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DEPOSIT-REFUND SYSTEM

Feasibility study on how to introduce a deposit-refund system in
Nairobi, Kenya

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KABUGU, SIMON MUGI: Deposit-refund systems.
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Master's thesis in Sustainable Urban Planning and Climate Change, 62 pages, 16
pages of appendices

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ABSTRACT

Plastic material has many applications. It is used in constructions, vehicle parts manufacturing, clothing and packaging. Although the usage keeps increasing, the long term effects of plastics waste continues to cause havoc to our environment. This research explores one way of collecting plastic bottles packages and aluminium cans from the consumers through reverse vending machines installed in the supermarkets.

Data from a very efficient waste collection and recycling in Finland was compared with an emerging market in Nairobi, Kenya. Recycling in Finland is one of the highest in Europe, and it is well organized including strict environmental laws and regulations unlike in Kenya where the laws are not well enforced. This has led to degradation of the environment, animals' health and local inhabitants. With data collected from the Lidl stores, the author was able to compare it with Nakumatt supermarkets in Nairobi, Kenya, got suggestions and drew conclusions on how recycling of plastic bottles and aluminium cans could be introduced.

The research shows that there is a huge difference between Kenyans and Finnish citizens on recycling mind set, and Nakumatt supermarket managers are reluctant to invest in the systems, which they are not sure if they will work. Based on the study, suggestions can be made that; the Kenyan government should educate people about recycling and its importance before introducing the recycling systems.

Keywords: Aluminium, plastic, recycling, deposit, refund, environment, waste

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ABSTRACT

Muovin käyttö ulottuu rakennusmateriaaleista, ajoneuvojen osien valmistukseen, vaatteisiin ja pakkauksiin. Vaikka muovin hyödyntäminen kasvaa jatkuvasti, pitkällä aikavälillä muovijätteen vaikutukset aiheuttavat tuhoa ympäristössämme. Tämä tutkimus tutkii yhtä tapaa kerätä muovipulloja ja alumiinitölkkejä kuluttajilta hyödyntäen supermarketteihin asennettuja palautusautomaatteja. Se vertaa erittäin tehokasta jätteiden keräystä ja kierrätystä Suomessa kehittyvien markkinoiden Nairobiin Keniassa. Kierrätys on Suomessa yksi Euroopan korkeimpia. Se on hyvin järjestetty tiukkojen ympäristölakien ja asetusten mukaisesti toisin kuin Keniassa, jossa lakeja ei ole pantu hyvin täytäntöön. Tämä on johtanut ympäristön tilan huononemiseen sekä eläinten ja paikallisten asukkaiden terveyden heikkenemiseen. Lidl myymälöistä kerätyllä tiedolla on pystytty verrata supermarketteja Nairobina Nakumattissa Keniassa sekä saada ehdotuksia ja päätelmiä siitä, miten muovipullojen ja alumiinitölkien kierrätys voitaisiin ottaa käyttöön. Tutkimus osoittaa, että on olemassa valtava ero kenialaisten ja suomalaisten kierrätykseen kohdistuvassa mielenlaadussa ja että supermarkettien johtajat ovat haluttomia investoimaan järjestelmään, jonka toimivuudesta he eivät ole varmoja. Kenian hallituksen pitäisi valistaa ihmisiä kierrätyksestä ja sen merkityksestä ennen palautusjärjestelmän käyttöönottoa.

Avainsanat: Alumiini, muovi, kierrätys, pantti, palautus, ympäristö, jätteet

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1 INTRODUCTION

Waste management in Nairobi, Kenya has been neglected for many years and this can be seen on the streets, in the estates and in Nairobi River where people dumps their waste. The few private companies which collect waste from estates end up dumping it on open fields. Nairobi has a population of about three million inhabitants and one dumping site in Dandora in Embakasi division. Organized youth and self-help groups' collects plastics and Aluminium items and sells them to few recycling companies. This type of plastics and aluminium metal business can be exploited and modernised to create jobs and clean the environment.

The author have been thinking the recycling systems in Finland is more advanced and the waste recycling systems in Kenya are not well organised. It was decided to choose some part of recycling system and research on it more to understand how it works in Finland and use the information on how it can help to clean the environment. In Nairobi, Kenya there is a problem with aluminium cans and plastic bottles waste and when the author got a chance to work in Lidl recycling department it was a good opportunity to use the available recycling facilities to do his research.

Recycling of cans and bottles has many advantages such as a source of income as well as cleaning of the environment. Nakumatt supermarkets provides a good platform for introducing the deposit refund system because its main target is; middle income earners, its big stores have enough space for installing reverse vending machines and it has good infrastructure which will be easier to install the systems.

The study was first carried out in existing systems in Finland through PALPA OY and case study Lidl Suomi Ky. It involved interviews to general public, store managers, PALPA OY administration manager, warehouse supervisor and work practise in Lidl central warehouse recycling department in Janakkala, Finland.

The background of the study included introduction, plastics materials, aluminium recycling, deposit-refund systems in Finland, recycling in Kenya, case studies from Lidl Suomi Ky and Nakumatt supermarkets in Nairobi and finally results

and conclusions. Currently, in Nairobi, Kenya there is no formal collection of PET bottles or aluminium cans. Local inhabitants around the dumping site collect plastics and aluminium metal parts and sell them to recycling firms.

This research offered the feasibility study on how recycling systems could be introduced through Nakumatt supermarkets around the city. It compared data from Lidl Ky and Nakumatt supermarkets to measure the viability of the system. The systems have various advantages such as attracting more customers, managing the environment and creating jobs to the society.

The methods used included collecting literature data from books, sending questions to different people to measure their attitude towards recycling, visiting different stores in Finland to interview managers and taking photos of recycling machines and checking how they operate and working in recycling department in Lidl to get the hands on the system.

2 PLASTICS

The evolution of plastics started in 1830s. Experiments with natural materials and chemicals resulted in a new material which was called vulcanised rubber. In the first decade of 20th century, a man made material was invented and named Bakelite and the plastic material was born. (Siegle 2006, 119)

Their development and consumption has increased from 1950s by 2000 per cent and is growing at the rate of four per cent annually. Currently, about 280 mega tonnes of plastics are produced annually with China as the main producer. (Worrell & Reuter 2014, 179)

2.1 Plastics applications

Plastics are synthetic materials which are flexible in nature. By changing its structural components, the properties of the final product can be manipulated. Its properties include; water resistant, durability, cheap to produce and better insulation. (Siegle 2006, 120). In 15 member states in the European Union, packaging accounts for large plastics usage (38%), then building and construction, household wares, automobile, electronics and other applications as shown in figure 1 below. (Worrell & Reuter 2014, 180)

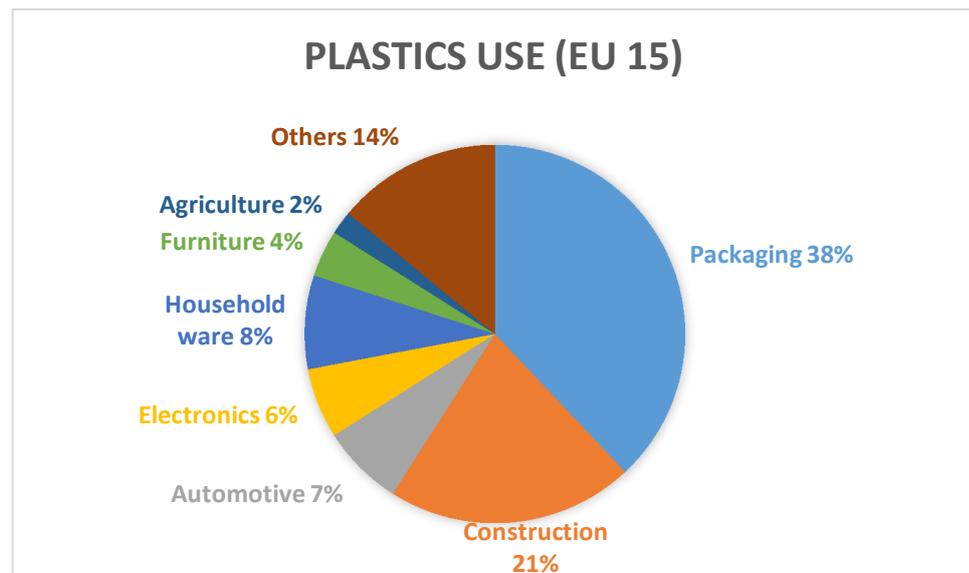


Figure 1. Plastics applications based on data from 15 EU member states

2.2 Drawbacks from the use of plastics

The production process consumes 8 per cent of oil produced in the world and the by-products consists of harmful solid wastes, nitrogen oxide, sulphur dioxide and carbon dioxide which are harmful both to human beings and to the environment. The chemicals used in stabilisation of the plastics, its colour as well as in the alteration of its properties have not been well researched on humans and their effects are not yet clear. (Siegle 2006, 121)

Chemicals such as phthalates, bisphenol A, brominated flame retardants, and dioxins have effects on hormones and are also carcinogenic. Phthalates which are widely used in PVC, may be released when plastics comes into contact with saliva. Plastics are also non-biodegradable. (Siegle 2006, 121)

2.3 Types of plastics

They are divided into two categories namely; thermoplasts and thermosets. Thermoplasts does not change the chemical composition when heated and can be formed into different shapes after melting, while thermosets can be moulded only once and their recycling is harder compared to thermosets. Polyurethane (PUR) is one example of thermosets. (Worrell & Reuter 2014, 180)

The major thermoplasts includes; polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyvinyl Chloride (PVC). Polyethylene consists of high density (HDPE), low density (LDPE) and linear low density (LLDPE). Figure 2 below shows the main plastics used in 27 member states in EU and have similar distribution as the whole world. (Worrell & Reuter 2014, 180)

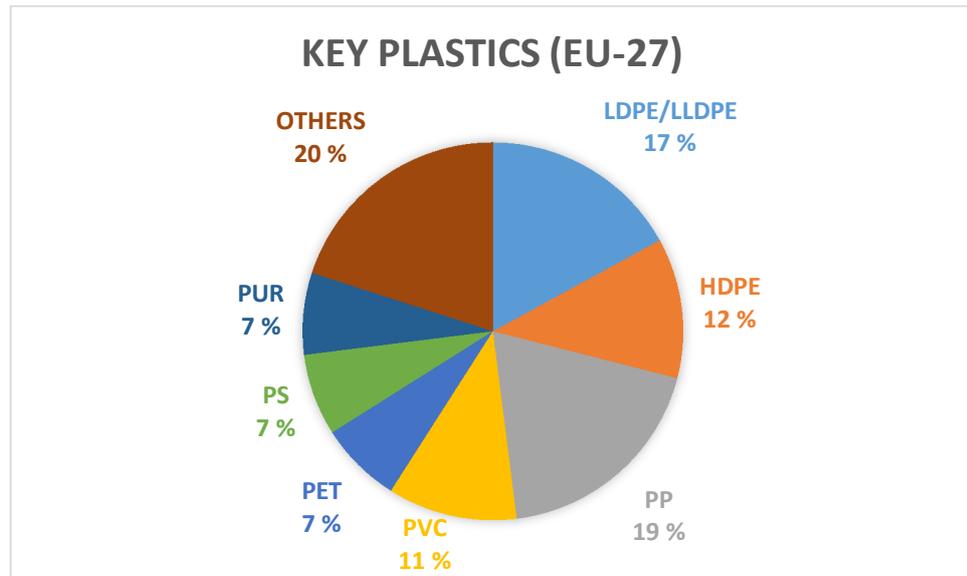


Figure 2. Major plastics used in 2011 in European Union. Based on data from plastics Europe.

2.4 Different recycling codes and plastics applications

The following is a breakdown of different recycling codes used to distinguish between different plastics. The number indicated helps in identification and sorting of plastics during recycling. (Worrell & Reuter 2014, 181-182)



The above recycling code is used for polyethylene terephthalate (PET). Its applications include; bottles for soft drinks, detergents, mineral water, packaging for meals and pharmaceutical products. Its properties includes toughness, strength and not permeable to moisture. (Hester& Harrison 2013, 86)



High-density polyethylene or HDPE is usually used in thick walled bottles, crates, jerry cans, barrels and packaging for carpets. It is strong, tough and permeable to gas.



Polyvinyl Chloride (PVC) is used in packs for medication, blisters and films for goods which are perishable. It is strong and tough.



Polycarbonate or PC is widely used in packaging for liquids such as milk. It is strong and resistant to chemicals.



Low-density polyethylene (LDPE) is used in foils, sacks, bread wraps and carrier bags for vegetables. It is strong, flexible and not permeable to moisture.



Polypropylene (PP) is used in boxes, crates, margarine tubs, packaging for confections and dairy products cups. Its properties includes, toughness, heat and chemicals resistance, strength and not permeable to moisture.



Polystyrene (PS) is used in vending cups, foam meat trays, ice boxes and video tapes covers. It is easily formed and versatile.



Other categories are grouped in this plastic recycling group.

2.5 Plastic packaging

Packaging plays a big role in protecting the product from the environment and preserves its quality. There are five main plastics used which includes PET, PP, PS, PVC and PE. The type of packaging used is essential so that the product arrives in good condition, it also contribute to the weight of the product and therefore has impact on logistics, environment and economic. Plastic packaging made from PET material, for example 500 millilitre drink bottles reduced weight by 33 percent from year 2000 to 2008 and as a result transportation costs were significantly reduced. (Hester & Harrison 2013, 84)

In 2011, the industry reported that flexible packaging had 14 percent market share and rigid plastics which are mainly PET had 22.1 percent while paper had 31 percent, metal 16 percent and glass 7 percent. The industry predicts that the market share for the plastic materials will increase and metal packaging will decrease. The demand of packaging materials is increasing due to growth in Chinese economy and it is projected to overtake the USA by 2017. Plastic has

many benefits such as less weight, easily produced and recycled and that's why it's the best choice for packaging. (Hester & Harrison 2013, 85)

2.6 Plastic waste collection, sorting and separation

The first stage in plastic recycling is collection. There are different methods used in different countries, such as:

1. Environment, disposal sites, dumping sites, street
2. Municipal waste and households
3. Curb-side collection
4. Bring systems, drop off centres, return vending
5. Selection and replacement in multi-trip applications, deposit systems

In South America and Asia, methods 1 and 2 above are mostly used to collect plastics. In Europe, North America and Japan, methods 2 and 3 are mostly applied. In countries like Germany, Sweden and Canada, method 4 is very common and in Denmark method 5 is used. In developed countries such as Finland, automatic machines or reverse vending are installed by food shops. These machines can distinguish between polymers, colours and the plastics collected are of high quality. The method used affects the quality of collected plastics as shown in table 1 below. (Thiele 2007, 273)

Table 1. Description for different methods of plastic bottles collection

Methods	Description	Quality
1	all sorts of foreign plastics, metal, soil, paper, different colours, impurities	difficult
2	mixed plastics, glass, metal, soil, all colours	poor

3	higher PET collected, other plastics, metal, paper, all colours	fairly good
4	low contents of other plastics, lower metal contents, limited colour content	good
5	no other plastics, no metal, paper and same colour	very good

2.6.1 Sorting and separation

Sorting is one of the main sections in plastics recycling. Plastics need to be sorted according to recycling codes as most of them are not compatible to each other. Sometimes a product can be made of different plastic materials with same characteristics and these acts as impurities after separation. This affects the quality of the final product and sometimes the whole production line. The price that the manufacturers are willing to pay for recycled plastics is determined by the price of virgin resin; hence the recycled plastic must be of good quality. (Scheirs 1998, 2)

Different methods are used for identifying and sorting of plastic waste, these includes; manual sorting, float sink separation and automated method. Sorting and separation depends on the properties of plastic to be sorted such as optical, chemical, physical and electrical. (Scheirs 1998, 2)

2.6.2 Manual sorting

This method of sorting involves a trained person who identifies different plastics as they pass along a conveyor belt. The sorting can be assisted by the use of light such as ultraviolet light. 'Black' light can be used to differentiate PVC and PET bottles. Manual sorting can be semi-automated by use of special lighting to assist in differentiating between PVC and PET as well as PS and PET and PVC. The process involves use of polarized goggles to sort plastics from a moving conveyor belt. (Scheirs 1998, 3)

This kind of sorting is labour intensive and it is not so effective. It is used in micro and also mini-enterprises in developing nations where labour is available and cheap. The higher labour cost increases the production cost making this method economically unviable in developed countries. There is possibility of human error hence reducing the quality of recycled plastics. This method consists of three steps: (Manrich & Santos 2010, 12)

Step 1.

First step is to identify the recycling code and note the number or abbreviation.

Step 2.

Second step is to check what application the product was used for, for example PET is used for soft drink bottles.

Step 3.

Finally from the list of most likely, check the specific distinguishing properties which are simple to compare, for example, PET and PVC are transparent while HDPE is opaque. Separation of PET and PVC is easy, for example, if the bottle has an injection point at the bottom it is PET while with a line it is PVC. (Manrich & Santos 2010, 12)

2.6.3 Automatic separation

This process is used to separate waste by its chemical or physical properties, these includes density, solubility, and thermochemical. (Scheirs 1998, 4). Sorting by density method has been used for many years. It involves sorting plastics by their different densities. There are two methods which uses density sorting, this includes: Float- sink and dry separation method.

Float-sink method is also called wet separation. It is one of the oldest method used in separation of mixed plastics. It utilizes a fluid medium with a density which is equal to the plastic in question. Plastics which are less dense than the medium will float while the ones denser will sink. Usually water, mixer of water and methanol,

sodium chloride (NaCl) solution and zinc chloride (ZnCL₂) solutions are used as the medium. (Scheirs 1998, 4)

This method is used in separation of polyolefins from PVC and PET using water as the medium. Its drawbacks includes; difficulties in separation of mixed polyolefin with nearly equal densities, difficult to control, low quality of sorted plastics and evaporation of the solution may lead to change of its density and affecting the end results. (Scheirs 1998, 4)

The dry separation method, air is used in the float-sink step. Air separation can be used to remove metal, glass and other heavy plastics. Light particles such as fibers from textiles can be removed through air table. This method has limitation because the decaying food left on the plastics is not separated and produces bad odor. (Scheirs 1998, 5)

2.6.4 Centrifugal and optical sorting

In this process, hydrocyclone is used. It uses centrifugal force to separate plastics and contaminants. This method produces high purity results even from most contaminated plastics. Automatic optical sorting can be used to separate different recycled polymer by the use of their color. For example, colored PET can be sorted from clear PET. (Scheirs 1998, 7)

2.7 Plastic recycling

In 2011, plastics consumption in European Union was estimated to be 47 mega tonnes and plastics waste was estimated as 25 mega tonnes. This indicates that there is considerable amount of plastics which is retained by the society. Some of these retained plastics are in construction which will become available as waste when the buildings are demolished. Packaging is the biggest contributor of waste (76 per cent) although it accounts only 38 per cent of plastic used. (Worrell & Reuter 2014, 183)

PET recycling has gradually increased due to usage especially in beverage industries. Constant supply, availability and the demand has increased the value of recycled material to almost that of aluminium. (Scheirs 1998, 122)

2.7.1 Challenges in PET recycling

Some challenges arise during recycling, these include:

1. Recycled PET has to compete with other cheaper resins for its applications.
2. Label adhesives cause discolouration of PET.
3. Residual moisture causes degradation when reprocessed if not dried completely.
4. High costs involved during collection due to volume of the bottles.

PET flakes must be of same colour, minimal contaminations and batch quality must be consistent. (Scheirs 1998, 124)

2.8 Mechanical recycling of plastics

This is the main technology used in recycling of plastics. It involves converting plastics into new products simply by melting and moulding. In the European Union, for example, mechanical recycling increased from 5 megatons in 2006 to 6.6 megatons in 2012. (Worrell & Reuter 2014, 184). It involves the following steps:

Sorting: The first step is collecting and transporting waste into the sorting area. The collected plastics contain different kinds of plastics and other contaminants such as metal and labels. These contaminants are removed and the plastic mixes are then separated into similar groups. Different techniques are used in combinations depending on the composition of the waste. These techniques include; sink-float, drum screens, Eddy current, X-ray and infrared sensors separation. The level of purity depends on energy costs and markets. The highest

achievable level of purity is between 94 to 95 % but, the purity should be at least 98% to be used in manufacturing processes. This means further refining is needed to increase the level of purity. (Worrell & Reuter 2014, 185)

Other steps includes; shredding, washing and reprocessing.

The next step is size reduction to enable processing of large volume of plastic waste. After shredding the flakes are washed. Plastics during their usage and collection get contaminants, it is necessary to determine those contaminants before recycling in order to use the appropriate cleaning method. Aqueous solutions are usually used to clean surface contaminants but they are not effective when they have dissolved into the polymer. Caustic soda and surfactants solutions are usually used in the process which involves shaking of grinded flakes in the solution. The process takes between 5 to 20 minutes at 88 degrees centigrade. (Manrich & Santos 2010, 12)

Different methods are used in reprocessing, these includes; agglomeration, fiber extrusion, injection, blow and film moulding. (Worrell & Reuter 2014, 186)

2.9 Chemical recycling of plastics

Chemical recycling is the use of depolymerization and decomposition to break down polymers into low molecular weight products. Different type of chemicals are then generated which can be used as raw materials. The process is divided into two groups namely; thermolysis and solvolysis. (Manrich & Santos 2010, 59)

2.9.1 Thermolysis and solvolysis

Thermolysis process operates in high temperatures ranging from 350 to 1000 degree centigrade. It involves three processes; gasification, hydrogenation and pyrolysis. (Manrich & Santos 2010, 59)

Solvolysis is the use of solvents and moderate temperatures. Different reactions takes place such as; hydrolysis (using water), methanolysis (methanol) and glycolysis (glycol). (Scheirs 1998, 157). Hydrolysis attention is increasing lately

due to low environmental impacts and is classified as green technology. (Manrich & Santos 2010, 59)

2.10 Energy recycling of plastics

Waste plastics contain energy which can be recovered through combustion. Incineration of waste produces steam which can be used for heating or generation of electricity. (Scheirs 1998, 508). PET waste containing impurities is more profitable in energy recycling; it contains high calorific value of 30.2 mega joules per kilogramme which is nearly equal to that of coal. (Chanda & Roy 2007, 2.14). Advantages of energy recovery through incineration include:

1. 90 percent reduction in waste mass.
2. Incineration destroys harmful contaminants.
3. By-products can be used in construction.
4. It is the safest method of disposing hazardous goods packaging. (Scheirs 1998, 509)

3 ALUMINIUM RECYCLING

Recycling is very important in continuation of aluminium use. Over half of products produced in the European Union come from recycled materials and this trend is increasing yearly. The high value of its scrap makes it more attractive for recycling. In 2004, for example, production of goods in European Union used 11.4 million tons and 8.4 million tons of these were from recycled raw materials. (EAA/OEA Recycling Division 2006)

3.1 Aluminium recycling industry

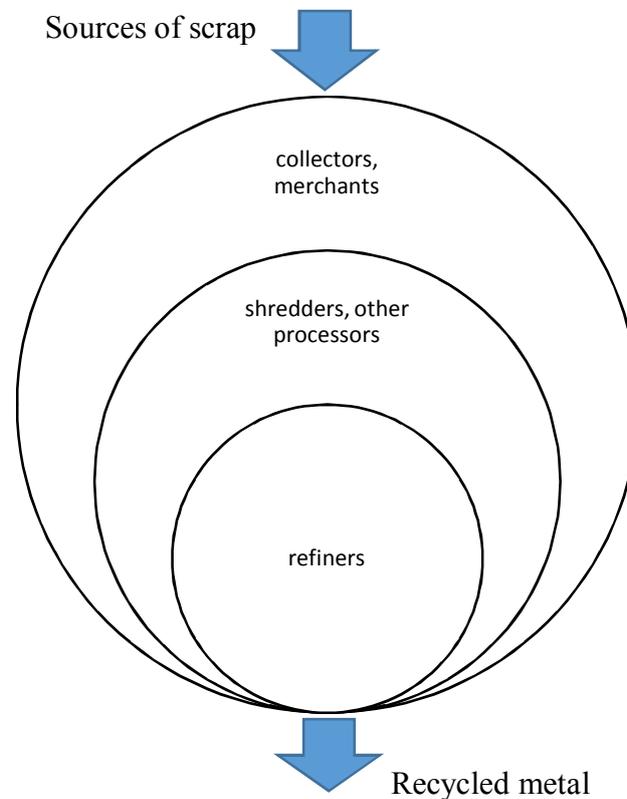


Figure 3. Aluminum recycling industry

The industry consists of three interdependent industries. Refiners and remelters treats and recycle scrap into aluminium ingots, shredders and other processors prepares the scrap materials for the refiners but they also depend on collectors who collects the scrap metals as illustrated in figure 3 above. (EAA/OEA Recycling Division 2006)

3.2 Benefits of aluminium recycling

1. Aluminium recycling uses 5 percent of energy needed to produce from virgin material.
2. Reduction in natural resource use, for example in 2004; 19 million tons of bauxite, 11 million tons of coal and 6 million tons of crude oil were conserved due to recycling in Europe.
3. Land conservation. If there is no recycling the metal could end up in landfills which might occupy thousands of acres.
4. Less environmental impacts. Recycling is more environmental friendly than producing primary metal and the by-products are also used in production of cement. (EAA/OEA Recycling Division 2006)

3.3 Aluminium applications

Most of applications of casting alloys are in transport sector where the material is used to manufacture car parts such as engine blocks. Other users are construction, electrical engineering, manufacturing of washing machines and escalator steps. Wrought alloys are used in beverage cans, windows, car bodies and trains as shown in figure 4 and 5 below. (EAA/OEA Recycling Division 2006)

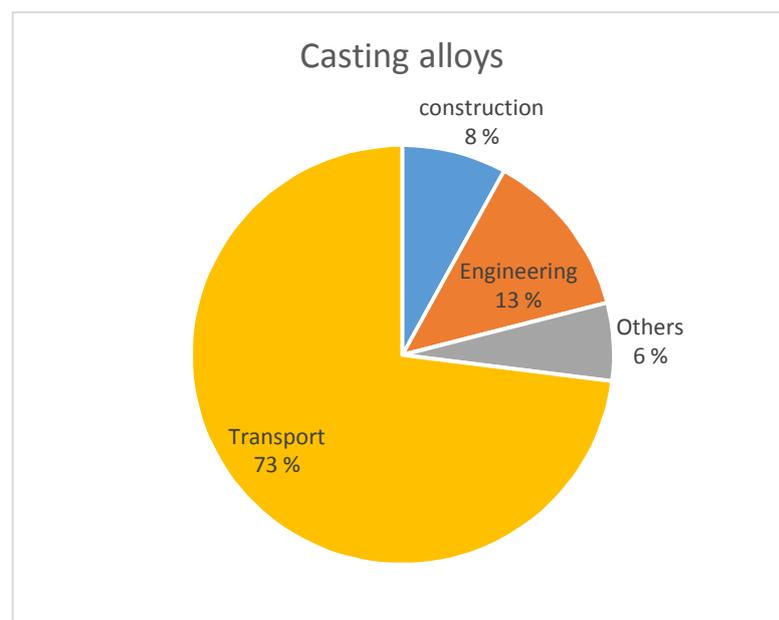


Figure 4. Casting alloys applications in Europe

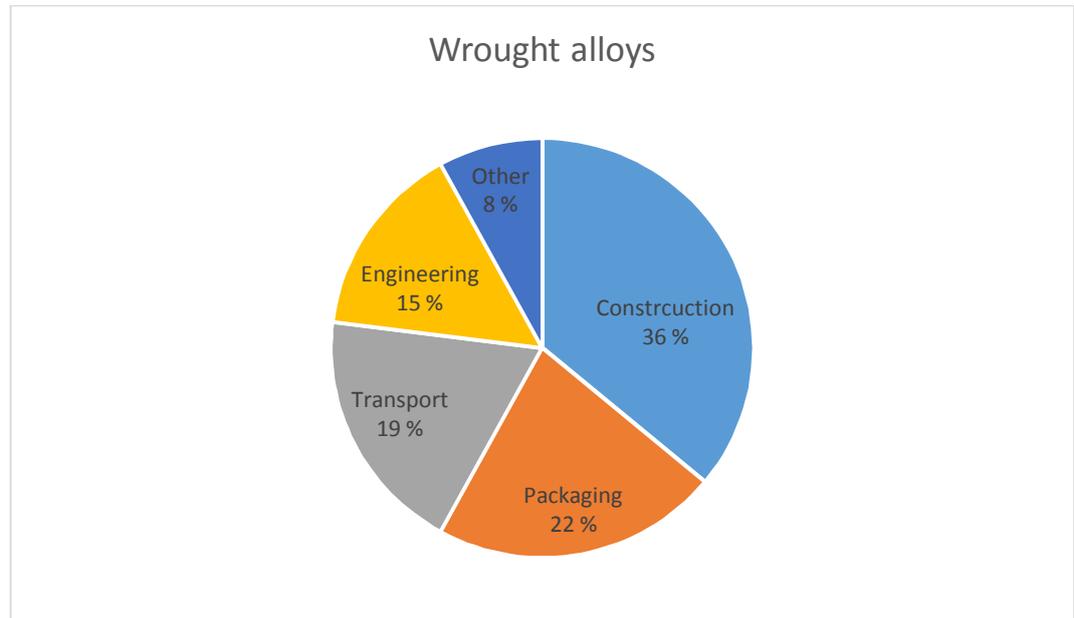


Figure 5. Wrought alloys applications in Europe

3.4 Steps in aluminium cans recycling

1. Collection. The used beverage cans (UBCs) are collected from different points such as reverse vending machines in the stores. Then they are compacted into bales of 400 kilograms and transported to collection centres. The bales are broken down and cans shredded into smaller pieces to ensure there is no trapped liquids. After the shredder a magnet separates ferrous metals from the material. (Green 2007, 122-125)
2. Delacquering. Shredded cans are laid on a conveyor which moves through a chamber with temperature of 520 degrees centigrade. Inside the chamber, other products of combustion and air are added to help in pyrolysis and combustion processes. (Green 2007, 122-125)
3. Alloy separation. After delacquering hot cans are moved into another chamber with nonoxidizing atmosphere. The alloy is mechanically broken up into smaller fragments along grain boundaries. The small fragments are diverted to lid smelters and the larger alloy particles to body smelters. (Green 2007, 122-125)

4. Melting and casting. First the oxides and contaminants floating on the melt are removed in skimming process. Bulky scrap is melted again and primary metal is charged to manipulate alloy composition. The metal is then transferred to holding furnaces for further treatments. It is then casted into ingots and finally to sheets which are shipped to can manufacturers. The new cans can be back into the stores in 60 days. (Green 2007, 122-125)

4 DEPOSIT-REFUND SYSTEM IN FINLAND

4.1 Laws and regulations

In Finland there are two Laws which led to introduction of deposit-refund systems:

1. Beverage packages law. (Valtioneuvoston asetuseräiden juomapakkausten palautusjärjestelmistä 180/2005).” Act of return systems for some beverage packages (Unofficial translation)”
2. Waste Act (646/2011; amendments up to 195/2012 included)

4.2 Finnish Returnable Packages company (PALPA)

The government introduced tax of 0.51 euros per litre to the beverage producers. In order to avoid this tax the producers formed PALPA Oy to deal with recycling of packages (Appendix 2). Now there are two systems in Finland; in one way the producer can pay beverage tax and no recycling and the other way is to join PALPA system which is the cheaper option and avoid paying tax. (Vihavainen 2015)

4.3 PALPA recycling system key figures

The main role of PALPA is to administer recycling systems. It is a non-profit company according to appendix 2. In 2005, tax exemption applied to only refillable beverage packages then in 2008 the tax was abrogated for reusable packages and this led to strong growth of aluminium cans and PET bottles as shown in the table 2 below. In 2013 there were 14000 collection points, 4000 reverse vending machines, 1500 new packages were verified, 1.7 billion deposit packages collected and 300 million euros of deposit credited. (Vihavainen 2015)

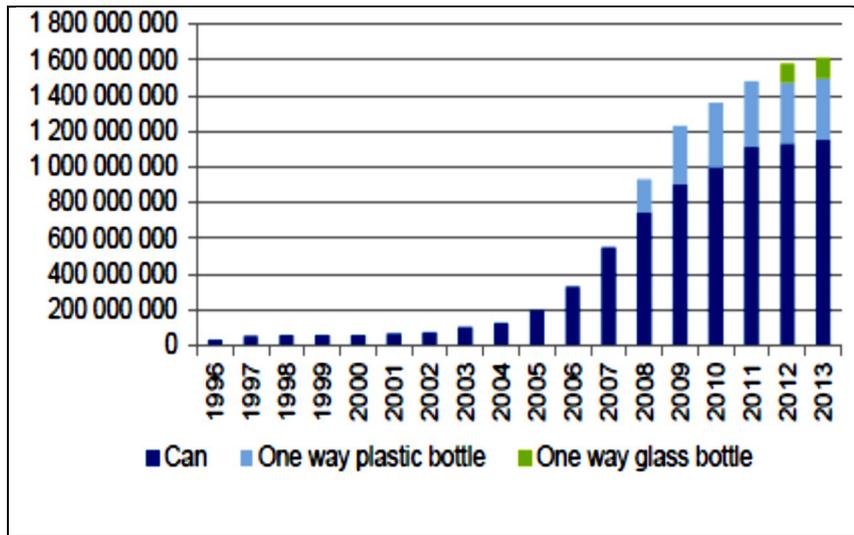


Table 2. Returned deposit packages from 1996 to 2013 in million units in Finland. (Vihavainen 2015)

Aluminium can



Recycled	Aluminium
Recycling rate	95 percent
Deposit	0.15 euro
Volume	In 2012 approximately 1 150 million returns and 17000 tons

	of aluminium recovered
Benefits	Cans are recycled into new ones. Aluminium can be reused many times. Its recycling uses only 5 percent of the energy needed to produce from virgin material.

PET bottle



Recycled	PET plastics
Recycling rate	92 percent
Deposits	0.10, 0.20, 0.40 euro
Volume	In 2013 approximately 344 million returns and 12500 tons of PET material was recovered
Benefits	Clear bottles are recycled to new ones and material for packaging industry. Coloured materials are used in textile industry.

4.4 How deposit-refund system in Finland works

The following is a breakdown of deposit-refund system in Finland from registration to compensation flow: The first step is registration. When a producer or importer want to introduce beverage to the market in Finland it is first registered with PALPA system and the producer is registered as a deposit payer. After the deposit payer is accepted, the firm must produce a security in terms of a bank deposit. Then the payer delivers the layout of PET bottle or a can as well as European Article Number (EAN) code to be approved. The samples are then sent to reverse vending machine manufacturers to test if the machine can identify the EAN code. Finally the deposit payer joins the system and is subjected to joining, bar code and deposit fee. (PALPA 2015)

Recycling is cooperation between different actors as shown in figure 6 below.

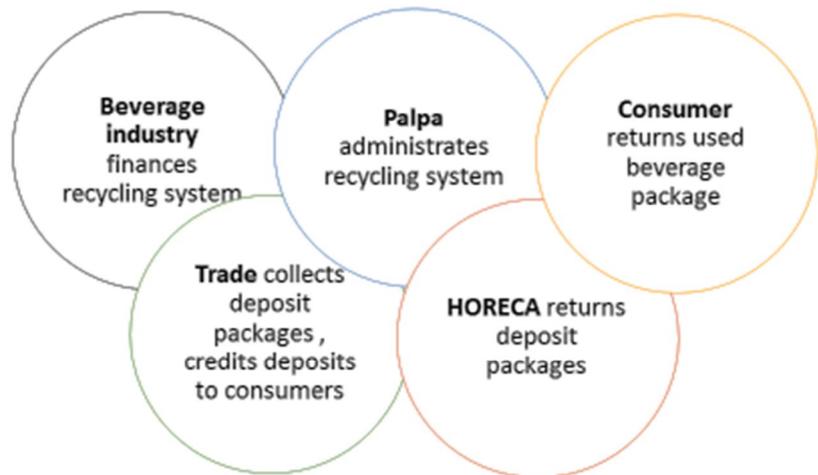


Figure 6. Different actors in recycling network (Vihavainen 2015)

The beverage industry finances the whole recycling system and Palpa administrate it. Consumer and HORECA (hotels, restaurants and catering) returns the packages and trade collects packages, credits deposits back to consumers and transports them to recycling companies. (Vihavainen 2015)

4.4.1 Material flow

Beverage industry or importer introduces a product to the market; the trade buys it and sells it to the consumer. The consumer uses the product and returns the package. The driver collects the returned package from the stores and transports it to operator such as Lidl warehouse. The operator makes bales from the packages and transports them to recycling companies as illustrated in figure 7 below. (Vihavainen 2015)

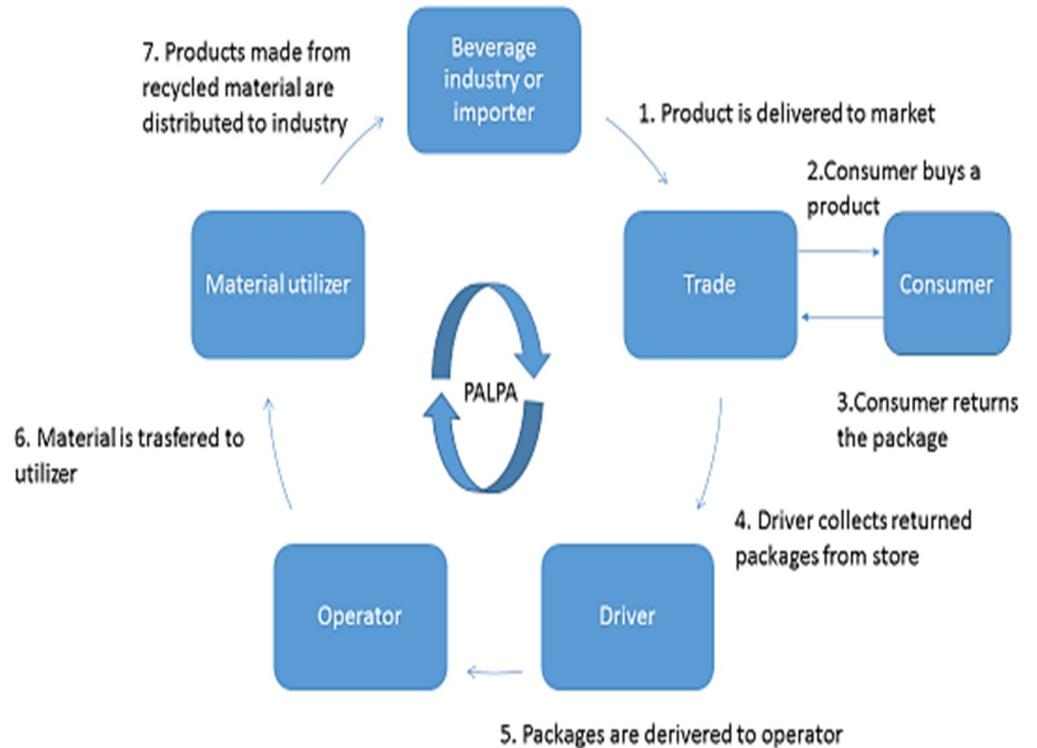


Figure 7. Material flow. (Vihavainen 2015)

4.4.2 Deposit flow

The deposit payer sends the sales amount to PALPA every month and pays the deposit. PALPA charges recycling and deposit fee from the payer according to the sales volume. Trade purchases the product from producer including the deposit. The consumer buys the product and pays the deposit to trade. Trade reports the sale and gets back the deposit, and then the consumer returns the package and is refunded the deposit as shown in figure 8 below. (Vihavainen 2015)

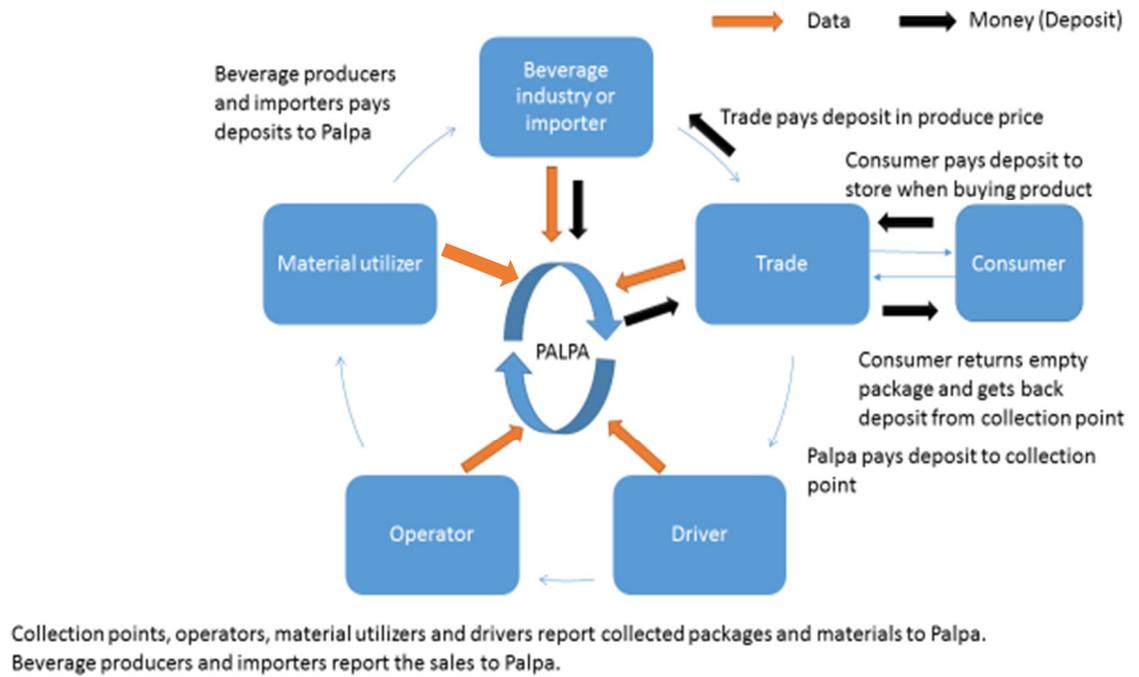


Figure 8. Deposit flow. (Vihavainen 2015)

4.4.3 Other payments and compensations flow

Beverage industry pays recycling fee to PALPA and material utilizer pays for the material. PALPA pays handling fee to collection point, transportation compensation based on driver's reporting and material handling costs to operator as shown in figure 9 below. (Vihavainen 2015)

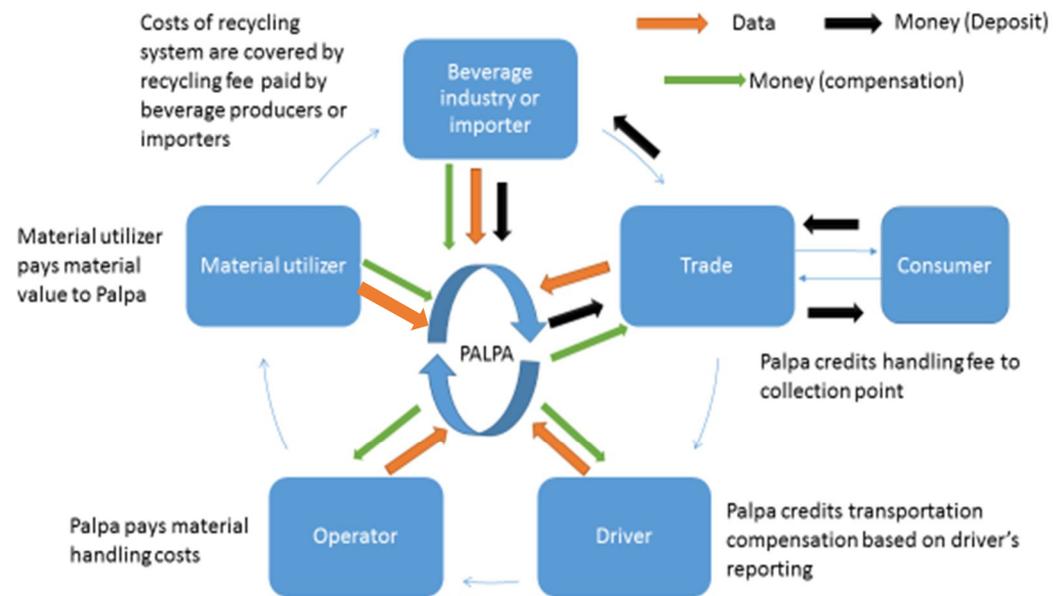


Figure 9. Compensations flow. (Vihavainen 2015)

4.5 Reverse Vending Machine operations

When the customer puts the can or bottle inside the machine, it scans the barcode and shape, and then it compares the data to the package database. The machine then sort, compress the package and print the receipt to the customer. PALPA then collects electronic data from the machine for deposit refund. In order for the package to be accepted into the system; it must be recyclable and processed, marked according to PALPA specifications, have a deposit, and fit into a reverse vending machine and possess a barcode. (Vihavainen 2015)



Figure 10 by Kabugu. Reverse Vending Machine. Model: TOMRA T-710

4.6 Advantages of Reverse Vending Machine (RVM)

1. Helps to reduce the littering of the streets.
 2. Attracts more customers to the stores.
 3. The material collected is compacted and this reduces its volume and logistics costs.
 4. It sorts the materials automatically therefore eliminating the need for sorting labour.
 5. The material sorted is of high quality.
 6. An instant reward motivates people to recycle more.
 7. Makes recycling easy as the machines are stationed in convenient places.
- (TOMRA 2015)

5 RECYCLING IN KENYA

In Kenya waste recycling is still in its infancy, the waste management laws are not so comprehensive and enforced enough and few people have knowledge about waste recycling (appendix 6). National Environment Management Authority of Kenya (NEMA) is responsible for environment management under the Ministry of Environment. Its main purpose is environmental auditing, inspection and licensing. (Nema, 2015)

In Nairobi, Kenya there is only one dumping site in Dandora area which is eight kilometers from the city centre and occupies thirty acres of land. According to concernusa.org, the population of 3, 5 million people in Nairobi generates 600 grams of waste and 850 tons is dumped dairy to the site. Over 200,000 organized youth and self-help groups' collects valuables such as plastics and aluminium metals which they sell to Kenpoly, Plastics Industries Limited, Aquamist Limited and Crown Beverages Limited for recycling. There is no other form of plastics collection in Kenya. (Concern worldwide, 2015)

5.1 Recycling system in kiosks

Retail trade in Kenya consists of small private kiosks, supermarkets and hypermarkets. Private kiosks have the biggest share in trade business. When a customer buys coca cola products in glass bottles he or she pays extra money for the package. If the customer has an empty bottle then the cost is reduced from the beverage product and the customer leaves the empty bottle to the kiosk attendant who collects them and next time he is ordering from Coca Cola Company he returns them for refilling again. Other method is reuse of the bottles for water or milk storage and for buying kerosene fuel. (Gathigi 2015)

5.2 Law and regulations

In Kenya, The Environmental Management and Co-ordination Act (EMCA), 1999 No 8 of 1999, facilitates in the establishment of legal framework for the environmental management and related matters. Waste Management Regulation,

2006 (Legal Notice No. 121) deals with handling, transportation and disposal of waste. The regulation classifies waste into different categories and recommends the best disposal methods. Its aim is to protect human beings as well as the environment. (Nema, 2015)

6 CASE STUDIES

6.1 Lidl Suomi Ky

Lidl was founded in 1930s as a grocery wholesaler in Germany. In 1973, the first Lidl stores were opened and in 1990s the company started to operate outside Germany. Today Lidl stores are located in many countries in Europe. In Finland the first shops were opened on 29th August 2002, now there are 142 stores and more than 4000 employees. (Lidl Suomi Ky 2015)

6.1.1 Warehouses

According to recycling supervisor, Pietilä (appendix 3), Lidl has two warehouses in Finland, one in Laukaa and the other one in Janakkala. They have the same operations and layout but the latter is the biggest in Europe. Laukaa warehouse serves the shops in Northern parts of Finland while Janakkala serves shops from Southern parts.

6.1.2 Recycling steps in Lidl

Lidl has two recycling systems; PALPA system and its own. PET bottles from PALPA are separated from Lidl owned PET by the reverse vending machines. The company rents the machines from Oy Tomra Ab as indicated in appendix 1.

Step 1

A customer returns empty bottles and cans to the shops and puts them in the machine which scans, sort, separate them automatically and prints the refund receipt.

Step 2

Stores collect PET bottles and aluminium cans in cartons. Different stores collect from four to eight cartons in a day as indicated in appendix 1. The store employees put barcode stickers on all the cartons to determine the kilometres and the source in order to calculate transportation costs.

Step 3

A logistics company then collects the cartons from the stores and takes them to Janakkala warehouse. Transportation is usually arranged by the warehouse such that the truck collects from stores which are near to each other. This is good for minimizing the kilometres driven by the trucks and to reduce transportation costs.

The warehouse usually receives Lidl bottles, PALPA and aluminium cans cartons like indicated in table 3 below.

Table 3. Typical cartons delivered in Janakkala warehouse in a week

	PET (Lidl bottles)	Palpa	Cans
Monday	90	101	143
Tuesday	98	75	166
Wednesday	97	79	123
Thursday	70	62	101
Friday	88	82	124
Saturday	93	66	136
Sunday	32	21	57

Step 4

Workers collect delivered cartons and scan the barcode. The data is then sent to main office in Vantaa to determine the transportation costs.

Step 5

Workers make two types of bales, one from Lidl bottles and the other from PALPA using baling machine PRESTO HPK 50 HS. An approximately 9 to 10 carton of PET makes 1 bale which weighs between 200 and 250 kilograms. Bale measurements are usually 70 centimeters width by 100 heights by 110 lengths. Then they are arranged as shown in figure 11 and 12 below ready for transport to PET Baltija Company in Latvia.



Figure 11 by Kabugu. Bales of Lidl PET bottles

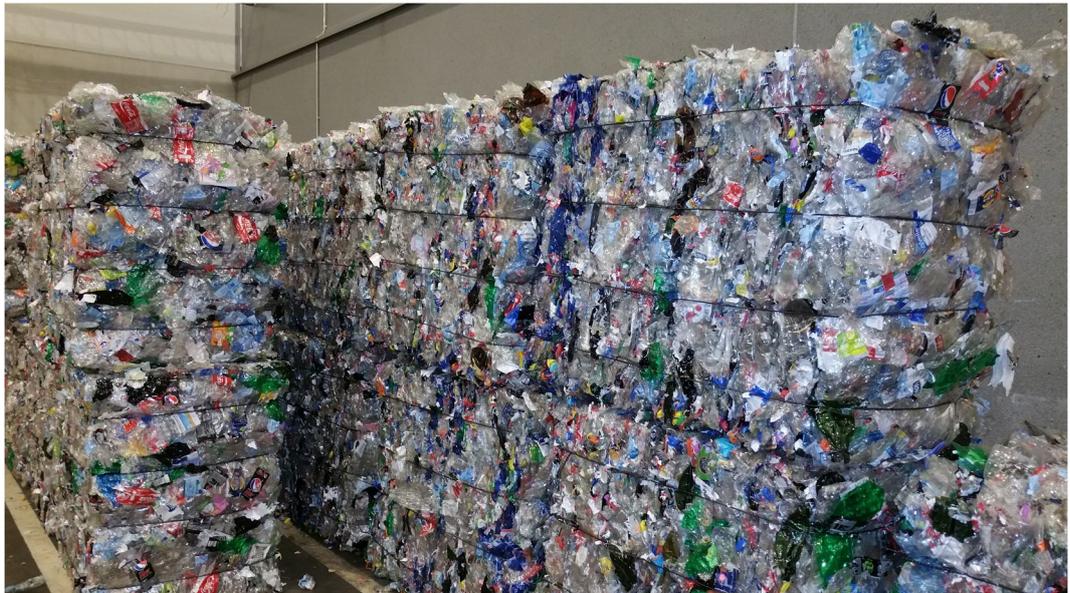


Figure 12 by Kabugu. Bales of PALPA PET bottles

Step 6

Aluminium cans cartons are emptied into a container as shown in the figure 13 below and then collected by Lassila & Tikanoja Oyj Company which transports them to recycling companies. Lidl ship 15000 kilograms of PET bails per week and 3300 kilograms of cans per day.



Figure 13 by Kabugu. Emptying carton of cans into a container

6.1.3 Baling machine model PRESTO HPK 50 HS operations

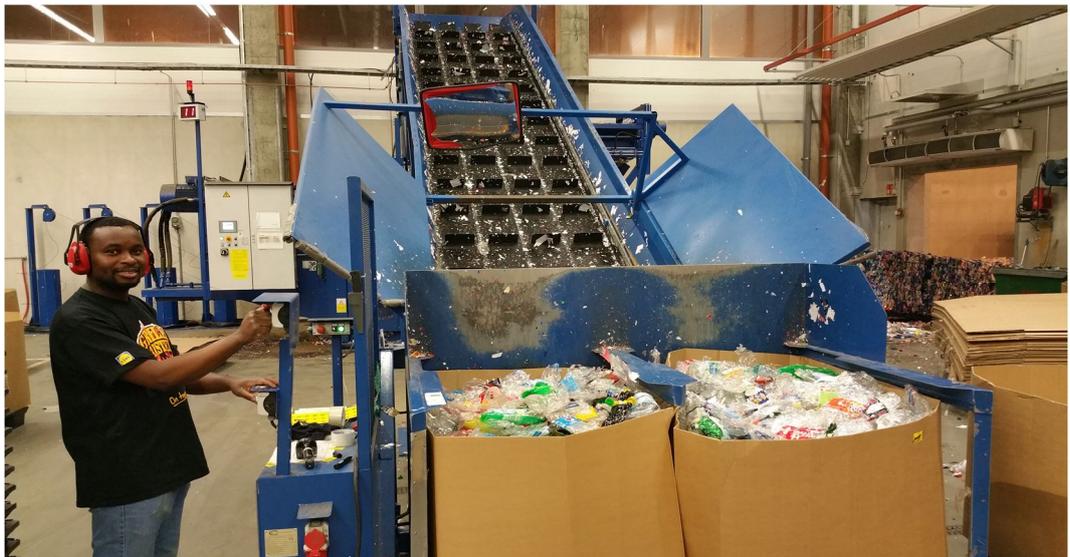


Figure 14 by Kabugu. Baling machine

The machine requires one operator as it is semi-automatic. It consists of a shovel, conveyer, compressor and a perforator. Two cartons of PET bottles are put onto the shovel of the machine; the operator then lifts them up and pours onto the moving conveyer using two buttons. The conveyor conveys the bottles up the machine and transfers them into compression chamber. Here the bottles are compressed into bales and wrapped tight with four wires as shown in the figure 15 below .It takes 9 to 10 cartons of PET to make 1 bale. In a shift of 8 hours the operator can put 250 to 300 cartons.

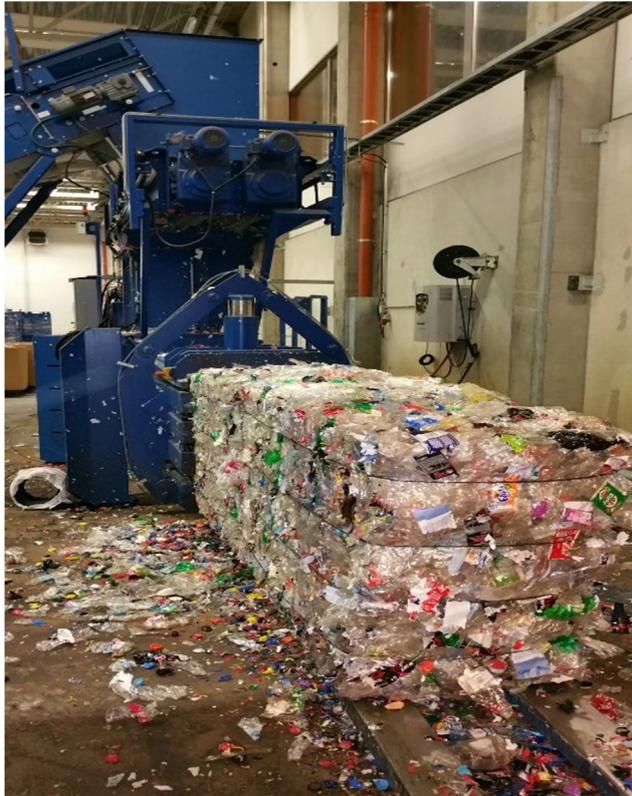


Figure 15 by Kabugu. Photo showing machine compressor and completed bales

The completed bales are then collected with a forklift and arranged on top of each other as shown in the figure 16 below.



Figure 16 by Kabugu. Forklift driver arranging PET bales on top of each other. Similar bales are stacked up on each other to save space and then they are weighed before transporting to recycling companies.

6.2 Nakumatt Holdings Limited in Nairobi, Kenya

Nakumatt Holdings Limited is a private company which was established in 1987. It is the biggest retail chain store in East Africa, with 7,500 employees and 51 stores in East Africa including 37 stores in Kenya, 2 stores in Rwanda, 4 stores in Tanzania and 8 stores in Uganda. The company consists of stores, supermarkets and hypermarkets which cater for 800,000 customers daily with over 75,000 ranges of products, turnover sales of equivalent to 450 million euros in 2014 and an average basket value of approximately 15 euros daily. (Nakumatt, 2015)

6.3 Recycling in Nakumatt supermarkets

The supermarket chain has recycling system only for 18.9 litres PET mineral water bottles. When the customer buys mineral water he pays approximately 15 euros for the product. Then he returns an empty bottle to customer service in the supermarket and the attendant scans the barcode and print out the credit note of equivalent to 10 euros. The customer can now use the credit note to pay for his purchases. There is no refund system for any other bottles or aluminium cans. (Chege 2015)

The case study will be on three branches namely; Nakumatt Mega, Village and City hall. Nakumatt Mega is the biggest in Nairobi city and is located along Mombasa road. The monthly sales are around 250000 euros and 10000 customers according to appendix 4. There are no reverse vending machines for returning plastic bottles as well as aluminium cans. The cans are disposed and the large mineral water bottles are recycled. Cartons used for packaging are collected and sold to Mathu Papers Company. According to the manager Mr. Chege, there are enough customers and space to sustain the recycling system but his suggestion is that it can't work and neither can he invest in it.

Nakumatt Village is located at Village Market with monthly sales of equivalent to 150000 euros and 10000 customers according to appendix 4. There are no reverse vending machines and they also recycle cartons and large mineral water bottles. The store manager does not know about the recycling machines but he suggested recycling of aluminium cans and plastic bottles can be good for the environment.

Nakumatt City Hall is located at the centre of the city. Its monthly sales are equivalent to 200000 euros, more customers and smaller area than the others. According to appendix 4, the manager does not know about recycling machines and he is not ready to invest in them, he suggested the space is a problem and don't know if it can work.

7 CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

According to Lidl store managers and Mr. Vihavainen in Appendix 1 and 2, recycling in Finland is well organized and mechanized; this has resulted in employment, cleaning of the environment, and in high recycling rates. The recycling company PALPA does not need to fund for campaigning since recycling is in people's minds as indicated in Appendix 5. In Lidl Janakkala, the scanning barcode system should be updated since there is material weight loss from the stores to the warehouse (Pietilä, 2015).

In Kenya, there is a working recycling system for Coca Cola glass bottles by The Coca Cola Company and 18.9 litres PET bottles by Crown Beverages Ltd and Aquamist limited (Appendix 4). There are no laws and regulations dealing with recycling of beverage packages. This has led to an informal way of recycling and collection by organized youth and self-help groups around the Dandora dumping site and within the estates. There are a few individuals who melt aluminium waste metal and mould it to cooking pots.

The Nakumatt supermarkets have enough monthly sales and customers to sustain reverse vending machines (Appendix 4), but, according to the stores' managers, it is not viable to install the machines and they cannot invest in them. Most of them do not know enough about recycling and about the reverse vending machines. According to Appendix 6, most people in Kenya do not understand what recycling is. When they buy plastic packages, they reuse those a few times to carry water or milk, and discard them eventually.

RECOMMENDATIONS

The Kenyan government could introduce recycling laws and regulations such that the producers are liable to waste generated from aluminium and plastic packaging materials. These laws could put more value to the waste which will make the recycling business more lucrative. This could lead to formation of recycling companies and necessary infrastructures for the installation of reverse vending machines. Incentives in terms of tax breaks could be offered to beverage

producers and supermarkets who engage in the recycling of the packages. There could be investment in circular economy in terms of education and machinery to reduce and reuse the waste. The Dandora dumping site could be cleared and used for other purpose, such as new affordable housing, and a new area allocated outside the city with the latest landfill technologies.

The public could be educated about the effects of waste to the environment through billboards, television documentaries, radio announcements, and posters. This could lead to mind and behaviour change about recycling. Aggressive campaigns about the importance of waste through non-governmental organisations could be done in order for the public to gain interest in recycling. Different recycle bins could be introduced to the estates, so that the inhabitants could separate the waste, this could also make it easier for the companies to collect different wastes, and add its value.

The government could find a constant market for recycled PET and aluminium cans, or use the existing companies to manufacture new products. They could, for example, export aluminium to countries like China where the demand is high. If this could be implemented, more jobs could be created, and the country could earn more foreign exchange. After the campaigns and public education, the supermarkets could gradually introduce reverse vending machines starting from the capital city, first smaller machine, for a pilot project, then the modern ones with automation as the recycling becomes more intense.

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APPENDIX 1

Lidl shops managers' interviews extracts.

The shops are open from Monday to Friday from 0900 to 2100, Saturday from 0900 to 1800 and Sunday from 1200 to 1800.

Interviewer: *How many customers who comes to the shop in a month?*

Päivikki, Lidl Janakkala: *We usually receive around 27000 customers*

Vänskä, Lidl Lahti: *53000 customers*

Rantio, Lidl Hätilä: *We get approximately 36000 customers*

Interviewer: *How many people who return PET bottles and cans in a day?*

Päivikki, Lidl Janakkala: *200 people in weekdays and about 150 on Sundays*

Vänskä, Lidl Lahti: *Around 167 people in a day*

Rantio, Lidl Hätilä: *200 people*

Interviewer: *How many cans and PET bottles are returned per day?*

Päivikki, Lidl Janakkala: *About 4000 cans and 2000 PET bottles in weekdays and Sundays 2000 cans and 1000 PET bottles.*

Interviewer: *How much profits do the shop makes from the return of PET bottles and cans?*

Päivikki, Lidl Janakkala: *None*

Vänskä, Lidl Lahti: *No profit*

Rantio, Lidl Hätilä: *None*

Interviewer: *Who owns the machine for returns the bottles?*

Päivikki, Lidl Janakkala: *Oy Tomra Ab*

Vänskä, Lidl Lahti: *Oy Tomra Ab*

Rantio, Lidl Hätilä: *Oy Tomra Ab*

Interviewer: *What is the machine model?*

Päivikki, Lidl Janakkala: *TOMRA T-820 and T-710*

Vänskä, Lidl Lahti: *TOMRA T-9*

Rantio, Lidl Hätilä: *TOMRA MultiPac*

Interviewer: *How many products with cans and PET bottles are sold per day?*

Päivikki, Lidl Janakkala: *844 products with PET bottles and 2107 products with cans.*

Vänskä, Lidl Lahti: *415 bottles with products and 1163 cans with products*

Rantio, Lidl Hätilä: *747 products with PET bottles and 910 cans containing products.*

Interviewer: *How much is the total sales from the shop in a month?*

Päivikki, Lidl Janakkala: *600000 euros*

Vänskä, Lidl Lahti: *520000 euros*

Rantio, Lidl Hätilä: *800000 euros*

Interviewer: *What about the maintenance of the machine, who does it and how often?*

Päivikki, Lidl Janakkala: *Shop attendants do basic cleaning every day and TOMRA does the major maintenance once in a year.*

Vänskä, Lidl Lahti: *TOMRA Service Company does the maintenance if there is a major breakdown of the machine.*

Rantio, Lidl Hätilä: *The workers do the basic cleaning and Tomra is responsible for other maintenance.*

Interviewer: *What is the size of the shop?*

Päivikki, Lidl Janakkala: *1200 square meters.*

Vänskä, Lidl Lahti: *1075 square meters.*

Rantio, Lidl Hätilä: *1200 square meters.*

Interviewer: *How many carton containers of PET bottles and cans are sent to central warehouse for recycling in a day?*

Päivikki, Lidl Janakkala: *6 containers.*

Vänskä, Lidl Lahti: *4 containers in a day and 2 on Saturdays and 1 on Sundays.*

Rantio, Lidl Hätilä: *5 to 8 containers mostly in the evenings.*

Interviewer: *How much is the average money a customer spends in the shop?*

Päivikki, Lidl Janakkala: *18 euros*

Vänskä, Lidl Lahti: *9.50 euros*

Rantio, Lidl Hätilä: *19 euros.*

Interviewer: *Is the return bottle machine good for the shop and why?*

Päivikki, Lidl Janakkala: *It's good for the shop because it attracts more customers when they return the bottles they spend that money in the shop.*

Vänskä, Lidl Lahti: *The machine attracts more customers and some customers donate through the machine which is a good idea.*

Rantio, Lidl Hätilä: *It attracts more customers because they can return all the PET bottles and cans unlike other shops. It is new machine and the customers have given positive feedback about it to the manager.*

APPENDIX 2

Extracts from interview with Finnish returnable packages company (PALPA) administration manager Tommi Vihavainen on February 19th 2015 at 1300 in Pasila, Helsinki.

Interviewer: *What is the main role of PALPA?*

Vihavainen: *PALPA was established in 1996 to administrate recycling system for beverage packages. Cans since 1996, PET bottles 2008 and glass bottles 2011.*

Interviewer: *Who owns it?*

Vihavainen: *Owners; trade 50% (Alko Oy, Inex Partners Oy, Ruokakesko Oy, Tuko Logistics Oy) and breweries 50% (Oy Hartwall Ab, Olvi Oyj, Oy Sinebrychoff Ab). It employs 13 personnel with revenue of approximately 70 million euros. It does not own operational assets only administrate the network. Recycling is cooperation; consumers, trade, HoReCa (hotels, restaurants, catering), beverage industry, importers, logistics and recycling operators. By joining the system, producers for the beverage avoid paying beverage package tax which is 0.51 euros per liter. Costs are covered by the fees from beverage producers and importers (members in the system). It is a non-profit company.*

Interviewer: *What is the percentage of recycling in Finland?*

Vihavainen: *Cans 95%, PET bottles 92% and glass bottle 91%*

Interviewer: *How much is the average person returns per year in Finland?*

Vihavainen: *An average person returns around 212 cans, 63 PET bottles and 21 glass bottles.*

Interviewer: *How many tons of aluminium cans and PET bottles are recycled in Finland in one year?*

Vihavainen: *17000 tons of aluminium cans, 13000 tons of PET bottles and 53000 tons of glass.*

Interviewer: *Where do they sell the recycled materials?*

Vihavainen: *PALPA sells the materials to recycling companies in France and UK (aluminium) and PET plastic to Finland, Latvia and Germany.*

APPENDIX 3

Extracts from interview with Lidl recycling area supervisor Juho Pietilä on February 27th 2015, in Janakkala warehouse.

Interviewer: *How many shops does Lidl Suomi has in Finland?*

Pietilä: *142 shops.*

Interviewer: *How many warehouses does Lidl Suomi has?*

Pietilä: *Two. In Laukaa and the other one in Janakkala.*

Interviewer: *Who arranges the transportation of PET and cans cartons from the shops?*

Pietilä: *Janakkala warehouse.*

Interviewer: *Does Lidl own the reverse vending machines?*

Pietilä: *No. It is cheaper for the company to rent them than own them.*

Interviewer: *Who owns the baling machine?*

Pietilä: *Lidl Suomi owns it.*

Interviewer: *How many times Lidl ships bales of PET in a month?*

Pietilä: *Once in a week so four times in a month.*

Interviewer: *How many times Lidl ships cans in a month?*

Pietilä: *Once per day and 26 times in a month.*

Interviewer: *Where does Lidl ship PET bales and cans?*

Pietilä: *PET bales are shipped to Latvia and Lassila & Tikanoja Oyj collects cans containers.*

Interviewer: *Does Lidl make profit from recycled materials?*

Pietilä: *No. Recycling is good for our environment and the company's image.*

Interviewer: *How many times is the baling machine maintained and who does it?*

Pietilä: *Workers does the daily cleaning and Lidl service does the normal maintenance. The machine manufacturer comes to service the machine once in a year.*

Interviewer: *Is recycling department good or bad for Lidl?*

Pietilä: *It's good for the company because it attracts customers to the shops and it's good to recycle PET bottles and cans otherwise the company would be paying tax and other companies to recycle them.*

Interviewer: *What can be improved in the recycling?*

Pietilä: *The scanning of collecting containers from the shops could be changed to limit the loss of weight between the shops and shipping.*

Interviewer: *How many workers are employed in the recycling department?*

Pietilä: *14 workers.*

APPENDIX 4

Extracts from interviews with Nakumatt supermarkets managers.

Interviewer: *How much is the total sales per month in your supermarket?*

Mr. Chege. Nakumatt Mega: *It's between 200000 to 250000 euros.*

Mr. Gichuru. Nakumatt Village: *150000 euros*

Mr. Kariuki. Nakumatt City Hall: *200000 euros*

Interviewer: *How many customers who comes to the supermarket in a month?*

Mr. Chege. Nakumatt Mega: *Average 10000.*

Mr. Gichuru. Nakumatt Village: *Approximately 10000 customers*

Mr. Kariuki. Nakumatt City Hall: *Around 15000 customers*

Interviewer: *What is your opinion about recycling of aluminium cans and PET bottles?*

Mr. Chege. Nakumatt Mega: *It can be a good idea in conserving the environment and cost saving.*

Mr. Gichuru. Nakumatt Village: *It can be good for cleaning our streets.*

Mr. Kariuki. Nakumatt City Hall: *It can help to clean our environment.*

Interviewer: *Do you have any kind of recycling in your store?*

Mr. Chege. Nakumatt Mega: *Yes we have recycling area for cartons and 18.9 liters PET bottles for mineral water.*

Mr. Gichuru. Nakumatt Village: *Yes only for blue label products and cartons.*

Mr. Kariuki. Nakumatt City Hall: *Yes only for cartons and big mineral water bottles.*

Interviewer: *Do you have any idea about deposit-refund system?*

Mr. Chege. Nakumatt Mega: *Yes I do but we don't have it.*

Mr. Gichuru. Nakumatt Village: *No.*

Mr. Kariuki. Nakumatt City Hall: *No.*

Interviewer: *Can you invest in deposit-refund system in your supermarket?*

Mr. Chege. Nakumatt Mega: *Partly only for bottled beverages that the supplying companies allow that, otherwise it can't work.*

Mr. Gichuru. Nakumatt Village: *No.*

Mr. Kariuki. Nakumatt City Hall: *No.*

Interviewer: *How do you attract customers to your supermarket?*

Mr. Chege. Nakumatt Mega: *Through radio, television, newspapers advertisements, billboards, sponsors events, sales and promotions etc.*

Mr. Gichuru. Nakumatt Village: *Through promotions, advertisements and after sale service.*

Mr. Kariuki. Nakumatt City Hall: *Through advertisements and promotions.*

Interviewer: *Do you sell many products with aluminium cans and PET bottles? How much is the sales?*

Mr. Chege. Nakumatt Mega: *Yes, we have many products with PET bottles but few with aluminium cans.*

Mr. Gichuru. Nakumatt Village: *Yes, we sell different types of mineral water with PET bottles and beer with aluminium cans.*

Mr. Kariuki. Nakumatt City Hall: *Yes, we sell them.*

Interviewer: *What is the size of your supermarket?*

Mr. Chege. Nakumatt Mega: *1670 square meters.*

Mr. Gichuru. Nakumatt Village: *1300 square meters.*

Mr. Kariuki. Nakumatt City Hall: *740 square meters.*

Interviewer: *What is the average money a customer spends in the supermarket?*

Mr. Chege. Nakumatt Mega: *Equivalent to 15 euros.*

Mr. Gichuru. Nakumatt Village: *Equivalent to 12 euros.*

Mr. Kariuki. Nakumatt City Hall: *Equivalent to 9 euros.*

APPENDIX 5

Extracts from interviews with general public in Finland.

Interviewer: *Do you recycle aluminium cans and PET bottles? How?*

Salo: *Yes I do recycle them by taking the ones with refund back to the shop and the ones without to metal recycling bin.*

Lagerroos: *Yes at home I recycle them and also papers. At work I recycle glass, lamp, cans, papers, cartons and bio-waste.*

Uronen: *Yes I recycle those which have refund by taking them back to the shop.*

Mansour: *Yes I recycle both of them. Usually I gather them for some time and then return them to the nearest shop when I have a bunch of them. When I return them it's usually around 50 to 80 pieces consisting of both aluminium cans and PET bottles.*

Gelbis: *I try to recycle both and I take them back to the stores.*

Interviewer: *Why do you recycle or why you don't recycle them?*

Salo: *I recycle them because I get the refund back.*

Lagerroos: *I recycle them because of refund. I also take those cans and bottle without refund back to the shop the same time. I don't recycle anything else at home because the recycle area is far and I don't have space for keeping waste at home. If the recycle area is near my house I will recycle everything. At work I am recycling because recycling area is near and there is space for waste.*

Uronen: *I recycle them because I get money back.*

Mansour: *I feel it is my duty to return them as they can be used for making new ones. A big part of my decision to return them relies on the fact that you get something back (cash refund).*

Gelbis: *Less trash on the streets and in the nature plus I get the refund from them.*

Interviewer: *Is recycling important?*

Salo: *Yes it's kind of important. I don't want to pollute the climate and I want to play my role in saving the nature.*

Lagerroos: *Yes recycling is important because waste can be reused. For conservation reasons I want to recycle and put my effort on nature wellbeing.*

Uronen: *Yes and I would like to recycle more.*

Mansour: *Recycling is important and I try to recycle as much as I can. Sometimes though it's just more convenient to throw them into the normal garbage, but that is seldom the case.*

Gelbis: *Of course it is important. Already we can see what is happening because of global warming and I can't imagine what will happen to people a few generations from now if we don't stop it as soon as possible.*

Interviewer: *If you don't get refund back can you still recycle aluminium cans and PET bottles?*

Salo: *Yes.*

Lagerroos: *Yes. Without refund I would still recycle if it doesn't affect my daily chores.*

Uronen: *No. I would like to recycle but I would be lazy to take them somewhere without getting anything back.*

Mansour: *Sometimes probably, but without the refund I wouldn't recycle them nearly as often as I do today.*

Gelbis: *Yes.*

Interviewer: *What do you think can be improved in recycling of aluminium cans and PET bottles in Finland?*

Salo: *I think it can be good idea that all cans and bottles in EU would have same refund that if you are buying them from other countries you can get refund back*

even in Finland. For example, many Finnish people buys cans from Estonia. This will encourage people to recycle more.

Lagerroos: I would be motivated to recycle more if the recycling area is near and easier to get rid of those things I want to recycle. I believe also that people will recycle more if they get information about the value of waste.

Uronen: Nothing. I think the system is already so good.

Mansour: I feel that Finland is doing outstanding job, having one of the best return-rates in the world (if not the best). I feel the attitude about recycling cans and bottles is a part of the Finnish mindset and that the only way it would change is if they took away the refund you get. I don't see any way it could improve from what it is at the moment.

Gelbis: I think the system now is really good.

APPENDIX 6

Extracts from interviews with public in Nairobi, Kenya.

Interviewer: *Do you recycle aluminium cans and PET bottles? And if yes, how?*

Kariuki: *I reuse bottles for carrying water and milk after cleaning them but cans I dispose.*

Njuguna: *I don't recycle aluminium cans but PET bottles I reuse them for carrying water, juice to work or to gym.*

Kiguta: *No. There is no means of collection.*

Ochieng: *By using them to store water or carry water for kids to school.*

Kagechu: *No. I don't recycle aluminium cans and PET bottles.*

Interviewer: *Why do you recycle or why you don't recycle them?*

Kariuki: *I do recycle them because I don't want to buy new one every time I put water or milk.*

Njuguna: *I don't reuse cans because once it's opened it can't be closed but the bottles have caps and easier to clean.*

Kiguta: *There are no specific recycling bins to put them for recycling purposes.*

Ochieng: *Aluminium cans most of them can't be resealed but the bottles have a cap to seal them with which is more convenient.*

Kagechu: *There are no facilities or industries to assist in recycling.*

Interviewer: *Is recycling them important and why?*

Kariuki: *It is important one because I save money.*

Njuguna: *Recycling them is important because it saves you money and helps in conserving the environment.*

Kiguta: *Yes. For proper use of resources and environmental preservation.*

Ochieng: *I think so but after all I just use them for a short period and then I throw them away.*

Kagechu: *Recycling them would be important for Kenya because then we would keep the environment clean, utilize the materials for other uses thus reducing manufacturing costs, people would be more conscious of how to dispose-off these cans and PET bottles.*

Interviewer: *What do you think can be improved in recycling of aluminium cans and PET bottles?*

Kariuki: *To be discarded after using them in a certain period of time.*

Njuguna: *PET bottles cannot stand high temperatures; they are disfigured once hot liquid is poured in. In order to improve this I think a good material can be used.*

Kiguta: *By improving their collection networks and creating awareness to users on their usage.*

Ochieng: *May be they collect them and recycle at the companies again.*

Kagechu: *First setting up these industries in Kenya would be very good starting point. Then the government would put in place guidelines and policies on how these industries will operate.*

Interviewer: *If recycling machines are installed in Nakumatt supermarkets for returning empty bottles and cans and getting refund back would you use them?*

Kariuki: *Yes I can.*

Njuguna: *Yes.*

Kiguta: *Yes but not always because it's far from where I live.*

Ochieng: *I think I would especially if the refund is a good amount.*

Kagechu: Yes I would use it. However am not sure if this is sustainable in the long run. The only consequence is to probably build a positive behaviour so that we can inculcate a recycling culture in our midst.