Department of Economics

5/2020

Sustainable Strategy for the Waste Management in Turkmenistan

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July 2020

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Introduction

The increase of household waste is the problem, which is exponentially growing along with the economic and demographic development of the world. Problems with waste disposal are not historically new, but structure and composition of waste in the last highly industrialized century became much more complex. Some new types of waste, which are not so easily dissolved within the natural lifecycle, require specific approaches and measures for handling it. Therefore, despite the ecological nature of this problem, it is impossible to solve it without economic instruments and elaborated comprehensive approach engaging all stakeholders. The circular economy is one of the concepts, which aimed to provide the solution to waste problem, by making waste a part of the economic cycle, and to make economic development be sustainable. Hence, waste management is now regarded not only as an environment protection activity, which require consistent financial investments, but also as a prosperous business sector, where finance can be also generated. Nevertheless, in most of the countries the potential of this field is not properly used.

In the developing, poor- and middle-income countries the potential of waste management is usually underestimated or not considered at all. However, the opportunities which are hidden in waste practices could be especially beneficial for these countries, as they solve a wide range of problems, including resources scarcity, unemployment, GHG emissions, environment and air pollution itself. Therefore, waste sorting at source and recycling, various innovative solutions should not be considered as a privilege of developed countries only, but on the contrary, the opportunity for all countries at the different level of economic development in order to be sustainable.

This study will concentrate on the case of Turkmenistan, newly industrialized country appeared in the world map after the collapse of Soviet Union in early 90ties. Along with other countries they were engaged with the rebuilding of their new economy and the issues of waste management were set apart. In the recent years, the need to adhere to international norms in order to achieve sustainable economic development requires to consider environmental impact of the activities, including in the waste management. Recycling and waste management gained more attention in the country, but there is still a lot of work to do.

The aim of this work is to provide a comprehensive overview of waste management in Turkmenistan and to provide recommendations and solutions in order to achieve sustainable development goals, adjusting the existing tools and practices to the case of this

country. An increase of share of the circular economy as well as the reduction of disposed waste quantities are considered as the main goal of proposed activities.

As this work is focused on the municipal solid waste (MSW), e.g. household and other urban waste, another question which arises with the development and implementation of waste management strategies is the acceptance and willingness to participate in these practices by residents, essential actors of household waste management on the everyday basis. The range of financial incentives and penalties should be chosen both to make the waste separation attractive to participate in for residents and to secure its efficiency in the long term. This work will also shed the light on the residents' attitudes and knowledge on the recycling and sorting of waste, as well as their willingness to participate in waste sorting and reaction to deposit-refund system.

The literature used as a theoretical background for this paper constitutes from following types of sources: scientific articles in the field of waste management and sustainability; analytical reports from environmental projects in Central Asia and worldwide; statistical data, outlooks and guidelines from international authorities such as UNEP, World bank and national agencies for environmental issues; available literature about Turkmenistan, including international reviews, legal acts of Turkmenistan and other sources describing the state of waste management in the country. In order to extend data sources on Turkmenistan, empirical study was conducted and analyzed.

This work will be structured as following. In the first part contemporary waste management issues and existing economic instruments in the framework of sustainable development goals (SDG) and circular economy will be analyzed. Then, important regulatory, social and financial tools in waste management strategy will be discussed. In the second part the overview of the current position of waste management in Turkmenistan will be provided. Legal basis of waste management, including existing legislation acts and gaps, will be examined. It will be followed by the current situation in waste collection and disposal, the state of recycling activities. As paper also discusses the social impact to waste initiatives, survey responses of residents will be analyzed using SPSS statistical software and descriptive methods in the empirical part of this study. This part will focus on the residents' attitudes to and willingness to participate in recycling. As the result of this work, recommendations for the waste initiatives in Turkmenistan, developed from the analysis of the gaps and survey data, will be proposed.

1. From the waste management to circular economy

1.1 From the waste management to circular economy

Waste management is one of the basic needs in the society, so basic that we notice its importance only if something goes wrong with its collection or the discard. In this first part of the current study, fundamentals of waste, waste management and circular economy will be presented and discussed. It will shed the light on the role of waste in Sustainable Development Goals (SDGs) and financial mechanisms underlying the waste management. The starting point here will be the definition of waste, which will help to introduce the following issues.

What is then waste? The term waste is defined by United Nations as:

> "materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded."

Being "an object the holder discards … or required to discard" (Waste Framework Directive 2008/98/EC) waste need to be managed during the whole process till its disposal, which is the scope of work for Waste management. Waste management includes the choice of activities on how to collect, to transport and to treat and which disposal methods to select.

1.1.1 Waste classification

Waste classification is the starting point for all waste initiatives. As waste need to be collected, treated and statistically recorded in a proper way, it should be classified. Waste classification in UNEP Guideline for waste management strategies (2013) propose classify waste by waste sources and waste streams. Waste sources indicate where does the waste come from, e.g. it's origin: households, public facilities, offices, hospitals, production, urban waste. Waste streams shows in which field is the waste generated: food-waste, e-waste, automotive waste. We can also distinguish type of waste by composition (the nature of it, e.g. paper, glass, plastic, batteries), degradability (organic vs nonorganic) and toxicity level (radioactive waste, hazardous waste, medical waste). Some types of waste can belong to 2 or more types. From the waste management prospective it's practical to distinguish

industrial waste, medical waste, sewage, hazardous and radioactive waste from municipal solid waste, as they require specific approach.

The current study will focus on municipal solid waste (MSW). MSW encompasses household and commercial waste, as well as other types of waste, which are objects to discards under the authority of municipal affairs (OECD 2015). MSW is mostly composed of food and organic waste, packaging waste, paper, plastic, glass, metals as well as other more durable products such as equipment, textiles, batteries, furniture. The proportion of waste types and composition of waste differs from country to country or region to region depending on the variety of factors. These MSW components will be discussed in more details below.

Food waste and other organic waste includes the residuals from alimentation and food loss storage in transportation, leaves and other green waste. This type of waste is mostly typical for middle- and lower-income countries (around 50% according to the World Bank report from 2018), rural areas and countries with agricultural economy. In highly developed countries and urban areas relatively less generated and other types of waste such as paper, cardboard, e-waste, metal and plastic waste are dominating (World Bank, 2018; p.4). Two main methods used for reprocessing it with material recovery are composting - with the conversion of waste to the organic nutrient for agriculture – and anaerobic digestion – with the extraction of biogas. Food and organic waste are easily biodegradable, but if not proceeded and dumped to the landfill, organic waste is the source of methane and carbon dioxide generation and contribute to GHG emissions. Another issue is that if organic waste mixes with non-organic components, it increases the overall amount of waste increases and recyclables are contaminated. In addition, the opportunity of reprocessing the organic waste in an easier way is missed. Composted organic waste is used as natural fertilizer for gardening and agriculture.

Paper waste including paper and cardboards constitutes around 17% in global waste composition (Kaza et al, 2018, p.29) and it is one of the most recycled materials in many countries. Even in countries with low recycling rates, paper is among the most recyclable materials. Due to variety and relative affordability of paper recycling technologies, they are adoptable for countries with different economic situation and for businesses of different scale.

There are number of benefits derived from paper recycling include substantial decrease of trees cut demand, savings of energy and water resources during the production

of paper. Decrease of tree cut demand has an impact to solve the deforestation problem, including all issues associated with deforestation.

There is the critique, that paper has recycling limits and cannot be recycled infinitely due to the specification of wood fiber transformation during the recycling. Nevertheless, even limit numbers of second lives would safe enormous resources.

Plastic waste is one of waste types which gained the widest resonance in the community. The concern about plastic waste started to grow in the recent dozen years because traces of plastic, constantly contaminating the environment last 60-70 years, became conspicuous nowadays. According to the estimates in the extensive research of Geyer, Jambek and Law (2017) 6300 million tons (MT) of plastic have been manufactured by 2015, which increased to 8300 in 2017. Among these 6300 MT in 2015 only 9% had been recycled, another 12% has been incinerated and 79% went to the dumpsite (Geyer et al., 2017; p.1). By keeping the current manufacturing capacities, the amount of plastic in the environment will significantly accumulate.

Plastic is used for manufacturing of different products, but the biggest share of disposed plastic waste comes from packaging waste and single-use goods. Around 40% of the total plastic (Plastics Europe, 2016) is used for packaging. Single-used goods such as plastic cups, straws, bags gained universal success after the revolution of plastic creation. Due to its convenience, durability, sterility and low production costs, it has rapidly widespread in all industries. Ironically, this durable material was in a biggest part used for nondurable goods which are thought to be disposed after the single use. Nowadays, it became one of the biggest concerns in the fight with plastic and created a lot of campaigns and environmental movements encouraging people to refuse from the single use items and move towards reusable bags, containers and other goods.

The problem of packaging waste appeared after the industrialization and development of chemical industry. Before appearance of plastic, natural packages were easily dissolved in soil and continued its way in the biological life cycle. The widespread of plastic packages along with the increased consumption and population growth developed into severe problem in some Asian countries. Taking advantage of the goods of chemical industry and convenient single-use packages, while keeping the same waste habits lead to the situation when non-biodegradable plastic waste was generated on the street and in the environment.

Packaging waste constitutes up to one-third of the total household waste in some developed countries. Because of this big share of fast disposed plastic, the fight with

packaging waste transformed into separate issue. This problem is especially severe in newly industrialized and developing countries where with the increasing consumption and rapid industry growth, current waste management is not capable to cope with increasing packaging waste.

The complexity of plastic influence on the environment lays in some positive features that plastic have. It helps to reduce food waste by protecting it from contamination, facilitating transportation and keeping it fresh longer, it requires less resources such as energy and water to produce big amounts of plastic than most its substitutes. In this sense, as it is impossible just to ban plastic in everyday use, other solutions should be elaborated, and recycling is seen as one of the preferred options.

Whether recycled or primary produced plastic has the same value is another point to be argued. There is a critique, that inspite of all positive sides of recycling, the recycling of plastic is not efficient in decrease of future plastic waste, unless it replaces the relevant share of primary plastic production (Geyer et al., 2017; p.2). According to this critique, the secondary plastic is less valuable because: 1) first, different types of plastic are usually mixed (even in the case of sorting at source); 2) second, considerable efforts are needed to clean contaminated plastic; 3) third, the recycled plastic can change its characteristics while transformed.

More sophisticated approaches are to be used for multilayer packaging, combining two or more material in it, for example plastic-coated cardboard or package containing aluminum layers which makes reprocessing more complex. These types of recyclable waste require additional separation on the special facilities, but there are successful examples with it (Kaiser et al, 2018).

Another solution refers to the development of biodegradable plastic, for instance, produced from sugar cane. But today it occupies a tiny share in all manufactured plastic, and it remains questionable whether this plastic is indeed easily biodegradable.

E-waste is another challenge of the 21st century and in terms of material recovery it is one of the most profitable type of waste. E-waste is not easy to proceed, but it is the source of valuable resources. It contains precious and rare metals such as gold, aluminum and others (UNEP 2013, p.13), but also hazardous components. This type of waste is faster generated in highly developed countries (Kaza et al, 2018, p.34).

1.1.2 Waste treatment methods and waste hierarchy

Landfill is the most used and probably the oldest waste disposal method globally (see Fig.1.). There is variability of landfill types developed through the years with different

impact to the environment: open dumpsites, controlled dumpsites, engineered dumpsites with the basic preparation of the terrain, sanitary landfills with gas collection system. The percentage of waste placed to dumpsites considerably depends on the country income level and free land constraints. From 39 % in high-developed countries up to 50% in middle income countries are placed in landfills, while in low-income around 90 % of waste ends up in open dumpsites (Kaza et al, World Bank, 2018, p.34).

One of the main problems with uncontrolled and poorly managed dumpsite facilities, along with occupation of free land potential, is the GHG such as methane and carbon dioxide emitted during the waste disassembly. The danger of landfill gases is multisided, from damaging ozone layer and impacting the climate change to making landfill terrains easily inflammable and toxic for surrounding areas (Webb, 2008). There are only 8% sanitary dumpsite with landfill gas collection systems (Kaza et al, World Bank, 2018, p.34), which means other dumpsites emit greenhouse gases. Total emissions from landfills reached 5% of total GHG in 2016. As can be seen here enormous amounts of waste remains stored in either in environmentally harmful conditions or in the better case in controlled conditions. When billions of tones of potential resources just dumped, occupying precious land and contaminating surroundings, that doesn't sound like the best solution for the waste treatment. The decrease of waste amount ending at the dumpsites is one of the priorities of waste management and disposal is the least preferable action in the waste hierarchy described below. Nevertheless, as some types of waste and residuals need to be disposed by the landfilling, the development of sustainable disposal facilities is essential (Webb, 2008).
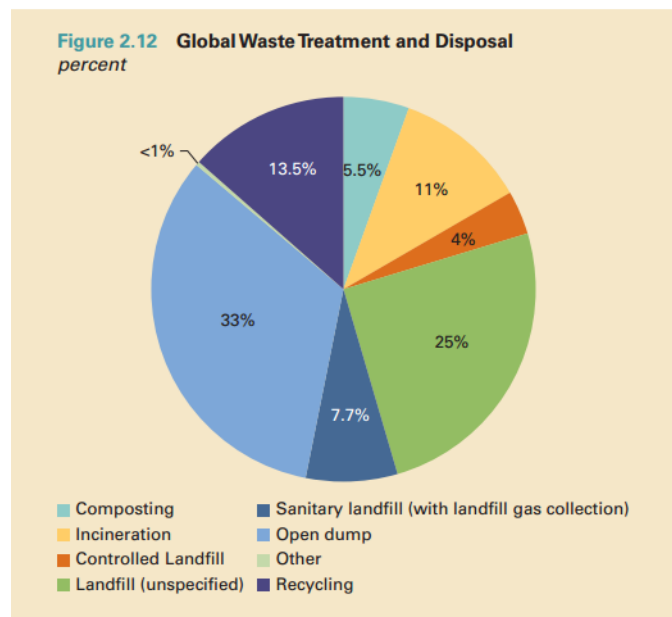

Figure 2.12 **Global Waste Treatment and Disposal**
percent

Figure 1. Global waste treatment methods. Source: Kaza et al, World Bank, 2018, p.34

Incineration is the alternative to landfill disposal, around 11% of waste is incinerated globally (Fig.1). Incineration is the thermal treatment of waste at specialized plants with or without energy recovery. While it is preferred to landfill and clearly surpass open burning, incineration remains to be a controversial issue. There was the critique concerning toxic emissions and air pollution, which is associated with old incinerators, but this issue is solved in modern systems, where pollutants and gases are captured by special emissions control technique. Another question whether incineration can be considered as aligned with sustainability principles remains open as it is not a treatment with material recovery. Nevertheless, as thermal processing destroys toxic elements and essential for some types of waste such as medical waste.

Recycling is the transformation of used materials into goods, bringing them back to the "cycle". The starting point for recycling is segregation of recyclable waste types such as plastic, glass, paper, cardboards end others from the residual waste. It requires either separate collection of waste (sorted at source) or collection with further segregation at the facility, then cleaning and reprocessing the materials. Recycling at source comprises collection of recyclables either using curbside pic-up systems, where households separate waste to be collected from the area or "take-back" system where some types of waste to need to be disposed at the central collection spots. The materials are then recycled, i.e. treated so that they can be used in production of new goods. Recycling which starts with sorting at source protect recyclables from contamination and save primary segregation costs at the facility, which makes recycling less costly and therefore more attractive.

Material recover facilities are aimed to receive and reprocess recyclables. Material recovery includes disassembly of products into component materials with further reprocessing of the useful parts, which are appropriate for reuse. As an example, the treatment of old cars usually undergoes material reprocessing, when all valuable materials, precious metals and worthy electrical compounds are retrieved.

Anaerobic digestion is another waste treatment method which convert waste into recourse, into fuel. In the special facilities creating lack of oxygen conditions waste undergoes disassembly with the use of special bacteria. Organic elements resulted from it are converted to biogas. There are different type of facilities for anaerobic digestion, which offers the various cost structure of its use.

US$/tonne	Incineration		Anaerobic Digestion	
	Capital Expenditures[a] (US$/annual tonne)	**Operational Expenditures (US$/tonne)[b,c]**	**Capital Expenditures (US$/annual tonne)**	**Operational Expenditures (US$/tonne)**
Europe	$600–1,000	$25–30	$345–600	$31–57
United States	$600–830	$44–55	$220–660	$22–55
China	$190–400	$12–22	$325	$25

Figure 2. Cost structure comparison. Source: Kaza et al 2018, p.105.

Study of Kaza et al for the World Bank (see Fig.2) provides the cost structure comparison between incineration and anerobic digestion costs. As it requires special technical facilities and bear operation costs, it is not widely used in low-income countries. Nevertheless, anaerobic digestion has potential if keep in mind that this is the source of clean energy.

Waste hierarchy
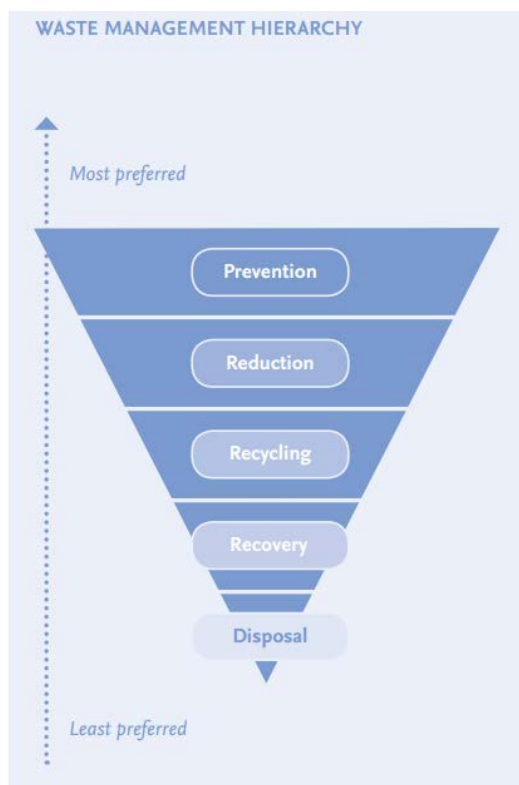
Figure 3. Waste hierarchy. Source: UNEP 2013; p.18

Waste hierarchy is the guideline concept for waste management, which indicated the preferability of actions towards waste (UNEP 2013) in terms of its treatment.

In the basement of the pyramid is waste prevention, i.e. elaborated solutions from the very beginning of the product lifecycle, innovative approaches in the way how product is designed and produced in order to prevent potential waste. Waste reduction principle realized through longer usage or reuse of products as well as minimization of loss of product during transportation and storage. Waste prevention and reduction have long term economic impact by saving costs for waste collection.

Then, the generated waste should be recycled or proceeded with material and energy recovery, i.e. treated as a resource. If waste cannot be recycled or otherwise proceed it is disposed. By disposal is meant landfill or incineration without energy recovery. In the frame of the hierarchy recycling comprises here composting and aerobic digestion, with the extraction of valuable nutrients for agriculture and fuel accordingly. Upcycling initiatives, which got attention last years, is a creative approach to reuse. Upcycling reuse wasted materials or products by transforming them into new the goods of new nature, bringing products 'up' in the cycle.

Waste hierarchy is also referred to as 3-R "reduce, reuse, recycle", outlining the priority of actions in reprocessing the waste and the way to bring resources back to cycle. This should be used as a guideline principle for waste management policy which is not only deal with waste treatment, but also with the goal to uncover potential in waste.

Unfortunately, in many countries this pyramid is still reversed with extensive landfilled waste and tiny share of recycled waste and lack of fundamental rethinking of the life cycle.

1.1.3 Circular economy

The waste prevention principle makes rethink the approach to the waste at the very initial stage, when it has not yet become a waste. Thinking of the recyclability of the product and it's packaging at the beginning of its production is essential part of the way to achieve circular economy.

Waste is the residual of the final product, and it is a natural element of the product life cycle. For hundreds of years product residuals were naturally disassembled and organically recycled in nature, but the industrialization and development of chemical industry has led to the inception of some types of durable materials and waste, which is not so easily dissolved. If we take the plastic as the mostly discussed example, it remains to be dissolved in natural environment dozens and hundreds of years as the most of widely used plastics are not biodegradable (Geyer et al. 2017, p.1).

It brings us to the circular economy concept, where all types of waste are assumed be returned to this new industrialized product life cycle with the maximum benefits for the economy. Circular economy is based on the idea of continuously reuse of resources and minimization of the residual waste, which cannot be reprocessed. Previous years economy developed in the linear way, e.g. from the extraction of virgin resources for the production to the disposal of waste (Central Asia Waste Management Outlook 2017, fig.4.). The idea of

circular economy refers to the new sustainable business model which will be economically beneficial for both manufacturers and the community. It argues for the longer life of products and use of renewable resources. It refers to the idea of biological lifecycle, where residual from one product are naturally disassembled and serve as a "food" as a resource for the other organisms. This so called "cradle-to-cradle" principle is a biomimetic approach, which is inspired by the natural lifecycle.

Circular economy states that the sustainability in economic development is possible to achieve without loss of benefits for producers and extensive costs, also avoiding the decrease in life quality for consumers. On the contrary, it provides numerous advantages such as save of energy and resource, decrease in air pollution, vacation of spaces which would be otherwise used for landfills. Economic benefits of the circular economy model are fulfilled in 2 main domains: both resource and the energy saving. Renewable input decreases pressure on virgin resources, by "recharging" the existing assets. Continual use of resources instead of disposal to landfill is in the core of the circular economy.
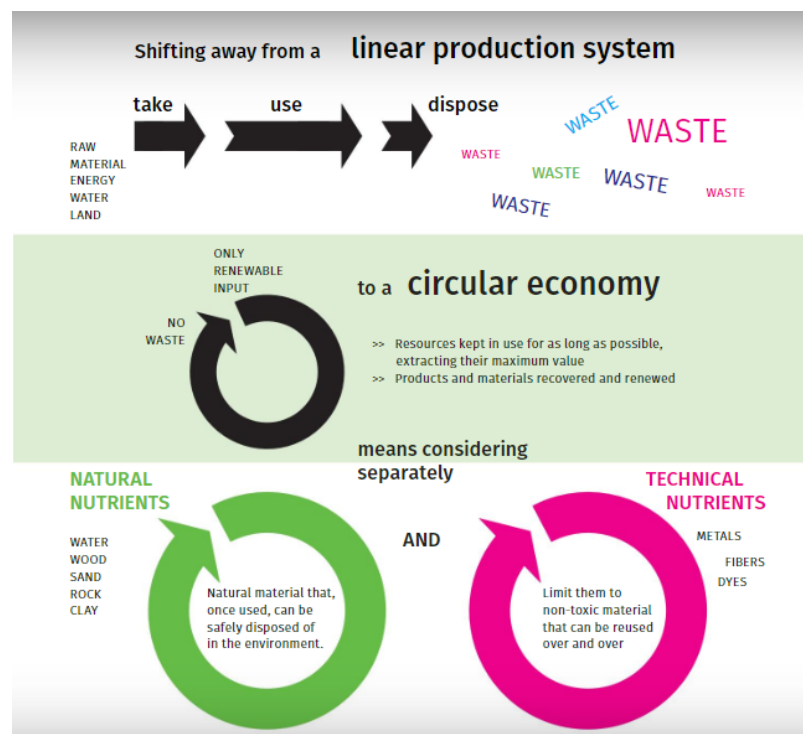
Figure 4 Circular vs linear economy schema. Source: Zoi, 2017, p.15

The main critique points of circular economy concept, that some secondary resources become less valuable, and recycling also requires energy. For example, due to the structure of wood fiber, paper can be recycled limited number of times, and due to variety and complexity of plastic elaboration reprocessing of plastic more efforts than production of raw plastic product. Nevertheless, the savings of recourses and energy makes recycling initiatives preferable among other waste treatment actions.

The concept of zero-waste cities is the fine example of circular economy principle applied to the urban environment and society level. Zero waste society concept advocate preservation of all resources from the production and through the consumption in order to avoid disposal. This idea may sound utopic from the first sight, because it's impossible to imagine the city existing without the litter, using only recyclable products and achieving 100% of recycling rate. Despite none of the countries fully achieved this ambitious goal, this initiative results in decrease of waste and inflame social movement. Even if this concept helps to achieve the minimization of waste amounts and a valuable behavior change in residents and community the impact can be considered as achievement providing long-term benefits.

1.2 Waste in SDGs framework

Sustainable development goals framework appeared in 2015 as the result of UN Summit and designated the commitment of countries to sustainable development by achieving results by 17 domains (SDGs, Appendix I). Waste management has an impact to the three fields of SDGs, providing environmental, economic and social benefits. In many of the goals out of 17, discussed below, can be seen the direct impact of waste management.

SDG 1. No poverty.

Waste management contribute to the fight with poverty by creating working places and employing workers from different social groups, including the most vulnerable individuals and communities. It provides employment opportunities for both low-skilled to high-skilled jobs. In some cases, waste collection is the substantial supplement to the income or even the main activity for some group of people. Opportunity to be engaged in waste collection way out of poverty for the poor (UNEP 2013, p.25).

SDG 2. Zero hunger.

Zero hunger and zero food waste are goals which are significantly correlated in the frame of SDGs. United Nations has set up the goal to double reduction of food waste and to avoid loss of products across the supply chain. Food waste is global issue and reaches around 30% of all food produced in the world (UNEP 2013, p.13). The loss of food products can occur during processing, storage and consumption. While contributing to the increase of waste quantities, food waste represents the loss of valuable resource, and the lack of food is the sever problem in low-income countries. To end hunger and lack of nutriment in the world till 2030 is one of the essential SDGs.

In some countries, supermarkets were banned to throw food and forced to donate it to charity organizations (Kaza et al 2018, p.31). By facilitating collaboration between units where food waste is generated and subjects in need is one of the solutions aiming both problems. Enhancing the preservation of food quality along the supply chain and the decrease of loss is also essential.

SDG 3. Good health and well-being.

Waste management is aimed to protect the surroundings from contamination and to ensure safe living in human settlements. In collection and elimination of waste away from living areas as well as keeping it in sanitary conditions is the enormous impact of waste management to the maintenance of public health. Litter and waste, which left in the cities non-treated cause viruses and infection spread, odors and inspiratory diseases, it is source of toxic which poison the water and other alimentary products. Proper treatment of medical waste, which may contain viruses and other hazardous elements is another challenge and mission of waste initiatives.

SDG 6. Strive to prevent water contamination

Uncontrolled dumpsites or controlled landfills, which usually has no engineered protection for the ground (Webb, 2008), contaminate both soil, surface and ground water. The decrease of waste disposed to landfill as well as the engineering of dumpsites are the efforts which prevent water contamination.

SDG 7. Affordable clean energy.

The demand on energy continues to grow along with population growth and cities development. While traditional source of energy as fossil fuels have negative impact on climate change and the environment, the use of alternative energy sources is required. Waste treatment provides one of the solutions. Anaerobic digestion, for instance, already deal with the issue of converting waste into clean fuel – the biogas. Methods of waste reprocessing with energy recovery has great potential in affordable clean energy solutions.

SDG 8. Decent work and economic growth.

Economic growth remains the priority, but this growth should be sustainable and decoupled from the waste quantities. As number of data shows, that waste generation is aligned with the GDP growth (Webb, 2008; UNEP 2013) and increase proportionally. The aim of solid waste management here is to decouple waste increase from economic growth by using waste hierarchy principles and introducing circular economy solutions.

Waste management also impact economic growth in the range of other ways. It increases business opportunities by creating secondary resource market, create job places, provides incentives resource saving.

SDG 9. Industry, innovation and infrastructure.

Waste management requires innovative solutions and infrastructure development in order to convert waste into resources and energy. Whether landfill, incineration or recycling, solutions should be technologically advanced in order to minimize environmental costs of waste and facilitate to extract maximum benefits out of waste. Innovation and technology have already improved the waste treatment. The use of incinerator facilities which could avoid air pollution, conversion of waste into energy, reprocessing plastic into new products – all these examples tell us that of innovative solutions are the key to more rational waste treatment.

SDG 11. Sustainable cities and communities

Solid waste management safeguard the sustainability of urban life by protecting cities and communities from contamination and viruses which would spread in the lack of proper waste collection and storage. As uncontrolled dumpsites cause odors and the source of viruses spread, solid waste management is aimed to fight these problems in order to increase life quality in cities and make it safe, clean and pleasant. The decrease of impact of MSW on urban environment is one of the priorities.

SDG 12. Responsible consumption and production

Achievement of success in waste initiatives in accordance with waste hierarchy requires principal transformation of consumption mindset and production patterns (UNEP 2013, p. 25). Creation of responsible consumer and producer is crucial in order to achieve this shift and to succeed in sustainable development goals. This is the challenge for producers, who bring products to the market and the responsible choice of consumers which product to choose. Extended producer responsibility is the actions where producers bear responsibility of their product till the end of the product life cycle and agree to accept product for recycling after its use, so called take-back system. When producers take responsibility to take and reprocess the waste associated with their products, this encourages them to seek for better solutions for product design, to use more easily recyclable or reusable packages, and to pay more attention to products they manufacture.

SDG 13. Climate action.

In the frame of increasing attention to the climate change, the impact of waste to greenhouse gas emissions is to be considered. Waste contributes to the GHG emissions in

two ways. First, uncontrolled dumpsites are the source of such GHGs as methane and carbon dioxide which are generated in the course of waste disassembly (Webb, 2018). Emissions from dumpsites have already reached 1.6 billion tons of carbon dioxide in emissions, 5% of total GHG in 2016. According to the estimation, if the current solid waste disposal will continue the same pace, by 2050, 2.6 billion tons of GHG were attributed to the emissions from the landfills (Kaza et al, World Bank, 2018, p.5). Solid waste management can bring impact to the mitigation of climate change through the reduction of greenhouse gases by providing solutions for waste disposal and storage to reduce emissions. Another indirect impact to climate change prevention is the fight with deforestation, which can be achieved through paper recycling to decrease the demand on raw wood fiber (UNEP 2013, p.28).

SDG 14. Life below water.

The problem of plastic and micro plastic pollution in the oceans is one of the biggest challenges to tackle as sea pollution affect a range of problems. Restriction on sea pollution is the subject of the number of international conventions protecting marine resources form waste pollution. The wide resonance was raised by the Ellen MacArthur foundation at the World Economic Forum in 2016 in Davos, stating that around 8 million tons of plastic ends in the ocean and harm marine animals. The aim of waste management is to protect oceans from hazardous and unbiodegradable waste and prevent plastic falling into waterways.

SDG 15. Life on land

United Nations SDG set up the targets to reduce overall amount of waste guided by the "reduce, reuse, recycle" principle and to diminish negative effects of waste on the environment. The positive impact of sound waste management is in saving of virgin resources and in slowing natural resource depletion, fight with deforestation and with all concerns associated with it.

SDG 17. Partnerships for the goals

Waste problems require comprehensive approach and collaboration on the global and local levels. Global partnership is essential in order to share responsibility and experience, to support developing economies to cope with the waste generation pace. Waste problems require collaboration between many actors, including governments, companies and consumers. Only if all stakeholders will act in a more thoughtful way in resource consumption, sustainable development can be achieved.

All SDGs certainly cannot be achieved through waste management, but waste management can impact these goals by the number of fields.

1.3 Social-economical aspects of waste management

This chapter will cover the tools used for development of waste management strategy on the National level and different aspects for its implementation. The role of stakeholders in waste management will be discussed.

There are three main actors, taking part in waste management in the different way: the government, producers and consumers. Each of these stakeholders impacts on the different level and in the different scope, but it's essential to accomplish cooperative and comprehensive efforts of them all in order to succeed in environmental actions.

The government plays an important regulatory role by setting up laws, regulations, defining the policy in waste management and determining the strategy suitable for the country, goals and targets. It operates using economic tools by providing subsidies for the sustainable solutions and introducing taxes, penalties and fees for undesired activities.

It also plays the role of controller, ensuring that business and community act align to the waste strategy goals, it collects statistics on the amount and composition of waste. Governmental structures oversee fulfillment of settled goals.

Producers play enormous role here as they manufacture goods or provide services which are aligned or not with the sustainable development goals. Pursuing profit as a main goal, more and more companies start to embody corporate social responsibility, i.e. to act for the benefits of wider community and to use environmentally friendly practices and processes.

Extended producer responsibility (EPR), touched above, is one of the schemas of private business involvement into waste initiatives. This may be fulfilled in different ways, but in core is the responsibility of producers to take care of the waste which come from their goods, for example, primary or secondary packages. They may either bear costs for collection by paying contribution to waste collectors or incorporate the price of disposal in product price, when consumers bear these costs (Kaza et al 2018, p.109). Another form of EPR is the take-back system, where consumers are triggered to bring recyclable products or material back to manufacturer, who bear responsibility to take it and then reintegrate into production cycle or reproceed in other way. Despite there are additional costs for the producer in take-back system, it can be compensated by the supply of secondary materials and in some cases to compensate the need in raw materials. Employment of economic

instruments is one the effective tools to change producers' behavior and to stimulate them to search for efficient solutions in production and easily recyclable materials.

Consumers are essential actors in the waste management system and their involvement is the crucial issue. Whether they are ready to accept the new approaches to waste, especially when it comes to the introduction of sorting at source, they are essential actors to make the system work properly.

Consumer responsibilization schema summarized by Giesler and Veresiu (2017) argue for the essential role of resident (consumers) as a stakeholder in environmental activities. Notwithstanding the level of country development and social position, each society member is able to take own responsibility in environmental problems and impact to them.

The paper of Giesler and Veresiu (2017) discusses the role of consumers as agents of change for 4 global problem, one of which is environmental problem. It suggests the shift in responsibility for problems from the corporate and state level to some degree of personal responsibility, and the development of "shared commitment". The route to create a responsible consumer labeled as P.A.C.T. routine and includes 4 stages such as "personalization", "authorization", "capabilization" and "transformation" as the final goal.

Development of "shared commitment" on the moral norms level is on the first stage of the process of creation of the responsible consumer. Personal commitment here occupies the central role in social problems solution. On the next step, consumers are "authorized" by "expert knowledge" and know how to make an impact. Capabilization is aimed to develop markets and infrastructure, which will be supportive for responsible consumer manner. As the result of this actions consumer is transformed into green consumer.

This schema would work well for the responsibilization of consumers in term of waste management. First, moral norm, normative behavior and attitudes towards recycling and waste treatment should be formed. Then instructions of how to segregate waste, deal with packages and others what and how should done to be developed. On the capabilization step, all elements of infrastructure and the market should facilitate consumer to behave in the certain way – in this case, to create suitable condition for waste segregation.

The idea of consumer responsibilization doesn't neglect corporate responsibility; it suggests the way for private-public partnership in order to achieve the common goal and the way to change the behavior.

Another issue raised in frames of consumer responsibility is violating behavior, which is not as easy to track in waste. Even if people want to engage to environmental

actions, "it needs to be easy for them to do so and they also need to feel than others are doing something too" (Giesler & Veresiu 2017, p.849).

As most of the waste is collected in communities, big or small, rather than in single households, it might be tricky to track who is violating the waste sorting or do not participate. Therefore, implementation of such systems requires higher degree of residents' responsibility and very coherent and well thought system of penalties and incentives.

Waste sorting is an effort consuming activity (Czajkowski et al 2017, p.649), and for making consumers make this effort, enough internal or external reasons and motivations are needed. Financial instruments as well as existence of recycling infrastructure are among important external reason. The introduction of opportunity costs for not sorting waste gained wider acceptance as external trigger to engage consumers into recycling initiatives. Among internal reasons authors (Czajkowski et al 2017; Huber, Viscusi & Bell 2018; Sorkun 2018) outline the impact of convenience factor, household income level, social norms, "neighbors-judge" social pressure, moral duty and attitudes on recycling behavior.

As can be seen from the above discussion, waste management strategy is the complex multicomponent unit and successful implementation of it require involvement of different tools and instruments.

Waste management demands involvement of different instruments, including political, economic and social tools to be used for the waste strategy. Following the framework developed in the UNEP Guideline for National waste management strategies (2013) and recommendations for solid waste management for sustainable development (Gunsilius 2015), important factors in the development of the national strategy for waste were summarized below.

Legislation and policy making is the regulatory instrument to structure the priorities and adhere to the goals. Legislation prescribe desired actions and set limits and restriction on products and activities which cause harmful consequences of waste on the environmental. It defines what is legal, what is not, what is the difference between authorized dumpsite and illegal dumping.

Regulatory role of the governmental structures as policy maker lies in having an influence on other actors to behave in a certain way. Policy is aimed to facilitate cooperation between various governmental units and voluntary associations. For example, it is necessary to regulate extended producers' responsibility or prescribe waste treatment regularities.

Rules, conditions, standard and instructions facilitate the use of recycling infrastructure and its acceptance withing the whole system. Bin color code, size and volume,

classification of waste streams – all these details are to be described. Requirements on data collection and conducts of statistics in waste is also under the responsibility of regulations and prescriptions.

Economic instruments complement regulatory tools and an effective mean for the realization of policy into practice. Implementation of economic and financial instruments in waste management follows 2 main goals. First, it is aimed to increase efficiency of activities and to facilitate the fulfillment of desired actions by the participants. Economic tools are effective incentives for reduction of waste amounts, waste segregation and for the participation in take-back system. Second, it is used to cover or compensate some costs of waste collection and treatment from the state budget. These instruments comprise subsidies, taxes, fees employed in dependence with goals.

Subsidies are applied for actions, which require high investments in order to implement innovative recycling initiatives or environmentally beneficial activities. Subsidies are aimed to support industries and producers which manufacture low-waste production, implement green technologies or use easily recyclable material, but cannot compete with cheaper non-recyclable substitutes due to the higher initial costs.

Introduction of taxes is aimed to restrict undesirable or environmentally harmful goods and services in order to make producers seek other greener solutions. The decrease in taxes or tariffs could also be efficient behavior adjusting instrument. For example, tax reduction for companies or decrease in charges households who use clean energy will make it more financially attractive.

While in one countries waste is still considered as a problem, other use waste as a resource and have created the secondary resources market. By using different economic and financial instruments it's possible to stimulate the secondary resources market to make circular economy function on the market basis, to be financially attractive and profitable, and not to be taken only as a charity initiative.

The decrease of waste quantities is economically sound, because it saves enormous public budget through decrease of labor, transportation, treatment and disposal costs. Financial instruments such as fees, deposits, lower charges for decreased waste volumes or waste quantities below the limit are widely used as incentives for consumers and households to participate in waste initiatives. By making production of big quantities of waste or use of nonrecyclable waste financially unattractive, it stimulates consumers to rethink their choices. Introduction of extra charge for undesirable products can also be considered as efficient financial instrument. For example, introduction of additional charge for plastic bags, which

were previously gratis, in some European countries substantially affected the amount of single-use plastic bags.

Deposit refund schema is the forms of take-back system implementation, which uses financial incentives for consumers to participate. As take-back require more efforts for consumer to bring the recyclables to the collection spot, and the effort is costly, they need to have incentives to do so. Deposits, which consumers pay for package, while buying products, represent the financial trigger to return the package and get back the money. Deposit refund system has also shown a sociological impact by providing source of income for vulnerable social groups and low-income class.

The choice of the appropriate set of economic and financial instruments is considered as a challenge for developing and transitional economies and they rarely use its potential because the lack of experience and scarcity of resources (Panayotou, 1994). Despite the experience of implementation of economic instruments in developed countries, who more actively practice them, cannot be just copied, it can be nevertheless helpful in developing of tailor-made solutions for the specific needs of the country in question.

In this context, it was interesting to look at the old papers documenting the very initial stage of emergence of the successful practices in waste management. Working papers on Dual System in Germany (Klepper & Michaelis, 1992) discussing the initial stage of the Dual system in Germany in early 90th provide an interesting insight on the expectations and uncertainties which were associated with the introduction of the system. Having this system successfully operating in Germany for around 30 years and since that time, this retrospective view might be useful for the other countries which are now on the way to develop their one approaches to the waste management.

Recycling system in Germany is one of the successful examples of combination of different instruments, economic tools and recycling practices. Collaboration between producers and recycling companies, extended producers' responsibility and choice of incentives for consumers, combination of curbside recycling and deposit refund system which together achieve efficient results. Recycling rate in Germany reached 65% and with this indicator Germany became the country with the highest recycling rate in the world (OECD 2015, p.50).

Dual System was introduced with goal to decrease and reprocess the packaging waste. While transportation and secondary packaging are instantly returned to the manufacturer for the reuse or reprocessing, take-back schema for the return of primary packaging was more complex to introduce due to the variability of materials and producers.

For this reason, package producers, retailers and material suppliers joined together into the Duales System Deutschland (DSD) corporation. Corporation assure the return of primary packaging from consumers to material reprocessing or recycling facility. Special label "green dot" issued by DSD and placed on the product package indicate that producer collaborate in recycling and recovery and these packages are to be disposed to the yellow bin for recyclables. Other waste is under the responsibility of municipal waste collection.

Collected packaging waste in Germany undergo either mechanical 39,4%, chemical 1,7% or energetic 58,8% recovery and only 0,1% is disposed (Kaiser et al 2018, p.8). Together with the introduction of deposit-refund systems, which make consumers bring back to the point of sale or the collection point, this system achieved high return rate of packaging. Dual system in Germany was efficient to stimulate the development of secondary material market and increase of recycling companies.

This example of how to convert waste problem into resource and waste management into profitable business is supported by the fact that recycling in Germany today is industry with 70 billion turnover (Waste Management in Germany 2018).

Creation of financial stimulus to achieve waste sorting at source requires complex unified system to be generally implements. "Pay as you throw" system built on "polluter pays" principle is one of the models using waste collection fee depending on the waste volume. This model is successfully implemented in Switzerland and to achieve around 53% recycling rate of waste (according to Swiss Federal Office for the Environment). Household pay for special bags for residual waste, while recyclable waste is cheaper or free to dispose. Residents are triggered to decrease the volume of not sorted waste, because it is costly.

However, as with all kind of service and household charges, settlement of waste collection fee or deposits amounts require thoughtful consideration in order to meet public acceptance (UNEP 2013, p.61) and not to affect vulnerable communities. Another risk associated with excessively high fees which do not meet public acceptance is that it may provoke illegal dumping and therefore require additional control. In some cases, non-monetary instruments play as important role as economic one.

Education is of the most efficient non-monetary tool, influencing behavior and attitude change both among consumers and producers. Informative campaigns increasing public awareness are focused on the raise of waste problems visibility and on the drawing attention to the environmental issues. Creation of attitudes and social norms, which encourage people to actively be engaged in recycling and waste segregation is the product of these activities. Basing on the knowledge about and attitudes to the impact of plastic,

consumers may voluntarily refuse from plastic bags and carry reusable bags. Aside to economic reasons, producers might be guided by the willingness to increase brand reputation and add favorability to the products thanks to "green = good". "Eco-labeling" is one of the forms to show the impact of the product on the environment and health and opportunity for producers (UNEP 2013, p.62)

Sharing of expert knowledge, instructions and trainings facilitate the acceptance of green consumption norms. Education programs for different groups and in different forms is the efficient way to increase awareness and impact the behaviors change. It is be especially efficient when included into schooling activities for children.

The way how countries deal with waste vary from country to country and are tailored based on the economic, social and other features. Ultimately, it is necessary to make sure that all elements chosen for the national waste management strategy work in alliance and provide a comprehensive approach to the problem.

In any case waste, as potentially profitable resource, should not be ignored, burned or just buried. Notwithstanding that recycling and waste reprocessing requires investments, untapped potential of waste is to undercover.

2. Current state of the waste management in Turkmenistan.

2.1 Country overview, legal framework in the area of Waste management

2.1.1 Country overview

Turkmenistan is a country in the Central Asia region along with the Kazakhstan, Uzbekistan, Kyrgyzstan and Tajikistan. The region is developing in many domains, facing the challenges of the rapid cities and population growth, construction boom and economic diversification. Intensive industrialization brought with it the rise of different environmental issues, including the increase of waste amount and the need to deal with it. From the beginning of 90th, after the Soviet Union collapse, these countries got their independence and the challenges to construct the internal policy and the state management along with the heritage of problems left from the Soviet Union period. At the early 90th a wide range of internal economic concerns of these new states and their so called "transitional economy" didn't allow to pay sufficient attention to the environmental issues. Nevertheless, in recent decades the ecological concerns in the region got closer attention and the number of works was already done.

Turkmenistan has population of 5,7 million people with GDP 6389 per capita (World Bank, 2017). The average size of the household is 5,3 persons (Assessment of e-waste for Central Asia 2017, p.36) from which around 50% is urban population. Country consists of 5 *velayats* (provinces) and the capital city Ashgabat. Ashgabat and the 5 principal cities Turkmenbashi, Mary, Dashoguz, Turkmenabat, Anew as well as the Avaza Tourist Zone are the major cities with the most developed infrastructure.

Having a lot of similarities with other Central Asian countries due to its historical past, Turkmenistan developed its own path. Due to the richness in energy sources – Turkmenistan occupy the 4th place worldwide in proved natural gas reserves (BP Statistical Review of World energy 2018, p. 26) – the country accumulated sufficient financial sources for its economic needs and the economic developed mainly extensively with the pressure on natural resources. There was no economic need to think about alternative source of energy or about the sustainable use of existing ones. However, in the last years the necessity of sustainability in economic development started to be recognized. The Government of Turkmenistan demonstrated involvement in the Agenda 2030 "Leave no one behind" for Sustainable Development. Its commitment appeared in nationalizing SDGs and in the fact that country co-financed joint projects on sustainable development According to the estimates in Progress Repost 2016-2017 of UN in two years the Government provided financial support for such programs in the amount of $4,091,893 (UNDP report 2017, p.8).

In the last years all Central Asia countries achieved some improvement in the field of waste management, including legislation elaboration and the enforcement of control of the waste disposal. Turkmenistan started to make efforts to improve waste management in order to meet international sustainable development goals, but there is a lot of works to be done.

2.1.2 Legal framework

Since the years of independence Turkmenistan acceded to some international environmental conventions, including Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters in and to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

Turkmenistan was among the first to accede to the Aarhus Convention by ratifying it on April 30, 1999. The Aarhus Convention is an important international legal instrument that promotes the protection of the rights of every person to live in an environment that is conducive to his health and well-being as well as the access to the environment related

information. The access of people on awareness of the environment related information is provided almost in all ecology related legislation acts, but in fact such information is not actively widespread.

Turkmenistan acceded to the Basel Convention in June 1996. Supporting the objectives on reduction and management of hazardous waste, country does not fully participate in the activities of the Basel Convention as it didn't provide the required annual reporting according to Turkmenistan First Environmental Performance Review from 2012.

The Law of Turkmenistan "On Nature Protection" (reviewed in 2014) was the basis legislative act for all environmental issues and contains environmental requirements for waste management (Article 37). The lack of the national legislation on waste was long considered a serious formal burden.

The adoption of the Law of Turkmenistan "On waste" in 2015 is an essential step in the improvement of waste management. This Law regulates issues of waste management and is aimed at "reducing waste generation and ensuring their rational use in economic and other activities in order to prevent their negative impact on public health and the environment" (Article 3). The reduction of waste quantities, introduction of circular economy, primacy of recycling over landfill are among the priorities stated in the Law. The Law provides definitions of the waste types and disposal methods, determine responsible institutions and regulations on dealing with waste, stipulates common rules of waste transporting and disposal.

Statement of the property rights on waste (Article 4) according to which "Ownership of waste belongs to their producer or to another legal entity or individual who obtained ownership of waste in accordance with the legislation of Turkmenistan" provides a legislation background for the involvement of private entities in waste reprocessing. The Law of Turkmenistan "On waste" is an essential background for the further development of waste legislation. There are around 20 by-laws prescribed to be enacted, including:

The procedure for the implementation of state accounting and control in the field of waste management (Article 6);

The list of wastes subject to import, export and transit through the territory of Turkmenistan (Article 6);

Waste classification, its list and criteria for determining the hazard level of waste (Article 15, part 2);

Regulation for the management of industrial and household waste (Article 17, part 2);

The procedure for the transporting of household waste (Article 19, part 2);

The regulatory document establishing the passport of hazardous waste (Article 20);

The procedure for the transport of hazardous waste (Article 20);

The procedure for storage of hazardous waste (Article 20);

The procedure for accounting industrial wastes (Article 26);

The procedure for accounting household waste (Article 26) and others.

The acceptance of the Law of Turkmenistan "On waste" demands the introduction of the unified statistical system and report forms in order to gather the data to fulfill the tasks described there. For that purpose, in the frame of the EU Project "Support to the introduction of Sustainable development policies in Turkmenistan" (2014-2016) a number of workshops for the statistic board were conducted and proposed detailed recommendations for the creation of statistic reports on waste, including classification of waste and its hazard level. Nevertheless, the statistical reports on waste are not implemented yet. The introduction of accounting and control measures on waste will allow to collect information needed for the development of the further strategy.

The other legislative acts include:

The Law of Turkmenistan "On Nature Protection" (2014);

The Law of Turkmenistan "On the Protection of Atmospheric Air" (1996);

Sanitary Code of Turkmenistan (2009);

The Law of Turkmenistan "On Radiation Safety" (2009);

The Law of Turkmenistan "On Chemical Safety" (2011);

The Law of Turkmenistan "On Hydrocarbon Resources" (2008);

The Law of Turkmenistan "On Ecological Expertise" (2014);

The Law of Turkmenistan "On licensing of certain types of activities" (2009);

Regulation on state ecological expertise approved by the President of Turkmenistan (1996);

The National Oil Spill Prevention and Response Plan in Turkmenistan, approved by the President of Turkmenistan (2001);

Rules of protection of coastal waters of Turkmenistan from pollution from ships, approved by the Decree of the President of Turkmenistan (2005);

The Criminal Code of Turkmenistan (2010) and the Code of Turkmenistan "On Administrative Offenses" (2013);

Safety rules in the oil and gas industry (1995);

Procedural registration at the border points of Turkmenistan and the transit of dangerous military cargoes, approved by the Presidential Decree (2003);

Presidential Decree "On licensing of import, production and sale of chemicals" (2010)

These days, international collaboration in the field of waste management includes the participation in the wide range of activities carried out in the Central Asia. Turkmenistan hosted a regional seminar on waste management organized by OSCE in November 2017 and recently took part in the Central Asia International Ecological Forum in Tashkent where commitment to the issues of waste management was declared.

A new project "Green Urban Development/Sustainable Cities" initiated by Global Environmental Facility in 2017 engaged into the improvement of energy efficient street lighting, sustainable transport management as well as includes waste management improvement issues (UNDP report 2017, p.36). Besides national and regional structures some international nongovernmental organizations such as USAID, UNEP, UNDP, GEF, Tacis, EEC, impact to the issues of sustainable development.

Nevertheless, the implementation of proposals and requirements usually takes a long time or not taking place because of different obstacles as comprehensive centrally governed strategy is not implemented yet.

2.2 Waste collection and disposal system in Turkmenistan

2.2.1 Waste collection

Table 1. provide an overview of state and local institutions in Turkmenistan are responsible for the different waste streams:

Table 1.State institutions and responsibility for waste treatment

Authority	Area of responsible
The Cabinet of Ministers of Turkmenistan	Overall coordination in waste management
Department of Communal Services	Household waste
State Committee for Nature protection and land resources	Industrial waste
Ministry of Health and Medical Industry and Sanitary-epidemiological service;	Medical waste
Ministry of Agriculture	Allocation of land for landfill
Local municipalities (hakimliks, geneshliks)	Household waste collection, transportation and disposal
State Concern "TurkmenChemistry"	Hazard and old toxic waste

Treatment of industrial waste is under the responsibility of the producing industries. The main type of industrial waste in Turkmenistan is produced by the oil industry. The treatment of oil tailings at the Turkmenbashi plant successfully uses technologies for dealing with oil tailings waste based on the assessment report of UNEP 2007 (p.102).

At the moment the collection, transportation and disposal of household waste as well as streets cleaning in Turkmenistan are under the direct responsibility of municipalities and are classified as sanitary measures financed from the state budget and local fees. Ministry of Agriculture allocate land for landfills. Then local authorities decide on the place of burial.

Till July 2018 all administrative issues on household waste, including the financing and general management, were under common control of the Ministry of Communal Services of Turkmenistan. The finance allocation has a linear structure. MCST received the finance for communal needs from the state budget and then allocated them locally among municipalities which use them according to the approved needs. In July by the Resolution of the President of Turkmenistan Ministry of Communal Services were reorganized and designated as a Department of Communal Services under the under the government of the Ministry of Construction and Architecture. Administrative functions of performing works on waste collection, street cleaning and other public services were assigned to municipalities of velayats (regions) and etraps (districts) (Order N.849 from 05.07.2018). The linear scheme of the waste collection financing remained without changes.

Waste collection in urban areas occurs from primary collection spots (see Fig.5.) which are located within the living areas. In rural areas and villages both primary collection spots and door-to-door collection are used. As can be seen on Fig. 5., the same kind of collection bins for curbside collection is used for many years. Private sector and international actors do not participate in the municipal waste collection system. However, there are some private companies which collect such recyclable materials as paper, glass and have recently started to accept plastic bottles.

Most of the financial provisions for environmental and communal needs, including for waste related costs, comes from the state budget. There are fees and taxes (city tax, waste collection fee), but they generate very small financial inflows and barely cover the overall costs. For instance, it is obvious that having the rates of city tax of 2 manats (0,57 $) per employed per month and communal fees for waste collection in amount of 12 manat (3,4$) per year from household it is impossible to generate enough financial sources. Here it's necessary to mention that Turkmenistan follows a strong social support policy and till 2016

other communal costs such as electricity, gas and water were free of charge or had high free of charge limits (Assessment of e-waste for Central Asia 2017).

Despite the scarcity of finance collected for these purposes by taxes and fees, according to the estimates provided in Turkmenistan First Environmental Performance Review 2012, there are enough financial resources in the country available for the improvement of waste dealing practices.

Figure 5. Curbside collection in Ashgabat in 2012 (left) and 2018 (right)
Sources: Turkmenistan First Environmental Performance Review, By author

In recent years first spots for separate waste collection (glass, plastic, metal) in Turkmenistan were introduced in public places. They first appeared in 2013 in the Avaza National Tourist Zone (see Fig.6), which was planned to meet ecological friendly international resort area's standards. Nowadays, more public areas are equipped with separate collection bins, but on the household level it is not implemented.

Figure 6. First bins for separate waste collection in 2013 in Avaza. Source: By author
Red – paper, yellow – glass, blue - plastic

2.2.2 Waste disposal methods and sites

Landfill dumping remains the mostly used waste disposal practice in Turkmenistan. The natural and demographic conditions of the region have also impacted to that. The availability of vast unoccupied desert territories being in the state ownership as well as the low population density - all these factors made landfill dumping the most attractive and less investment-demanding way of waste disposal. The comparative analysis of the development of landfill spots in the last 15-20 years (see Fig. 7. and Fig.8) provided in the Central Asia Waste Management Outlook (2017) shows the improvement in waste disposal sites and its conditions.
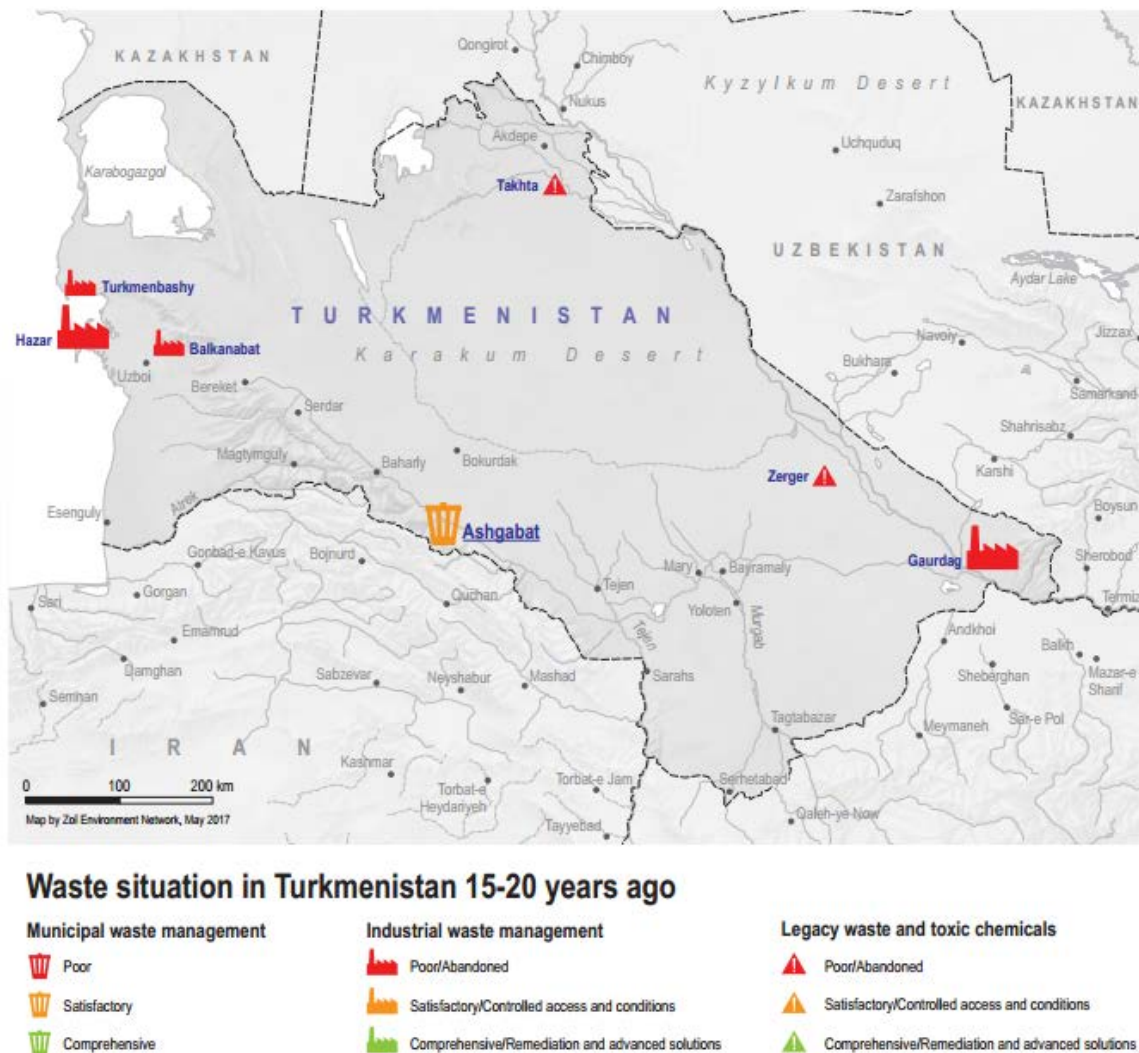

Figure 7. Waste situation in the last 15-20 years. Source: Central Asia Waste Management Outlook 2017, p.40

As can be seen on the Fig.7. in the past 15-20 years the municipal, industrial and toxic waste disposal sites were in a poor state, most of the waste infrastructure was here from USSR period and not properly managed. According to the current estimates as shown on the Fig. 8 condition of disposal sites improved from poor to satisfactory for industrial waste and to comprehensive and from "poor" to "advanced" for toxic waste disposal sites. This improvement is the result of activities of the state concern "TurkmenChemistry" (Central Asia Waste Management Outlook, p.44) succeeded in dealing with toxic, radioactive waste and pesticides, including waste left from the USSR and collected from the other abandoned sites in the country, by reburial the old waste on special monitored sites.
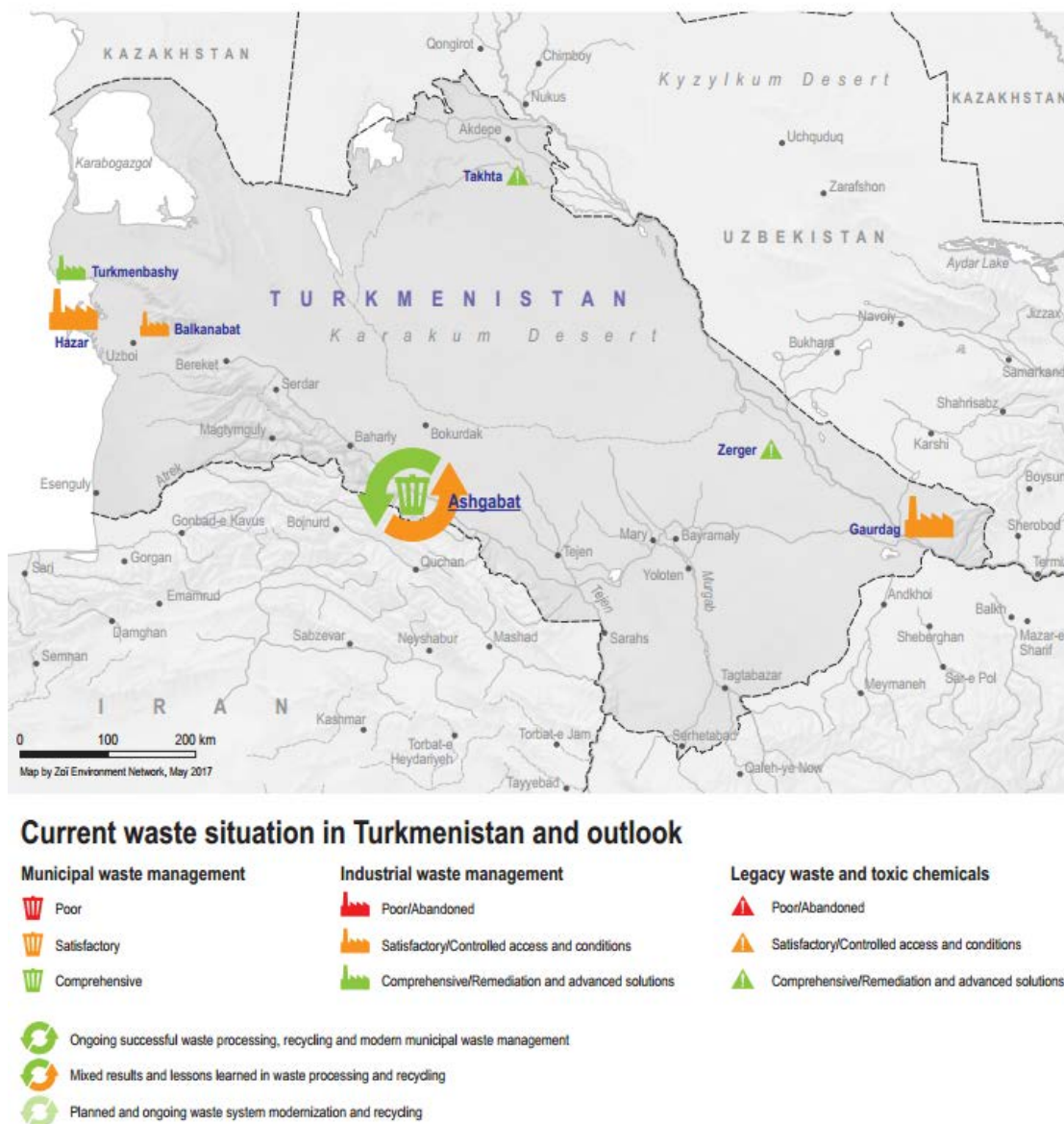

Current waste situation in Turkmenistan and outlook

Municipal waste management	Industrial waste management	Legacy waste and toxic chemicals
Poor	Poor/Abandoned	Poor/Abandoned
Satisfactory	Satisfactory/Controlled access and conditions	Satisfactory/Controlled access and conditions
Comprehensive	Comprehensive/Remediation and advanced solutions	Comprehensive/Remediation and advanced solutions

Ongoing successful waste processing, recycling and modern municipal waste management

Mixed results and lessons learned in waste processing and recycling

Planned and ongoing waste system modernization and recycling

Figure 8. Current state of disposal sites. Source: Central Asia Waste Management Outlook 2017, p.41

The situation with medical waste received closer attention after the adoption of the National Program for the Safe Management of Medical Waste in Hospitals. Incineration

remains the main method for medical waste disposal in cities, only the plant in Ashgabat imply the advanced approach.

Municipal dump in the capital city annually receives around 200 tons of waste (Central Asia Waste Management Outlook 2017, p. 42). The old municipal dump in Ashgabat was closed in 2009 and the new one is located at the outskirts further from the city.

Particular attention is given to the organization of the safe waste collection and disposal. In the comprehensive study of landfills in Central Asia conducted by S. Webb in 2008, predominance of open dumpsites and controlled landfills were in the region were outlined. Nowadays according assessment of regional reports landfills in Turkmenistan are considered as reliable as they are provided with advanced technologies protecting the environment from contamination in line with sanitary rules and ensuring neutralization of negative impact of solid waste.

Uncontrolled waste disposal, uncontrolled landfill. At the present, the situation with unauthorized waste disposal and illegal landfill is practically solved. The Code of Turkmenistan "On Administrative Offenses" (2013) provides for "The release or burial of industrial, domestic and other wastes to places not established and not permitted in accordance with the legislation of Turkmenistan shall result in the imposition of a fine on individuals in the amount of up to four, on officials up to ten sizes of the base value" (Article 141). The control of unofficial disposal spots together with penalty system showed efficient results. The problem of unauthorized disposal sites in the cities, especially in the capital city, has been basically solved within the last 10 years.

The situation with the cleanliness of the streets has become much better due to the equipment of public areas with bins and regular cleaning of streets. Nevertheless, in some areas there are not enough trash bins available. In the street waste can be seen the predominance of plastic and packaging waste (Fig. 9).

Figure 9. Average content of street waste in Ashgabat, 2017. Source: By author

Nevertheless, street waste, consisting of paper, plastic packages and plastic bottles can be considered as a problem, despite municipal street cleaning services are successful in keeping streets clean. The roots of the street waste problem should be mostly solved using educational methods in order to increase responsibility level.

2.2.3 Waste composition and recycling

The exact amount and the composition of the household waste is not available due to the absence of related statistics. According to estimates taken from international reports and overviews it warries around 1 million tons of household waste per year. According to other estimates (Troschinetz & Mihelcic 2009, p.318) the amount of daily waste reaches up to 0.399 per person which gives us around 2,08 million tons of waste per year. The complexity of the estimations and the differences in assessed amounts of waste could be also explained by difference in approaches to how the waste should be measured and what is considered to be a waste.

Food waste dominates in the household waste in Central Asian countries, followed by paper, glass and growing share of plastic (Central Asia Waste Management Outlook 2017, p. 7). According to sources (Anelamova 2012, p.167; Assessment of e-waste for Central Asia 2017, p.38) around 75% of all waste constitutes from these 4 types of waste.

Recycling activities.

While being a part of USSR Turkmenistan participated in a centralized waste management and recycling system existed during that period. This system was successful in recycling paper, scrap metal, reusable glass containers and food waste. Due to the extensive agitation works and educational programs involving schoolchildren and adults in the reprocessing of waste recycling rate was relatively high. For instance, according estimates (Sim et al 2013, p.106) paper collection rate reached around 90% in 1980. Nevertheless, after Soviet Union collapsed, this system ceased to exist in all former Soviet republic due to the change in management patterns and insufficient attention to this field. As a result, after 1990s, waste reprocessing volumes declined sharply. The changes in consumption patterns and the increase of packaging waste in recent 20 years demand the elaboration of the new measures to cope with these new challenges in waste management.

Nowadays, recycling practices in Turkmenistan have a very slender share in both state and private sectors and therefore recycling rate is estimated to be not higher than 1% (Central Asia Waste Management Outlook 2017). Some projects in the frame of State Program for the Support of small and medium enterprises in 2011-2015 were aimed to engage private sector investments into recycling initiatives (Yolamanova 2016).

Considerable step in the development of recycling was done in 2009 when the first plant for sorting, recycling and processing of waste costing more than $ 30.8 and with a production capacity of 750 tons of was launched near the capital city, in Rukhabat region. The plant was constructed to meet the existing needs for processing solid household waste, glass, plastic and metal. The plant is also intended to deal with medical waste, including a special building for the disposal of potentially hazardous medical waste where will occur its sterilization and grinding. However, the plant didn't operate its full capacity now and there is no available information on the quantity and composition of waste already recycled.

Private waste collectors. During the last months the number of the private points accepting paper and plastic bottles in the neighborhood has increased. Nowadays there are more private firms working with plastic bottle producers and paper recycling companies. Payment rates for taking 1 kg of paper and 1 kg of plastic bottles are 1 and 1,5 manat (0,3 and 0,5 Euro) accordingly. Such low payment rate (especially regarding plastic bottles) makes it unattractive attractive for middle class residents to collect, store and bring plastic bottles and paper to the collection spots. Moreover, it is considered as an activity for poor people and that's why is assessed as harmful for the reputation for middle-class.

Paper. Paper and glass recycling are among the widest recycling initiatives carried out in Turkmenistan, practiced several private companies. Currently, only 2 private companies in Ahal region produced around 4 698 tons of products from recycled paper in 2017 with the considerable total year turnover. The collection of paper is mostly carried out upon the direct agreements with companies to collect their corporate paper waste, but this doesn't address the wider community. In the last years, some private recyclables collectors started to accept paper from households, but the narrow scope. The reason for that is the minority of accepting spots which limits participation of households and low payment rates. However, paper recycling has high potential in the region.

Since Turkmenistan belongs to the low forest cover countries and paper goods are predominantly exported, the issue of paper recycling deserves even closer attention. The profitability of the field is especially high for the country with the scarce paper raw materials.

The accessibility and affordability of paper recycling technologies making this sector even more attractive.

Organic waste. Food waste is estimated to occupy the largest share in household waste in Central Asia countries, especially in the rural regions. Organic waste recycling has a great uncovered potential for Turkmenistan, because of big share of food waste and affordability of composting even on the household level. Elaboration of organic waste would yield nutrients to the agriculture, which is a valuable resource for deserted soil of the region.

Other types of waste. In general, there are no specialized collection points for used batteries and other hazardous elements from municipal waste. There are capacities for recycling mercury lamps (Chemical plant in Lebap region) and old batteries (Kelete city) in different parts of the country. The recycling of metal, developed in soviet times, has improved since 2009 when the first steel plant was commissioned (Assessment of e-waste for Central Asia 2017, p.38). The production of crumb rubber, which is used for coverages of treadmills, fitness and gyms, etc., based on the used tires recycling, has also been adopted. Nevertheless, in all cases the information on possible acceptable materials and recycling spots is very scarce and not widely accessible both for public and researchers.

2.3. Residents insights in waste management

Considering the importance of residents' role and cultural differences in implementation of recycling initiatives, it was essential to get some useful insights from their side. In order to test residents' willingness to participate in recycling activities and protentional acceptance of waste sorting, survey using online questionnaire (Appendix III) was conducted. The study was aimed to test introduction of two initiatives: sort at source and take-back system and assess the following issues:

1) the willingness to sort waste at home by introducing financial incentives;
2) the willingness to participate in take-back system;
3) the value of financial incentive for participation in waste sorting;
4) the value of financial incentive for participation in take-back system;
5) attitudes to and knowledge about waste sorting and recycling;
6) factors and determinants which influence the behavior.

2.3.1 Data collection and Methodology

Primary data for this research was collected using online survey created in Qualtrics software. The online survey link was distributed in social media in the special groups where it could reach Turkmenistan's citizens. Total sample of 119 complete responds (n = 119) of country residents was collected and analyzed using descriptive methods and SPSS statistical software. The nature of the study doesn't allow to use pure AB-testing approach, but some test methods such as Correlation analysis and Independent T-test were used to track the linkage and correlation between the concepts.

The questionnaire was distributed in Russian language in order to reach wider community as it keeps the role of lingua franca in Turkmenistan. Then the questionnaire data was then translated into English by author in order to make it suitable for the further analysis. Missing values were possible to avoid because the survey forced to respond all questions. Only in 2 surveys last socio-demographic questions responds were missing, by uncertain reason, but they were not eliminated as all other data was complete. In order to avoid social desirability bias, i.e. the risk they choose responses to look more favorable, all surveys were anonymous.

Questions were created in order to test assumptions and potential factors determining recycling behavior (sort at home and take-back). In order to test willingness to participate in recycling by sorting at home (curbside recycling), survey participants were provided two options with opportunity cost in collection fee for not participating in recycling. Then they were also asked to choose the amount of opportunity cost motivating for recycling. As addition to pick-up recycling, the willingness to participate in take-back system was also tested. Respondents were first asked about their willingness to participate in take-back recycling and then to select the deposit amount, which would be sufficient incentive to bring bottles back to the collection point.

The choice of variable was based on the literature review. Such determinants as convenience factors, "neighbors-judge" social pressure and used in Czajkowski study (2017) measured for both sorting at home and take-back using bipolar scale in pairs "convenience – inconvenience", "troublesome – easy", "time-consuming – not time-consuming " and impact on reputation (as a reflection of social judgement motives). Multi-items scales for knowledge and attitudes measured the values for recycling, waste sorting, impact of plastic and personal impact. Impact of plastic was included in both cases, because it is one of the most discussed topics in the waste discussion.

Knowledge about environmental issues is a part of community rights in accordance with Aarhus convention. Attitudes are the reflection of moral positions, which are influential for the behavior.

Socio-demographics.

74% female and 26% male took part in the survey. The age profile is randomly distributed, with prevalence of young participants (around 77% to 35-year-old), but this comply with the age demographics structure of Turkmenistan. The prevalence of young respondents can also be explained by the fact that survey was distributed online and with the use of social media.

Car ownership question (Q13) was aimed to measure the income level as this feature may influence the results. 77,8% of the respondents do not own private car, but as most of the respondents were women, that could bias the result and no reliable inferences about income level can be taken from it. Nevertheless, the car ownership could potentially simplify fulfillment of take-back system, but no correlation was found here.

Data preparation.

As multiple items were used to look at Knowledge and Attitudes variables, reliability analysis was run to test if all items were related and can be combined to one reliable measure of the variable. As reliability analysis showed, multiple items for Knowledge (*Cronbach's Alpha = 0.822*) could constitute reliable value together as Cronbach alpha was higher than 0,7 (Appendix V. fig. 1). Aggregate values for Knowledge (questions 3 a to 3 d) was computed. Questions for Attitudes were also reliable together (*Cronbach's Alpha = 0.769*) as reliability analysis showed (Appendix V. fig. 2). Aggregate value for Attitudes (questions 4a to 4 d) was also computed.

2.3.2 Data analysis and discussion

Waste sorting. According to findings 83,17% of the respondents preferred to sort waste and to pay less. Nevertheless, as opportunity cost necessary to make them participate in curbside recycle (difference in payments between two options) was chosen 100 manat, the highest option. 85% of those who has chosen not to sort, would agree to sort if payment would be 100 higher than proposed in the study design, so the difference proposed was too low.

Table 2.Crosstab opportunity cost & willingness to sort

How much should be the difference between 2 waste collection options to make you separate waste	Total	To pay 20 manat and to sort	To pay 70 manat and not to sort
		83,17%	16,83%
100 manat	50,4%	43,4%	85,0%
20 manat	21,8%	25,3%	5,0%
30 manat	9,2%	11,1%	0,0%
50 manat	11,8%	12,1%	10,0%
70 manat	6,7%	8,1%	0,0%

As this question has potentially divided participants into 2 groups, it became possible to conduct statistical analysis to test the difference between these 2 groups: those who preferred to pay 20 manat and to sort (group 1) and those who preferred to pay 70 manat and not to sort (group 2).

Statistical analysis has also approved that the opportunity cost was significantly different between two groups (Appendix V, fig.3). The amount of difference in waste collection fee for group 2 was significantly higher in means (4,6 vs 3,3), which implies that they have chosen higher fee that will make them segregate waste. It's possible to make 2 inferences from this result. First, higher financial incentive can involve more people in waste segregation. Second, this amount is acceptable for most of respondents and could be implemented in practice within the current timeframe.

Then the relation between willingness to sort waste and other variables such as knowledge, attitudes, intrinsic and extrinsic recycling factors, infrastructure perception was tested in order to identify factors influencing the decision to sort waste in this case.

Analysis showed strong significant correlation between knowledge and attitudes (Fig.4, Appendix V). It also stated correlation between knowledge and intention to sort waste, but even stronger correlation between attitudes and intention to sort waste. Strong positive attitudes influence the decision towards recycling in a higher rate than knowledge (0,307** vs 0,220*).The means for knowledge and attitudes were also higher in the group that indicated willingness to participate in waste sorting.

Among the reasons for waste sorting (Q6), 60,87% of respondents indicated that infrastructure for waste sorting has an impact to their decision to sort at source. Financial reasons – such as incentives and penalties both were important in only 13%. Considering that 36,97% and 39,50% of respondents (Q7) were "strongly disagree" to "disagree" that sorting infrastructure in the country is developed and 28,95% & 36.84% think that recycling

infrastructure is not developed, lack of infrastructure is the issue in waste management, which this study revealed.

We can assume here, that in the presence of developed infrastructure or the awareness of infrastructure residents would be more willing to participate in waste sorting. Here, certainly, only intentions are expressed, and they might be different from the actions, but it is possible to make an inference based on this data.

Question 6 also allowed to write other reasons influencing the decision to sort waste (Appendix IV, Q6_text). Despite there were only 9 responds, they provided valuable insights into resident's opinion about sorting waste and how it should be implemented. Recommendations covered development of waste sorting infrastructure, including introduction of "special packages according to the color scheme, garbage bins" and automats which will accept waste. Provision of educational activities for different levels (including kindergarten and universities) and instructions of how to sort waste was an essential factor for waste segregation. "If I would know how to do it correctly" is one of the replicas supporting that need. Overall increase of public awareness and involvement of everyone in waste sorting in order to bring sense to activities was also mentioned:

> "If it would be accepted throughout the region! And it turns out that you
> sort, try not to litter anywhere at all, but most of the citizens of your region don't
> care about the cleanliness of the streets and the environment as a whole"

One of the expressions was "if the government will show interest in this issue ", which indicated the need to get more state involvement as a policy maker and governmental support to implement recycling.

Deposit refund. Reaction to the implementation of deposit-refund system with the introduction of deposit refund was another recycling activity, tested among residents in the survey. Respondents were asked to indicate their willingness to participate in the activity and then to choose the amount of deposit, which will be appropriate to make them participate.

62% of respondents claimed that they would be definitely ready and 22% probably ready to participate in deposit-refund system. Deposit-refund system is considered as requiring more effort in comparison to curbside bin collection, that's why the lower value in comparison to first recycling option was expected.

As for the deposit amount, respondents have chosen 1 manat[1] in 34,45%, 2 manat in 31,09%. Correlation analysis between the choice of the payment amount in both cases (for deposit and waste collection) indicated that there was a significant relation in choice, i.e. if the respondent has chosen higher value in the first question, he /she has chosen the higher value for the deposit amount (see Fig.7, Appendix V). That may be an indicator of different income level / expensiveness level perception.

23,5% respondent indicated that there are private collectors of waste in the neighborhood. Among these around 50 % accept plastic bottles, then paper 25%, and the rest accept metal and glass.

Other factors. Knowledge level remains moderate to low and none for recycling for 55,46% vs 44,54% for respondents who assessed their knowledge as extended and wide. Slightly lower result (and the lowest among the four options) was for the knowledge about waste sorting (57,14% vs 42,86%). Knowledge about plastic impact on the environment gained the highest rate, where participants assessed it as extended and wide in 63,02%. Knowledge about personal impact to environmental assessed it as extended and wide in 51,26%.

As for the assessment of Attitudes, all rates were higher. By choosing "agree" and "strongly agree" respondents expressed positive attitudes to recycling in 90,6%, to waste sorting in 86,2%, confirmed belief about bad impact of plastic in 92,31% and agreed about importance of personal participation in 93,97%. Hence, despite the lack of expert knowledge, big percentage of respondents showed positive attitudes towards recycling.

Q7 and Q8 measured potential intrinsic determinants for deposit-refund and waste sorting at home such as convenience versus inconvenience, effort, time-consumption and impact on the reputation associated with waste sorting at home.

Surprising results were in achieved in the question about impact on the reputation. Almost 20% of respondents responded that sorting at home would harm their reputation. This number was even higher in the case with deposit-refund system, where 35,25% (25,23% and 5,04%) of responded expressed this concern. In spite the high percentage of respondents who indicated positive or neutral impact of these recycling activities on reputation, negative values were quite high to be discussed and considered.

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[1] 1 manat = 4 Euro as for the date of survey conduct

Despite in most cases recycling is associated with socially favourable behaviour and is influenced by social norms (Czajkowski et al 2017; Sorkun 2018) and the link between social norms and pro-environmental behavior was discussed (Huber/ Viscusi/ Bell 2018), this result provides an alternative perspective to the issue. As it was stated before, some recycling activities might be associated with activities for poor people and that's why respondents might have responded this way. The same "neighbors-judge" social pressure principle works here, but in a different way. It outlines the need to consider cultural and social differences while implementing any waste initiatives. It also indicates the need to work on attitudes towards recycling by increasing public awareness.

As for other factors, deposit-refund was also received as less convenient, troublesome and time-consuming in slightly more cases than waste sorting. It was predictable because bring waste back to collection spot rather than to perform action at home requires additional effort.

2.3.3 Critique

Online survey provides preliminary insights into residents' willingness to participate in recycling activities and their awareness about waste issues. The sample though cannot be considered as representative, because of several reasons. First, the size of the sample is not big enough and can be the object of small number bias. Second, the social profile of respondents doesn't represent all layers of population, but only educated adults having access to the internet, probable urban citizens. In addition, the sample contained more female respondents, which could have an ambiguous impact on the results. From the one side, women are mostly involved in household activities and waste treatment, but from the other side the sample is biased because of gender inequality.

Another critical point is that the intentions and willingness to participate may differ from the actual behavior when it comes to practice. But these psychological issues are out of the scope of the current study. The main goal of the study was to shed the light on the attitudes, knowledge, intrinsic and extrinsic factors impacting behavior, potential resistance and sensitivity to financial incentives which the implementation of WM strategy can face in Turkmenistan.

3. Analysis of barriers and recommendations

3.1 Analysis of barriers

The overview of existing literature on WM in Turkmenistan as well as the empirical study uncovered the following gaps and barriers:

1) lack of coherent WM strategy involving all stakeholders;
2) insufficient statistics and irregular data collection;
3) absence of waste separation facilities and recycling infrastructure;
4) lack of awareness about environmental issues and need of trainings.

1) Despite the participation in international and regional activities in the field of waste management, there is still no coherent and integrated strategy for waste management. Development of the coherent strategy on the waste management is a primary step towards circular economy which ensure solution of waste dealing problems along with the SDGS.

2) No regular data collection and available statistics on waste composition and its quantities in Turkmenistan is considered the considerable obstacle. Statistic report form on waste in Turkmenistan was abolished in 1994. Since that time the data on quantities and composition of waste is not available. Submission of other internal statistics under the international agreements and is also not fulfilled. Even required by the Basel Convention annual report was submitted only once between 1999-2007. For that reason, expert estimates and assumptions are taken as a baseline for making implications on the amount of waste disposed. The lack of available data about Turkmenistan and the absence of regular statistics hinders the possibility of comprehensive analysis and implications. The need to collect data on the waste amount according to the waste classification is reflected in the Art.3 of the Law of Turkmenistan on Waste but is not yet implemented.

3) Presence of separation facilities and recycling infrastructure is fundamental condition for recycling. Empirical study indicated the lack of separate collection facilities on the household and community level. Scarcity of recycling spots and bins for separate waste collection as well as its hindered accessibility is regarded as a serious obstacle for the development of waste separation practices (Singh, 2015). In recent years first spots for separate waste collection (glass, plastic, metal) in Turkmenistan were introduced in public places. They first appeared in 2013 in the Avaza National Tourist Zone (see Fig.5), which was planned to meet ecological friendly international resort area's standards. Now recycling bins can be found in some public places (bus stations, supermarkets) in the capital city

Ashgabat and primary cities of the regions, but separate waste collection bins are not introduced on the household level.

Despite the importance of the introduction of recycling bins in the public area in Ashgabat and Avaza as a first step toward waste separation, this meets 2 main obstacles to succeed. First, as the waste recycling plant doesn't operate, all waste goes to the common landfill, making sorting at source useless. This concern may be the main burden for citizens who already want to participate in environmental actions but see no sense in it because of absence of recycling facilities.

Second, as there are people who doesn't know "how to do it correctly", not everyone can properly use these bins, because they need instructions, or they are simply not aware of the purpose of recycling and waste sorting. Theses burdens show how important is it to use coherent approach to the waste issue. That brings us to the need of instructions, explanatory and training activities and to the high importance of the community participation.

4) The need to increase awareness about environmental issues, to provide trainings and other informative campaigns was one of the essential extrinsic factors in order to facilitate recycling.

As the participation of population in the waste separation is considered as a key and basic element in making recycling system work, it's essential to address the community participation to ensure the success of recycling activities. Apart from the economic incentives, penalties and other instruments which motivate active participation as a "hard tool", activities which educate and explain waste practices should be considered as a starting point in attraction of the wider community to environmental problems.

Empirical study showed that about than 55% of respondents have from "none" to "common" knowledge about recycling & waste sorting and this number can be even higher. If we assume that survey respondents are educated, active internet users, the knowledge level in wider community can be even lower. Hence, preliminary explanatory and educational activities about the purpose of waste separation and recycling can facilitate here.

It is certainly impossible to expect immediate response and the changes in behavior straight away from the entire community, as even in highly developed countries with the long experience in waste separation the participation of all the citizens is not always met. Nevertheless, awareness of the wider community of the waste problems is an essential part on the way to the sustainable development goals. It is an essential element in involving citizens and making them share responsibilities in environmental issues. This consumer

responsibilization can be the solution not only for developed countries, but for all countries on every level of development.

Another impact that knowledge can bring is to change the attitudes towards recycling. Despite the study showed positive attitudes towards recycling, residents indicated the concern, that waste sorting or bringing bottles back to the collection spot may harm their reputation. This perception should be changed to eliminate this barrier for engagement into recycling.

Now, there are no comprehensive efforts to increase population awareness about recycling benefits and current ecological concerns in the wider community in Turkmenistan. The lack of these knowledge on the school level as well as unawareness of such problems among adults in Turkmenistan complicate the issue. As the empirical study showed, despite the high willingness to participate in recycling, the knowledge level about this issue remains low.

Some positives changes in information spread within the last year should be mentioned. Much more publications covering recycling initiatives appeared in newspapers. Nevertheless, the absence of coherent educational and informative campaigns, increasing awareness about recycling purpose and benefits in a wider community is still the case.

3.2 Waste management in Turkmenistan in SDGs framework.

Since the adoption of sustainable development goals by Turkmenistan, improvements in different domains were made. The following overview in the framework of SDGs is aimed to show the impact of improvements in waste management in achievement of sustainable development in the country and adherence to international agenda.

SDG 1. No poverty.

Despite the country doesn't have severe poverty problem, creation of working places and income for the most vulnerable groups will contribute to the economic development. Material reprocessing and recycling facilities can be placed in less developed regions and towns in order to provide jobs for different skills level workers and support regional economy.

SDG 2. Zero hunger.

As Turkmen society has a special respect to food products, the food waste is usually carefully treated. In rural regions food waste is feed to animals, but in the urban area, there

are not as many solutions for its alternative disposition. There is the need here to develop programs with charity organizations and collaborations with organizations supporting people in need. Another focus is to be done on prevention of food waste due to better storage and transportation along the supply chain.

SDG 3. Good health and well-being.

The activities for safe treatment of hazardous and medical waste, elimination of illegal open dumpsites in human settlement areas – all these actions were already big steps made in the protection from harmful aspects of waste. Further actions which could be done in this direction is the control of open burning of waste, which is practiced in some communities.

SDG 6. Strive to prevent water contamination

Water is very valuable resource for Turkmenistan as for the country with deserted landscape. A lot of work is being done for the water resources protection. The purpose of waste management here should be to ensure protection of ground waters from contamination caused by existing and planned landfills.

SDG 7. Affordable clean energy.

Despite Turkmenistan has enough energy recourses reserve such are natural gas and oil, which is the background of the country's economy, elaboration of new clean energy solutions should also be in the focus. Development of clean energy is the global concern and probably the future of energy recourses. Anaerobic digestion, for instance, already deal with the issue of converting waste into clean fuel – the biogas. This embodies the opportunity for both organic waste treatment and production of alternative energy source.

SDG 8. Decent work and economic growth.

As there is huge uncovered potential in waste as resource, which is currently just ends in landfill, it is necessary to stimulate secondary resources market in Turkmenistan. Subsidies for prospective recycling initiatives, state procurement for products made from reprocessed materials, and other economic instruments, financial tools involving consumers into recycling behavior, - variety of instruments should be employed here. Encouraging the producers to participate in circular economy will help to achieve sustainable growth, which will be decoupled from the increase of waste quantities.

SDG 9. Industry, innovation and infrastructure.

The choice of the right technologies appropriate for the country purpose and target waste streams is one of the success factors. In the case of Turkmenistan with high percentage of organic waste, capacities for organic waste reprocessing by composting and anaerobic

digestion should be increased. Paper recycling should also be among the priorities. Small and medium-size businesses need to be encouraged to use R&D and innovative solutions in recycling. The need for infrastructure was also considered as a obstacle for waste sorting according to the survey results.

SDG 11. Sustainable cities and communities

Innovative solutions in waste collection and recycling are among the priorities in achievement of sustainable cities and higher quality of urban life. United Nations Development Program in Turkmenistan currently works on the "Sustainable cities" program in major cities of Turkmenistan. The project includes implementation of recycling initiatives. Pilot project introducing of curbside recycling of household waste in one of the communities is discussed. Testing initiative will include design and installation of facilities for waste segregation, instructions and training for residents. If this will show successful results this model can be replicated in other communities and cities. Hence, that indicates the need of attention to waste treatment for sustainable cities.

SDG 12. Responsible consumption and production

Educational campaigns for both consumers and producers about recycling and personal responsibility in environmental issues should be organized. It will be the first step towards consumer responsibilization and creation of extended producers' responsibility. The route to the sustainable development demand principal shift in consumption mindset and personal responsibility. Extended producers' responsibility should be incorporated into the new waste management strategy. By forcing producers to participate in reprocessing of waste caused by their products, circular economy mechanism can be activated. Responsible consumption will be possible if green alternative will be proposed.

SDG 13. Climate action.

The decrease of waste disposed to landfills as one of the priorities of waste management in Turkmenistan will allow to decrease GHG emissions caused by landfill gases. Despite no precise estimations can be made here due to the lack of data, some inferences can be made here. Bearing in mind the amount emissions caused by landfills and the fact that almost all waste from the last 30 years was stored in the landfills, it can result in extensive emissions saving. Hence, waste management will assist in accomplishment of emissions decrease according and contribute to climate action goals.

SDG 14. Life below water.

As the land having access to the Caspian Sea, Turkmenistan is concerned about the protection of marine life. Prevention of costal marine pollution can be the subject of further

researches. Waste management actions for the protection coastal regions should be particularly careful in resort areas to protect the seaside area from the consequences of tourism activities and pollution associated with mass tourism. The project of Avaza National tourism zone was the first resort zone, projected with the focus on ecologically friendly solutions. The bins for separate waste collection in the public spaces were implemented here among the first in the country.

SDG 15. Life on land

Recycling and reuse of materials provide number of benefits due to the natural conditions of the country. Composting of organic waste can provide natural nutrient for the deserted soil and therefore contribute to fight with desertification. Fertilized soil will result in better agriculture and gardening outcomes and ameliorated harvest.

Protection of raw resources is another positive environmental effect. For the country with lack of natural forest resources paper recycling has high potential. It can first, minimize the demand on paper from the raw wood fiber, and seconds, will decrease in emissions caused by the transportation of paper to the country. Use of composting as the source of natural fertilizer is for the agriculture.

Separate collection of hazardous elements in household waste, which is currently not implemented, is necessary to protect the environment from the contamination by hazardous elements, for instance lithium or mercury from the used batteries.

SDG 17. Partnerships for the goals

New waste management strategy of Turkmenistan should bring producers of packages and products, retail industry and recycling companies together in order to set up the action plan. Collaboration with global environmental organization and use of international expertise is necessary in order to get valuable knowledge for the implementation of projects.

3.3 Recommendations for waste management strategy in Turkmenistan

The results of the study outline that it's essential to consider cultural values and psychological differences in countries while elaborating and implementing waste management strategies and there is no universal approach to this issue. For each country the strategy should be tailored, using different methods to develop the strategy better fitting the case. In order to achieve substantial shift in how waste management works, the common

effort of all stakeholders, including governmental structures, private sector and residents should made.

Current recommendations were developed following the literature overview, SGD framework, results of empirical study and considering all gaps and barriers, revealed in the research. They include combinations of different elements aimed to succeed in waste management.

The adoption of the Law on Waste in 2015, which states priorities in waste management provide a definition of waste types and streams was already a big step for waste management improvement. Nevertheless, it was not enough supported by other measures. Governmental support as a policy maker should be also fulfilled by the introduction of new waste management strategy. The priorities of new waste management strategy should include:

− development of statistic measurements for waste, according to the waste classification;
− analysis of waste composition, including historical composition of waste in landfills to define the most problematic type of waste;
− minimization of waste quantities disposed to the landfill;
− development of recycling infrastructure, including material recovery plants and separate collection facilities;
− increase of the share of circular economy and increase of recycling rate till 2030;
− creation of secondary resources market;
− introduction of extended producers' responsibility;
− educational campaigns to increase public awareness;
− engagement of residents into to waste segregation and recycling;
− promotion of partnership in waste initiatives on the local and global level.

New strategy should include numeric goals and timeframes to achieve them. These numeric goals should include percentage of increased recycling rate, most problematic waste streams and targets, financial resource allocation and financial inflows, economical instruments to apply. In order to set the waste targets and recycling rates more detailed data on composition of waste and waste volumes is required. Therefore, the introduction of measurements is essential first step in setting up and fulfilling numeric goals. This numerical data together with other indicators are necessary to monitor the progress, i.e. whether the amount of waste has decreased, whether recycling rate of paper/glass became higher.

In order to determine prioritized waste stream targets for Turkmenistan, it's necessary to conduct more detailed analysis of waste composition. Nevertheless, based on the discussion above, the following waste streams are to be considers are prioritized: plastic packaging waste, paper, organic waste and hazardous elements in household waste.

Protecting environment from hazardous elements from the household waste should have the initial priority. Separate collection of hazardous elements in household waste will be important step in protection of communities from the hazardous elements such as lead, mercury lamps, used batteries, containing lithium and mercury. Special spots for batteries and similar waste should be promoted.

Paper is valuable material in Turkmenistan due to the lack of natural wood fiber resources, paper recycling and secondary use of this resource have high potential on the market. As the solutions for paper recycling are more affordable even on the middle private business level, paper recycling market should be stimulated.

The increase of plastic and packaging waste is the global problem and extended producers' responsibility approved to be one of the effective models to achieve deduction of waste quantities and increase of recycling rate for plastic. Despite implementation of deposit refund system and require comprehensive approach and partnership between many stakeholders, it is possible to succeed in it in Turkmenistan, if it will be promoted on the governmental level. According to the study of the study, residents showed their commitment to recycling and potential readiness to participate in both waste segregation at home and deposit-refund.

As public budget allows to make investments into the infrastructure, innovative solutions for waste treatment such as recycling and anaerobic digestion facilities, waste segregation infrastructure should be launched. The strong need for infrastructure improved was indicated in the result of empirical study. This need is to be taken into consideration by the governmental units.

Economical and financial instruments such as initial subsidies for recycling companies, differentiated payments fees for waste collection, deposit refund system should be employed to stimulate secondary materials market in Turkmenistan, which is currently developed in a very narrow scope. When circular economy will function on the market basis, recycling can be transformed into profitable business. Subsidies will allow small businesses to participate in recycling initiatives. The balance between penalties and stimulus should be defined. Recycling should be also financially attractive for consumers to take part in. As was discussed above, fees for accepting paper and plastic are too low and are not considered as

incentive for middle class consumers. 1 manat for 1 kilo of plastic bottles doesn't justify the effort for collection, keep and transportation of rather big volume of plastic bottles. As was supported by the study results, more attractive fees need to be thought of.

Together with the introduction of recycling plant, recycling infrastructure at the household level needs to be installed. As was proposed by the UNPD project for sustainable cities, this may start with the one demo community, testing curbside recycling and its efficiency. Such experimental project will allow to test design of community recycling infrastructure, needs for educational programs and such kind of pilot project on the small size will be easier to implement. In the case of success this "recycling community", this model can be replicated in the wider scope.

Education and Public awareness. Information campaigns should be launched to promote accessible sources of knowledge for the wider community, including kindergarten, schools, organizations, communities. These educational campaigns should cover key sustainable development topics, including climate change, energy consumption and fuel sources, waste sorting and its purpose, recycling and its benefits, about personal impact to the environment. Implementation of recycling facilities require detailed information about types of waste, such as recyclable and nonreclyclable, instructions of how to sort waste correctly.

Of the important consequence of comprehensive educational campaign is to achieve the change in residents' behavior, which, in the long term, will impact the saving of resources and the formation of green consumer, or environmentally responsible consumer. Increase of awareness should also include the reports about achievements in waste management practices. This will help to ensure residents that their actions indeed make an impact, are practiced in the wider community and is socially desirable action.

Ultimately, the set of measures chosen for the waste strategy should be implemented sequentially in order to make the whole system work. It will be possible to achieve the breakout in waste management only by having all elements of the strategy working together. Only in the case of the presence of necessarily infrastructure, the activation of producers' responsibility, the enhance of public awareness and ability to participate, the long-term progress and SDGs can be achieved.

Conclusion

This paper was aimed to provide a thorough analysis of waste management in Turkmenistan in order to propose a guideline for the further development of waste initiatives in the country and elaboration of waste management strategy in alliance with sustainable development goals. Therefore, the overview of the literature on waste practices and instruments, and collection of data about Turkmenistan was conducted.

In order to gather additional practical information, the survey among residence of Turkmenistan was conducted. This empirical study allowed to shed the light on the number of residents' insights. Useful data into the state of recycling infrastructure, their attitudes and knowledge about recycling, their willingness to participate in waste segregation, sensitivity levels for waste collection fees and potential of deposit refund system implementation was collected. Despite some limitations of the study due to insufficient representativeness of the sample not including all population groups, it enabled access to additional information source from the consumers side. Around 90% of the 119 of respondents demonstrated positive attitudes towards recycling activities and around 80% willingness to participate in waste sorting and deposit refund supported by financial incentives. The study revealed the lack of knowledge on recycling and the need for better infrastructure.

Another purpose of this paper was to put together all data on waste management in Turkmenistan and to comply the comprehensive overview which will contribute into scarce scientific and practical data in the field of waste management in Turkmenistan.

The focus of this work was on the household waste, the ways and methods to achieve sorting at source and encourage recycling actions. As the result of this paper barriers and problems existing in waste management in Turkmenistan such as lack of recycling infrastructure, absence of statistical measurements of waste, narrow scope of secondary resource market, lack of involvement of business and residents in recycling were detected. As the way to tackle these problems, recommendations for the waste management strategy were proposed.

The study has also distinguished priorities among waste streams and recycling actions aligned with these priorities were suggested. These actions included the education and increase of public awareness, infrastructure improvement and implementation of statistical collection. The accomplishment of the goal to reduce disposed waste and increase the share of the circular economy is possible when all discussed elements function in compliance.

Despite some positive actions in waste management, including introduction of Law on Waste, which determines basic definitions and regulation, as well as the progress in treatment of medical waste, the absence of systemwide coherence limits the potential of waste management in the country. This paper tried to discuss elements of successful national waste strategy in order to map out the directions for further work.

There are still issues which require further researches and data collection. Forthcoming studies can replicate the survey with the bigger and more representative sample, can investigate other social and economic factors. It will be necessary to get more precise data on waste composition and quantities. However, this paper provides a stable background for the eventual researches.

Bibliography

Legislation acts

The Law of Turkmenistan "On Waste" (2015), Available: http://minjust.gov.tm/mcenter-single-ru/147 [09.12.2019]

Code of Turkmenistan "On Administrative Offenses" (2013), Available: http://minjust.gov.tm/mcenter-single-ru/1 [09.12.2019]

Books, reports and writings

Central Asia Waste Management Outlook, ZOI. 2017 Available: https://zoinet.org/product/central-asia-waste-management-outlook/, https://zoinet.org/wp-content/uploads/2018/02/CA-waste-rus.pdf [10.01.2020]

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098 [3.12.2019]

Environmental performance reviews Turkmenistan. United nations economic commission for Europe (2012), United Nations. Available: https://www.zaragoza.es/contenidos/medioambiente/onu/941-eng-sum.pdf [7.01.2020]

Government of Turkmenistan and United Nations Partnership Framework for Development 2016-2020. Progress Report 2016-2017. Agenda 2030 "Leaving no one behind". (2017). Available: https://turkmenistan.un.org/en/123-turkmenistan-and-unpfd-2016-2020-progress-report-2016-2017 [09.01.2020]

Gunsilius, E. (2015). Economic instruments in solid waste management: applying economic instruments for sustainable solid waste management in low-and middle-income countries, Available: https://www.giz.de/en/downloads/giz2015-en-waste-management-economic-instruments.pdf [25.11.2019]

Klepper, Gernot; Michaelis, Peter (1992) : Will the Dual System manage packaging waste?, Kiel Working Paper, No. 503, Institut für Weltwirtschaft (IfW), Kiel, Available: https://www.econstor.eu/bitstream/10419/597/1/042680107.pdf [10.12.2019]

Kaza, S., Yao, L., Bhada-Tata, P., & Van Woerden, F. (2018). What a waste 2.0: a global snapshot of solid waste management to 2050. World Bank Publications. Available: https://elibrary.worldbank.org/doi/abs/10.1596/978-1-4648-1329-0 [14.12.2019]

OECD (2015), "Municipal waste", in Environment at a Glance 2015: OECD Indicators, OECD Publishing, Paris. Available: https://www.oecd-ilibrary.org/docserver/9789264235199-en.pdf?expires=1581518198&id=id&accname=ocid49016910&checksum=3246B8E64E85851C258C273AD3927ADB [10.12.2019]

Panayotou, T. (1994). Economic instruments for environmental management and sustainable development. Nairobi: UNEP, Available : https://www.cbd.int/doc/nbsap/finance/Panayotou1994EconInstEnvMgSusDev_199EcInsEnvMgSusDev.pdf [07.12.2019]

PlasticsEurope. Plastics – The Facts 2016; PlasticsEurope – Association of Plastics Manufacturers: Brussels, Belgium, 2016. Available: https://www.plasticseurope.org/application/files/4315/1310/4805/plastic-the-fact-2016.pdf

Sub-regional integrated environment assessment: Central Asia. Interstate Sustainable Development Commission (ISDC). Scientific-information center. (2007) UNEP. Branches of SIC of ISDC ASHGABAT – Available: https://wedocs.unep.org/bitstream/handle/20.500.11822/9850/-Sub-regional_integrated_environment_assessment_Central_Asia-

2007Sub_regional_integrated_environment_assessment_central_asia.pdf.pdf?sequence=3 [09.12.2019]

The Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety of Germany (2018) Waste management in Germany. Available: https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/abfallwirtschaft_2018_en_bf.pdf [24.11.2019]

Turkmenistan First Environmental Performance Review (2012). United nations economic commission for Europe. UNITED NATIONS. New York and Geneva, 2012, Available: http://www.unece.org/environmental-policy/environmental-performance-reviews/enveprpublications/environmental-performance-reviews/2012/1st-environmental-performance-review-of-turkmenistan/docs.html [29.11.2019]

BP Statistical Review of World energy. June 2018. Available: https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf [15.10.2019]

Glossary of Environment statistics. Available: http://data.un.org/Glossary.aspx?q=waste [10.11.2019]

Databases for environmental data in Central Asia. Available: http://livingasia.online/la_data [16.11.2019]

UNDP official website in Turkmenistan. Available: https://www.tm.undp.org/content/turkmenistan/en/home.html [26.11.2019]

United Nations statistics. Available: https://unstats.un.org/unsd/snaama/resQuery.asp [05.11.2019]

Website of nature protection Ministry of Turkmenistan. Available: http://natureprotection.gov.tm/index.php/ru/orhys_ru/ [16.09.2019]

United Nations Environmental Program (2013). "Guidelines for National Waste Management Strategies Moving from Challenges to Opportunities" (PDF). ISBN 978-92-807-3333-4. Available: http://wedocs.unep.org/handle/20.500.11822/8669 [3.11.2019] Yolamanova H. (2016) Turkmenistan develops an integrated approach to addressing waste management issues. Available: http://turkmenistan.gov.tm/?id=10433 [10.10.2019]

Articles in Journals

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e1700782.

Giesler, M. & Veresiu, E. (2014). Creating the responsible consumer: Moralistic governance regimes and consumer subjectivity. Journal of Consumer Research, 41(3), pp.840-857.

Huber, J., Viscusi, W. K., & Bell, J. (2018). Dynamic relationships between social norms and pro-environmental behavior: evidence from household recycling. Behavioral Public Policy, 1-25.

Kaiser, K., Schmid, M., & Schlummer, M. (2018). Recycling of polymer-based multilayer packaging: a review. Recycling, 3(1), 1.

Manni, L. A., & Runhaar, H. A. (2014). The social efficiency of pay-as-you-throw schemes for municipal solid waste reduction: A cost-benefit analysis of four financial incentive schemes applied in Switzerland. Journal of Environmental Assessment Policy and Management, 16(01), 1450001.

Perrin, D., & Barton, J. (2001). Issues associated with transforming household attitudes and opinions into materials recovery: a review of two kerbside recycling schemes. Resources, Conservation and Recycling, 33(1), 61-74.

Sim, N. M., Wilson, D. C., Velis, C. A., & Smith, S. R. (2013). Waste management and recycling in the former Soviet Union: the City of Bishkek, Kyrgyz Republic (Kyrgyzstan). Waste Management & Research, 31(10_suppl), 106-125.

Singh, N. (2015) Waste Separation at Household Level: Comparison and Contrast Among 40 Countries. Indian Journal of Applied Research, Volume : 5 | Issue : 1 | Jan 2015 | ISSN - 2249-555X

Sorkun, M. F. (2018). How do social norms influence recycling behavior in a collectivistic society? A case study from Turkey. Waste Management, 80, 359-370.

Troschinetz, A. M., & Mihelcic, J. R. (2009). Sustainable recycling of municipal solid waste in developing countries. Waste management, 29(2), 915-923.

Webb S. M (2008). Management of Environmental Risks Associated with Landfills in Seismically Active Regions in the New Independent States of Central Asia. Doctor degree thesis. University of Natural Resources and Applied Life Sciences, Vienna

Sources in foreign languages

Assessment of e-waste for Central Asia with a focus on Kyrgyzstan and Tajikistan. In original language: Предварительная и краткая первоначальная оценка электронных отходов для Центральной Азии с фокусом на Кыргызстан и Таджикистан (2017), Available: http://www.fsci.tj/images/stories/img_text1/ocenka_elec_otxod.pdf [16.11.2019]

Management of obsolete pesticides Turkmenistan. Working Paper. In original language: Управление устаревшими пестицидами Туркменистан. Рабочий документ (2012). http://www.ihpa.info/docs/library/other/improving/Turkmenistan-WD-RUS.pdf

Anelamova K.B. (2012) Separate collection of municipal solid waste in Turkmenistan - problem and solutions. In original language: Анеламова К.Б. (2012) Раздельный сбор твердых бытовых отходов в Туркменистане – проблема и решения. Available: http://pasos.org/wp-content/uploads/2012/10/AnelamovaPASOS.pdf [26.12.2019]

Appendix I. Sustainable Development Goals

Source: https://www.undp.org/content/undp/en/home/sustainable-development-goals.html

Appendix II. Waste management in Turkmenistan overview

Source: Central Asia Waste Management Outlook, 2017 p.38-39. https://zoinet.org/product/central-asia-waste-management-outlook/
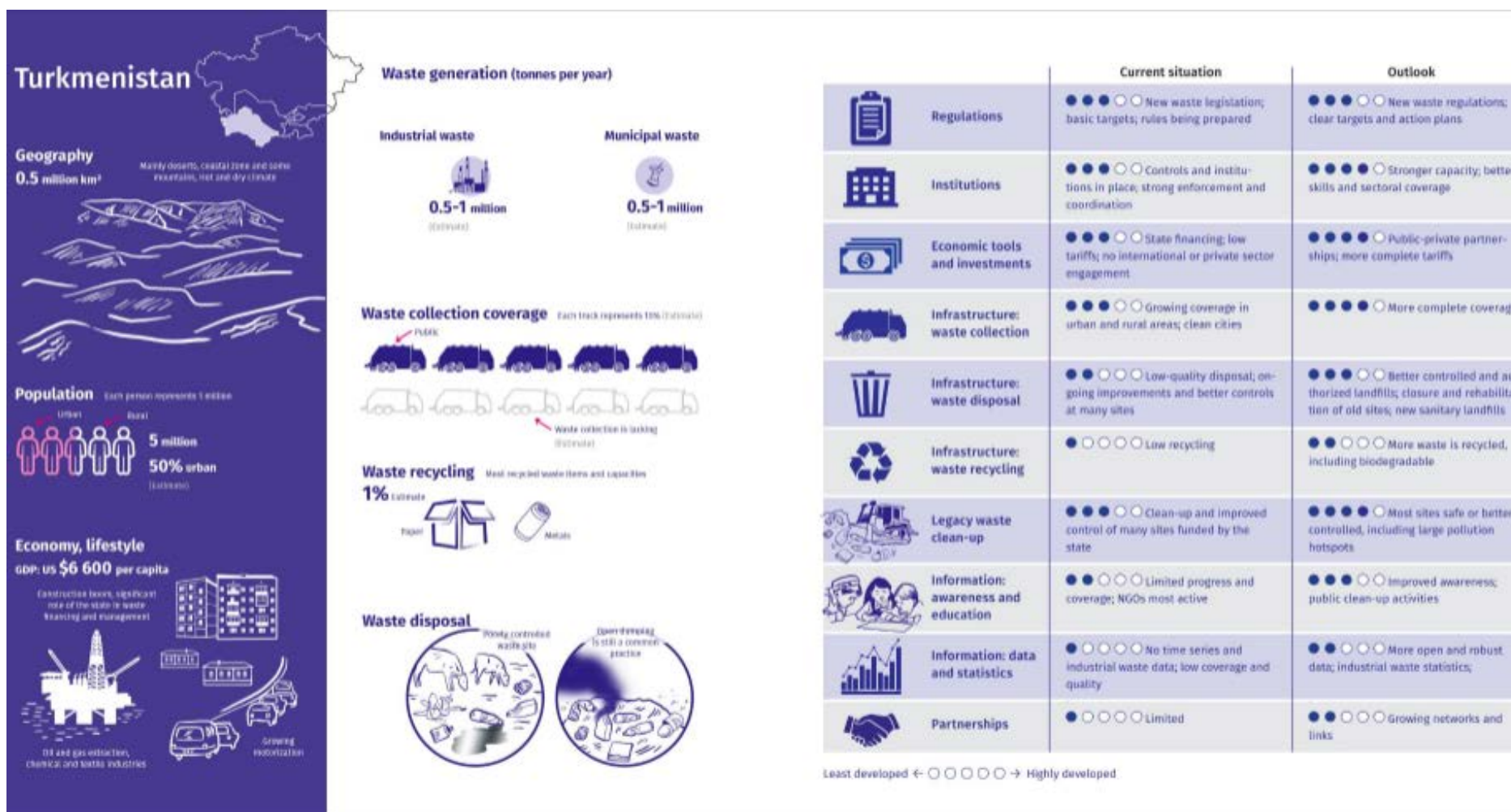
Appendix III. Questionnaire design

Variable name	Question code	Measuring Question(s)	Scale
Readiness to separate waste + financial incentives	Q1	Imagine that your waste collection company want to change the service conditions. You can either choose to pay 70 manat per month and not to separate waste as usual or to pay 20 manat per month and separate waste in 4 different bins: plastic, paper, glass and organic. Which option would you choose?	(1) To pay 70 manat and not to separate waste (2) To pay 20 manat and to separate waste
Opportunity cost in waste collection	Q1a	How much should be the difference between 2 waste collection options to make you separate waste?	o 20 manat o 30 manat o 50 manat o 70 manat o 100 manat
Willingness to participate in deposit-refund system	Q2	Imagine that all beverages in plastic and glass bottles got **X** manat more expensive, but you can take this **X** amount of money back if you will bring empty bottles back to the supermarket. Would you be willing to bring plastic and glass bottles back?	*5-points* *from 1 to 5* Definitely will not Probably will not May or may not Probably will Definitely will
Activating financial threshold	Q2a	How much should the deposit amount* to make you bring plastic and glass bottles back? *(1 Euro = 4 manats)	o 0,3 o 0,5 manat o 1 manat o 1,5 manat o 2 manat
Knowledge about recycling	Q3	I can assess my knowledge about recycling as I can assess my knowledge about sorting waste as I can assess my knowledge about the harm of plastic on the environment as I can assess my knowledge about how to impact into environment protection as	4-item scale *5-points scale* None (never heard about) Little (I've heard something about it) Moderate (common facts) Extended (I'm interested in this topic) Wide (I am actively interested in the topic)

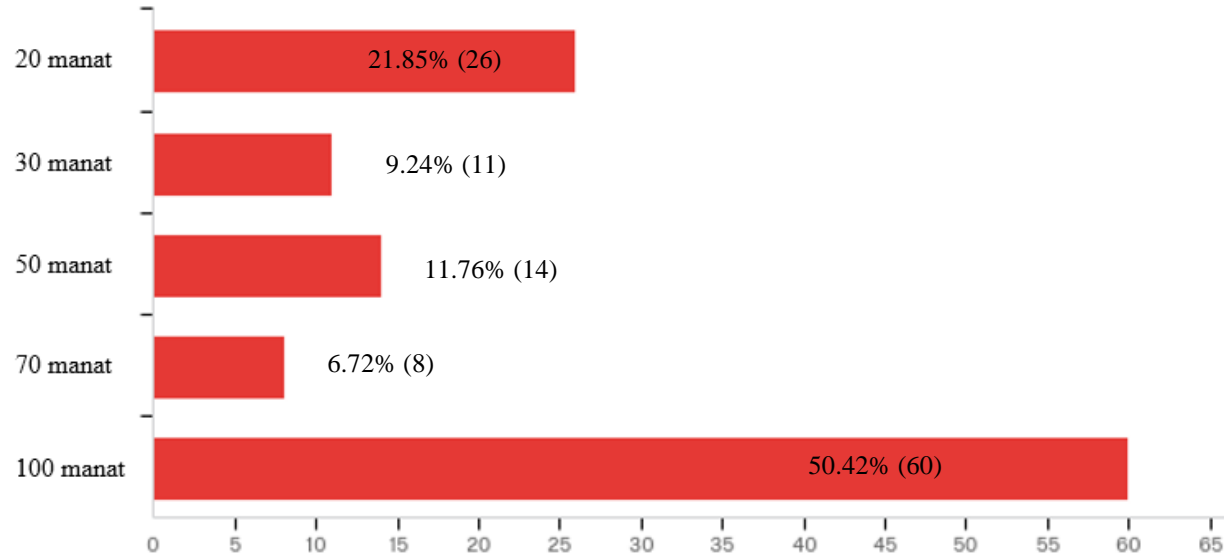| Attitudes to recycling	Q4	I have positive attitudes towards recycling	4-item scale
		I think that it is important to sort waste at home	5-points scale
		I believe that plastic is bad for the environment	Strongly disagree
		I believe that it is important to participate in environment protection	Disagree
			Neither agree nor disagree
			Agree
			Strongly agree
Recycling infrastructure perception	Q5	I think that recycling infrastructure is developed in my country	2-item scale
			5-points scale
			Strongly disagree
		I think that infrastructure to sort waste is developed in my country	Disagree
			Neither agree nor disagree
			Agree
			Strongly agree
Extrinsic recycling factors	Q6	In which case you would be ready to sort waste ☐ if there is a proper infrastructure for that ☐ if there will be a penalty for not-sorting waste ☐ if it will be financially attractive ☐ I would never sort waste ☐ Other _____	Priority from 1 to 5
Intrinsic recycling factors Convenience Time-consumption Reputation	Q7 Q8	Bringing bottles back to the supermarket would be inconvenient – convenient troublesome – easy time-consuming – not time-consuming will be harmful for reputation – will improve my reputation // Sorting waste at home would be inconvenient – convenient troublesome – easy time-consuming – not time-consuming will be harmful for reputation – will improve my reputation	2-item scale 5-points bipolar scale
Private collection options	Q9	Are there any private collectors of plastic and glass bottles coming to your area?	

	Q9a	If yes, which kind of waste do they accept?	plastic bottles, paper, metal other (please, indicate)
Socio-demographic			
Gender	Q10	Gender	
Age	Q11	Age	
Education	Q12	Please indicate your education level	High school College Bachelor's degree Master's degree PhD
Income level	Q13	Do you have a private car?	

Appendix IV. Survey results.

Q 1 Imagine that your waste collection company want to change the service conditions. You can either choose to pay 70 manat per month and not to separate waste as usual or to pay 20 manat per month and separate waste in 4 different bins: plastic, paper, glass and organic. Which option would you choose?

To pay 70 manat and not to separate waste: 16,81% (20)

To pay 20 manat and to separate waste: 83,19% (20)

Q1a - How much should be the difference between 2 waste collection options to make you separate waste?

20 manat: 21.85% (26)

30 manat: 9.24% (11)

50 manat: 11.76% (14)

70 manat: 6.72% (8)

100 manat: 50.42% (60)
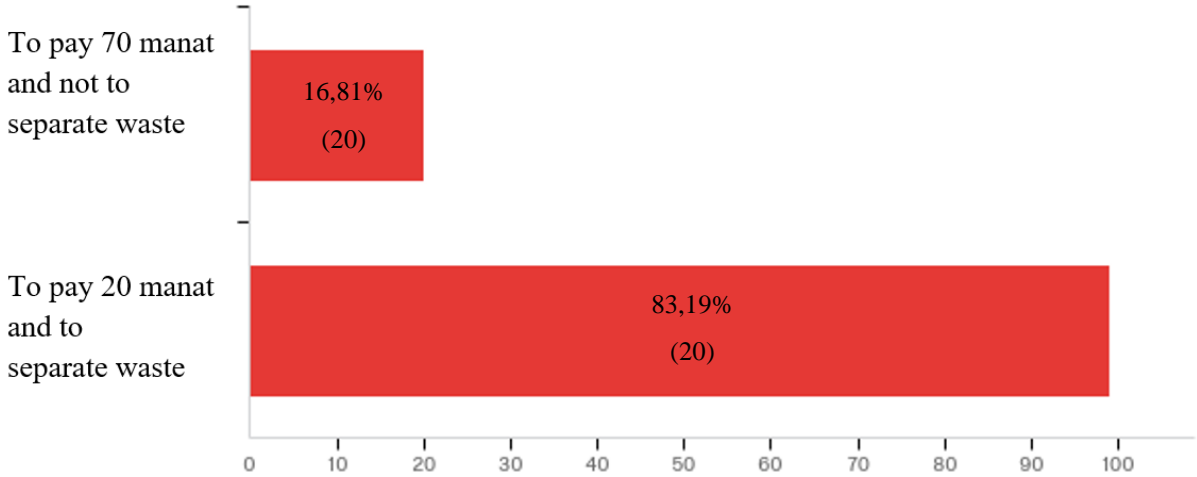
Q2 - Imagine that all beverages in plastic and glass bottles got <u>X</u> manat more expensive, but you can take this <u>X</u> amount of money back if you will bring empty bottles back to the supermarket.

Would you be willing to bring plastic and glass bottles back?
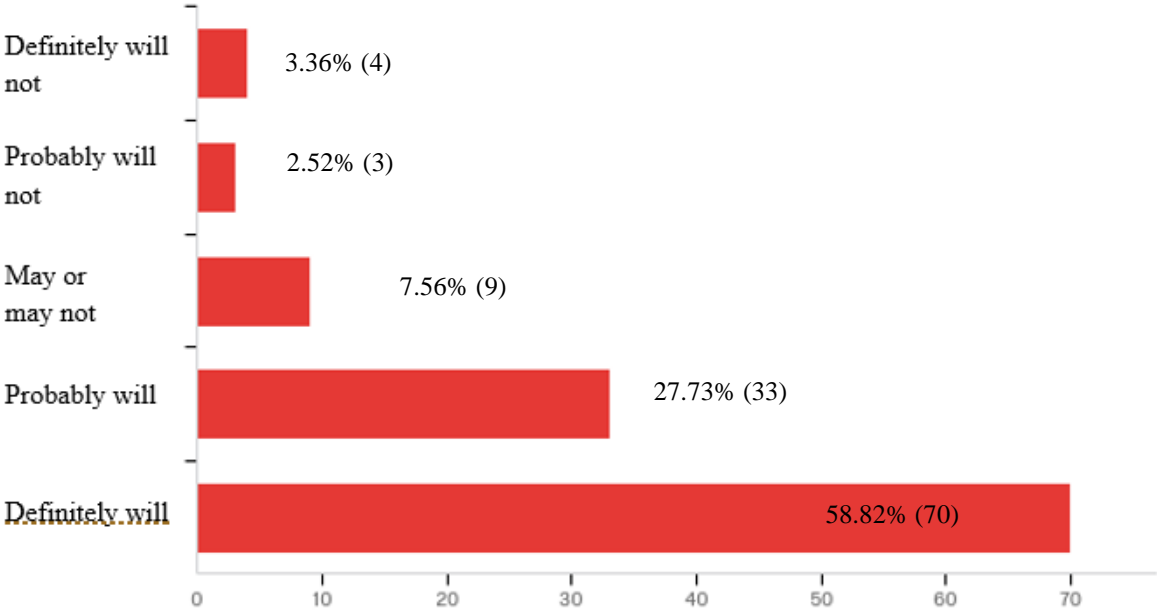
Q2a - How much should the deposit amount* to make you bring plastic and glass bottles back?
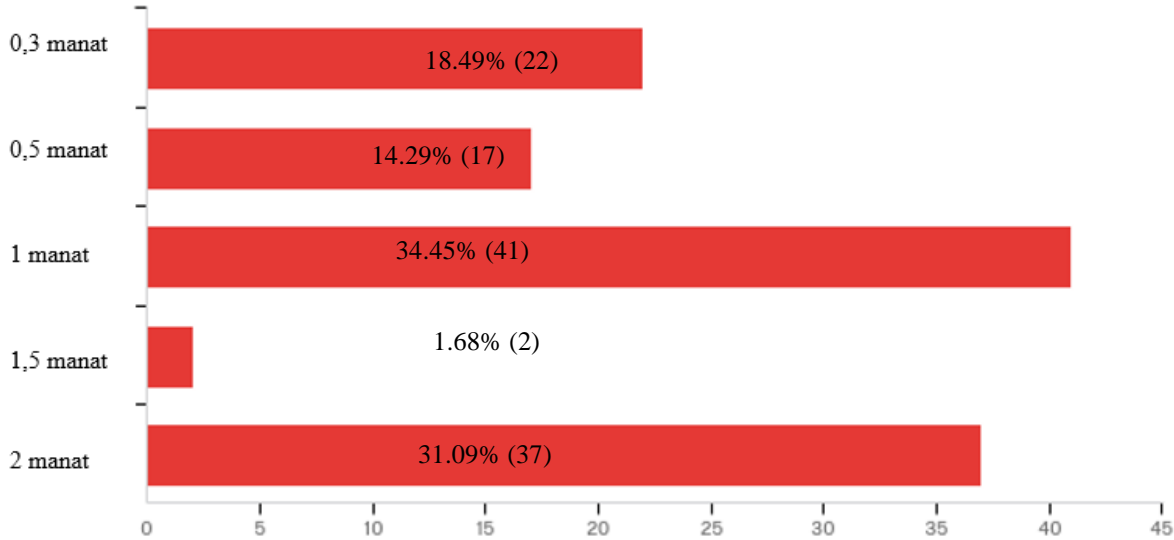
Q3 – Please, assess the following statements

#	Question	None (never heard about)		Little (I've heard something about it)		Moderate (common facts)		Extended (I'm interested in this topic)		Wide (I am actively interested in the topic)		Total
		%	#	%	#	%	#	%	#	%	#	%
1	I can assess my knowledge about recycling as	4.20%	5	11.76%	14	39.50%	47	23.53%	28	21.01%	25	119
2	I can assess my knowledge about sorting waste as	1.68%	2	8.40%	10	47.06%	56	21.01%	25	21.85%	26	119
3	I can assess my knowledge about the harm of plastic on the environment as	0.00%	0	5.04%	6	31.93%	38	31.09%	37	31.93%	38	119
4	I can assess my knowledge about how to impact into environment protection as	4.20%	5	10.92%	13	33.61%	40	28.57%	34	22.69%	27	119

Q4 – Do you agree with the following statements?

#	Question	Strongly disagree		Disagree		Neither agree nor disagree		Agree		Strongly agree		Total
		%	#	%	#	%	#	%	#	%	#	%
1	I have positive attitudes towards recycling	1.71%	2	2.56%	3	5.13%	6	34.19%	40	56.41%	66	117
2	I think that it is important to sort waste at home	0.00%	0	0.86%	1	12.93%	15	26.72%	31	59.48%	69	116
3	I believe that plastic is bad for the environment	1.71%	2	0.00%	0	5.98%	7	25.64%	30	66.67%	78	117
4	I believe that it is important to participate in environment protection	0.00%	0	0.00%	0	6.03%	7	23.28%	27	70.69%	82	116

Q5 Do you agree with the following statements?
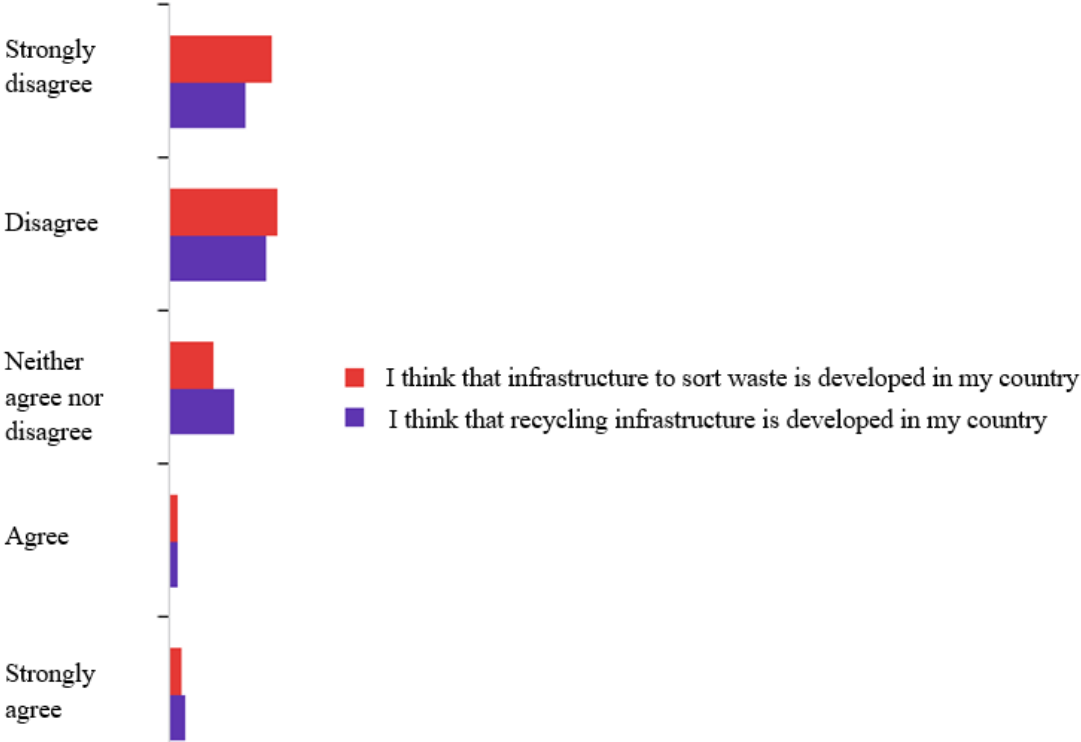
#	Question	Strongly disagree		Disagree		Neither agree nor disagree		Agree		Strongly agree		Total
		%	#	%	#	%	#	%	#	%	#	%
1	I think that infrastructure to sort waste is developed in my country	36.97%	44	39.50%	47	15.97%	19	3.36%	4	4.20%	5	119
2	I think that recycling infrastructure is developed in my country	28.95%	33	36.84%	42	24.56%	28	3.51%	4	6.14%	7	114

Q6 - In which case you would be ready to sort waste?
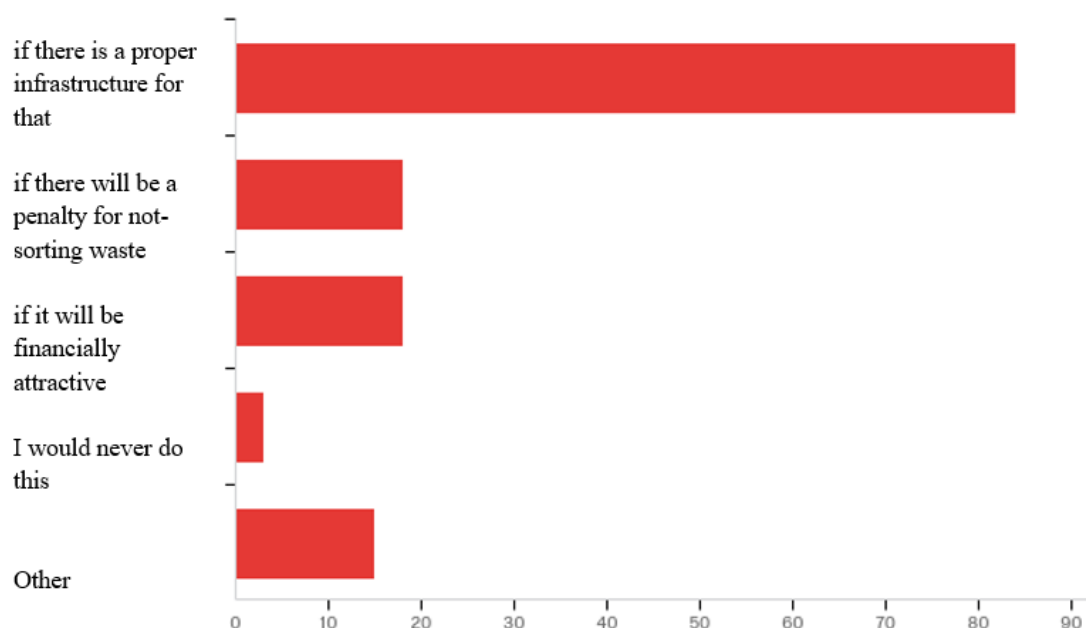
#	Answer	%	Count
1	if there is a proper infrastructure for that	60.87%	84
3	if there will be a penalty for not-sorting waste	13.04%	18
4	if it will be financially attractive	13.04%	18
6	I would never sort waste	2.17%	3
5	Other	10.87%	15
	Total	100%	138

Q6 text Other reasons

Always

If I would know how to do it correctly

Just let residents know with banners about waste sorting and do it. After all, this is already relevant in all countries. It is necessary to put automates for sorting garbage where it will be possible to pay utility bills or to get money when sorting waste* (semantic translation). And everyone will sort the waste. Children should know that it will be developed in the future. Good luck with the project.

If the government will show interest in this issue

If all the conditions for sorting waste were created (special packages according to the color scheme, garbage bins)

I'm already sorting it

There should be special lesson for both kindergarten and universities

That's very simple. There should be separated bins for each type of waste.

If it would be accepted throughout the region! And it turns out that you sort, try not to litter anywhere at all, but most of the citizens of your region don't care about the cleanliness of the streets and the environment as a whole

Q7 - Bringing bottles back to the supermarket would be

#		1		2		3		4		5		6		7		
1	inconvenient	20.17%	24	5.04%	6	7.56%	9	13.45%	16	10.92%	13	6.72%	8	36.13%	43	convenient
2	troublesome	17.65%	21	4.20%	5	9.24%	11	14.29%	17	8.40%	10	11.76%	14	34.45%	41	easy
3	time-consuming	14.29%	17	5.88%	7	16.81%	20	12.61%	15	10.08%	12	13.45%	16	26.89%	32	not time-consuming
4	will be harmful for reputation	25.21%	30	5.04%	6	6.72%	8	13.45%	16	5.04%	6	9.24%	11	35.29%	42	will improve my reputation

Q8 - Sorting waste at home in would be

#		1		2		3		4		5		6		7		
1	inconvenient	15.97%	19	5.04%	6	8.40%	10	10.92%	13	10.92%	13	10.08%	12	38.66%	46	convenient
2	troublesome	15.13%	18	6.72%	8	10.08%	12	10.08%	12	12.61%	15	10.08%	12	35.29%	42	easy
3	time-consuming	13.45%	16	6.72%	8	12.61%	15	15.97%	19	15.97%	19	4.20%	5	31.09%	37	not time-consuming
4	will be harmful for reputation	19.33%	23	0.84%	1	4.20%	5	10.08%	12	10.08%	12	5.04%	6	50.42%	60	will improve my reputation

Q 9 - Are there any private collectors of plastic and glass bottles coming to your area?
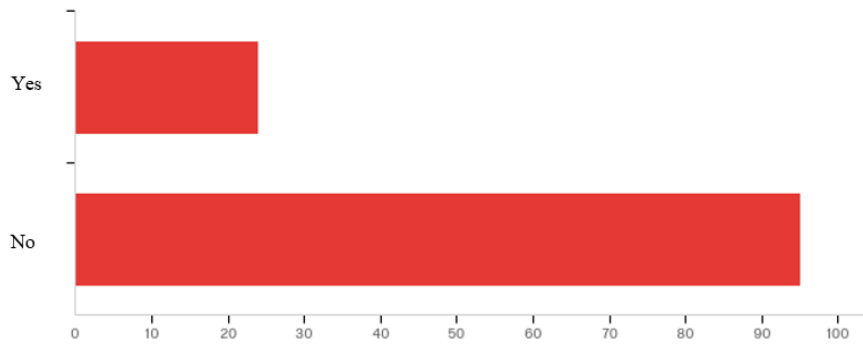
#	Answer	%	Count
1	Yes	20.17%	24
6	No	79.83%	95
	Total	100%	119

Q9a – If yes, which kind of waste do they accept?
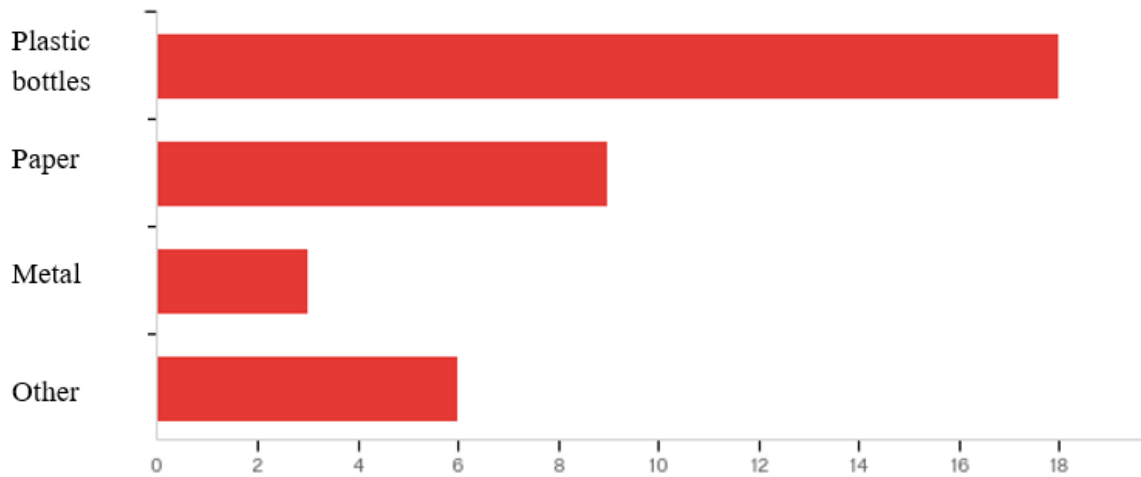
#	Answer	%	Count
1	Plastic bottles	50.00%	18
2	Paper	25.00%	9
3	Metal	8.33%	3
4	Other (please, indicate)	16.67%	6
	Total	100%	36

Q18_4_TEXT

Glass

Q10 - Gender
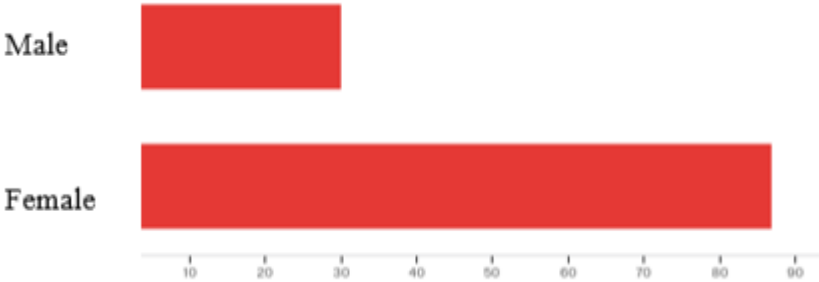
#	Answer	%	Count
1	Male	25.64%	30
2	Female	74.36%	87
	Total	100%	117

Q11 - Age
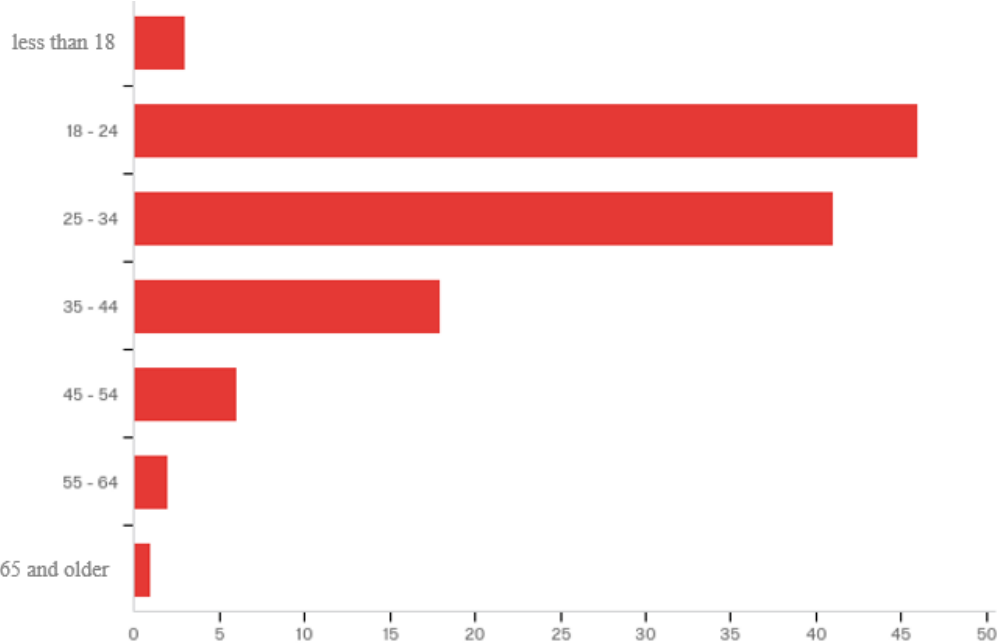
#	Answer	%	
1	less than 18	2.56%	
2	18 - 24	39.32%	
3	25 - 34	35.04%	
4	35 - 44	15.38%	
5	45 - 54	5.13%	
6	55 - 64	1.71%	
7	65 and older	0.85%	
	Total	100%	117

Q12 – Education level
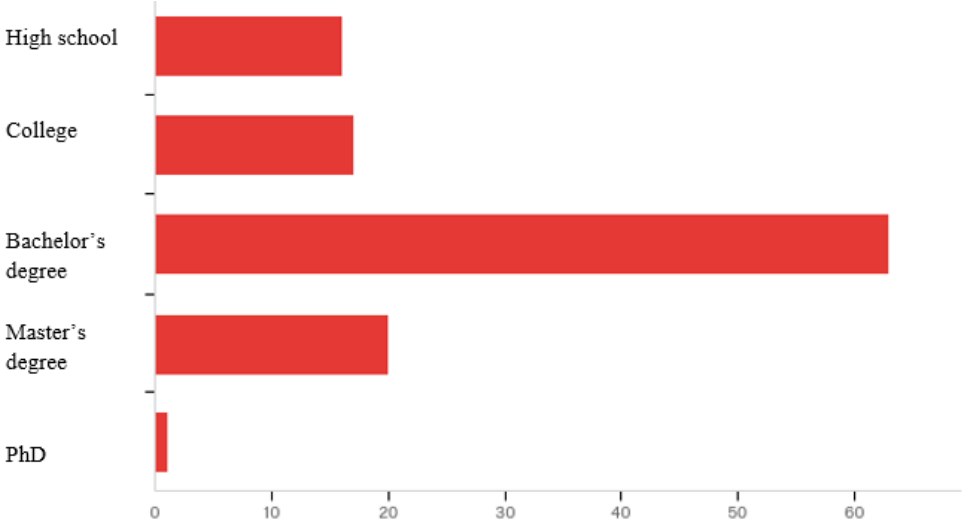
#	Answer	%	Count
1	High school	13.68%	16
2	College	14.53%	17
3	Bachelor's degree	53.85%	63
4	Master's degree	17.09%	20
8	PhD	0.85%	1
	Total	100%	117

Q13 - Do you have a car?
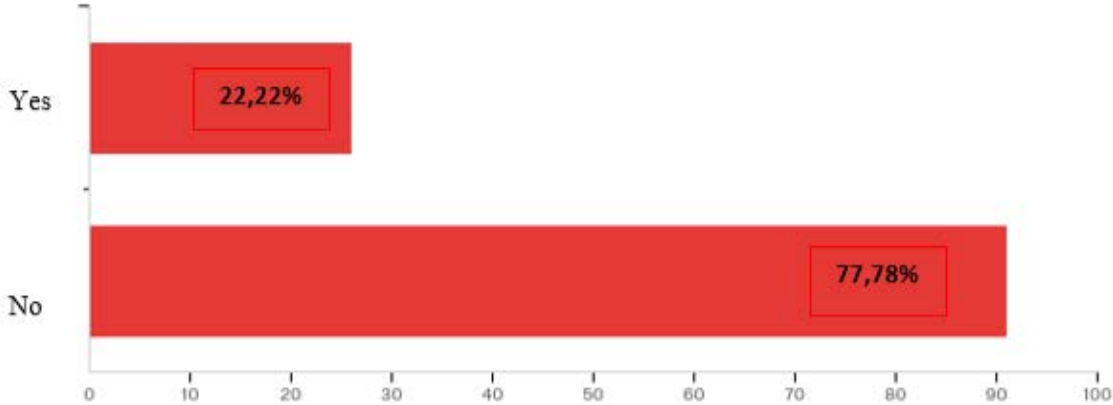
Appendix V. Study analysis.

Reliability Statistics

Cronbach's Alpha	N of Items
,822	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
My knowledge about recycling can be assessed as	28,62	14,254	,663	,779
My knowledge about sorting waste can be assessed as	28,39	16,021	,856	,690
My knowledge about the harm of plastic on the environment can be assessed as	27,92	21,867	,616	,822
My knowledge about how to impact into environment protection can be assessed as	28,53	14,539	,628	,800

Fig. 1. Reliability analysis knowledge scale.

Reliability Statistics

Cronbach's Alpha	N of Items
,769	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
I have positive attitude towards recycling	13,64	3,126	,456	,780
I think that it is important to sort waste at home	13,64	2,670	,723	,627
I believe that plastic is bad for the environment	13,53	2,953	,562	,720
I believe that it is important to participate in environment protection	13,44	3,389	,578	,719

Fig. 2. Reliability analysis attitudes scale.

T-Test

Group Statistics

	Imagine that your waste collection company want to change the service conditions. You can either choose to pay 70 manat per month and not to separate waste as usual or to pay 20 manat per month and separate waste in 4 different bins: plastic, paper, glass	N	Mean	Std. Deviation	Std. Error Mean
How much should be the difference between 2 waste collection options to make you separate waste?	To pay 70 manat and not to separate waste	20	4,60	1,046	,234
	To pay 20 manat and to separate waste	99	3,33	1,690	,170

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
How much should be the difference between 2 waste collection options to make you separate waste?	Equal variances assumed	28,701	,000	3,222	117	,002	1,267
	Equal variances not assumed			4,381	42,051	,000	1,267

Fig.3. Independent Sample T-test opportunity cost difference between 2 groups.

Method: Independent Sample T-test is used to measure the difference in means and to check whether this difference is significant. If the Levene's test is significant (less than 0,05), then the bottom line of 2-tailed significance if checked. If 2-tailed significance is less than 0,05, the difference between result is considered to be **statistically significantly**

Fig.4. Correlation analysis between attitudes and knowledge.

Fig.5. Difference between Attitudes and knowledge in dependence in 2 groups.

		Sorting waste at home in would be - (evaluate the following parameters by the scale) - inconvenient – convenient	Sorting waste at home in would be - (evaluate the following parameters by the scale) - troublesome - easy	Sorting waste at home in would be - (evaluate the following parameters by the scale) - time consuming - not time consuming	Sorting waste at home in would be - (evaluate the following parameters by the scale) - harmful for my reputation - improve my reputation
Imagine that your waste collection company want to change the service conditions. You can either choose to pay 70 manat per month and not to separate waste as usual or to pay 20 manat per month and separate waste in 4 different bins: plastic, paper, glass	Pearson Correlation	,141	,080	-,061	,206*
	Sig. (2-tailed)	,126	,385	,509	,024
	N	119	119	119	119

Fig.6. Correlation analysis between willingness to sort and intrinsic factors.

Correlations

		How much should be the difference between 2 waste collection options to make you separate waste?	How much should the deposit amount* to make you bring plastic and glass bottles back?
How much should be the difference between 2 waste collection options to make you separate waste?	Pearson Correlation	1	,302**
	Sig. (2-tailed)		,001
	N	119	119
How much should the deposit amount* to make you bring plastic and glass bottles back?	Pearson Correlation	,302**	1
	Sig. (2-tailed)	,001	
	N	119	119

**. Correlation is significant at the 0.01 level (2-tailed).

Fig.7. Correlation analysis between choice of charge amount.

Declaration of Academic Integrity

I hereby confirm that I prepared this master's thesis independently and on my own, by exclusive reliance on the tools and literature indicated therein. The thesis has not been submitted to any other examination board.

Frankfurt (Oder),   Anna Korostova