A MULTI-SCALE APPROACH FOR URBAN WASTE MANAGEMENT: CASE OF TIRANA

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Approval sheet of the Thesis

This is to certify that we have read this thesis entitled **"A multi-scale approach for urban waste management: Case of Tirana"** and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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ABSTRACT

A MULTI-SCALE APPROACH FOR URBAN WASTE MANAGEMENT:

CASE OF TIRANA

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The rapid growth of the population has impacted various urbanization challenges in Tirana, the capital city of Albania. One major problem is the pollution and management of the waste of this overcrowding. The current waste management system is believed to fail constantly since architecture and urban planning aren't involved during the design thinking process. The goal of this study is to propose solutions and interventions in a multiscale approach. The multilevel includes the macro level which belongs to the city level, the meso level which belongs to the neighborhood level, and the last level which is the micro-level, which belongs to the zoomed-in part, the building itself. This research has followed an integrative methodology, where the social and physical investigation are mixed together with the best practices, otherwise known as case studies. These are made possible with the usage of software like QGIS, AutoCAD, Illustrator, and 3D Visualizers. An important key part of this research paper is the representation of the current chaotic state, what causes it and how can us intervene to prevent this problem. It explains some interventions in a current city, neighborhood, and building.

Keywords: *circular city concept, cross-scale, investigation, material flow, multiscale, sustainability, waste management.*

ABSTRAKT

NJË PËRQASJE MULTISKALARE PËR MENAXHIMIN E MBETJEVE: RASTI I TIRANËS

Balla, Aurela

Master Shkencor, Departamenti i Arkitekturës

Udhëheqësi: Dr. Artan Hysa

Rritja e shpejtë e popullsisë ka ndikuar në sfida të ndryshme të urbanizimit në Tiranë, kryeqytetin e Shqipërisë. Një problem madhor është ndotja dhe menaxhimi i mbetjeve i këtij mbipopullimi. Sistemi aktual i menaxhimit të mbetjeve besohet se dështon vazhdimisht pasi arkitektura dhe planifikimi urban nuk janë konsideruar gjatë procesit të projektimit. Qëllimi i këtij studimi është të propozojë zgjidhje dhe ndërhyrje në një qasje multi shkallare. Multi niveli përfshin, nivelin makro që i përket nivelit të qytetit, nivelin meso që i përket nivelit të lagjes, dhe nivelin e fundit që është niveli mikro, i cili i përket pjesës së zmadhuar. vetë ndërtesa. Ky hulumtim ka ndjekur një metodologji integruese, ku analiza sociale dhe fizike ndërthuren me praktikat më të mira, të njohura ndryshe si raste studimore. Këto analiza dhe propozime janë bërë të mundura nga përdorimi i softuerëve si QGIS, AutoCAD, Illustrator dhe 3D Visualizer. Një pjesë e rëndësishme kyçe e këtij punimi kërkimor është përqasja e gjendjes aktuale kaotike, çfarë e shkakton atë dhe si mund të ndërhyjmë për të parandaluar këtë problem. Ai shpjegon disa ndërhyrje në qytet, lagje dhe ndërtesë aktuale.

Fjalët kyçe: *qytete qarkulluese, investigim, qëndrueshmëri, materiale rrjedhëse, menaxhimi i mbetjeve, multi shkallar, ndërshkallar.*

To my family, friends and loved ones who encouraged me along the way.

You have been a constant source of support during the challenges of graduate school and life.

I am truly thankful for having you in my life.

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I want to express my gratitude to my Supervisor, Artan Hysa, for his guidance and encouragement in helping me complete my master's thesis work and be professional. I also want to thank Epoka University, my friends, and my professors for their assistance in getting my thesis completed. Finally, I would like to thank my family for their unwavering love and support. They motivated me, and none of this would have been possible without them.

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CHAPTER 1

INTRODUCTION

1.1 Problem Definition

Countless threats surround us day by day, but it's an irony that many of these threats come from our actions. The environment is affected by many factors, but a high percentage is taken by a large amount of solid waste that comes from the waste of each resident and not only. We think that we are doing our job by filling endless plastic bags and throwing them in bins, but it seems that we aren't.

The idea of designing a waste management system comes from the current chaotic state of waste treatment in general, and how much damage it leaves to the environment, our health, and the future. In Albania, waste is collected by individuals and community bins, and then they are sent to landfills (Alcan, 2013). Capacities for this activity are limited and may exceed their ability within 10 years. This type of waste management comes as a result of the lack of special facilities (MIE, 2020).

Waste is turning into a huge problem and unmanageable. Even if we try to put the best technologies out there, even if we try to find innovative solutions it still can't be solved since the population is growing day by day and with them also the consequences that they bring.

Waste management strategies are consuming a lot of money from the municipality and still, we have a high rate of pollution and a high number of disturbed citizens. It is believed that many waste management systems fail because of the lack of consideration of urban planning and architecture together with its features (Dorri, 2015).

This thesis has treated the linkage of this issue with architecture since in most cases it is left out. With some architectural approaches, we can help a lot to minimize the impacts on different scales, starting from a city scale, a building scale, and later on a dwelling scale. As we can see there is a lot that architecture can solve.

1.2 Scope of work

The problem that this thesis aims to treat is quite known and felt by each one of us. This thesis aims to treat waste management in a more complex way, not to have just a facility to manage the waste, because it is quite visible that the management of waste and recycling can't be solved just by having a modern and new facility, but by proposing ideas in different levels and in a circular way.

After making some research about the literature review, the *circular city* concept and *multi-scale approach* were two important keywords that are integrated into this thesis. Many countries have tried to integrate these terms into their waste management systems and architecture and urban planning was present in some of them.

To have a real-time solution, it is selected a problematic site. For this, are used the QGIS software to provide a map starting from some factors like building distribution, density, and population. Then is chosen the area with the highest population.

After the site was chosen, some urban analyses were made, physical and social. These are further explained in the methodology chapter.

This thesis was concluded with some proposals for the multiscale approach, macroscale, mesoscale, and microscale approach, respectively. These proposals are on a cross-scale level which means they can be implemented everywhere and some contextual interventions into the chosen site.

1.3 Research Questions and Objectives of the Study

The main objective of this thesis is the usage of urban planning and architecture into solving this major and everyday issue, like waste management. The urban planning is supposed to be used into finding the problematic spot, analyzing that area, and later representing the proposals at the architectural level, with some interventions in the city, roads, and buildings.

Secondly, it aims to propose some solutions on different scales, starting from a city scale, neighborhood scale, and then a dwelling scale. Before detailing them a cross-

scale approach and intervention should be presented. It should later be detailed in a more contextual example.

The overall objective is to propose solutions to have a sustainable life and society, less pollution, and an easier and smart life. Even though these are more general and social proposals, they follow the thesis all over it and should be emphasized time by time.

1.4 Organization of the thesis

This thesis is organized into 6 chapters. In Chapter 1 is introduced the problem, which in this case is the poor waste management system and problems with recycling, which are caused by poor urban planning. It continues with the objectives and scope of the work. Chapter 2 consists of the literature review, where are mentioned some helpful information that contributed to the results. The methods used are explained in Chapter 3. An integrative methodology is used. After using these methods Chapter 4 are shown the analysis, the feedback from the social investigation, and a part for discussion. Chapter 5 is the core of the thesis since there are given the proposals. Concluding with Chapter 6 where the overall thesis is summed up and leaves some recommendations to others for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 State of the Art

The literature review is divided into some different paths, firstly starting with material flow analysis, consisting of the lifetime of a material. Then continuing with the current situation of waste management in the case of Albania. The literature review is also a section dedicated to the UN Nations goals. Waste management is also treated based on Circular City Concept; a new term widely spread nowadays. This term has been brought up by many states in different approaches that are mentioned below. It is important to mention that these approaches have a high level of diagrammatic proposals. This chapter is concluded with some case studies which will have a high impact on the proposals and with some discussions.

2.2 Waste Management in overall

Waste Management is seen as a complex and multidisciplinary topic, since it includes a wide range of fields, such as legislative, environmental, economic, urban planning aspects, etc. Many waste management methods are seen to fail due to a lack of attention to urban planning and design, as well as their characteristics. The relationship between this problem and architecture is usually neglected (Hoornweg, 2012).

Architects may play a significant role in the design of waste-treatment plants because they consider social and environmental issues from the beginning. A unique legislative framework has been critical in supporting the move toward alternate waste-management practices in Sweden, where nearly all garbage is diverted from landfills. Not all architects will succeed in this integrated approach, and not all projects are fit for

it, but architecture symbolizes an opportunity for those projects that have such potential (Kara, 2018).

2.2.1 Material Flow Analysis

Material flow is also known as recycling. Recycling is a widespread term that consists of a process that converts waste materials into new materials and objects. Moreover, recycling has countless benefits naming also that it prevents pollution, saves energy, helps to create jobs and conserves valuable resources (EPA, 2021).

All of the materials on go through a similar process overall (KAB, 2021).

1. Collection (taking the best scenario that they are differentiated in their origin)
2. Sorting (they need another sort inside the family)
3. Processing (the part where they need unique treatment, usually crushed and washed)
4. Converting (turning them into raw products)
5. Manufacturing (the point is to turn them usable again)

2.2.2 Waste Management in Albania

Every year, Albania produces roughly 1 million tons of municipal waste. The debate over whether landfilling, recycling, or incineration should be prioritized continues to rage, as the government plans to build two incinerators in Fier and Tirana (INSTAT, 2022).

The city's Sharra landfill does not meet the criteria. These are insignificant in comparison to the nearly 180 things thrown and mistreated across the facility. They have an additional 120 marks outside of each standard. But it doesn't end there, because we've only covered around two-thirds of the total. The remaining 1/3 of the land is thrown via streams, rivers, pits, cliffs, and other places where it is out of control, such as in rural sections of the territory (MIE, 2020).

In *Figure 1*, are shown the treatment methods of waste management based in (INSTAT, 2022). Even though there is an improvement on the treatment methods, still there is a considerable amount of waste sent to landfills or at informal recycling.

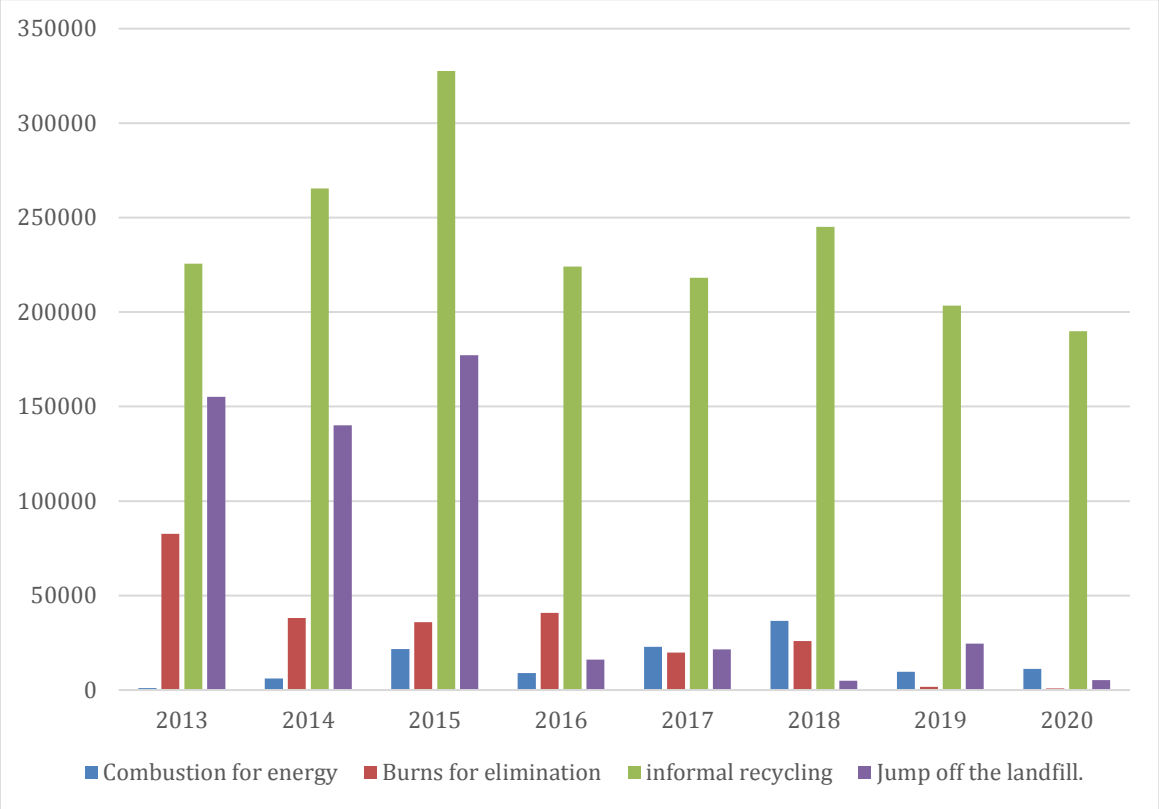

Figure 1. Treatment Method of Waste during 2013-2020 *(INSTAT, 2022)*

In Albania, it is currently estimated that reclamation and recycling are less than 10%. In addition to the Eco Tirana Project, which undertook the differentiated collection initiative in early 2016 (but still needs substantial improvements), the rest of the recyclable materials are collected by the informal sector (Jahaj, 2016).

In *Figure 2* are shown the percentages of types of waste of households, where the organic waste holds the most percentage. On the other hand, also the plastic, wood, glass and paper have a high percentage.

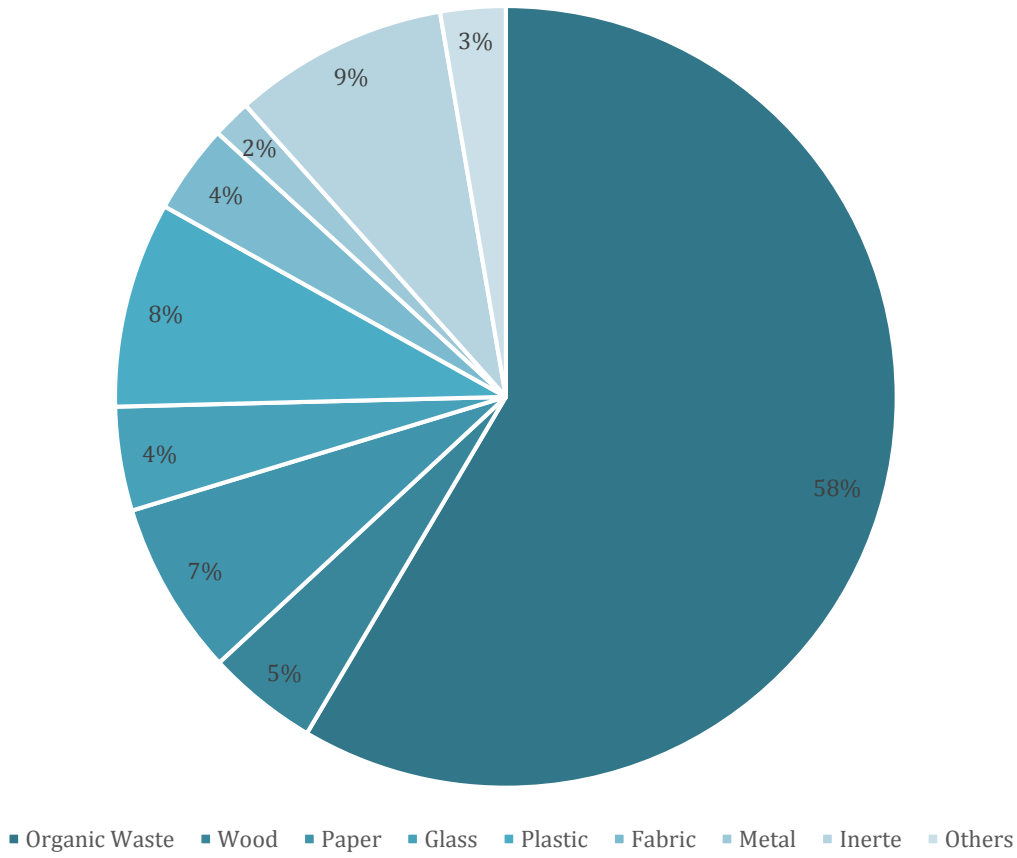

Figure 2. Household Waste Percentage in Albania *(INSTAT, 2022)*

However, the recycling industry in Albania is stable and has sufficient capacity to trade and process recyclable materials that accumulate. However, increasing the level of recycling and recovery can be achieved only with a stronger commitment on the part of the municipalities, i.e., through the realization of the collection of differentiated waste according to legal requirements (Oncioiu, 2020).

2.2.3 Waste Management based on UN Goals

The Sustainable Development Goals, are gaining a lot of attention now in 2022. Their main goal as named in their name is to be as sustainable as possible. One of their

goals is also mentioned the material footprint and what are their initiatives (Waage, 2021).

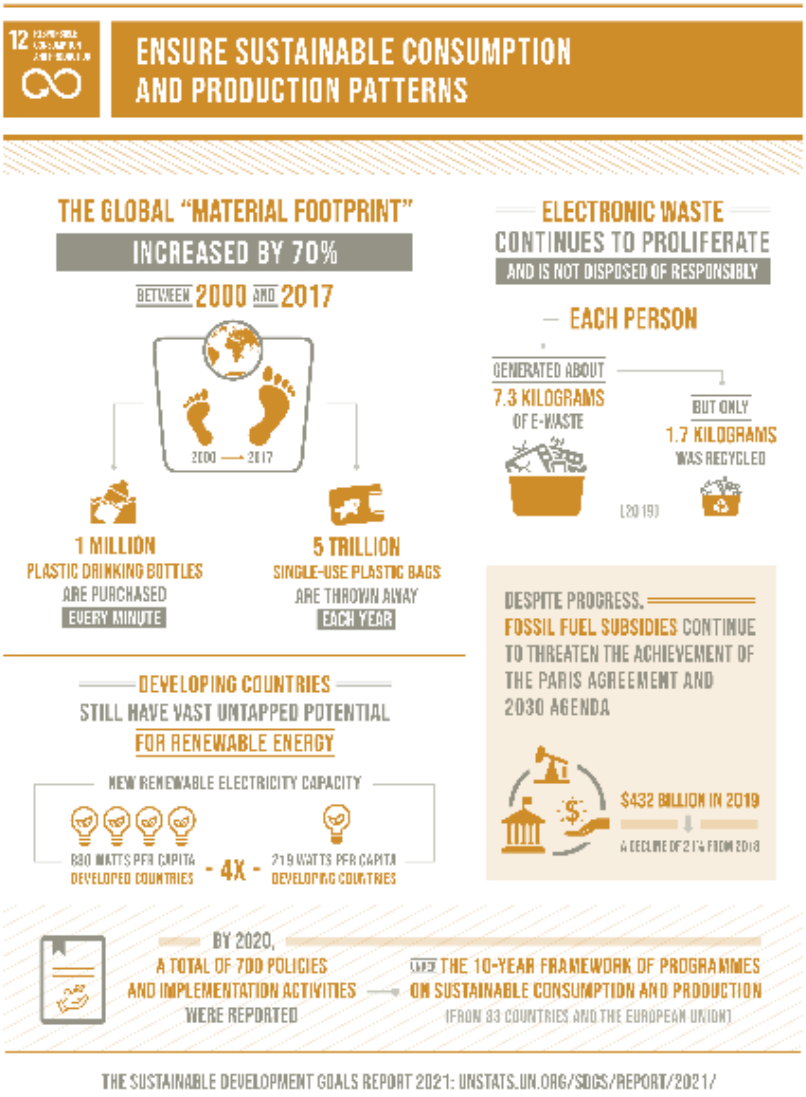

Figure 3. The 12th Goal of SDGS

As it is shown in *Figure 3*, the global material footprint increased by 70% between the years 2000-2017. More than 1 million plastic bottles are being purchased every minute and a more catastrophic number is that 5 trillion plastic bags are thrown away each year. Based on their research each person generates normally 7.3 kg of waste and only 1.7 kg is being recycled in the best scenario. Based on these dangerous numbers they have implemented around 700 policies (SDGS, 2022).

2.2.4 Waste Management based on Circular City Concept

We can bring countless solutions just by analyzing how nature works. There are no landfills in the natural world, but on the contrary, the materials flow, which means that the waste of something is food for another species, until they decompose and turn into the soil to get reproduced again naturally (Malinauskaite, 2017).

On the other hand, we as humans have neglected this fact and come to a linear approach. We take, we make, and then we dispose of, as it is shown in *Figure* **1***4* (Williams, 2019). If we refer to how nature works, circularly, and we implement this idea into our way of thinking then we have a circular city. It means running the city like nature runs its own business (Nelles, 2016).

Figure 4. Linear Economy Model

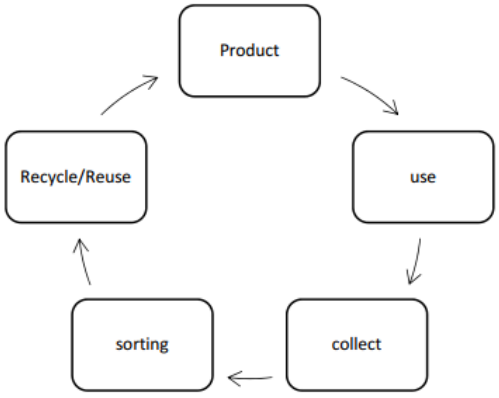

Figure 5. Circular Economy Model

In a circular city, nothing goes to landfills, as is seen in *Figure 5*. Rather than considering waste as something to be gathered and to be dug in, we can benefit from it. So, in this case, we don't only reduce the waste but we also transform it into resources (Malinauskaite, 2017).

2.3 International Novel Approaches in Waste Management

Below are listed and explained briefly, how some important countries cope with waste management and how they link it with the circular city concept. The mentioned countries are Germany, Italy, Netherlands, Croatia, and South Korea.

2.3.1 German Approach

Based on the German approach this has made people even more aware of the separation of waste, which means we have an enormous increase of recycled items. Germany now has reached 14% of recovered raw materials, and they are now going for 20% (UzZaman, 2016). What is more interesting is that it didn't only contribute environmentally but also economically. Starting from the benefits based on efficiency but also the employment of people in this new sector (Nelles, 2016).

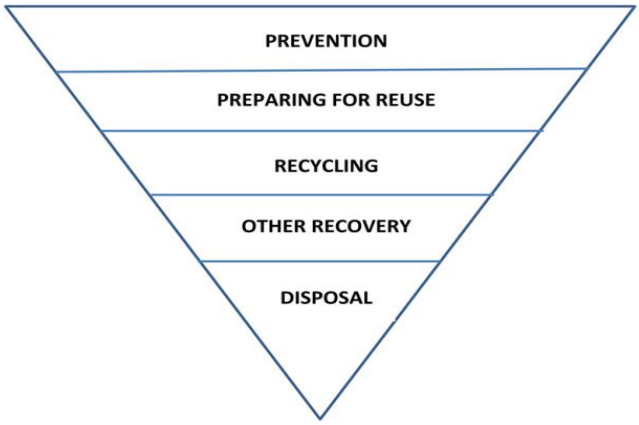

Figure 6. Waste Hierarchy according to European and German Law

Some of the policies of the German country start, firstly by preventing the creation of waste in the first place. The pyramid hierarchy is shown in *Figure 6*. It also has introduced the uniform recycling bin, in this case, waste can be collected in a larger quantity and a better quality. Another policy is that waste cannot be landfilled without pretreatment, which means more protection for the climate and health. According to the fundament of the process, it is done by fees and taxes (Nelles, 2016).

2.3.2 Italian Approach

The way of managing the waste differs from country to country, based on their incomes and how they raise awareness. In the Italian case, they simulate that the best performer is to minimize the landfill and maximize the separate collection. In Figure 7, are shown in diagrammatic way the compounds of waste management in Italy, starting from composting, landfills, co-incinerators and also a total map, gathering all of this information. It is visible that this kind of infrastructure takes a considerable amount of space.

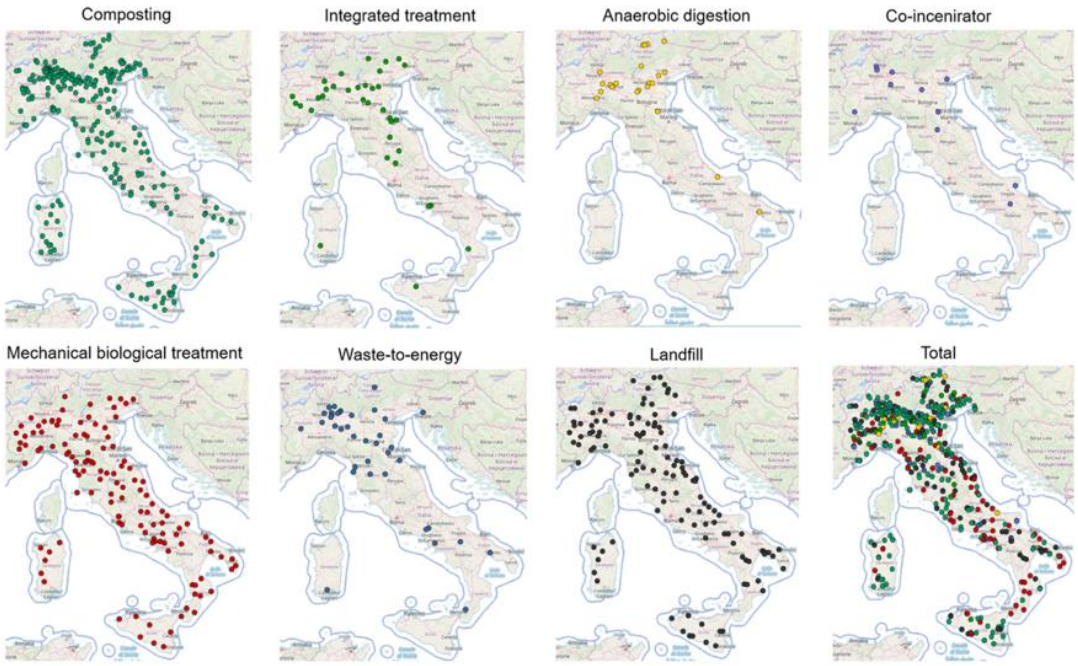

Figure 7. Distribution of waste management facilities across Italy

When the circular diagram is analyzed, as it is shown in *Figure 8,* they aim to shorten the road for transportation of waste, in this case, we don't only reduce the fuel consumption but also the bad landmark that it leaves in the environment, less traffic for the same conclusion, or even a better one (Foggia, 2021).

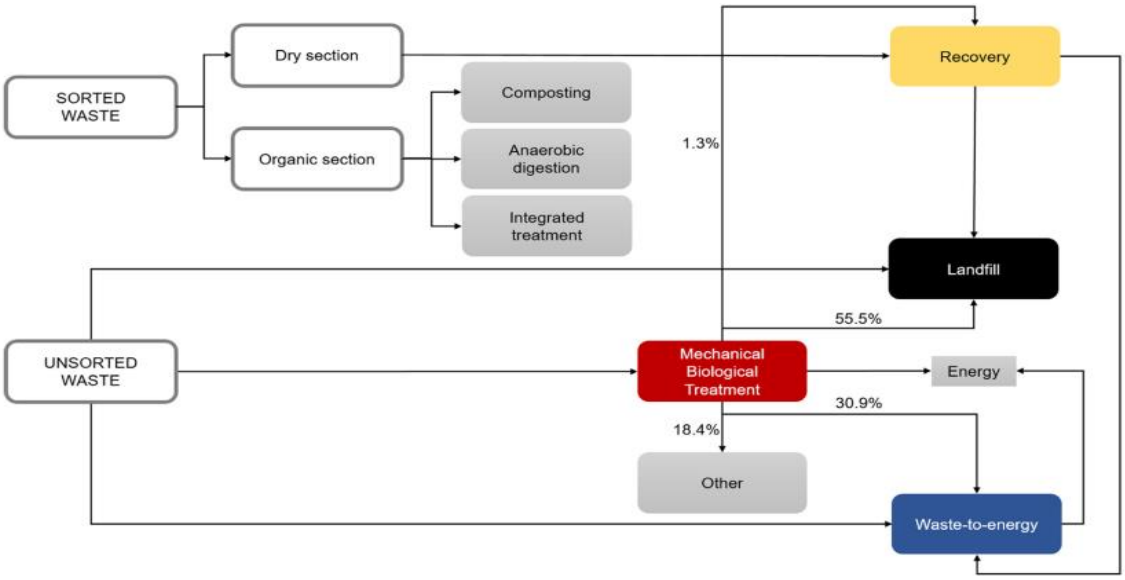

Figure 8. Diagram of Waste Management in Italy

2.3.3 Netherlands Approach

When talking about a circular city, an ideal one, the waste should gradually disappear. Even if we try our best, we can with the management at a recycling level, without the measurements at the top of the chain, when we talk about the product design practices, we still won't have the desired results.

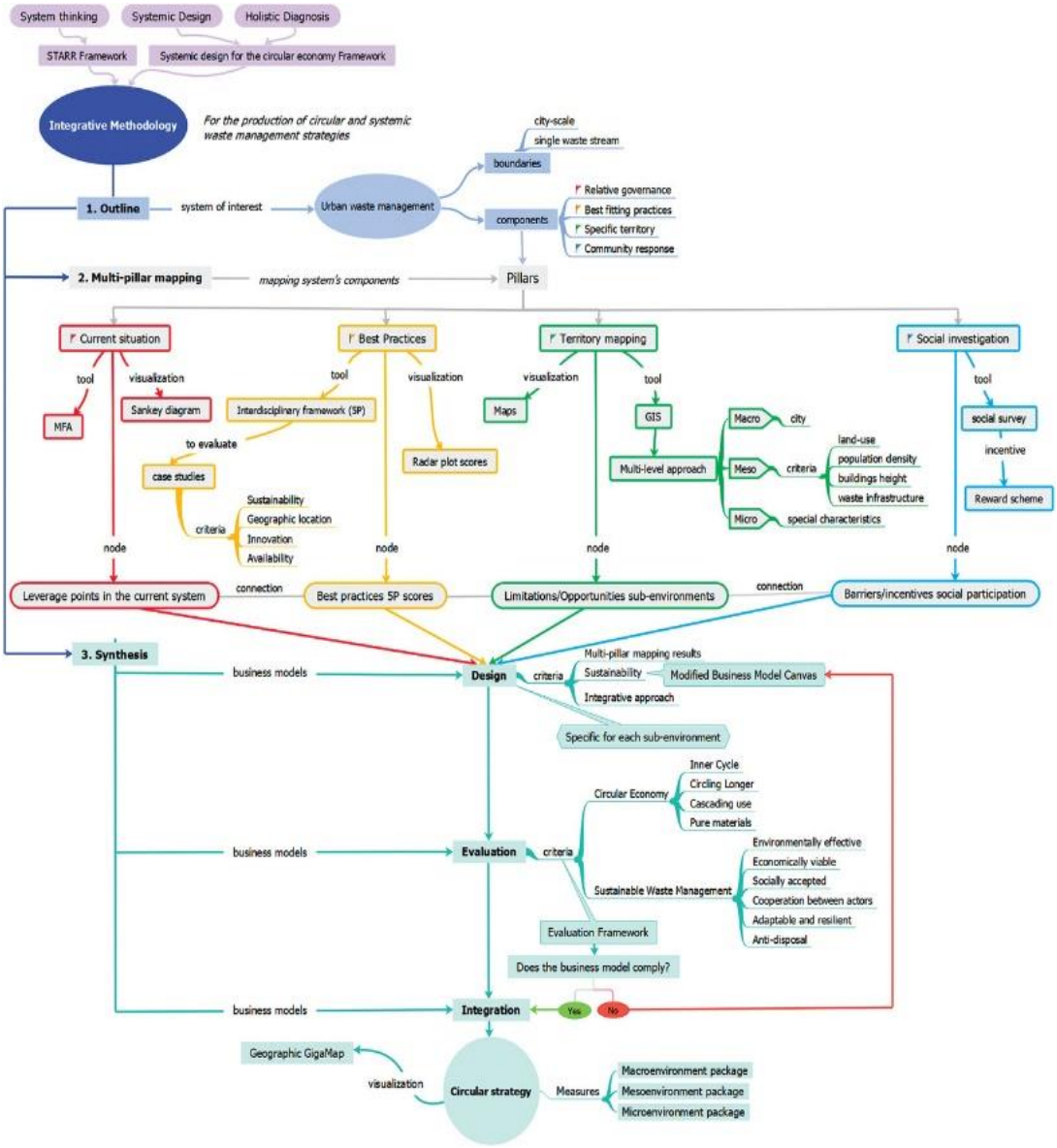

Figure 9. Diagram of Waste Management in Italy

They represented a toolbox for a circular and integrative waste management system *(Figure 9)* that can be adapted to every city and waste stream (Viva, 2020). An important and very interactive methodology was the surveying of the experience of the citizens by making a questionnaire. They listed many questions starting from the way they treated the waste, what can they do, and how they felt about them around.

2.3.4 Croatia Approach

One of the main reasons why the current waste management system is not sustainable is the low recycling rate. From a historical perspective, Croatia has been very dependent on landfilling, one of the cheapest ways. It should find sustainable ways to get accepted by the law: (Ribić, 2017) Architecture isn't quite visible in this proposal *(Figure 10).*

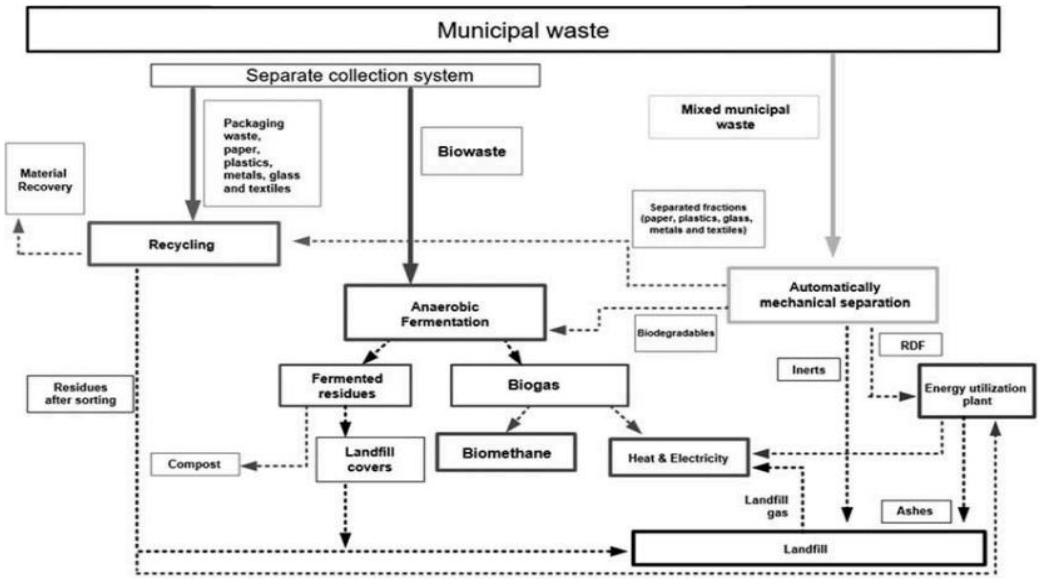

Figure 10. Diagram of Waste Management in Croatia

2.3.5 South Korea Approach

Their focus is that by 2025 they should be very similar to the German Approach, leaving in landfills only the inert materials, dangerous ones. Even if the specialized facilities are built, they still aren't managing the waste. It means that just having a big facility won't solve anything. In *Figure 11* is shown a diagram of what they bring and what they propose. They also encourage household waste management and the recycling of land (Kim, 2018).

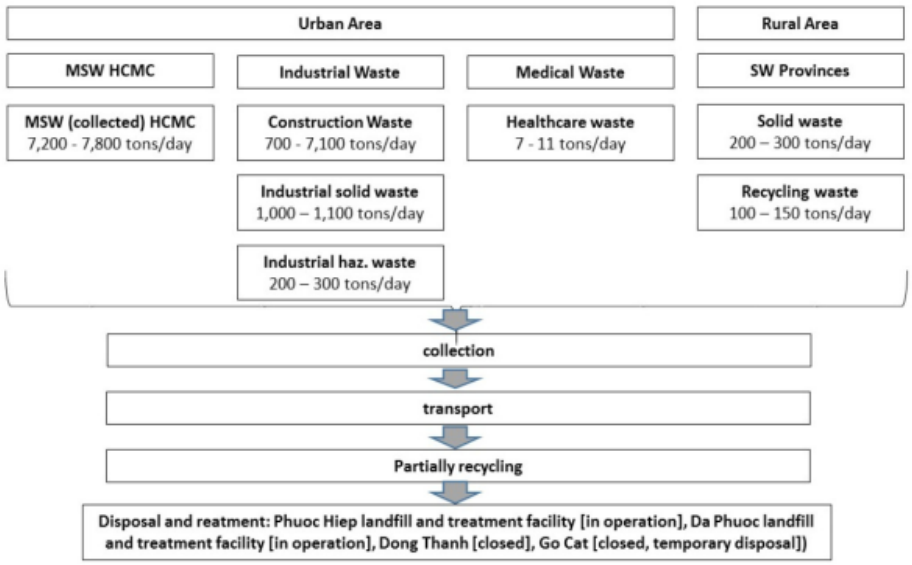

Figure 11. Diagram of Waste Management in South Korea

2.3.6 Discussion on International Approaches

All of the cases that are mentioned above aim for the same thing, to have a circular city and less waste, but they present unique solutions for achieving the same goal. One important point to focus on is the absence of architecture in the treatment of the cases.

Architecture is very linked to the city and how it works, but also in the building and even the furniture is architecture. Even though many of the maps come from an architectural approach, their presence would have contributed a lot to solve these issues.

Based on the diagrams and solutions that they proposed, all of them tried to send a very little amount of waste into the landfill. In an ideal circular city, waste should disappear. We can start by integrating the current linear approach.

In the case of Amsterdam, architecture played an important role in territorial mapping. They focused on four points such as density, building height, land use, and waste infrastructure. They used GIS software. The land use was subcategorized into residential, agricultural, and industrial. The city center was also included and also some hot spots like supermarkets or even universities, and also other points of interest.

2.4 Case Studies

Below are presented some case studies that will impact a lot in the proposal part of the thesis. These examples are taken in consideration by countries that focus more in sustainability, like Netherlands and Spain

2.4.1 Automatic Waste Collection, (AWC) Amsterdam

A new residential complex is to be constructed in 2022 in Sluisbuurt, Amsterdam as it is shown in *Figure 12*. This will be a whole new neighborhood that will consist of 5500 apartments, schools, and other necessary facilities. This new residential area aims to be sustainable. The winner of this project is Mari Matic, which is specialized in this field and has a unique energy-efficient technology (IPWCA, 2022).

Figure 12. Sluisbuurt 3D Model

Its strategy is to have an underground system. The waste will be thrown in a smart bin as it is shown in *Figure 13*. The waste will be collected and transferred to the special facility by underground pipe network.

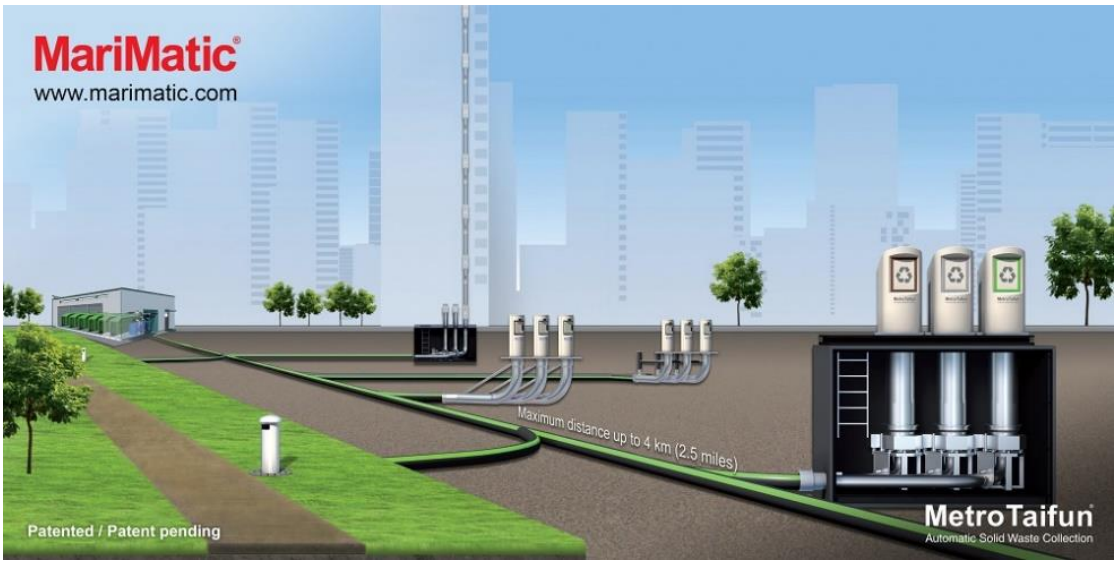

Figure 13. Proposal system

Some parameters of this system are for example large waste bags of approximately 150 liters and the size of the pipe is 30 cm in radius with an automated airflow system that will be used for possible blocking moments. It is believed that it will eliminate the noise and pollution that we are facing every day. Some other benefits are: less odor, reduced traffic and support for recycling (IPWCA, 2022).

2.4.2 Pneumatic Waste Collection System (PWCS), Malaysia

Modern cosmopolitan areas are seeking greater and more creative waste gathering and trash management solutions. Existing approaches used only difficult labor and diesel vehicles, which pose the danger of waste overflow and poisoning.

As cities grow more heavily crowded, smart management becomes increasingly essential. When hygienic treatment combines highly efficient requirements, solid waste management is always a logistical challenge. Cities all across the world are demanding better and faster garbage management systems (PWCS, 2022).

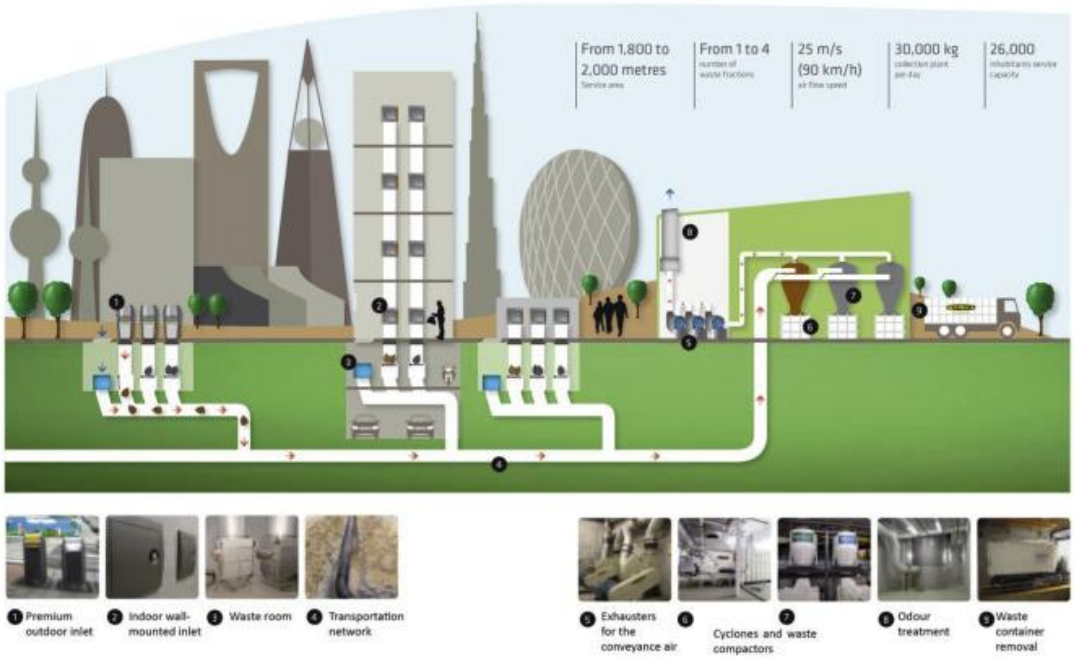

Figure 14. PWCS Cross Scale Approach

Effective waste management systems must be included in the planning stage of each construction project. The permanent pneumatic waste collecting system makes cleanup easier by transporting it through pipes under overpressure and compacting it in insulated containers, as it is visible in *Figure 14*. The technology practically removes the circumstances that allow hazardous germs, smells, and bugs to develop. Unappealing waste bins soon be a thing of the past.

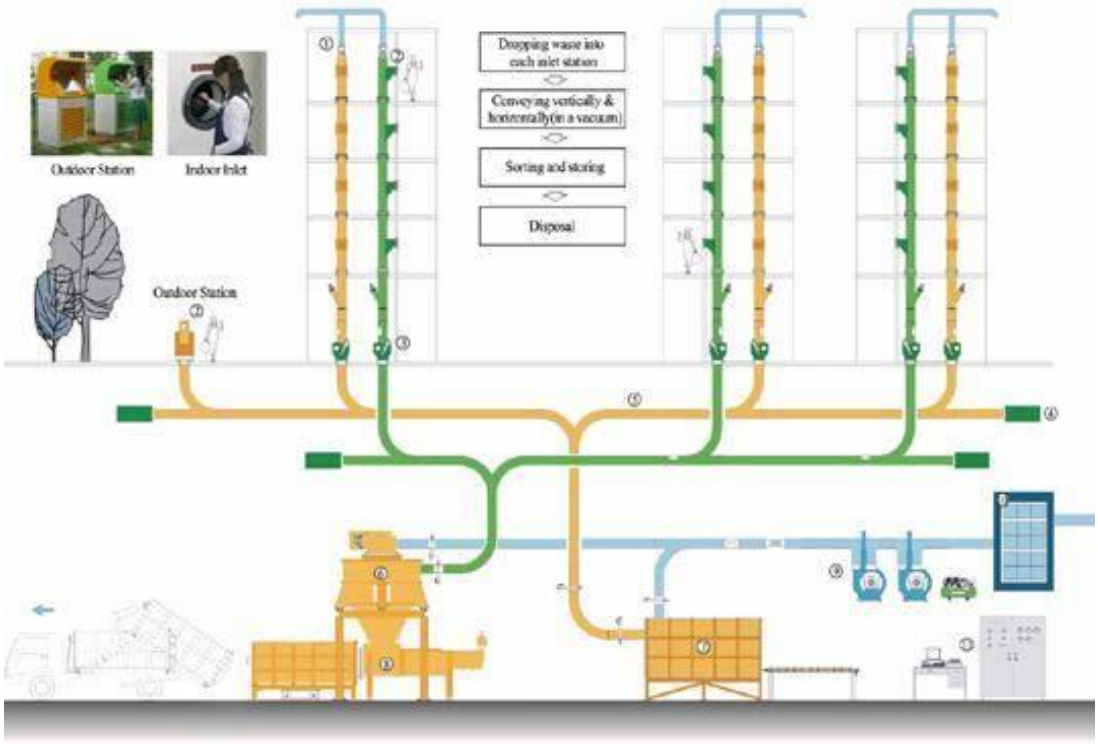

Figure 15. Section of PWCS

Waste transportation in the cities of the future with a metro system It is a complete system for places linked to the metro network. In *Figure 15* is shown a section of the current mentioned system. The system gathers various waste components (including plastic) from various sections of the city and transports them to Garbage Collection Stations, which are positioned underground in the metro network. Throughout the day, the metro network is utilized to carry people, while at night, the underground system is being used to transfer rubbish to the waste treatment facility. Benefits include increased sorting and recycling possibilities, as well as lower emissions from less truck travel in residential areas - no diesel in your city's downtown.

2.4.3 Urban Pneumatic Waste Collection System, Spain

URD Urban Plants are URD's answer for automated waste disposal in places with emissions averaging 20 tons per day, enabling the implementation of the most recent developments in Salary Services *(Figure 16)*. Pneumatic waste collection systems, which can provide several benefits over the previous vehicle collecting methods, are the development of the waste collection, upgrading the procedure to 21st

century standards, which should not be manual collection. The system may gather as many fractions as needed at the same time (URD, 2022).

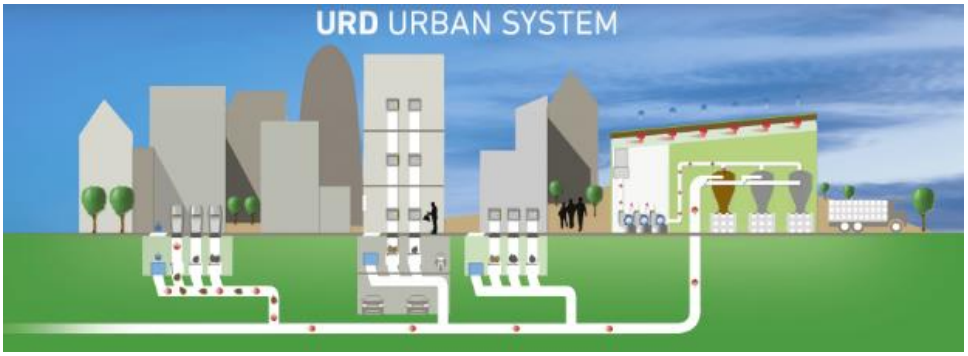

Figure 16. URD Proposal

Several benefits are named from this collection system, starting from users where we can mention the availability in every moment and improves hygiene. On an urban scale, the system will be underground, we won't be disturbed anymore from the unpleasant view and vandalism will be neglected. No more trucks on the roads. It is proved that it will have a very good impact also on the economy of the city. It will be fully automated and smart monitored, as it is indicated in *Figure 17* (URD, 2022).

Figure 17. Image Proposal of URD

2.5 Common Discussions on Case Studies

These proposals will have a high impact on the results of this thesis. They are a very good example to follow. With these scenarios, we can show how far technology has gone.

The above-mentioned cases are very similar in what they bring. They all propose some underground and very innovative solutions. All of them aim for one big thing, sustainability. But we should also emphasize the hygiene that they aim for, the easier everyday life that they propose.

Also, in these new scenarios, is quite visible the integration of the system with the building, which in our current system it is totally left out.

CHAPTER 3

METHODOLOGY

3.1 Overview of Materials and Methods

This thesis has followed multiple methods. After performing literature research and review, it is time to explain how to implement these findings in a real-case scenario. The methodology of this thesis is based on integrative methodology.

Firstly, it is started with a physical investigation with an overall perspective of the city that we will conduct our proposal, in our case Tirana, Albania. Then we continue to develop our analysis with the help of different software like QGIS, AutoCAD, Sketchup, Photoshop, Illustrator, etc.

Secondly, another methodology like a questionnaire is done. The attached questionnaire may be found in the APPENDIX section. After questioning a certain amount of people and gaining their feedback, we were able to generate some charts that describe better the situation. It is important to emphasize that the questionnaire is done in different sections for different scales. And the target was divided into two big groups, domestic and commercial.

Thirdly, again with the help of other software like AutoCAD, Photoshop, and 3D Visualizers we were able to propose some solutions on different scales on an architectural level. This was implemented in two cases. The first case belongs to an actual apartment and shows how this innovation in architectural aspects can help to improve waste management and daily life. On the other hand, we will have the second case, how this system can be thought and implemented into a new building.

3.2 Methodical Diagram

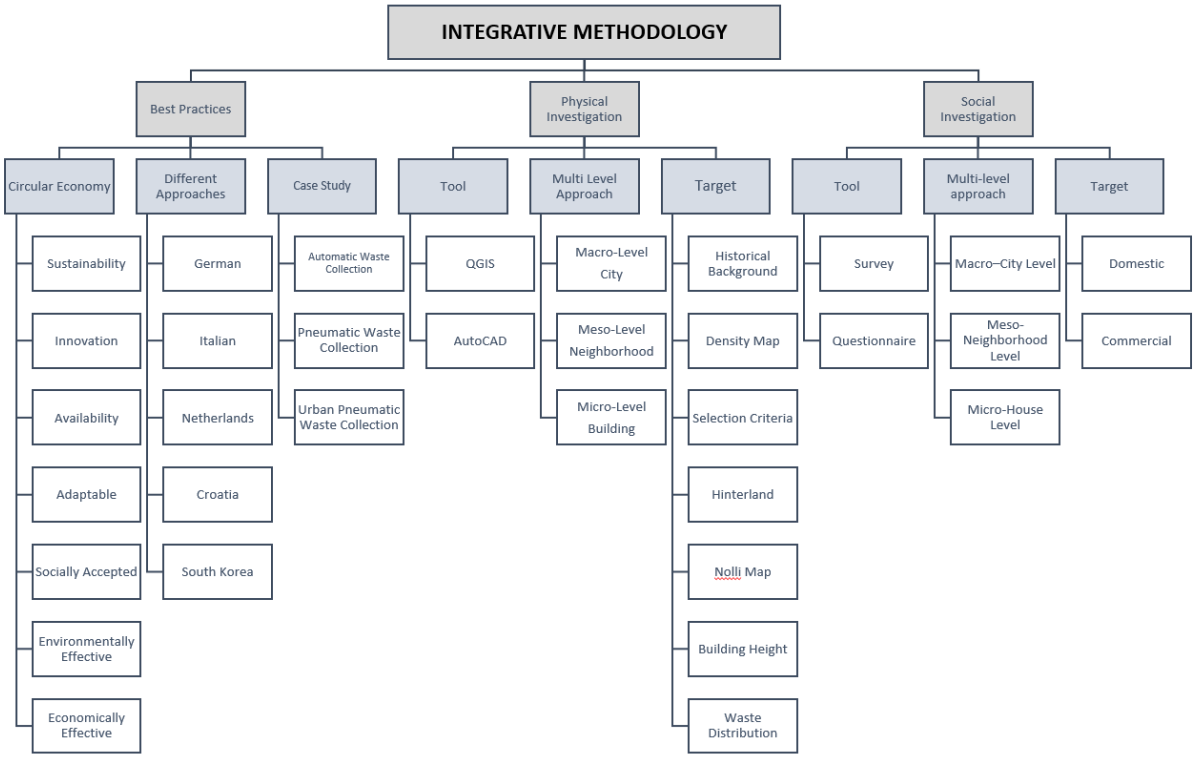

Figure 18. Integrative Methodology Diagram

In the *Figure 18* above, is illustrated a diagram that shows the methodology followed during the thesis research. The integrative methodology is believed to be the most fruitful one since it combines some specific fields to bring a better understanding and new innovative solutions.

The first branches are the best practices which focus more on literature review, and below it is divided into a circular economy and its mottos and some case studies that have done similar research but implemented in different countries.

Secondly, we have the Physical Investigation. We as architects can contribute a lot to this aspect because it consists of some urban analysis that firstly we have to use QGIS software to gather data and also AutoCAD and Photoshop. This Physical Investigation will be implemented into a multi-level approach which means it will have information on the macro-level which is a term for city level, meso level for the neighborhood, and micro-level for buildings, which will be divided into two other branches dwelling and commercial level, since not only as dwellers but also as stores

we produce a lot of waste. The diagram is also shown the branch of criteria and is listed the criteria that this physical investigation will be focused more.

Thirdly, we have the social investigation, which belongs to the surveying of a certain number of citizens. For this, we will need a questionnaire. After making some research for a proper questionnaire and to gain the required feedback we can construct some diagrams and show the emerging state and the disturbance from the citizens and also some sincere proposals from each of them.

3.3 Physical Investigation

In the physical investigation, several analyses are done. We start with an overall perspective of the city that we will conduct our proposal, in our case Tirana, Albania. The first one is the historical background of the city where are defined the characteristics and how it has been developed during different years.

Secondly, with the usage of the QGIS software, we have been able to generate maps and also define some hot spots to propose solutions based on some important factors like building distribution, building height, population, land use, waste infrastructure, etc.

Thirdly, with the help of AutoCAD software, different maps were generated, since the maps from QGIS were in lack of other important information, for example, roads, trees, etc. These maps were further elaborated in other software like Photoshop and Illustrator.

3.4 Social Investigation

In social investigation is included the survey which in this case is a questionnaire. There is developed a traditional way of questioning the citizens, by meeting them on roads or in their workplace and asking them the questions. The attached questionnaire may be found in the Appendix section.

Firstly, based on the aim of the questionnaire the survey is constructed, with mainly yes or no questions intentionally, since the number of questions is approximately 30 and the asked person will be bored. The questions are listed in English, but they are later translated into Albanian, not to have the language gap and to be more practical.

Secondly, 150 copies were printed and it took two visits to conclude all of them. After questioning these amounts of people and gaining their feedback, we were able to generate some charts that describe better the situation. The last question was an open-ended one, in which we were able to gain their perspective.

CHAPTER 4

ANALYSIS

4.1 Introducing the Case of Tirana

Tirana is the capital of Albania and one of the largest cities in the Balkan Peninsula. The Metropolitan area of Tirana is the largest in Albania (MIE, 2020). It is a city in development, which means the overcrowding will be an important issue, which leaves its marks. This overcrowding has led to large pollution and untreated urban waste.

4.1.1 Study Area

The region of Tirana is located in the central part of Albania *(Figure 19 and Figure 20)*. It borders the Durres Region in the northwest, with the district of Dibra in the northeast, the district of Elbasan in the southeast, with the district of Fier in the South-West, and with the Adriatic Sea in the west.

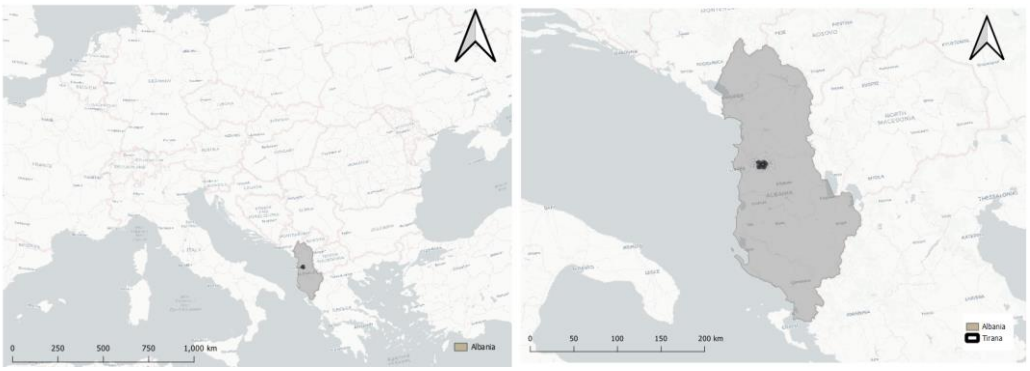

Figure 19. Europe Map, Albania, Tirana

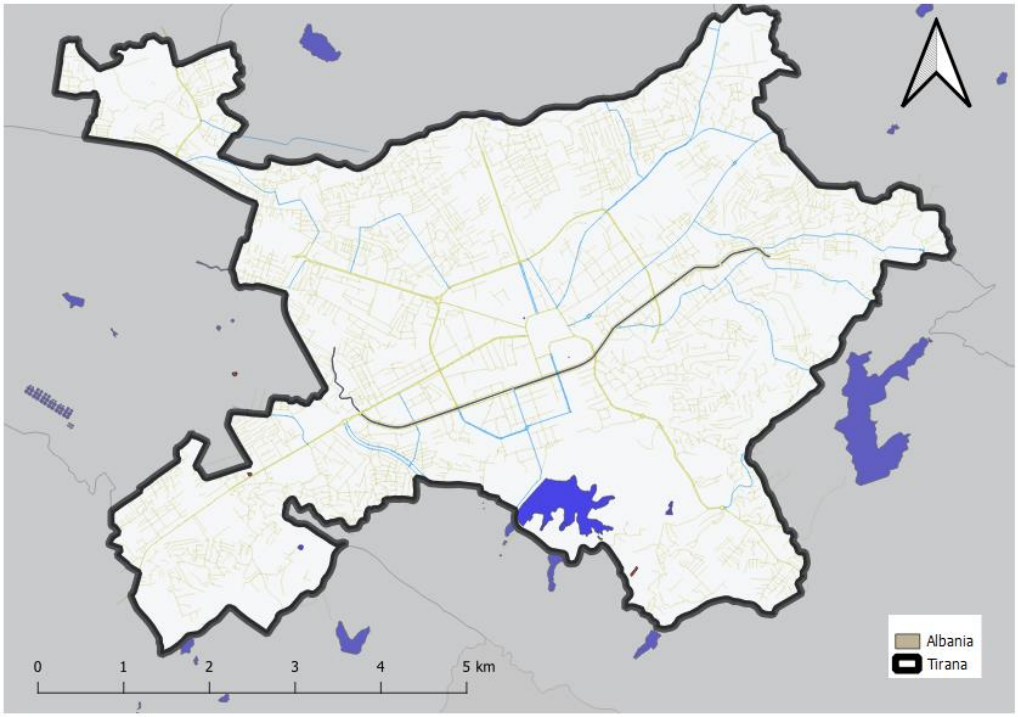

Figure 20. Tirana Map

Tirana city has changed a lot in the last two decades. Multiple population growth in Tirana, including population growth caused by the internal migration that erupted after 1991, as well as the gradual but steady increase in living standards and consumption for citizens during this period, have increased the pressure for new construction mainly of residential type (Aliaj, 2003).

Tirana's high density and compactness, as well as the fact that much of the city is easily accessible by foot, provide an exceptional opportunity to reverse the negative effects of car dominance and develop a pedestrian-friendly city with car restrictions and adequate public transportation (Pojani, 2010). But this kind of city has its own cons.

Overcrowding causes issues such as waste management, high levels of air pollution, and severe noise pollution in the metropolis. As the number of populations has grown in recent decades, solid waste has become a major problem. The city and its surroundings are littered with untreated solid waste. Even though this is becoming a worldwide problem, it is obvious that it is highly linked with urban distribution and high density. That is where architecture can take place and contribute.

4.1.2 Historical Background of Tirana

Tirana is a city with many values and history. The history of Tirana shows us that the city throughout its development has tended to extend to horizontality, preferring that the highest points be objects of special importance such as minarets, bells, clocks, and other objects of this type. This kind of expanding is also illustrated at the maps in *Figure 21*.

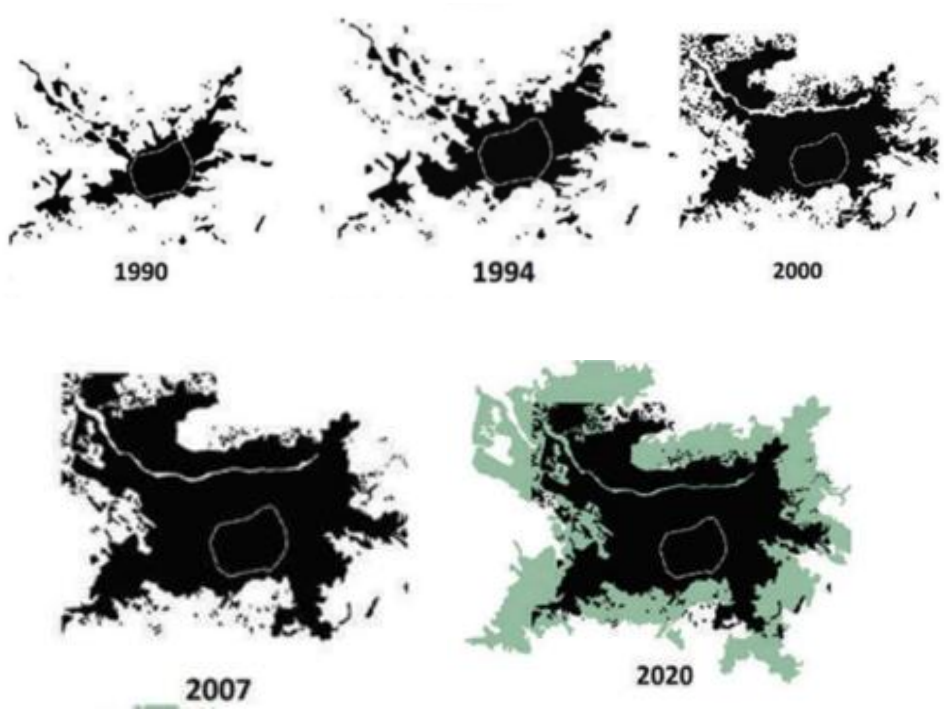

Figure 21. Urbanization of Tirana

In Tirana's post-socialist period, multifamily house building has been one of the principal residential kinds. Tirana's post socialist era apartment buildings include informal housing complexes on the edge of cities and multi - storied buildings in the city center (Manahasa, 2021).

20 years ago, the city of Tirana was dominated by low 1-story and 2-story buildings, but then with the increase of population the constructions started to increase in height but also the city of Tirana started to spread on the unbuilt lands, but the constructions made in them are illegally located and also most of them are illegal constructions.

4.2 Physical Investigation

The problem with poor waste management is seen and experienced in many places in Tirana, but it's better not to have a random selection. In this case, we created a list to analyze the city of Tirana and pick the most problematic spot. The analysis will be focused firstly on building distribution, building height, population, land use, waste infrastructure, etc.

4.2.1 Selection of the Study Area

The problem with poor waste management is seen and experienced in many places in Tirana, but it's better not to have a random selection. In this case, we created a list to analyze the city of Tirana and pick the most problematic spot. The analysis will be focused firstly on building distribution, building height, population, land use, waste infrastructure, etc.

4.2.1.1 Density Analysis

The map in *Figure 22* is based on the online server of INSTAT. The features are generated by a square grid of 1 km.

Figure 22. Population Distribution *(INSTAT, 2022)*

So, it is seen that the information isn't very specific, so the QGIS Software can contribute. A Geographic Information System (GIS) is a computer program that is used to capture, store, query, analyze, and display geographical data from the actual world for a specific set of applications. This method is used to determine the best route for gathering data. Solid waste is a type of garbage. GIS is a tool that not only saves time and money but also improves accuracy not only in terms of site selection but also in terms of creating a digital data bank for future use. The purpose of usage of this software in this thesis was to study the density and population, select the most populated area, and implement the interventions (Shoba, 2013).

Firstly, we put the Tirana buildings on the Open Streets Map. Then, we put the Building Height Map of Tirana. By integrating the information from the two maps, we gained values for the surface of buildings multiplied by the height. The total surface is then divided by 25, to gain a value for the population. After that, we generated a grid of 100 m x 100 m, that is illustrated in *Figure 23*.

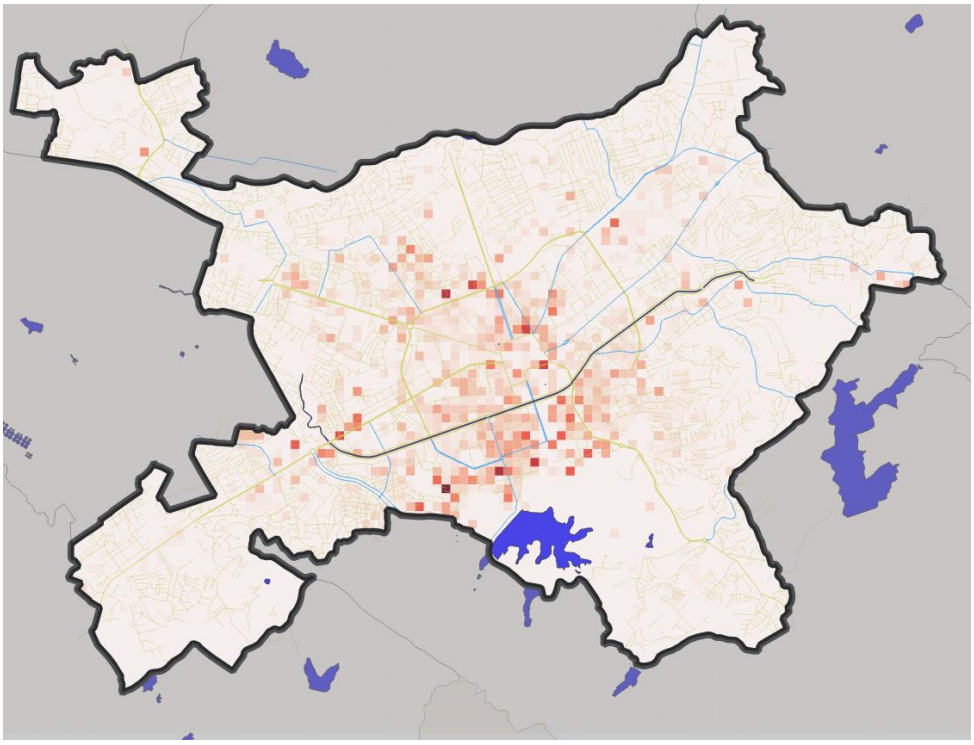

Figure 23. Grid Map of Population, Tirana

As it is visible from the graphical representation above, the areas with the highest population are the ones in the central part of the city, across the Ring of Tirana.

4.2.1.2 Selection Criteria

When we have a zoomed-in map in the part with the highest population, the results are quite understandable. This neighborhood is named “Komuna e Parisit” and is characterized by a diversity of building typologies. Below in *Figure 24* is represented an orthophoto from ASIG Geoportal.

Figure 24. Orthophoto of the zone with the highest density

In *Figure 25*, is shown a diagram that shows the selection criteria of the study area. So, if we did a buffer of 3 km around the densest point, we would have an artificial boundary. To neglect this, we used some principles of Image of The City, the New Ring Highway of Tirana is an important separation feature. Another partition was done in the significant morphology distribution of the villas and the new urbanized area. Some linear roads, helped us to define the study area better.

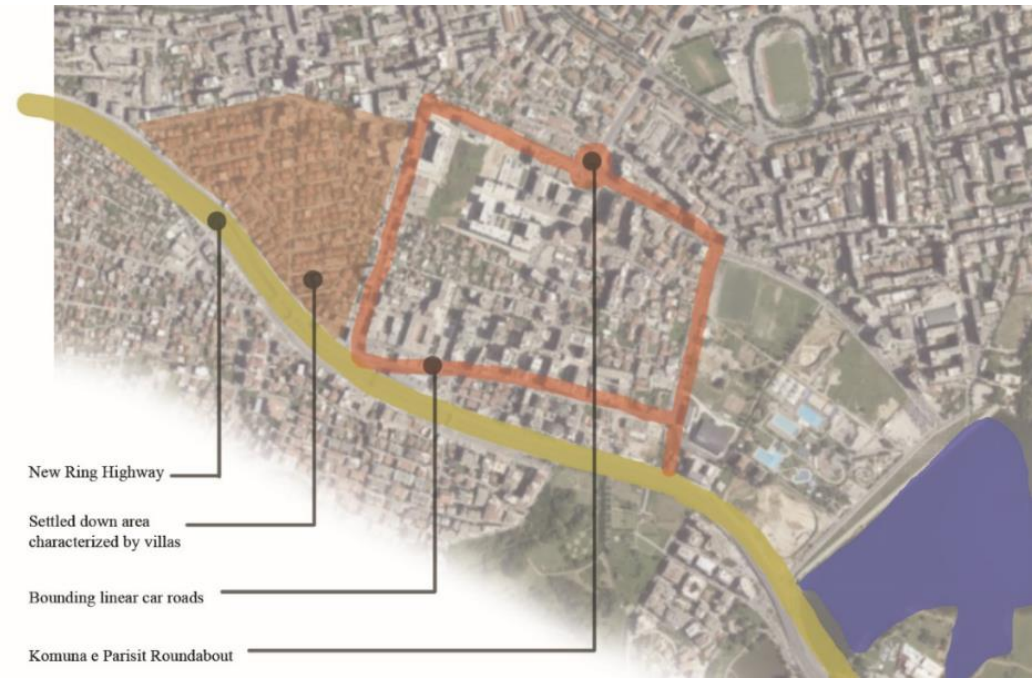

Figure 25. Diagram of selection criteria

In *Figure 26* is represented a zoomed-in orthophoto of the zone with the highest density. The urban chaos is quite visible. To better understand the morphology, characteristics, and features of the area, some analyses were done.

Figure 26. Selected Study Area

4.2.1.3 Historical Background of the Study Area

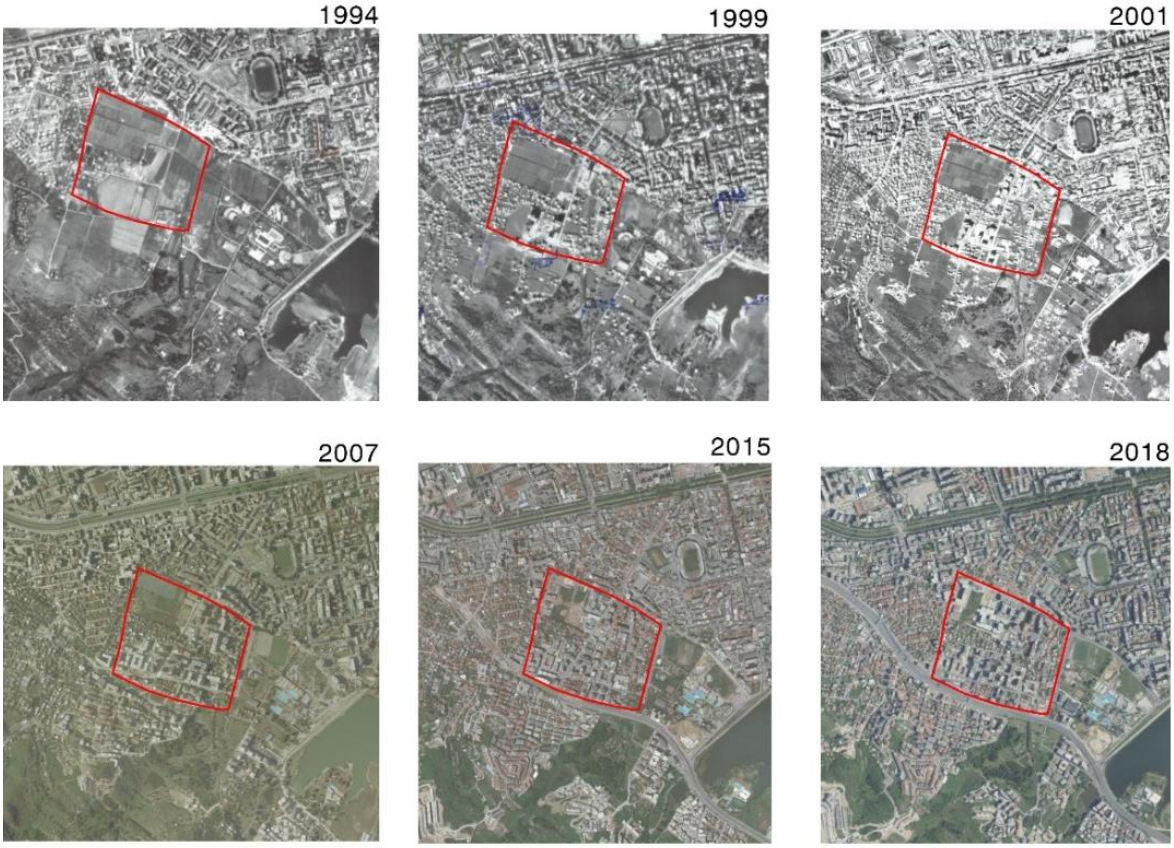

Figure 27. Study Area through years (ASIG, 2022)

In *Figure 27* above, is shown the selected site during different periods, starting from 1994 to 2018. The interesting part is that when the other part of the area beyond boundaries was being urbanized with villas and low store buildings, this part was left untouched. This has become a problem in this area because it was later filled with high store buildings and complexes, making a problematic spot with high density, no sun, narrow roads, no public spaces, and what interests us with a difficult area to manage the waste. From here we can see what an improper and unthought urban and architectural step can bring. It can bring pollution, poor hygiene, and disturbed citizens.

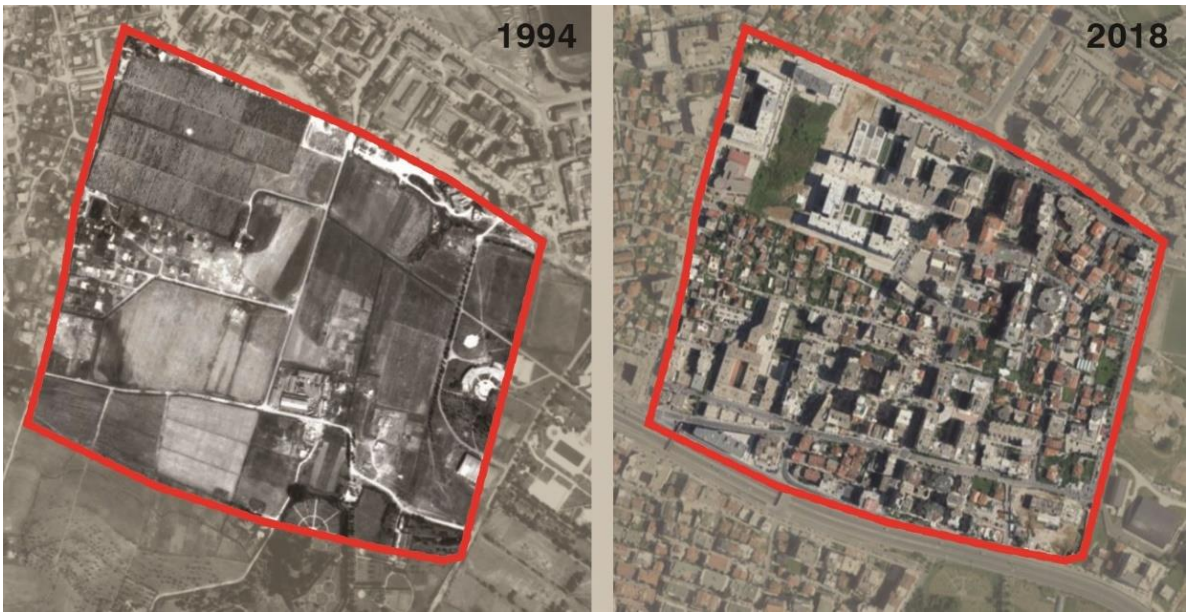

Figure 28. Orthophoto of Urbanization of Study Area

In this orthophoto in *Figure 28*, is visible the before and after what is discussed in the previous paragraph. So, from having these divided agricultural fields, we now have high store complexes, and more to be constructed.

4.2.1.4 Hinterland and Circulation

The hinterland analysis is important for this thesis because it aims to calculate the road that a truck takes to send the waste from the selected site to the landfill. In *Figure 29* is illustrated the map of Tirana City, with the site and its connection with the Sharra Landfill.

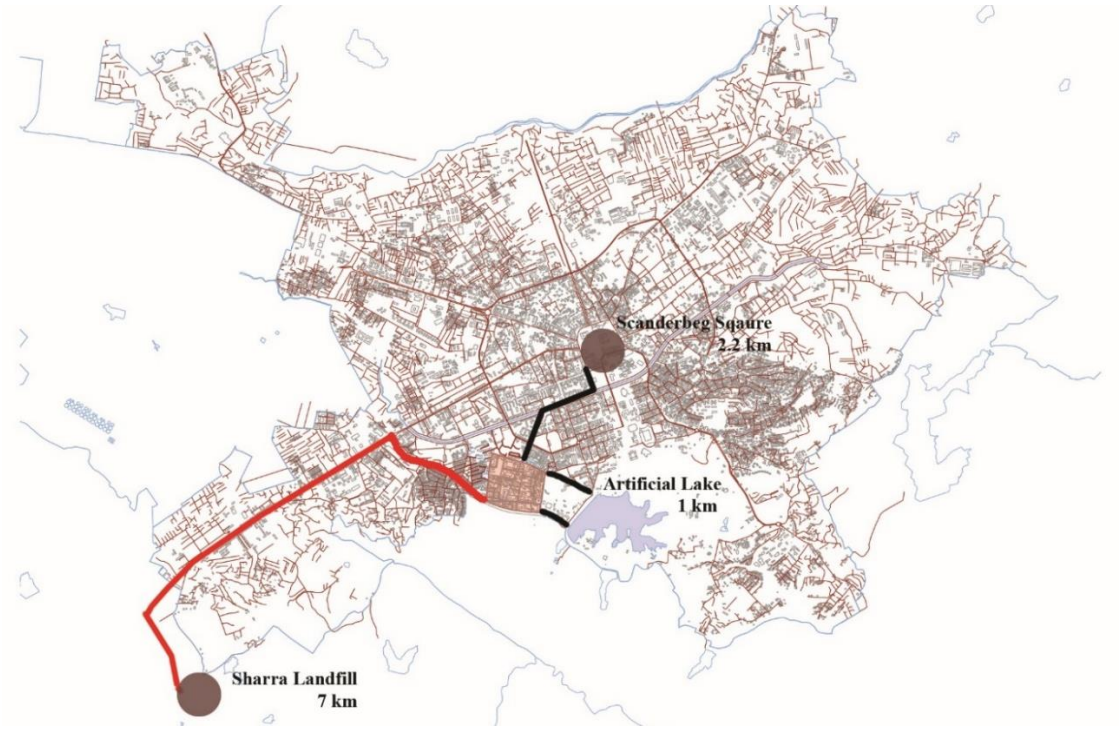

Figure 29. Hinterland Map

Even though as a number 7 km isn't a faraway one, we should emphasize that 7 km in the traffic of Tirana is calculated as 40 min to 1 hour time. In this calculation, these trucks should also be considered as an addition to the traffic. The fuel consumption should also be calculated.

Figure 30. Circulation Map

Moreover, when we got closer to the study area, the circulation is also analyzed. As it is visible in *Figure 30*, this site is characterized by very narrow roads, with one sense, and it may cause a lot of traffic when the waste is collected and may cause disturbance to the citizens.

Also below in *Figure 31*, is represented a photo of a trunk collecting waste and causing traffic on a wider road near the highway.

Figure 31. Photo collecting waste

4.2.1.5 Building Height

At the *Figure 32*, is represented the gradient map of the height of the buildings of the study area. The measurement of them is done in a traditional way, by going to the site and counting the floors.

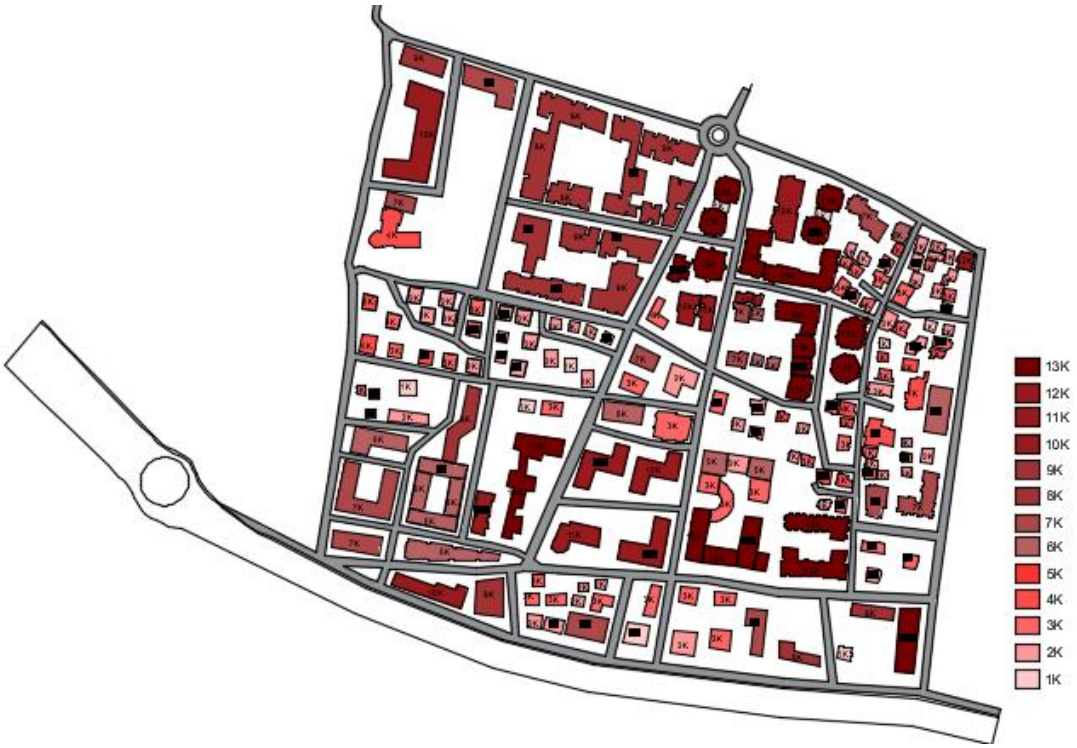

Figure 32. Building Height Plan

At the figure above, is represented the gradient map of the height of the buildings of the study area. The measurement of them is done in a traditional way, by going to the site and counting the floors. In *Figure 33* are shown two 3D maps, where one of them show the buildings of the neighborhood and the other shows in red color the highest ones, which in this case are of 13 floors.

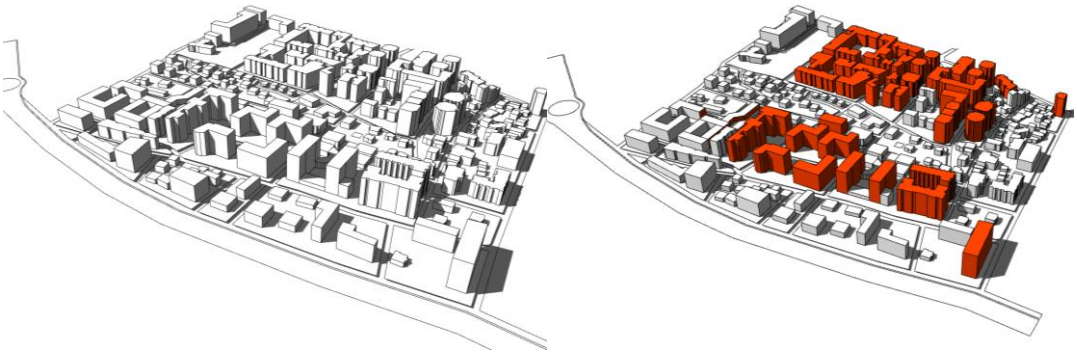

Figure 33. Highest Buildings 3D

This area is characterized mainly by two types and seems that there isn't a middle way, it seems like there are just villas with a low story and the high story mainly 13. The density is also visible in the photos below in *Figure 34*. This analysis will help us to choose the highest building and propose an intervention.

Figure 34. Photos of High Buildings

4.2.1.6 Land Use and Ground Floor Use

This map is important in our thesis because we aim to reflect proposals not only for domestic but also for commercial usage. Nowadays ground floors are being used

only for services since there is a lack of privacy to have an apartment on the ground floors.

Since the building should work as a whole it is very important to take into consideration also the commercial usage of the buildings. This is not the only reason, because the businesses produce a very high number of solid wastes, and this shouldn't be neglected. The area is filled with a diversity of functions starting from the high number of cafeterias and restaurants, bakeries, pharmacies, restaurants, hairdressers, shops, etc.

4.2.1.7 Waste Bin Distribution

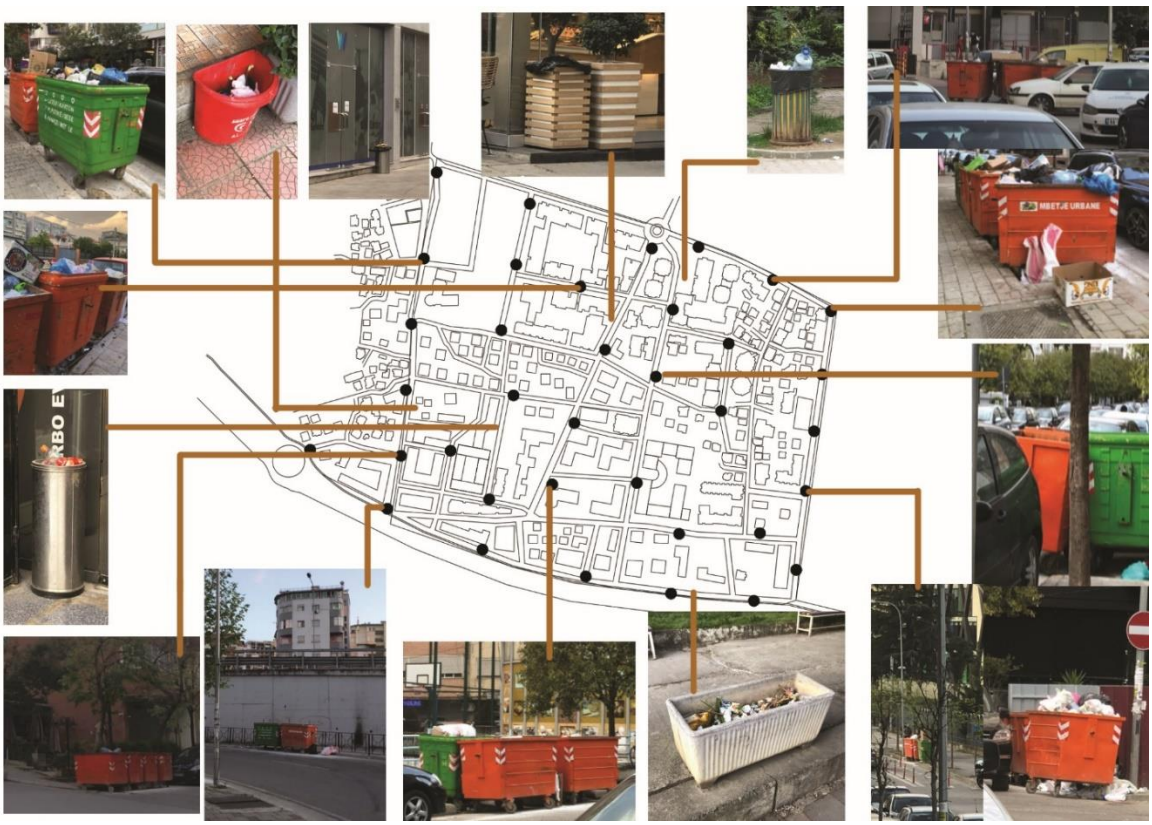

Figure 35. Waste Distribution Map

In the *Figure 35*, are indicated some fragments of different bins. The area is well covered with bins, which means you don't have to walk a lot to throw the waste. This can be considered a good point but on the other hand, this can disturb the citizens and

also can ruin the facades of the roads. The bins in most cases interrupt the sidewalks, are inside the parking areas, etc.

The most spread bin is the orange one which is a general bin, it is seen in every black point on the map above. In some scenarios are also included some green bins, which serve as different ones, but are out of function since they make the same work as the orange one and no one respects its writings.

4.3 Social Investigation

This thesis includes also a survey of citizens. A certain amount of them is asked. The main aim of this survey is to gain feedback and experience from the people who live in the selected neighborhood. The feedback will be collected into a multiscale approach, how they feel about the city, neighborhood, and building level. Since a lot of waste comes also from the commercial use buildings where we can see that almost all the ground floor of buildings are filled with stores of different function and they are part of a whole building, so when giving proposals they have to be taken in consideration too.

4.3.1 Content of Questionnaire

The questionnaire consists of 34 questions in total. Most of them are multiple-choice questions, where there is a high number of yes, no, or maybe questions. This is done intentionally because many of them may be disturbed by long and not understanding questions. Just one question, the last one has left an open-ended question, where the asked person will share their own opinion.

This questionnaire is divided into several sections. The first section consists of questions in overall view where they are first asked if they live or work there. Then some general questions are asked, for example, their age group, gender, and if they have been educated or heard about recycling. In the second section are asked questions regarding the macro scale, and city-level approach. They are asked if they see burning waste and about traffic which is a huge problem nowadays. The third section continues with the mesoscale approach, neighborhood-level where they are asked where and when

they send their waste, how far are from home, and are they disturbed in this aspect. The fourth section is a little bit unique since it is divided into two columns, where the first column is to be filled by the people who live there and the other by the ones who work there. Because we emphasized this questionnaire aimed to have responses on two typologies, domestic and commercial.

In *Figure 36* is shown the printed questionnaire that was done to the asked citizens. The formal questionnaire is attached to the APPENDIX Section.

PYETESOR

MENAXHIMI I MBETJEVE

- Qellimi i ketij pyetesori eshte te ndihmoj ne nje kerkim studimor i cili propozon zgjidhje ne nivel arkitektonik.
- Ai synon te pyese nje numer te caktuar qytetaresh ne zonen e Komunes se Parisit dhe eksperiencen e tyre.
- Eshte i ndare ne disa seksione, pasi ne synojme reagime ne qasje multiskalare.
- Pjesmarrja ne kete kerkim esht vullnetare dhe do te dokumentohet si anonime.

Seksioni 1 – E pergjithshme

1. **Profili**
   a. Une jetoj ketu
   b. Une punoj ketu
   c. Tjeter
2. **Mosha**
   a. 5-15
   b. 15-20
   c. 20-30
   d. 30-50
   e. 50-70
   f. 70-me shume
3. **Gjinia**
   a. Femer
   b. Mashkull
4. **Jeni edukuar ndonjher mbi menaxhimin e mbetjeve?**
   a. Po
   b. Jo
   c. Ndoshta
5. **Keni degjuar ndonjher mbi rendesine e riciklimit?**
   a. Po
   b. Jo
   c. Ndoshta
6. **Mendoni se arkitektura mund te ndihmoje ne nje sistem me te mire te menaxhimit te mbetjeve?**
   a. Po
   b. Jo
   c. Ndoshta

Seksioni 2 – Nivel Qytet

7. **A hasni mbeturina ne rruge?**
   a. Po
   b. Jo
   c. Ndoshta
8. **Shikoni mbeturina qe digjen?**
   a. Po
   b. Jo
   c. Ndoshta
9. **Shikoni ne trafik dhe rruge kamiona duke mbledhur mbeturina?**
   a. Po
   b. Jo
   c. Ndoshta

Seksioni 3 – Nivel Lagjeje

10. **Ku i hidhni zakonisht mbetjet?**
    a. Ne koshat e lagjes
    b. Ne rruge
    c. Ne qendra riciklmi
    d. Tjeter
11. **Ka kosha publik afer shtepise/punes tuaj?**
    a. 100 m
    b. 100 m – 200 m
    c. 200 m – 500 m
    d. 500 m – 1000 m
    e. Tjeter
12. **Si eshte gjendja e koshave?**
    a. Shume e mire
    b. E mire
    c. Normale
    d. E keqe
    e. Shume e keqe
13. **A e konsideroni kete si problem?**
    a. Po
    b. Jo
    c. Ndoshta
14. **Kur do te deshironit qe mbeturinat te mblidheshin?**
    a. Ne mengjes
    b. Ne mesdite
    c. Ne mbremje
    d. Kurdohere

Seksioni 4 – Nivel Ndertes

Ne qofte se jetoni ketu, ju lutem plotesoni:

Nivel Banese

15. **Sa njerez jetojne ne shtepine tuaj?**

    _____

16. **Cfar lloj mbetje vjen ne shtepine tuaj?**
    a. Leter dhe karton
    b. Plastike
    c. Mbetje nga ushqimet, organike
    d. Kanace, Metal
    e. Qelq
    f. Cope
    g. Tjeter
17. **Ne cfar lloj koshi i koleksiononi mbetjet?**
    a. Qese plastike mbetjesh
    b. Qese plastike te perdorur
    c. Karton
    d. Tjeter
18. **Sa shpesh i boshatisni koshat?**
    a. Njehere ne dite
    b. Cdo dy dite
    c. Cdo tre dite
    d. Njehere ne jave
    e. Tjeter
19. **Kur i boshatisni zakonisht koshat?**
    a. Ne kohe te papercaktuar
    b. Ndermjet ores 6:00-18:00
    c. Mbas ores 18:00
    d. Tjeter
20. **Si ndiheni per mbetjet ne shtepine tuaj?**
    a. Nuk eshte problem
    b. Aroma shqetesuese
    c. Ze shume hapesire
    d. Tjeter
21. **A i diferenconi mbetjet ne shtepine tuaj?**
    a. Po
    b. Jo
    c. Ndonjehere
22. **A keni hapesire ne shtepine tuaj per te kosha per te diferencuar mbetjet?**
    a. Po
    b. Jo
    c. Ndoshta
23. **A keni kohe per te diferencuar mbetjet?**
    a. Po
    b. Jo
    c. Ndonjehere
24. **Cfar do te sugjeronit per nje sistem me te mire te menaxhimit te mbetjeve?**

    _____

Ne qofte se punoni ketu, ju lutem plotesoni:

Nivel Tregetie

25. **Cili eshte profesioni juaj?**

    _____

26. **Cfar lloj mbetje vjen ne vendin tuaj te punes?**
    a. Leter dhe karton
    b. Plastike
    c. Mbetje nga ushqimet, organike
    d. Kanace, Metal
    e. Qelq
    f. Cope
    g. Tjeter
27. **Ne cfar lloj koshi i koleksiononi mbetjet?**
    a. Qese plastike mbetjesh
    b. Qese plastike te perdorur
    c. Karton
    d. Tjeter
28. **Sa shpesh i boshatisni koshat?**
    a. Njehere ne dite
    b. Cdo dy dite
    c. Cdo tre dite
    d. Njehere ne jave
    e. Tjeter
29. **Kur i boshatisni zakonisht koshat?**
    a. Ne kohe te papercaktuar
    b. Ndermjet ores 6:00-18:00
    c. Mbas ores 18:00
    d. Tjeter
30. **Si ndiheni per mbetjet ne shtepine tuaj?**
    a. Nuk eshte problem
    b. Aroma shqetesuese
    c. Ze shume hapesire
    d. Tjeter
31. **A i diferenconi mbetjet ne shtepine tuaj?**
    a. Po
    b. Jo
    c. Ndonjehere
32. **A keni hapesire ne shtepine tuaj per te kosha per te diferencuar mbetjet?**
    a. Po
    b. Jo
    c. Ndoshta
33. **A keni kohe per te diferencuar mbetjet?**
    a. Po
    b. Jo
    c. Ndonjehere
34. **Cfar do te sugjeronit per nje sistem me te mire te menaxhimit te mbetjeve?**

    _____

Figure 36. Printed Questionnaire

4.3.2 Feedbacks from citizens

The questionnaire was done traditionally, they are printed and are asked down the roads and in different businesses. A total number of 130 citizens are asked where 87 were people who lived there, 35 worked there and 8 papers were wrong or lack of information.

For the gathering of information and generation of numbers and graphs, is used EXEL. There are created 34 tables, with their response and the numbers are added one by one until they are summed up, then is used the chart option.

The first section of the questionnaire was about the profile of the asked citizen, since we have two target profiles, people who worked there and people who lived there, how did they feel about their workplace, homeplace, city and neighborhood. In *Figure 37* is shown the bar chart of profile of asked people, where 35 % of them worked there and 65% lived there.

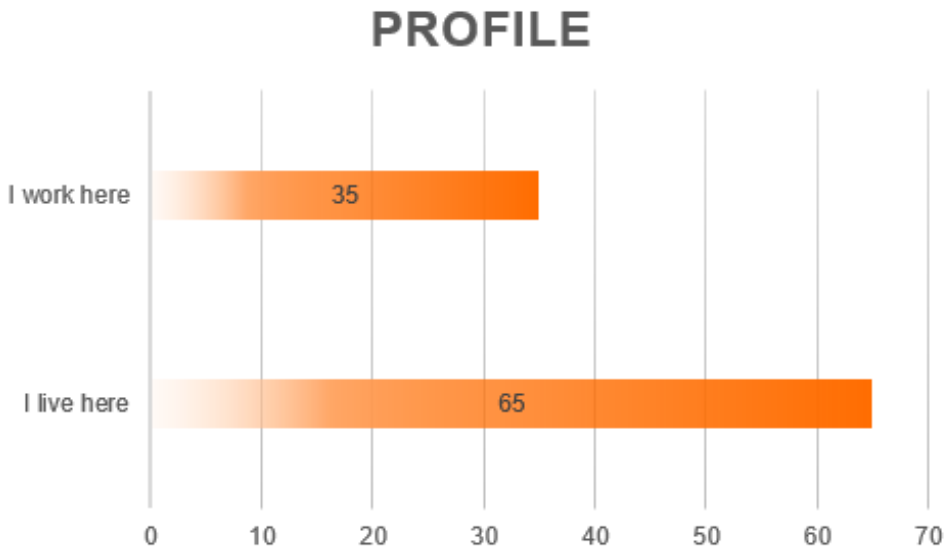

Figure 37. Bar Chart of Profile of the asked people

The bar charts below, show the age group and gender, respectively *Figure 38* and *Figure 39*. The results are shown in percentages. There is diversity in the age of questioning people, which we aimed for this one, and also the gender we have them both evolved nearly equally.

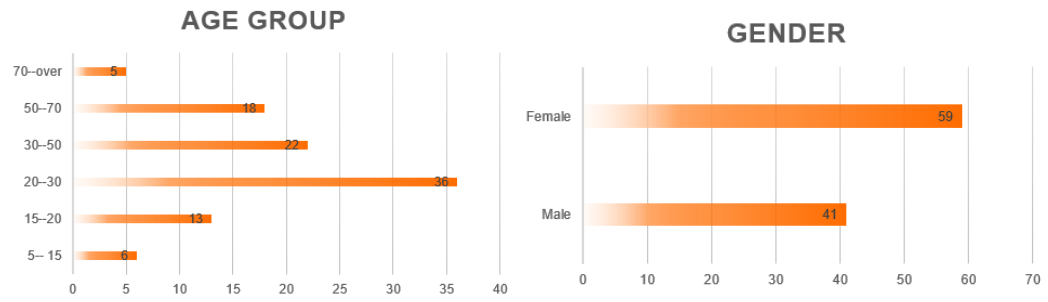

Figure 38. Bar Charts of Age Group and Gender

Continuing with the overall view questions in *Figure 39*, they were asked if they have been educated and heard about the importance of recycling and when we compared the age with the respective response, the younger generation was more aware of them compared to older age groups.

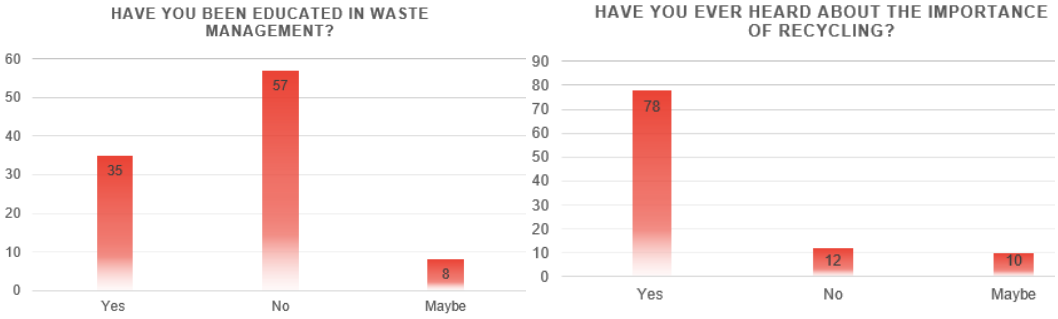

Figure 39. Column Charts of Education on Waste Management and Recycling

The question of architecture and waste management, which belongs to *Figure 40*, is a little strange the fact that they were in doubt with approximately 62%. So, they weren't quite sure that the architecture can contribute.

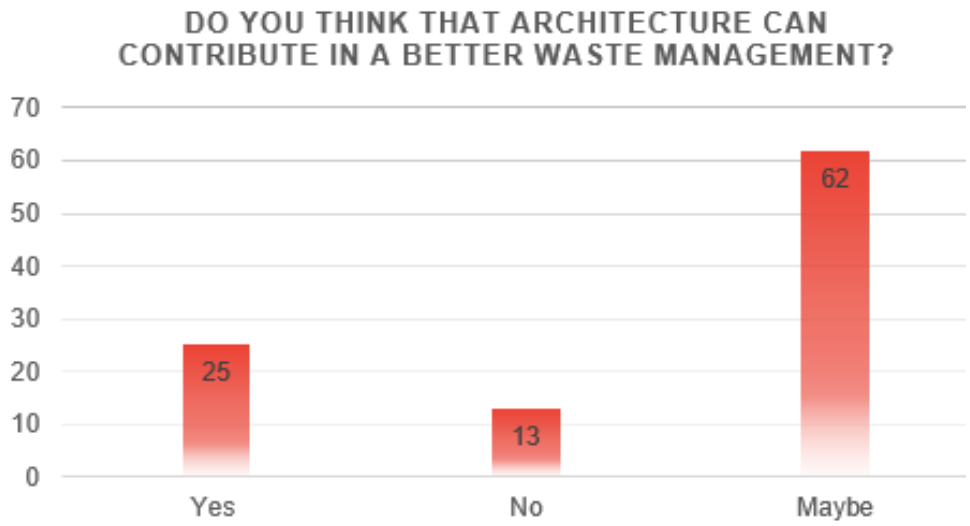

Figure 40. Column Chart of architecture and waste management

When they were asked about the burning waste, many of them approximately 83% answered no, also visible in bar chart of *Figure 41*. It means that this method is old school right now, and is a plus for the environment. These numbers are also evident at *Figure 1. Treatment* Method of Waste during 2013-2020 , where the burning of waste is almost eliminated.

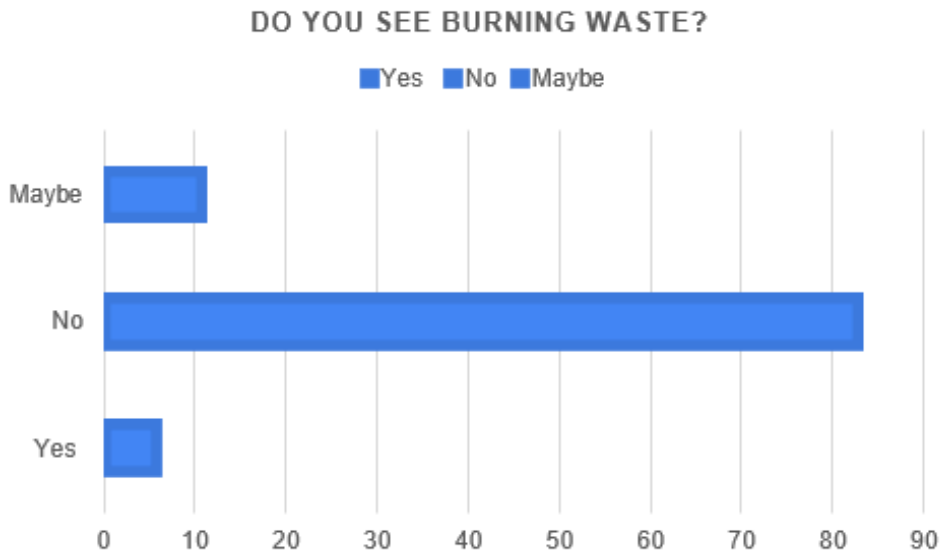

Figure 41.Bar Chart of Burning Waste Response

But what was disturbing the citizens was the waste on roads and the trucks which made a lot of traffic, disturbing views, odors, etc. This is evident at the huge difference of yes or no responses, represented in *Figure 42*.

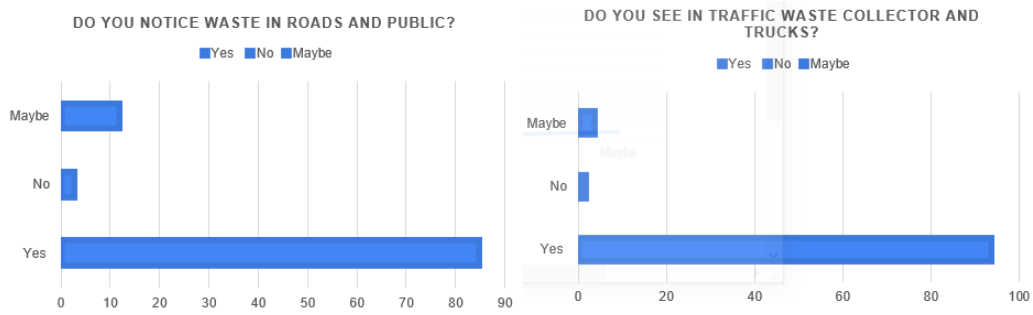

Figure 42. Bar Chart of Waste in Roads and Traffic

The graphs below are shown the responses on a neighborhood level. Most of them answered that they usually put away their bins at neighborhood gathering places and didn't feel good about this thing, because many of them claimed that this kind of bin disturbs them. The percentages of these responses are shown in *Figure 43* and *Figure 44*.

Figure 43. Column Chart of placement of Waste

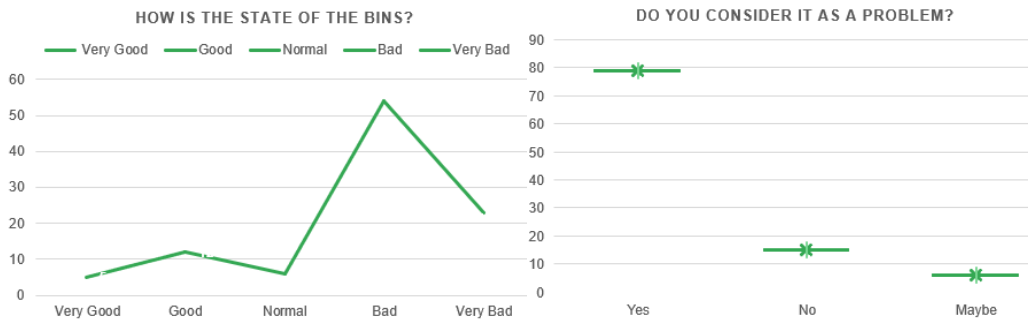

Figure 44. Line Chart of the state of the bins

Even though the bins aren't away from their home, a high percentage of them stated that it should be perfect if the waste is taken from them in any time, without the need that someone should take a bag with waste and throw them in a larger bin and stay like that for a lot of time *(Figure 45).*

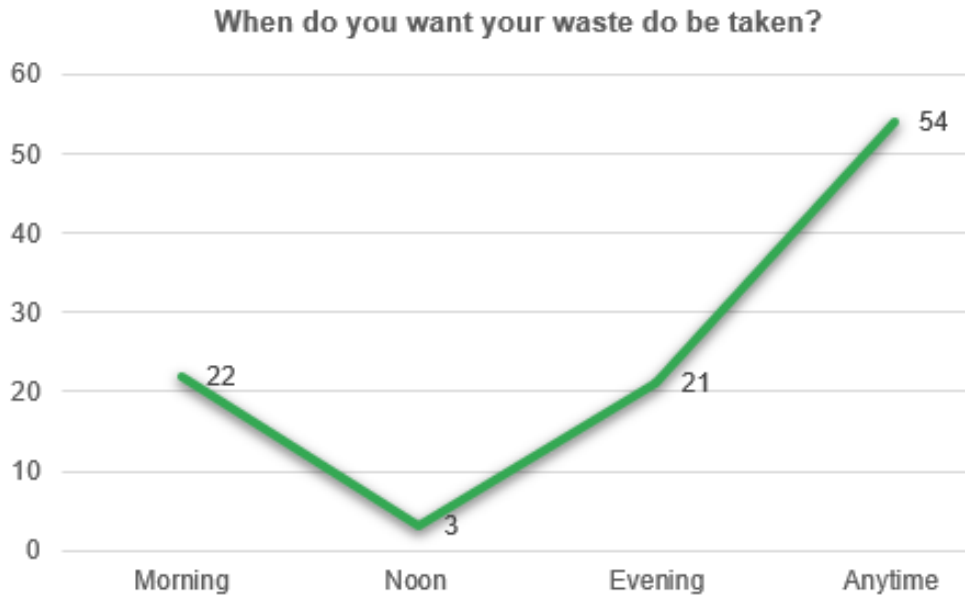

Figure 45. Line Chart of the time of waste to be taken

The fourth section of this questionnaire is for building level and firstly there are asked the people who lived there. The family classes were mainly little ones with approximately 3 persons, as it is stated in *Figure 46.*

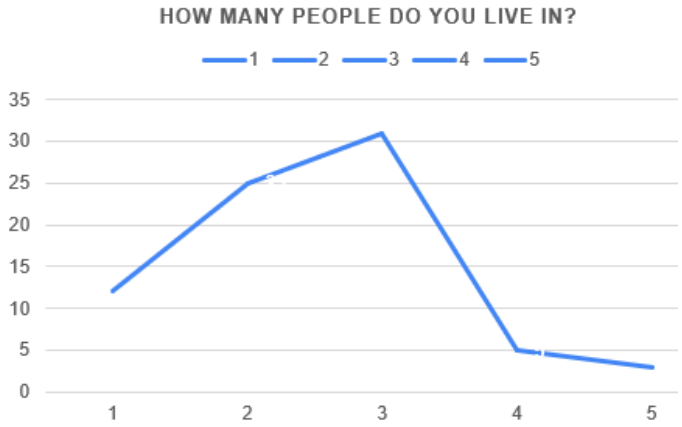

Figure 46. Line Chart of Number of People in Apartments

At the *Figure 47* is represented the column chart where types of wastes are indicated. Plastic has the highest numbers and is a very problematic material.

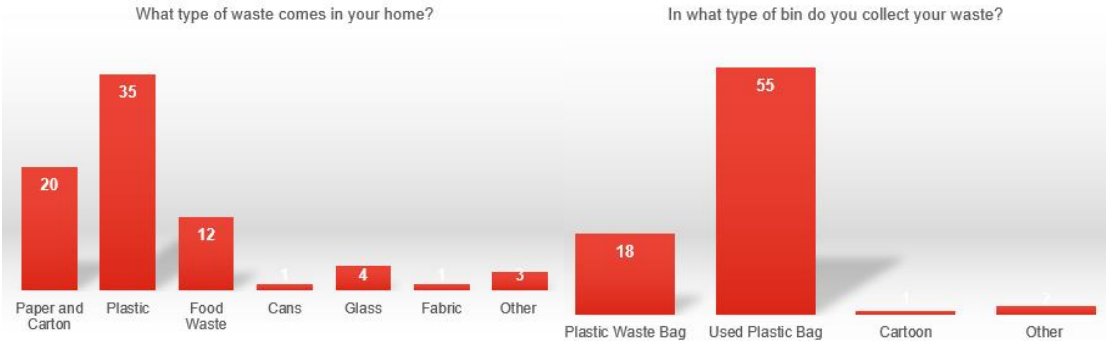

Figure 47. Column Charts of types of waste and bins

In *Figure 48*, are represented the Line Charts of some yes or no questions, where are visible the high numbers of no replied about time and space in their home.

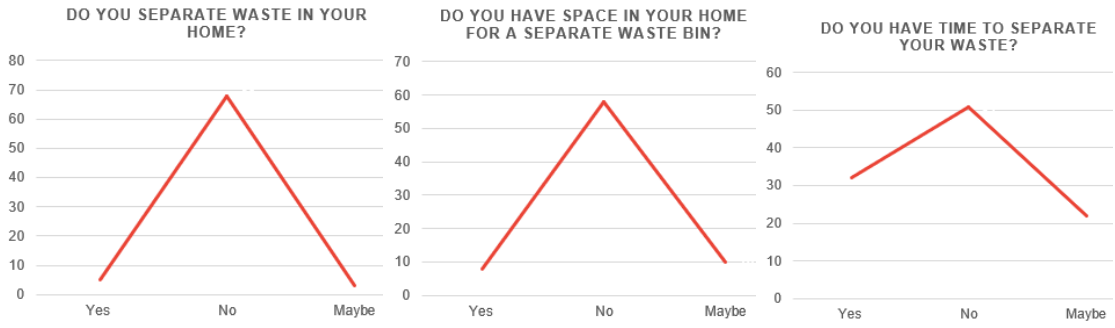

Figure 48. Line Charts of time and space for waste

The questionnaire was concluded with an open-ended question, where the citizens are asked what would they suggest for a better waste management and here are some of their responses: Closer bins and in a better state, cleaner, municipality investment, something more practical, having more bins, better differentiation, bins closer to home, waste be collected more often, raise awareness, more municipal employed, specific bins for specific shops, hygiene, more bins, more recycling centers, more information, group to deal with it, modern systems, commitment to recycling, better places for bins, investment etc.

4.4 Discussion on Analysis

This analysis helped this thesis to emphasize the problems, what brought them, how is the state and how do people feel about them. The current state is chaotic, due to the poor urbanization method followed. People feel very disturbed and unpleasant by the current infrastructure and want better management.

The problem genesis is quite obvious in the analysis part. The revitalization and a new hygienic neighborhood can't be constructed since it would be impossible. But with some interventions based on analysis and suggestions we can bring proposals that can adapt the current situation and provide regulators for future interventions.

What is interesting at the responses of the questionnaire, are the proposals from the last questions. The people state that they want more bins, more recycling centers, but the problem isn't at the quantity of them, since we can see from the waste distribution map, that there are too many of them. The problem is at the quality and to functionality. So, it's obvious that we don't need more bins, we want bins that work.

CHAPTER 5

POTENTIAL PROPOSALS AND SOLUTIONS

Recycling systems not only minimize waste and save money, but they also develop a sustainable image. People are now focusing on sustainability and eco-friendly by reducing their carbon footprint and becoming more environmentally friendly by putting a recycling program in place. Doing so is just another way to better serve the world. One way is to control what you bring to your home. So, we should raise awareness to double-check products before bringing them home. This should become a lifestyle.

Many institutions are dealing with finding a proper solution for the environment, but in many cases, architecture is left out. It is to be considered as a neglection because there are a lot of problems that architecture can solve. So, below are listed some proposals at different architecture levels.

5.1 Cross Scale Approach for Waste Management in Tirana

When we think of the problems within the city, waste is considered a big problem, but a bigger problem that impacts a lot of us is the traffic. Many of us have faced waste vehicles every hour of the day, on roads, or even doing the process. It may be a little disturbing, starting from the fact that they have to stop at the normal lane, and people have to wait until it is finished. Another unpleasant thing is also the odor that they cause. Besides the traffic, it causes also fuel consumption, pollution, noise, and disturbance to the citizens.

The Cross Scale Approach brings a solution that can be implemented in each scenario. So, one proposal can be the transportation of the waste in a flowing system underneath the land, in a mechanical way, as it is shown in *Figure 49* below. So, as it is visible from the drawing the waste off each building undergoes a path underneath to be

collected at a proper place, without any transportation. The same goes also for the bins around the city, which can be used by random residents.

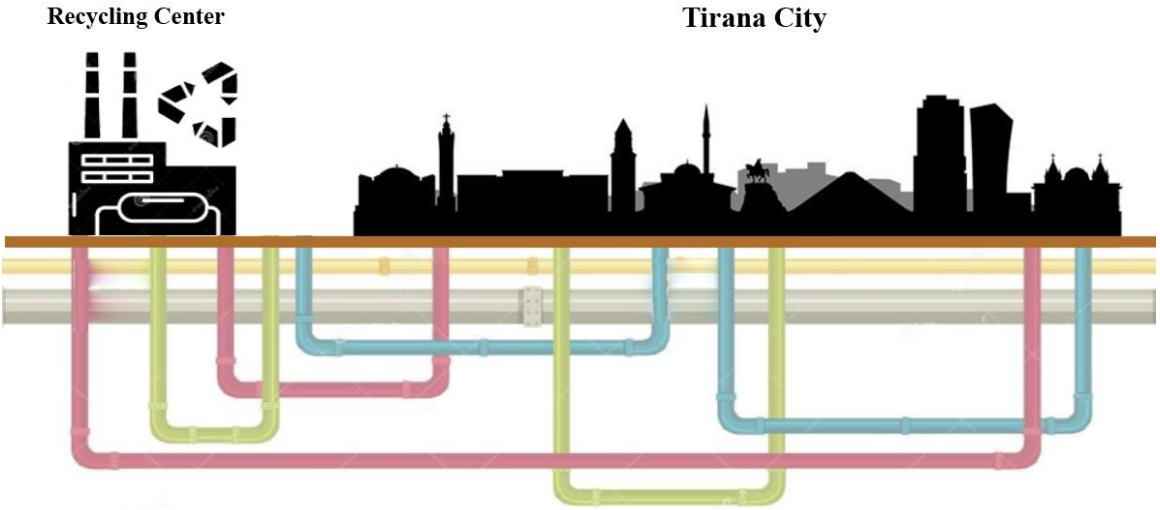

Figure 49. Cross Scale Approach for Waste Management in Tirana

5.2 Multi-Level Interventions

The multi-level term is widely used in this thesis, so now it has the peak meaning since we are proposing what we had in objective. The interventions are done firstly in Macro, when we have the city of Tirana, Albania. Secondly, in Meso, when we have a problematic study area. Thirdly, we have Micro, the highest building on the site and we propose our intervention. These are further explained below.

5.3.1 Macro Level Intervention

As it is stated above, in the diagram we see the silhouette of Tirana City. The proposal of the city is similar to cross-scale approach. This proposal will be very suitable for Tirana years later because it will solve many issues, like traffic, pollution, odor, noise, etc.

5.3.2 Meso Level Intervention

After conducting the analysis, taking into consideration one of the hot spots, now is time to provide some suggestions. Since we are talking about neighborhoods, it means that the bins should be thought with a system as was mentioned above. They won't be used anymore as bins for collecting the waste from residents, but just as bins for pedestrians, not to throw the waste on the roads.

For the distribution of them, we will use the actual places since they seem well distributed and people are used to these places. The 3D and Plan of distribution of the bins are shown in *Figure 50* and *Figure 51* respectively.

Figure 50. 3D Distribution of Smart Bins

Figure 51. Plan of Distribution of the Bins

One huger problem than the spreading of these bins is the design of them. So instead of having a huge massive phosphorescent bin, it should be better to have elegant ones, and correctly and thoughtfully spread. These bins should also be smart ones. Below, in *Figure 52* is shown a collage of the actual state, followed by the proposal and then a section together with the underground part.

Figure 52. The intervention of Neighborhood Bins

5.3.3 Micro Scale Intervention

From the analysis, of the building height map, we can spot the highest buildings. There are many buildings with 13 stores, as we can see from the maps below in *Figure 53*, but by zooming in we pick one of them to try our interventions.

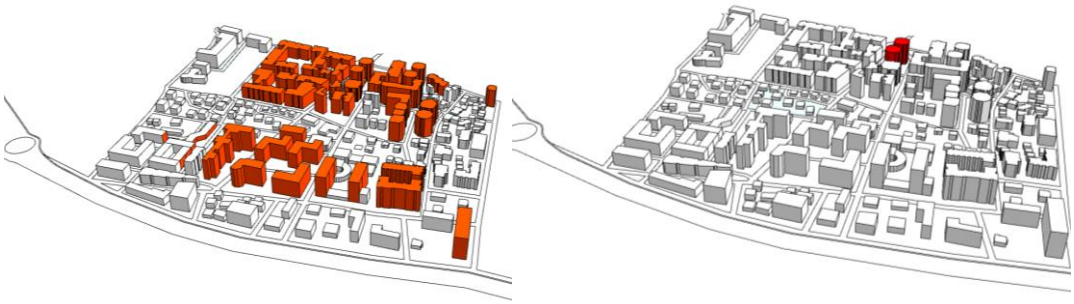

Figure 53. Highest Building

By using ASIG Geoportal, there is generated an orthophoto of the selected building shown in *Figure 54*. Then, by going on site, is taken the photo of the actual building, shown in *Figure 55*. The building consists of two identical towers, linked with a one-store building on the ground floor. This building is used for commercial purposes on the ground floor and residential purposes in the other 12 stores. The chaos is quite understandable.

Figure 54. Photo of the selected building

Figure 55. Orthophoto of the Selected Building

By using the given data and Revit Software, a 3D of the building is generated. This is shown in *Figure 56*. As displayed from the image, the density is visible. Starting from a building scale, this thesis is proposing a system that should work like a disposal system. This kind of disposal should be part of a unique and special system integrated with the building, for example, a sewage system.

Figure 56. 3D of the selected building

After that, the masterplan, plan and elevation are generated. They are also generated from Revit Software. They are shown in *Figure 57*, *Figure 58* and *Figure 59*, respectively.

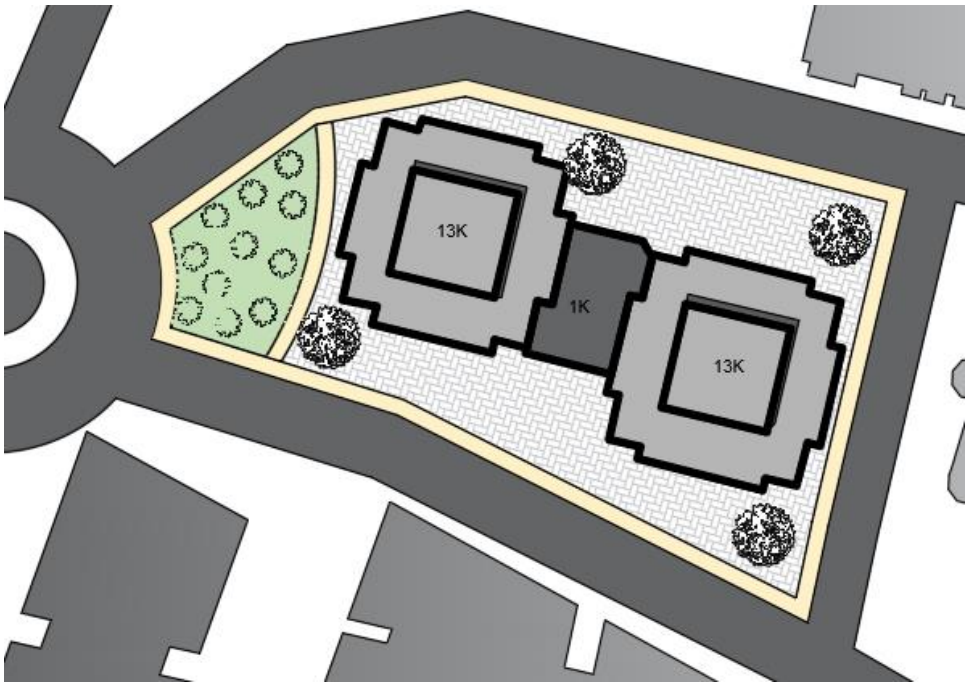

Figure 57. Masterplan of the selected building

From the masterplan, it is visible the exposure to the roads from the four sides of the building. It means that the implementation of the system should be thought carefully to seem as aesthetic as possible.

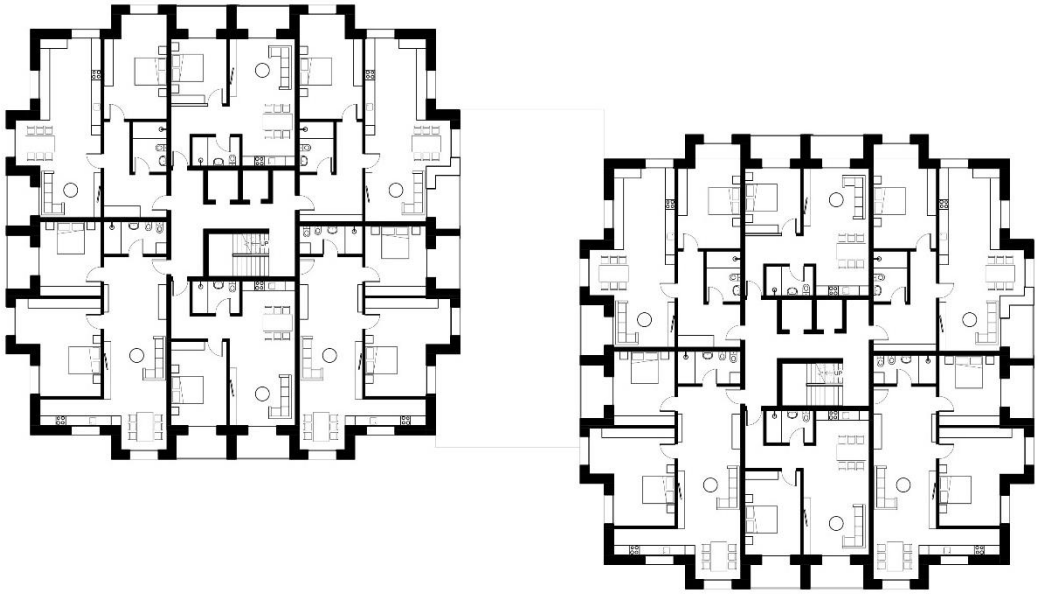

Figure 58. Typical floor plan of the selected building

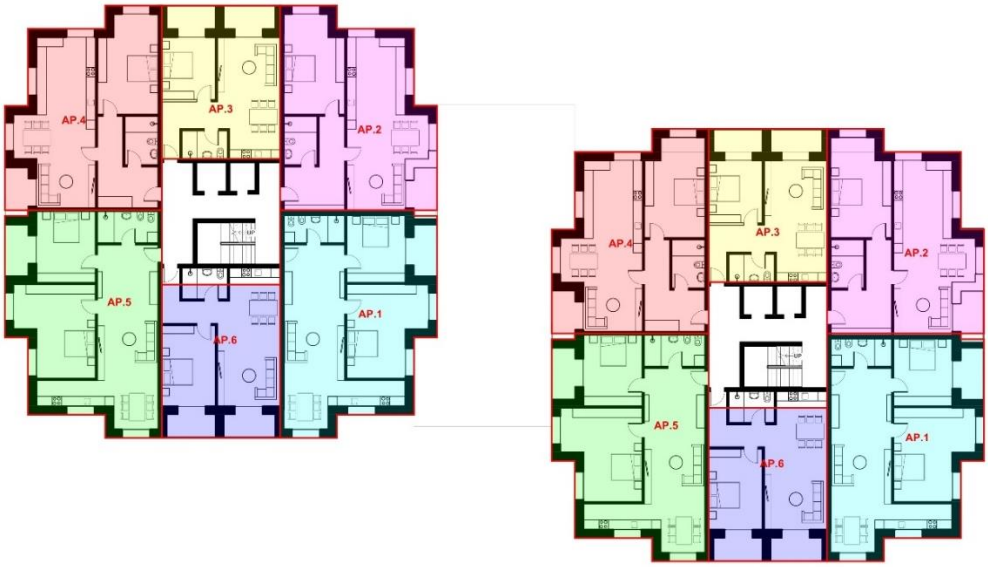

Figure 59. Apartments of the selected building

From the plan, the number of apartments can be analyzed. So, as it is visible in *Figure 58*, this floor consists of 6 apartments. The same goes for the other part of the building. What is helpful is that 4 of the apartments are at the corners of the building, so the system can be implemented at one part that doesn't block anything and the space can still be functional.

Figure 60. Elevation of the selected building

This system will be adapted to the actual building. Below in *Figure 60*, are represented the favorable picked spot. In this case, they can be attached at the pocket

created at the corners. Some windows will be removed and covered, but this doesn't affect the space to much since another window lights the environment. What impacted this selection more is the fact that it will be nearby the kitchen.

Meanwhile, for the two apartments at the center, this system will be a little different since it will have a square shape, and will be far from kitchen. However, the space of kitchen and living room can be easily exchanged for it to perform better. The system will be placed at the balcony of the same apartment and no window will be affected.

It should be emphasized that the system will be fully isolated, hygienic, and also with a pneumatic function to prevent blockage. The dimensions are 1.5 X 5.5 m and 1.5 X 1.95 m for the square ones. The tubes are inserted into this block.

What this thesis suggests is that this problem and issue should be followed since the building is projected. So, this new shaft is to be considered in the dimensions of every newly designed building. The plan, elevation and 3D of the intervention, is represented in *Figure 60*, *Figure 61* and *Figure 62*, respectively.

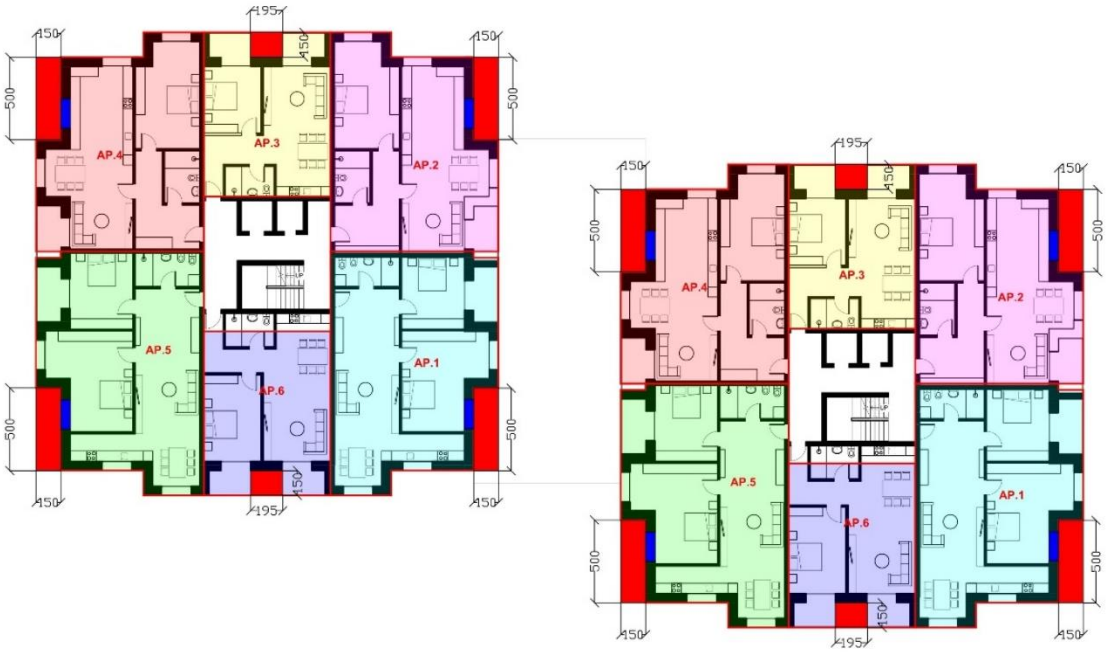

Figure 61. Intervention for the system

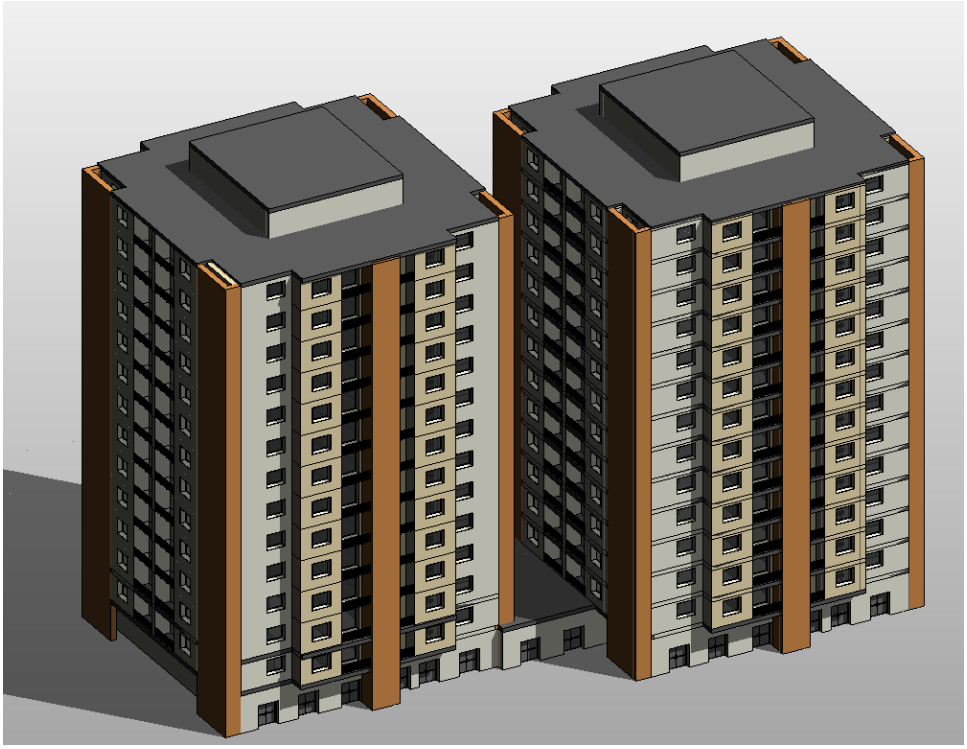

Figure 62. *3D* of the Intervention

Figure 63. Elevation of the Intervention

CHAPTER 6

CONCLUSIONS

6.1 Overview of the Performed study

This thesis represented some solutions for a better waste management system for a more sustainable lifestyle. This was concluded by using multi scale approaches and interventions. Starting from choosing a particular problematic spot, then zooming in and choosing also a problematic building.

In macro scale approach, the Tirana City is analyzed together with its statistics and features. By taking into consideration some analyses that were made, we were able to present some proposals and interventions on other scales. The density of the city is analyzed by using QGIS Software.

In meso scale approach, this thesis analyzes the densest spot that resulted in the macro scale. These analyzes were helpful to show more the problem and what causes it. These problems become evident also in the survey methodology, where most of people answered that they needed more bins, more employers, but the problem wasn't on the quantity as stated by the analyzes, but on the quality and functionality. This thesis also suggests some conceptual interventions on neighborhood bins.

In micro scale approach, the densest building is chosen, by the building height map, and by generating the plans, sections and elevation of the selected building, the system that is mentioned at the case studies is implemented. It was a challenging part, where the system should be adopted in this actual building.

6.2 Limitations of the study and Further Improvements

There should emphasize some limitations that these proposals have. For instance, we are quite aware that this proposal requires a large amount of financing, starting from the new technology applied and the cost that it requires to produce. This should be named a very innovative solution that powerful cities are adapting nowadays.

Another limitation is that this system should be a new one and can't be adapted to the actual waste management system, since the actual one works with truck transportation and community gathering waste, meanwhile the proposed interventions require underground system transportation and very individual bins.

6.3 Recommendations and Final Remarks

Throughout the thesis are given some interventions for a specific city, neighborhood, and building. But of course, the interpretations and the continuation of these proposals and interventions can be numerous.

On a dwelling scale, this thesis recommends furniture that will have its place in every home. It will perfectly make the process of differentiation, and a smarter solution that let these pieces flow in a hidden way, integrated into the building for them to be sent to the particular facility.

Other recommendations are listed below:

- Guidelines on *circular city concept* for the case of Tirana city.
- Designing some guidelines on a *neighborhood scale*, considering the proper width of the bins, how far away they should stay, etc.
- Guidelines on a *building scale*, which can be taken in consideration for future buildings.

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APPENDIX

Questionnaire

-The goal of this questionnaire is to help in study research that also proposes solutions on an architectural level.

-It aims on questioning a high number of citizens of Tirana City and their experiences.

-It is divided into several sections since we aim for feedback in a multiscale approach.

-Participation in this study is voluntary and it will be documented as anonymous.

Section 1 - Overall View

1. General Profile
    a. I live here
    b. I work here
    c. Other
2. Age Group
    a. 5-15
    b. 15-20
    c. 20-30
    d. 30-50
    e. 50-70
    f. 70-over
3. Gender
    a. Female
    b. Male
4. Have you been educated in waste management?
    a. Yes
    b. No
    c. Maybe
5. Have you ever heard about the importance of recycling?
    a. Yes
    b. No
    c. Maybe

6. Do you think architecture can contribute to better waste management?
    a. Yes
    b. No
    c. Maybe

Section 2 - City Level

7. Do you notice waste on roads and the public?
    a. Yes
    b. No
    c. Maybe
8. Do you see burning waste?
    a. Yes
    b. No
    c. Maybe
9. Do you see in traffic waste collectors and trucks?
    a. Yes
    b. No
    c. Maybe

Section 3 - Neighborhood Level

10. Where do you usually put away your waste?
    a. Neighborhood bins
    b. In roads
    c. Recycling centers
    d. Other
11. Is there any public bin near your house?
    a. 100 m
    b. 100 m – 200 m
    c. 200 m – 500 m
    d. 500 m – 1000 m
    e. other
12. What is the state of the bins?
    a. Very Good
    b. Good

c. Normal
d. Bad
e. Very Bad

13. Do you consider it a problem?
    a. Yes
    b. No
    c. Maybe
14. When would you want the waste to be collected?
    a. In the morning
    b. In afternoon
    c. In night
    d. Anytime

Section 4 - Building Level

If you live here, please fill below:

15. How many people do you live in?

    _____

16. What type of waste comes into your home?
    a. Paper and Carton
    b. Plastic
    c. Food Waste
    d. Cans
    e. Glass
    f. Fabric
    g. Other
17. In what type of bin do you collect your waste?
    a. Plastic Waste Bag
    b. Used Plastic Bag
    c. Cartoon
    d. Other
18. How often do you empty your bin?
    a. Once a day
    b. Once in two days

c. Once in three days
d. Once a week
e. Other

19. When do you empty your bin?
    a. Indeterminate time
    b. Between 6:00-18:00
    c. After 18:00
    d. Other
20. How do you feel about waste in your home?
    a. It’s not a problem
    b. It smells bad
    c. It gets a lot of space
    d. Other
21. Do you separate waste in your home?
    a. Yes
    b. No
    c. Sometimes
22. Do you have space in your home for a separate waste bin?
    a. Yes
    b. No
    c. Maybe
23. Do you have time to separate your waste?
    a. Yes
    b. No
    c. Sometimes
24. What would you suggest for better waste management?

Section 4 – Building Level

If you work here, please fill below:

25. What is your occupancy?

    _____

26. What type of waste comes into your workplace?
    a. Paper and Carton
    b. Plastic
    c. Food Waste
    d. Cans
    e. Glass
    f. Fabric
    g. Other
27. In what type of bin do you collect your waste?
    a. Plastic Waste Bag
    b. Used Plastic Bag
    c. Cartoon
    d. Other
28. How often do you empty your bin?
    a. Once a day
    b. Once in two days
    c. Once in three days
    d. Once a week
    e. Other
29. When do you empty your bin?
    a. Indeterminate time
    b. Between 6:00-18:00
    c. After 18:00
    d. Other
30. How do you feel about waste in your workplace?
    a. It’s not a problem
    b. It smells bad
    c. It gets a lot of space
    d. Other
31. Do you separate waste in your workplace?
    a. Yes
    b. No
    c. Sometimes

32. Do you have space in your workplace for a separate waste bin?
    a. Yes
    b. No
    c. Maybe
33. Do you have time to separate your waste?
    a. Yes
    b. No
    c. Sometimes
34. What would you suggest for better waste management?

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https://docs.google.com/forms/d/e/1FAIpQLSeFrfbvF1rlKU6Xl2UF6PM43WwEs6OtnD4qFgxl_HxJkyNu3Q/viewform?usp=sf_link