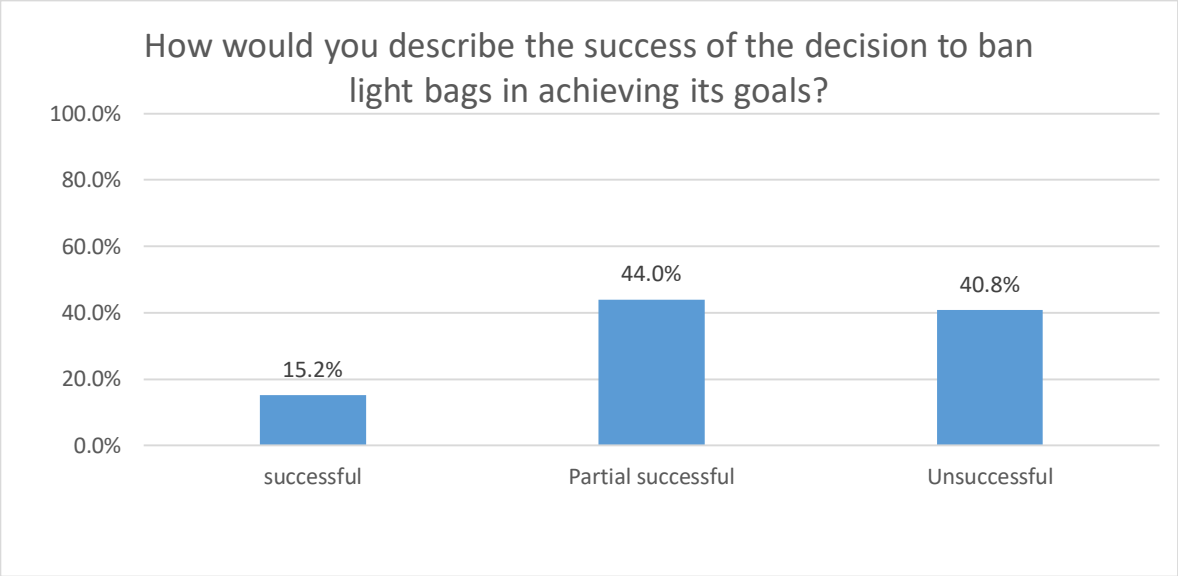

Figure (4.38): success of the decision to ban light bags in achieving its goals

Only (66, 15.2%) of 434 they are saw that the success of the decision to ban light bags in achieving its goals, (44%) saw that its partial successful and 40% thought that it unsuccessful decision.

Table (4.12): Relationship between demographic variables and important statements:

Variable1	Variable2	Pearson Chi-Square	P-value	Comment
When you buy baker's goods what kind of bag do you use?	Sex of Participant	2.510	0.473	NS
	Age Group	26.898	0.008	S
	Marital status	6.611	0.085	NS
	Educational status	4.396	0.883	NS
	Occupation	16.619	0.342	NS
when you buy hot foods (milk/beans) what kind of pot do you use?	Sex of Participant	11.981	0.017	S
	Age Group	24.459	0.080	NS
	Marital status	13.851	0.008	S
	Educational status	10.018	0.614	NS
	Occupation	44.192	0.001	S
Why do you prefer to use the plastic bags?	Sex of Participant	3.920	0.417	NS
	Age Group	9.442	0.894	NS
	Marital status	5.132	0.274	NS
	Educational status	9.146	0.690	NS
	Occupation	21.580	0.364	NS
How long time do you use a shopping bag?	Sex of Participant	7.758	0.051	NS
	Age Group	26.364	0.010	S

Variable1	Variable2	Pearson Chi-Square	P-value	Comment
	Marital status	7.297	0.063	NS
	Educational status	5.125	0.823	NS
	Occupation	24.701	0.054	NS
Do you think that plastic bag wastes cause problems?	Sex of Participant	3.363	0.186	NS
	Age Group	7.190	0.516	NS
	Marital status	1.191	0.551	NS
	Educational status	5.375	0.497	NS
	Occupation	13.111	0.218	NS
Have you heard environmental impacts of plastic bag wastes on environment?	Sex of Participant	5.282	0.022	S
	Age Group	3.173	0.529	NS
	Marital status	1.717	0.190	NS
	Educational status	3.830	0.280	NS
	Occupation	2.433	0.786	NS
After you have finished the use of plastic bag what do you do with it?	Sex of Participant	23.364	0.000	S
	Age Group	19.974	0.460	NS
	Marital status	13.545	0.019	S
	Educational status	29.753	0.013	S
	Occupation	21.498	0.665	NS
Do you think that all shops should offer plastic and paper bags for their customers?	Sex of Participant	8.184	0.017	S
	Age Group	7.266	0.508	NS
	Marital status	2.189	0.335	NS
	Educational status	1.371	0.968	NS
	Occupation	7.268	0.700	NS
Do you think that plastic bags should completely disappear from shops?	Sex of Participant	4.902	0.086	NS
	Age Group	3.741	0.880	NS
	Marital status	0.545	0.761	NS
	Educational status	3.550	0.737	NS
	Occupation	11.773	0.301	NS

Chi square test were use at 0.05 significant level, S ≡ Significant association, NS ≡ Not significant association.

4.3 What has been done to response

The Supreme Council for the Environment and Urban Promotion in Khartoum State issued a decision by the start of 2016 to stop dealing with plastic bags less than 6 microns and effective application at the start of 2017, the decision was planned to limit the quantities in the markets and factories. As the Council attributed the decision that the bags lead to environmental pollution and health and cause cancers. According to this decision, 900 million bags were confiscated, about one hundred and four factories have been suspended from production, and 15,000 workers were displaced from the production wheel according to the plastic factories division of the federation of chambers of industry, and thus cause an increase in the number of unemployed citizens after the ban. Protecting and preserving the environment from pollution caused by plastic bags is what the supreme council for the environment in Khartoum is seeking by issuing a decision of banning the manufacture and circulation of these bags.

Dozens of plastic manufacturers said the government's justifications for the decision were not convincing, and saw the decision as a reflection of the government's failure to address an environmental crisis and contravened the country's investment law.

from the interview with an Assistant Environmental Inspector working in The Supreme Council for the Environment Department of Supervision, Inspection and Violations, she said that the ban decision was issued by the Legislative Council, the General Administration of Supervision, Inspection and Violations on 2016, and on January 2, 2018, the beginning of implementation, environmental Protection and Promotion Law 2008 Amendment 2015 is a booklet containing more than 30 paragraphs, including Paragraph 7 related to the law prohibiting the manufacture and circulation of bags less than 60 microns thick

The law prohibiting the manufacture and circulation of plastic bags less than 60 microns, the first stage is industrialization The second phase distribution The third stage is the shops on the main and secondary streets. The decision was partially successful in the first months of its release, with a rate of 70 percent.

Preparation for the implementation of the decision has been made since the year 2015 through awareness campaigns, flyers, seminars, moving theaters, video, audio and read advertisements, in addition to workshops set up by the Supreme Council for the Environment. Many scientific papers and research papers were issued by specialized bodies that participated in the workshops established by the Supreme Council for the Environment and Urban Promotion.

Months after the issuance of the decision resulted in an increased awareness among citizens of the harm of using light plastic bags and an increase in

conviction of the necessity to stop their circulation in addition to the conviction of more citizens to refrain from using plastic bags to transport hot foods. By the side of industrial part many factories have taken the initiative to add substances to increase the percentage of dissolution in the bags, on the other hand some Powerful factory owners refused to stop operating their machines and factories. some factories resistance by all means to court decisions, such as some factory owners moving their machines to other states or working at night to avoid inspections. The number of violations is more than 3519 consist of factories, shops, and distribution centers. The value of the levy for the factory is twenty-five thousand pounds after the first warning, fifty thousand pounds after the second warning, then the factory will be closed and the machines and material confiscated as shown in figures (4.39-4-42).

There was a clear weakness and lack of manpower working in awareness raising compared to the size of the state. The executive authorities that carry out the closure and confiscation procedures have some weakness, and it is necessary to seek the help of the prosecution for the implementation, because even after the issuance of a decision to close any factory or confiscate its products, the decision was suspended and bypassed. Among the obstacles is the need to coordinate with local councils and civil defense to implement the decision and control. There are also administrative problems, such as a lack of machinery and cars, and places to store seizures and bags confiscated by the executive authorities.

figure (4.39): Amount of raw materials confiscated after inspection

figure (4.40): Bags contrary to specifications

Figure (4.41): Rolls plastic bags confiscated after inspection and violation

Figure (4.42): Sacks of raw materials contrary to the specifications

4.4 Steps of policy formulation for policymakers:

This section presents a 10-step roadmap to guide governments, environmentalists, top politicians, members of parliament and major stakeholders, that decide to opt for a policy approach in the introduction of a ban or levy. The roadmap draws upon the experiences, both positive and negative, of other countries that have already implemented bans and levies on single-use plastics (primarily plastic bags and Styrofoam).

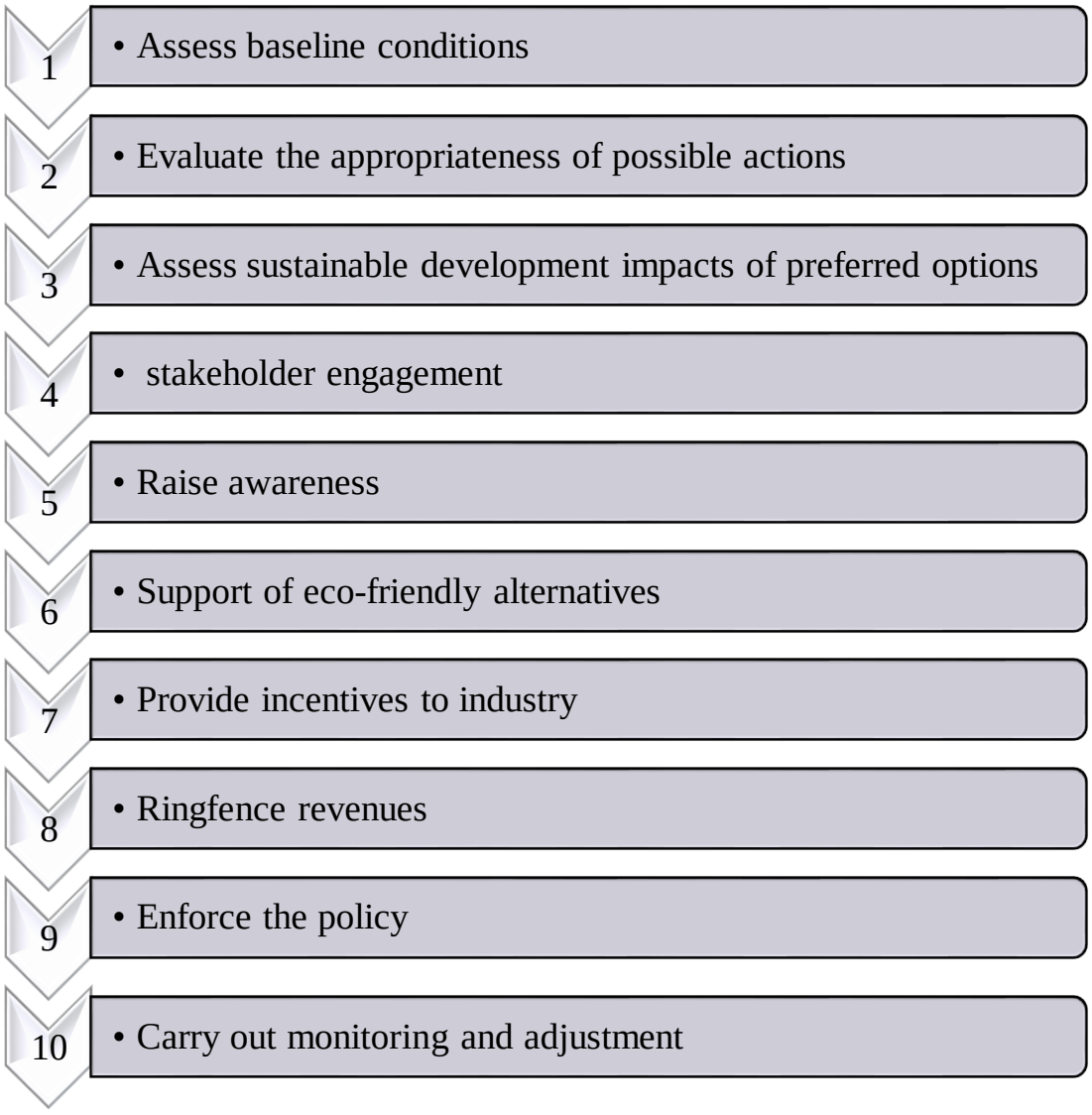

Figure (4.43): ten steps roadmap for policy makers

1. Assess baseline conditions

The baseline assessment study should answer an important question:

- what is the extent of the problem?
- what are the impacts that the mismanaged single-use plastics are imparting on human health and wildlife, the environment, and the economy?
- what is the source of pollution, citizen negligence, poor collection systems, improper disposal sites?
- How much the willingness to pay for a certain good or service by the consumers?

2. Evaluate the appropriateness of possible actions

Based on the findings of the baseline study, it will be important to evaluate what are the most appropriate instruments that will be beneficial in addressing the specific problem. The most important elements to be analyzed are the institutional capacity and the existing economic conditions to ensure that the instruments being considered are realistic and have high chances of being successfully implemented.

Institutional capacity is the element that insure smooth political influence of the ministry regulations support and enforcement. Economic conditions are the element to ensure the existence of effective legal systems and estimate the time and resources needed to implement the regulations. (Table 4.12) shows the main instruments to make solution packages to deal with single use bags problem.

Table (2.12): The main possible instruments to formulate a solution package

Type of instruments to reduce single-use plastic waste		Overview of Method	Example of applications	Positive impacts
Voluntary reduction strategies		It builds on the understanding that for change to be long-lasting, it needs to be voluntary and based on choice	Promotion of reusable alternatives to single-use plastics (e.g. promotion of reusable bags, reusable bottles, etc.)	Allows time for population to change consumption patterns, which can trigger changes among manufacturers Allows time for affordable and ecofriendly alternatives to enter the market
	Public - private partnerships	The agreement sets the overarching goal, but leaves the choice to the private sector on how to achieve the results	Voluntary agreements between government and retailers (e.g. to encourage retails to voluntarily ban or phase out single-use plastic bags)	Valid alternative to bans Achieves reductions in single-use plastic consumptions Stimulates businesses
			Agreements with producers (e.g. to voluntarily establish Extended Producer Responsibility, including deposit return schemes)	
Public education		It requires a gradual and transformational process, key to change consumers' behavior	Introduction of environmental conservation principles in school curriculums	Common denominator for the success of any initiative
			Social campaigns	
Policy instruments	Regulatory	Bans the use, sale, etc.	Ban (total or partial)	- simple to introduce - Can reduce amount of plastic consumed - a step towards more comprehensive policies
		Laws and acts mandating that packaging manufacturers bear some responsibility in recovering packaging waste	Extended Producer Responsibility	Reduces amount of packaging lingering in the environment Fosters business responsibility Stimulates recycling sector
	Economic	Levies or taxes	Levy on suppliers	
			Levy on retailer	
			Levy on consumers	
	Combination of regulatory and economic		Ban and levy	A combination of the above
			Extended Producer Responsibility	

3. Assess sustainable development impacts of preferred options

After the possible actions has been assessed, governments may be left with a short list of possible suitable instruments. a key step is to study the sustainable development impacts of the short-listed choices. Assessing the social, economic and environmental impacts of a policy will also help identify its boundaries and scope.

4. Stakeholder engagement

Acceptance from stakeholders is important, and can be ensured through calls for early inputs, policy discussion meetings, and wide-reaching awareness campaigns. Special attention should be paid to mapping the main stakeholder groups that will be affected by the new policy and their power. The most common stakeholder groups that might be engaged include national and local government entities, national waste management authorities, local waste management officers, Trade and industry associations, single-use plastic producers, Retailers, Individual citizens and organized civil society groups and environmental NGOs.

5. Raise awareness

Evidence shows that resistance is likely to decrease if consumers are aware of the social, environmental and economic impacts of mismanaged single-use plastics. These can be communicated through a variety of methods, including Educational programs, workshops in schools, extensive multi-media awareness-raising campaigns using TV, radio, newspapers, social media, door-to-door campaigns, and distributing alternative options to single-use plastics

Each campaign should have a clear and simple message and should clarify shows why a certain instrument has been chosen and what will be the benefits for the population.

6. Support of eco-friendly alternatives

Before banning plastic bags or any single use plastic, governments should offer a valid alternative. Eco-friendly and alternatives should provide the same or better properties of the items that are to be regulated.

The uptake of recycling technologies can be facilitated through the introduction of economic incentives (including tax rebates, research and development funds, technology incubation support and public-private partnerships).

7. Provide incentives to industry

When wanting to regulate the production and consumption of single-use plastics, governments are likely to face resistance from the plastic industry as well as from importers and distributors. To limit resistance and gain as much support as possible, governments must consider providing incentives to industry. It may be beneficial to introduce the incentives long before the new legislation is put into effect in order to guarantee enough time for plastic manufactures, distributors and retailers to adapt to the new law by deplete existing plastic bags stocks, begin alerting consumers of the upcoming change and purchase new alternatives.

8. investment of revenues

When introducing a levy on any economic instrument of single-use plastic products, and to maximize public benefits, the revenues from the levy could be reinvested to:

- Support specific environmental projects
- Boost the local recycling industry and create job opportunities
- Finance local awareness initiatives.

9. Enforce the policy

To guarantee good enforcement and monitoring of the policy it is important to clearly distribute and define roles and responsibilities between local and national authorities and organization. It would be advisable to consider measures that ensure that the necessary skills and human resources and therefore budget, will be in place before the policy enters into force.

10. Carry out monitoring and adjustment

It is important to monitor the progress and effectiveness of the policy introduced and adjust the policy accordingly. It is important for governments to keep the public updated on the progress and benefits achieved. Progress could be monitored in several ways, including through audits, surveys, impact assessments and focus-group interviews. It would be advisable to review the policy instruments on a regular basis.

Chapter Five

Conclusion and Recommendation

Chapter five

Conclusion and recommendations

5.1 Conclusions

The results indicated that the larger proportion (418, 66.90%) of the respondents used plastic bags more frequently than any other plastic products regardless of their age, occupation, and economic and educational status. Low price (135, 34.30%) and easy availability (305, 77.40%) were the main reasons for the widespread utilization of these products. (163 males, 43.2%), and (214 females, 56.8%) of 377 participants believe that the problems associated with plastic bag waste are animal death, human health, blockage of sewage, deterioration of natural beauty of environment, agricultural problems The findings of the study also indicated that the trend of utilization of plastic bags is increasing from time to time. We also observed many shopkeepers and retailers distributing plastic bags free of charge to their customers for carrying other sold items. This suggests that cheapness and free distribution of these materials by retailers or supermarket owners are believed to be the main reasons for the widespread usage and problems of plastic In order to reduce the problems associated with plastic bag wastes, it is recommended to educate the public not to use plastic bags, and to use eco-friendly alternative bags made from clothes, natural fibers and paper and end free distribution of plastic bags by retailers.

Based on the results obtained from the interviews and questionnaire the following Conclusions are drawn below:

1. majority of the Khartoum residents widely used plastic bags in their daily life activities. Some of the main reasons attributed to the widespread usage were low price, easy availability and light weight.
2. bag bans and taxes don't reduce litter or keep plastic litter out of the landfill. Without plastic grocery bags, people just purchase replacement bags made of thicker, heavier plastic and then send those bags to the landfill, too.
3. Plastic bags only make up a tiny fraction (less than 0.5 %) of the Sudanese municipal solid waste stream. Many items drive up litter more than plastic bags, including food wrappers, cups and cans.

4. the easiest way to minimize the environmental impact of carrier bags is to reuse them as many times as possible and, at the end of life, dispose of them in the correct place.

5.2 Recommendations from the study:

1. To solve the problem of plastic bags littering the policymakers should design packages of integrated and dense programs using campaigns, laws and support investment to achieve sustainable solution of the problem.
2. the government should improve the mechanism of plastic waste collection by introducing centers to collect and separate solid waste before the landfill stage. These centers should spread in neighborhoods localities and city markets.
3. Activate poor families to work in separate plastic waste and give them the proper governmental support to collect, separate and storing properly.
4. Encourage the investment in the recycling industry and eco-friendly shopping bags.
5. All the single use plastic products must be taken into account by policy makers as a major threating of Sudan environment.
6. Renew the ban law again in a form of comprehensive package of economic, regulatory and social scenario.

6.3 Recommendation for future study: -

1. Recommended to intake the same study in each States of Sudan.
2. Recommended to conduct studies on life-cycle assessment of single use and re-usable bags in Sudan.

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- United Nations Environment Program , 2018 , Single-use Plastics (a Roadmap for sustainability)

Appendix A

End User Survey

Dear participant,

this survey is designed as a tool to understand the level of awareness in people in Khartoum state about how to use plastic bags and how does its disposability is affecting the environment. Your views are extremely important to the success of the survey as well as to the efforts being made to minimize environmental impacts of plastic bag wastes. Thus, are kindly requested to cooperate in giving responses to the items given in this questionnaire. Multiple responses are possible for the items. Please use " √ " mark.

Part 1 questions: Participant profiles

Sex of Participant: male/female

Age group: <20 years- 20-29 years - 30-39 years – 40-49 years – 50< and above

Marital status: single adult- adult parent with family

Educational status: □ illiterate □ primary education □ high school education □ higher education

Occupation: □ student □ government employee □ privet sector □ private job-daily laborer □ house wife □ other ……..

Residential area: □ Khartoum □ Jabal awlia □ Omdurman □ Umbada □ Karary □ Khartoum north □ East Nile □ other:……

Location of work : : □ Khartoum □ Jabal awlia □ Omdurman □ Umbada □ Karary □ Khartoum north □ East Nile □ other:……

Years on Khartoum: □ <5 years □ 5-9 years □ 10-14 years □ 15-19 years

Part 2 questions: (consumption behavior of the respondent)

1-How often do you visit commercial stores?

□ daily □ weekly □ monthly □ occasionally

2-How do you plan your daily/weekly shopping?

□ I decide what to buy in the shop

□ I make a shopping list

□ I make a shopping list and take a shopping bag.

3-What are the different kind of items you usually use plastic for?

□ Bags □ cups & plates □ bottles □ packaging □ other …….

4-When you buy baker's goods what kind of bag do you use?

□ thin plastic bags □ paper bags □ fiber bags □ other…….

5-when you buy hot foods (milk/beans) what kind of pot do you use?

□ thin plastic bags □ plastic pot □ metallic pot □ glass pot □ other: …….

6- Why do you prefer to use the plastic bags?

□ They are cheap □ They are light in weight □ They are easily available

□ Lack of alternative materials □ other reason …….

7-How long time do you use a shopping bag?

□ one time □ a few times □ for a few years □ until it is damaged

Part 3 questions: (environmental awareness of the respondent)

8- Do you think that plastic bag wastes cause problems?

a) Yes b) No c) No idea

9- If your answer to question 8 is 'Yes', what are the problems?

□ Animal death □ Human health problem □ Blockage of sewage (drain) systems

□ Deterioration of natural beauty of environment □ agricultural problems □ all above

10-Have you heard environmental impacts of plastic bag wastes on environment? □ Yes □ No

11- If your answer to question number 9 is "Yes", how or where?

□TV/radio □ School/university □ From professionals □ Published materials

□ Internet □ Other……

12-After you have finished the use of plastic bag what do you do with it?

□ Through it to the floor □ Dust bin □ reuse □ sell it □ burn □ Burying

□ recycle □ other ……

13- Which parts of Khartoum state seriously polluted by plastic bag wastes?

□ Parks □ Waste dumping sites □ Market places □ Crowded residential areas

□ Roadsides □ open places in the city □ sewage (drain) lines □ Others ……

14- The trend of utilization of plastic bags is: □ Increasing □ Decreasing

15-If your answer is to question 14 is "Increasing", what are the possible reasons?

□ low cost □ Durability □ Availability wherever and whenever required
□ Lack of awareness of the community □ Others
……

16- If your answer is to question 14 is "Decreasing", what are the possible reasons?

□ Availability of alternative materials
□ Awareness of the community
□ Increasing prices of plastic bags after banning
□ difficulty to found it after banning
□ Others ……

Part 4: self-opinion and suggestions and willingness to reduce consumption

17- Do you think that all shops should offer plastic and paper bags for their customers? (Customers can decide which type they want to use.)

□ yes □ no □ maybe

18- Do you think that plastic bags should completely disappear from shops?

□ yes □ no □ maybe

19-if you answer q(18) yes which is the best alternative material?

□ cloth bag linen b) a shopping bag with the logo of the shop
c) with strong handles d) paper

16- Additional comments (if any)

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Thank you for your cooperation,