Creating and Assessing Scenarios for Incremental Community Development

A Case Study in Pikine Est (Senegal)

Politecnico di Torino

Master's Degree Thesis

Architecture for Sustainable Design

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Turin, Italy

2019

A mi familia, a quien dedico estas primeras líneas en español
y a quienes debo la mayor parte de lo que soy y lo que tengo.
Espero poder retribuirles con creces.

To my friends, who have taught and helped me in ways they
can't even begin to imagine.

To all the educators - not limited only to university teachers -
who have made it possible for me to arrive successfully to this
point of my career.

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INTRODUCTION

1. Introduction

This Thesis offers an alternative approach to the irregular migration issue lived by the Senegalese people, taking the peri-urban community of Pikine Est as a case study. This paper consolidates as the final project of my academic path; a period comprised between Bogotá, Colombia (essential core Architecture subjects studied during four years) – and Turin, Italy (adding an extra year to the conventional five year term in order to obtain simultaneously my master's degree in Architecture for the Sustainability Design). Being developed and focused on yet another physical context – different from Colombia and Italy – such as Senegal, this project strives to merge the knowledge acquired in both academic experiences. By gathering in one integrated urban intervention the social and environmental components learned at the Pontificia Universidad Javeriana in Colombia and the technological and assessment factors learned at the Politecnico di Torino, this proposal can seek to be culturally adequate as well as responsive to its specific context.

The development of this project is also possible thanks to the collaboration with the municipality of Pino Torinese. Since 2017, they have been active participants in decentralized cooperation projects with the Pikine Est municipality at Dakar (having already attained experience on promoting youth aggregation through sport in the Parcelles Assainies, peripheric neighborhood in Dakar in the year 2000). The most recent of these projects included the possibility to integrate students from the Politecnico di Torino thanks to relations initiated by Professor Giovanni Vincenzo Fracastoro. By these means, the team leading this program from the municipality was able to provide the necessary contacts to support this work and to offer feedback on its evolution from a more empirical and realistic point of view. This Thesis is supported by their experience in project management and their most recent visits on site.

The objectives formulated by the Pino Torinese municipality were set in accordance with Pikine Est's mayor, as well as several associations based both in Dakar and in Pino. Their main purpose is to support the local administration's policy dedicated to creating opportunities for the youth and the women in order to prevent emigration from being the only path to build a future of their own. The actions to reach said point are as follows: 1) provide youth and women with cultural and formative opportunities, 2) increase aggregative and sportive opportunities as a motor for social and scholar recovery, 3) gather elements to support a startup for waste recovery in future projects, and 4) stimulate reflection regarding decentralized cooperation and migratory phenomena in the Pino Torinese territory. Sharing a common main goal to support youth and women (the former being the most likely to migrate and the latter being the most disadvantaged[1] group),

1. Supported in Section 1.1: Background

it is a purpose of this Thesis to **include these ongoing actions on at a level of preliminary project formulation,** trying to provide an accurate, innovative, and feasible insight addressing the irregular migration phenomenon. The methodology for doing this and the results achieved will be discussed in detail through the pages in this document.

Finally, it is also highly pertinent to mention that research and some sections from the urban analysis were carried out in collaboration with Gloria Tessarin, another master's degree student from the same course who showed interest as well in this general Thesis subject. The papers later partook different paths due to the identification of different problematics and therefore different approaches and solutions for each. Some of the graphic material exposed may be courtesy from Gloria Tessarin, or product of common elaboration, in which cases it will be correspondingly stated in the image's source.

1.1 Background

Being part of human history makes us inevitably part of a migrant history. The places we inhabit, the ways in which we live, the different behaviors that characterize multiple cultures over the globe are all factors that may take place thanks to human movements from one place to another. We can venture into saying that these movements were all conducted intending to find better conditions for an individual, a community, or even a whole empire. Whether migrating from water to land in order to evolve to earthly, oxygen-breathing creatures, or finding new places to grow higher quality produce than before, or even while trying to discover a new trade route with the Indies, we have always moved from one place to another wanting for more.

We know now, however, that the more our nations expand and the larger that social and economic gaps grow between societies, the more difficult it becomes for this migrant history to follow its natural course. Slowly, with the passing of time, emigrating to another country becomes something more constantly frowned upon by the receiving country. Although there is never a single receiving country, since the scale generally tips from side to side (for instance, situations such as Colombians migrating to Venezuela in the early nineties are now mirrored with Venezuelan's migrating to Colombia during recent years), this constant shuffle of cards in which receiving parties change by the decade or so leads to unprepared countries on how to embrace newcomers. Sooner or later, a welcoming country reaches a point of saturation in which it is no longer possible to sustain new arrivals as well as the citizens of its own, so the first solution that jumps out is the closing of the borders (taken literally in some occasions, as for the growing tendency of building walls separating one country from another).

Migration Today

According to the *Agence Nationale de la Statistique et la Démographie* (ANSD for its initials in French), the entity in charge of monitoring economic, social, demographic, and several other categories of statistics for the Republic of Senegal, it is this very closure of the borders the first responsible for worsening the migratory issue (NDIONE,2018). It is very pertinent for such an entity to make said statements, given that these measurements alter the records and statistics regarding irregular entries from one country to another. This phenomenon is illustrated in the following diagram.

Figure 1. Negative Approach on Migration

Contraction of the migratory policies

numbers and statistics rise again

necessity for alternative entry routes

lower national growth

a lost opportunity

More people migrate

More Dangerous Routes

dead relatives

youth abandoning homes

less control

uncertainty among the migrants' families

Difficulty in gathering data
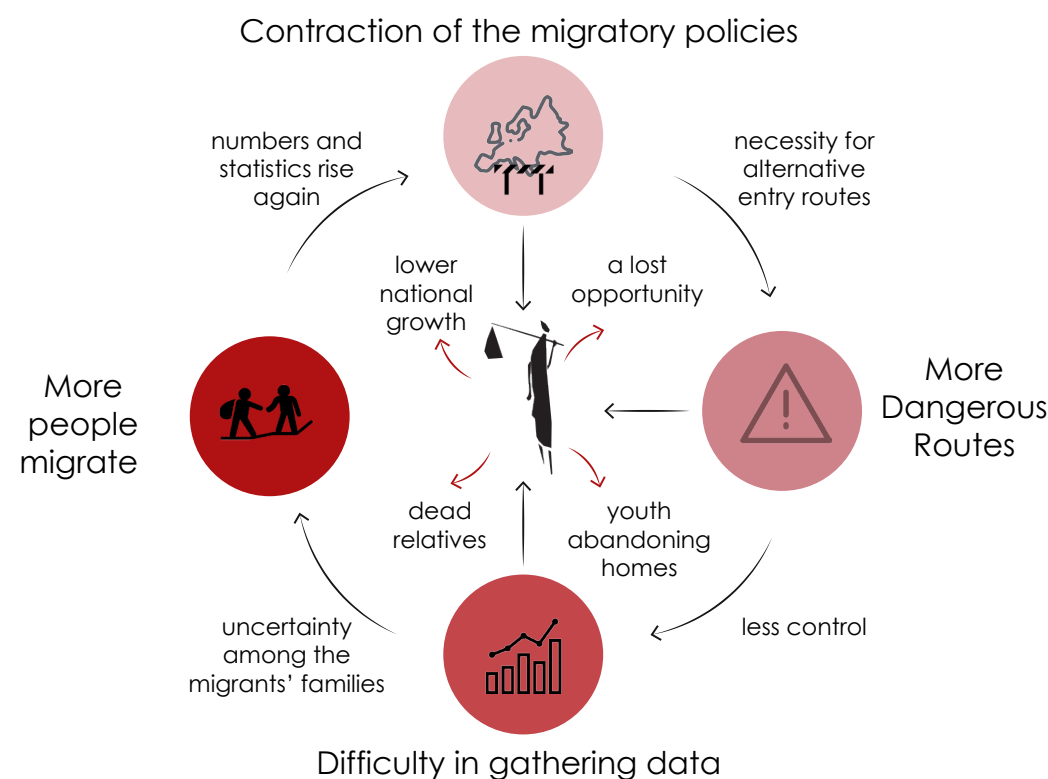
Source: Elaborated by the author based upon NDIONE, 2018

Increasing the rigidness of border controls does not end the migratory issue, it just moves it. Peoples' need to access well-settled countries is still there. As a consequence, migrants simply look for new routes, with less control, but usually with higher danger. Such is the case of migrants rejected by Italy and taking upon searching for opportunities in France. As border regulations and controls tighten up, these people risk it all by crossing the Alps. Usually unprepared and unadapted to this environment, around fifteen migrants – on average – are rescued each night by Red Cross volunteers in the Alpine area (Livesay, 2019).

These scenarios, where perilous routes are chosen for their lacking surveillance, are therefore followed by complications to gather data, expressed as another link in the cycle of Figure 1. In the previous example, I referenced how rescuers were able to find an estimate of fifteen people per night. This, however, does not account for how many people are unfortunately not even found, having possibly perished in their attempts to cross borders. There is no information on who leaves their country of origin, so there will be even less regarding who arrives, how, and where. Such fragmented data makes it nearly impossible to calculate the magnitude of the migratory phenomenon (NDIONE, 2018).

It becomes more concerning when tracing back the path to a migrant's family. There are people back home, counting upon him or her to arrive safely to a better destination and make a better living for them. But lacking means of communication make it impossible for a family to know the whereabouts of its relatives while on their journey, and most of the time families end up stumbling upon heartbreaking news through lists with names of those found dead along the many paths of migration. This happens sometimes even months after their departures. Sadly enough, when conditions in your home country are not proper, migration seems to be the only way out, so there is usually a younger sibling to follow an older one's path, and seek for better opportunities on other lands, for it is also seen as a sign of dishonor if you do not provide for your kin when it is corresponding (Guilbert, 2016; Searcy & Yaya, 2017). As migrants arrive successfully to their destinations, the numbers shown by the data increase, therefore leading to an increase in migratory policy contractions, and thus completing a seemingly endless cycle to this issue.

Naturally, this does not mean that countries should be forced to host all who arrive in it, for eventually even the richest of nations will become saturated with people and unable to offer the same for all. Instead, the implication in this statement is to suggest that the approach to the migratory phenomenon should be reconsidered. The first scope of the diagram is to graphically show how migration is being addressed today, and how it grows into a perpetual cycle, every time with deeper repercussions. There is also a secondary scope to it, which serves the purpose of **understanding which stage of the cycle can and should be intervened in order to revert its negative effects**. This is where the inner arrows of the diagram come to play.

The outer spheres in the cycle represent external factors influencing migration, but the inner part represents how individuals and communities are affected by them. This is depicted as an abstract human figure, (like those typically seen in traditional African art styles) though in this case, it is not joyful as these paintings usually are, given that it carries its belongings as a migrant. It may seem a subtle gesture, but it is a way to show how African essence is carried away with every person that forcefully migrates. With young people fleeing from

the scarce possibilities to design a future for themselves in their home countries, African nations lose potential motors for internal growth, since the generations in which the future depends on are chasing their ideals elsewhere. By perpetuating this path, the intrinsic values of the continent are bound to suffer a huge impact. Therefore, investing in the youth, their opportunities, and their sense of belonging to a home country might help take a 180° turn on the battle against lives lost to irregular migration.

As I have already shown, the top-bottom solution is inadequate for this situation. It implies a change in the general mindset that revolves around it, until we are all conscious it is a condition that must be targeted at is roots in order to be controlled, always keeping as the main goals the preservation of the human lives at stake and the interior strengthening of their countries thanks to their own force. Decentralized cooperation programs such as the one involved in this project – explained in detail in Section 1 (Introduction) – make this possible for countries such as Senegal, which may not count upon the necessary monetary or formative resources in order to kickstart said development projects.

Senegal appears to be a well-positioned country when compared to other sub-Saharan nations, even so, that it receives migrants from other countries in Africa. Unlike most of its neighbors (such as Mali, Guinea, and Sierra Leone), it is not menaced by war or conflicts, which compose a high relevance motivation to leave one's nation (Guilbert, 2016). This suggests however that one must take different considerations in order to analyze the basis of the internal problem forcing youth to leave the country. **Could it be that the problem lies merely in economic instability? Might it reside deeper within?**

The first approach to this research begins with a demographic revision, maintaining this project's interest to keep the community in the first place. We can observe in Figure 2 how the population in Senegal is distributed almost equally among women and men. This parity is also appreciated by its distribution between rural and urban areas, the former distributed across 53.5% of the Senegalese territory, with the remaining 46.7% occupied by the latter.

Figure 3, on the other hand, serves the purpose to show contrast on how the Senegalese population, though relatively equal regarding gender (50,2% for women and 49,8% for men), is not as homogeneously spread geographically, tending to locate near the capital and its surroundings. This is the first evidence of migratory movements for our specific case study. Since this project pretends to offer viable responses upon migration for the Senegalese case, it must also consider domestic migration, in order to provide foresight on its appropriate size and capacity to able to serve a realistic amount of people.

Figure 2. Population Density for Senegal (2013)
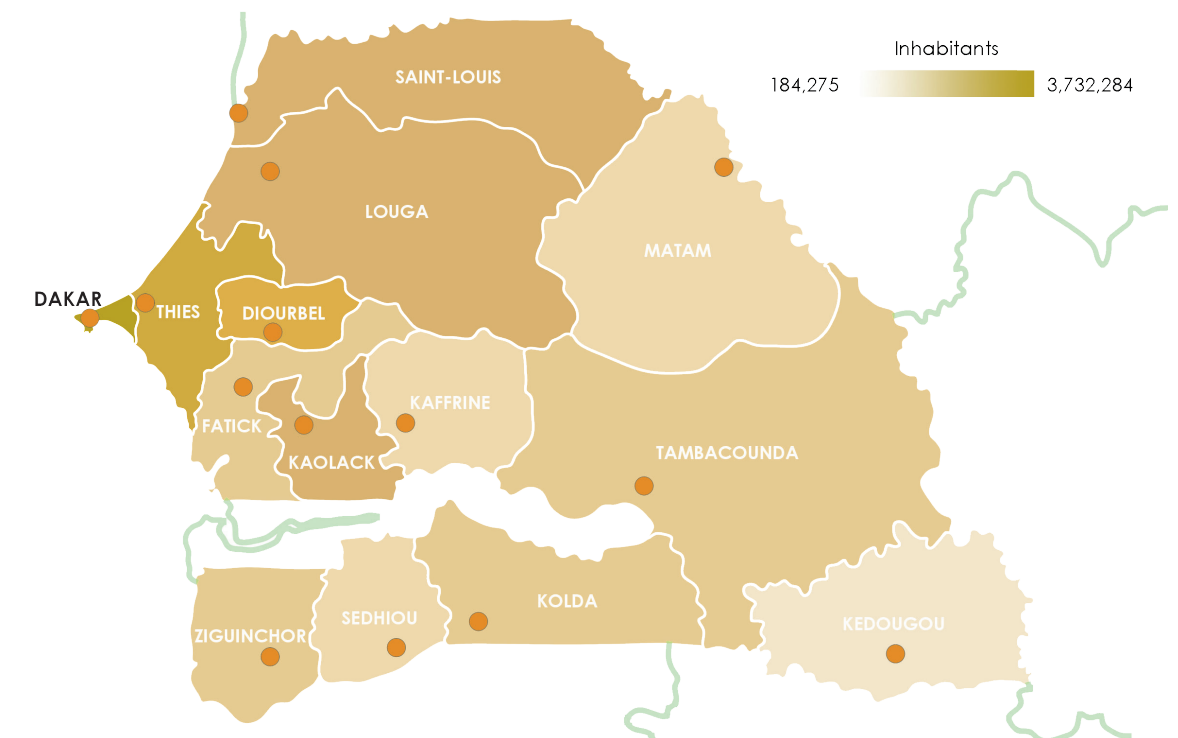
Source: Re-elaborated by the author based upon NDIAYE, 2014

Figure 3. Population Pyramid Chart for Senegal (2013)
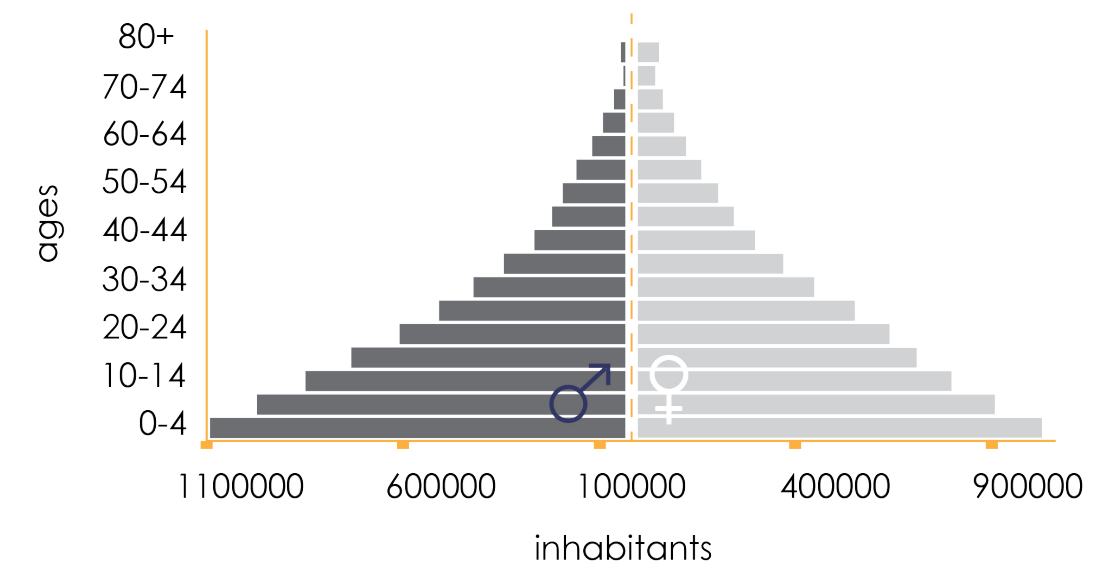
Source: Courtesy of Gloria Tessarin based upon NDIAYE, 2014

Following the conclusions suggested by Figures 2 and 3, we go deeper into studying the

reasons for emigration, seeking to reveal what is lacking in the country. According to the Report on the Migratory Profile elaborated by the previously mentioned ANSD, the major motivation to emigrate is work-related, followed by study motivations and by familiar reasons. These factors could be roughly translated into saying that labor conditions in Senegal are inadequate, that the youth is indeed leaving the country, slowing its rate of progress, and that a smaller fraction of migrants decide to leave either seeking to provide for their families, or following the steps and the stories of success told by one of their relatives already living abroad. This gives us an insight into which matters should we address first in order to provide possibilities for people to build a future of their own in Senegal. The aforementioned motivations are graphically represented in Figure 4.

Figure 4. Motivations for Migrants to leave Senegal (Left), Age when Migrating (Right) - 2013
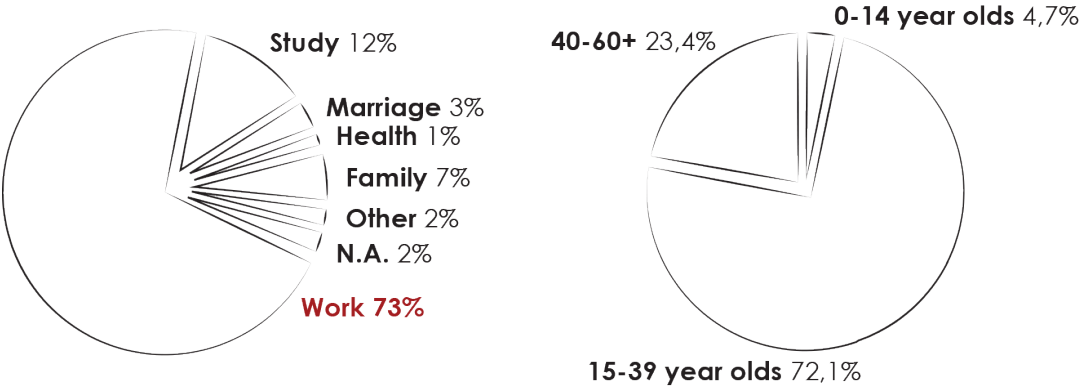
Source: Re-elaborated by Gloria Tessarin based upon NDIAYE, 2014

The chart to the right in Figure 4 is highly relevant to the future development of this Thesis. It clearly shows that the age group formed by young people is the one that tends the most towards migration. Upon further research, this information acquires much more relevance when discovering that the group of migrants between 25 and 29 years old (a margin of only four years compared to the individual categories established by the chart in Figure 4 with a margin of fourteen years each) makes up for a 20,1% out of the 100% migrating population (NDIAYE, 2014). Such high percentages might suggest an estimated age for our **target group**. But we are yet to arrive at another disturbing conclusion thanks to the Report redacted by the ANSD: much like Senegal's population, the overall migrant population is equally distributed among men and women, however, out of all the migrants who return to Senegal after having successfully made a better life in a distant country, 97% are men, while only the remaining 3% are women (NDIAYE, 2014). With such data, we were driven to perform specific research on why conditions for migrant women are apparently disadvantageous in Senegal.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) lead a

Partnership for Girls' and Women's Education alongside Procter and Gamble during a two-year period (between 2011 and 2013). Its one-year report, however, was rather discouraging, as the article cited how Senegal was classified as "unlikely to meet the Education for All (EFA) goals by 2015 and ranked 117th out of 127 countries in the EFA Development Index"[2]. The report pursued the idea of arriving to gender equality in the Senegalese educational system. Sadly enough, the higher the educational level, the lower inclusion of women[3]:

Table 1. Gender Parity in Education for Senegal (2009)

Primary Education Enrollment			Transition from primary to secondary			Secondary Education Enrollment		
M	F	GPI	M	F		M	F	GPI
72%	74%	1.04	62%	57%		34%	27%	0.79

Source: Re-elaborated by the author based upon EFA Global Monitoring Report statistical tables (school year ending in 2009)

In the original table published and contained in UNESCO's one-year report, it is also possible to find adult[4] literacy rates for men (62%) and women (39%). These numbers depict the general panorama of the women in Senegal, with literacy being a decisive factor in the economic prosperity of a household, rates of employment, and position in society. Apart from the economic reasons that may lead to scholastic abandon, we can rely on the conclusions of the One-Year Report (2012) to explain the social obstacles that women in Senegal face to obtain equal access to education:

"(…) early marriage, teenage pregnancy, the long distance to school, unsafe roads and poor infrastructure of school buildings, as well as the low quality of education constitute other impediments to girls' enrollment, retention and completion of education. Furthermore, socio-cultural norms and practices concerning the role and position of women in society and other challenges such as gender-based violence, contribute to the low literacy rate of girls and women."

_____

2. UNESCO / "UNESCO Global Partnership for Girls' and Women's Education - One Year On" / 2012
3. GPI – in the following table – stands for Gender Parity Index, the ratio of female to male values of each indicator. A GPI value of 1 signifies parity among genders.
4. Fifteen years old and over

Despite requiring future verifying – since they are research born and not formulated in-site – **these motivations may portray the general panorama for the Senegalese woman**, and why the gender gaps appear as a major reason for the existence of unwelcoming conditions for them there. In such geographical contexts, it is also pertinent to examine the infrastructural panorama influencing our target group before embarking on an intervention. For this scope, we will reduce our scale of study, on a first instance, to the territory of Dakar. To assist in supporting disambiguation of high relevance for this project we make use of Figure 5, representing Dakar's territorial division. As stated before, the ultimate scale of study will be the territory of Pikine Est, so it is essential to prove that although it was generally included as part of Dakar's territory (therefore apt to vantage from urban infrastructures and services), it was usually left out from the city's development plans, despite being considered as a peri-urban area ever since its establishment in 1952 up to the act of decentralization which rendered it part of the independent city of Pikine in 2013.

Figure 5. Dakar's Territorial Division
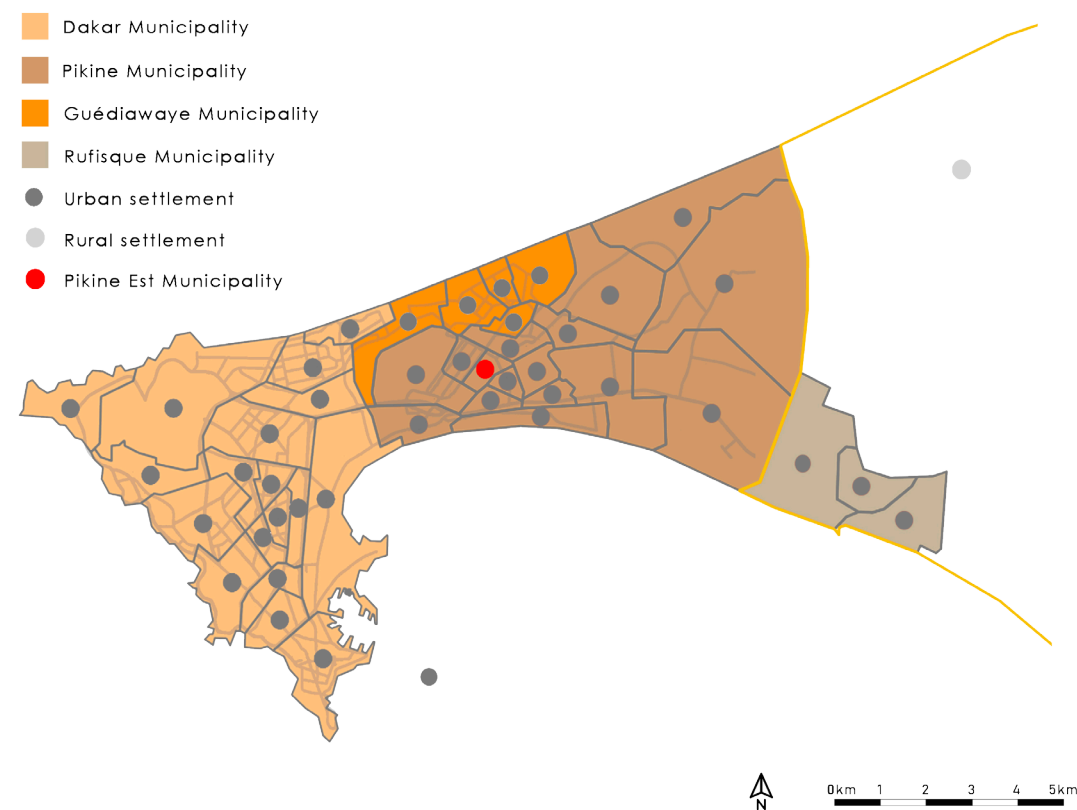
Source: Re-elaborated by the author based upon SANÉ, Y., 2014

Dakar was founded in 1857 due to the geographic potential it offered as a natural harbor. In fact, Senegal is known as the gateway to Africa, being Dakar its westernmost point. A second main factor that determined its foundation was its proximity to the island of Gorée, center of the Atlantic slave trade. Both motivations to found the city lead into turning it into an urban area destined mostly for labor and production. Naturally, this has repercussions

on urban development. Alé Badara Sy (2013), geographer, urbanist, and president of a think tank regarding Senegal's urban issues presents Dakar's urban situation through its historical context:

> "The current form of the city is the result of a segregating process advanced in a piecemeal fashion since the colonial occupation with a "working" city (*la ville "utile"*) that was planned while the rest of the region was left to itself. This illustrates the social and spatial disparities that prevail in the agglomeration."

In this explanation he also mentions how **peripheric areas were left out along the history of the city's consolidation**, supporting one of our previously mentioned statements. This leads to economic instability, social isolation, weak urban planning among other problematics highlighted by Alé Badara Sy (2013):

> "The population of Dakar represents a quarter of the national population and half the urban population. Young people—those less than 35 years old —represent more than 70 percent of the regional population. This population is unequally repartitioned and is located principally in the large cities of the agglomeration (Dakar, Guédiawaye and Pikine). More than 97 percent of residents live on close to 40 percent of the region's area, the rest being composed of weakly populated rural and agricultural zones. This illustrates a "one-way" urbanisation which has not unfurled without bringing with it social consequences (insalubrity, begging, delinquency, etc.). These disparities explain the importance of flows between Dakar, zone of activity and employment, and its suburbs, zone of dormitories, underequipped and isolated."

There is little to no cooperation between the relatively recent city of Pikine and the metropolitan Dakar. This is especially discouraging when discovering that the boroughs in Pikine (such as Pikine Est) were mostly created by displacing people inhabiting Dakar's former periphery when the city needed area to expand. With these actions there will always be a sense of social resent, further damaging possible links between institutions. Today, the periphery faces problems as land shortage, overcrowding, and environmental hazards. This doesn't mean that the metropolitan area of Dakar is safe from such threats. The following four pages propose a simple, but efficient exercise. Each page contains a map. Maps in confronting pages are presented this way in order to evidence a relation between them. Although they are re-elaborated using documents by different authors, they make perfect sense when overlapped, considering the parameters they represent. It is yet another proof of how crucial it was for the development of this Thesis to filter information and to compare it among sources, in order to arrive at perhaps previously unvisited conclusions.

Figure 6. Land Use Distribution in the Dakar Territory

Legend:
- Central business district
- Mixed use
- Primarily residential
- Isolated rural structures
- Industrial / Commercial
- Port areas / Airports
- Green urban areas
- Forests
- Water bodies
- Agricultural / open non urban land

0km 1 2 3 4 5km
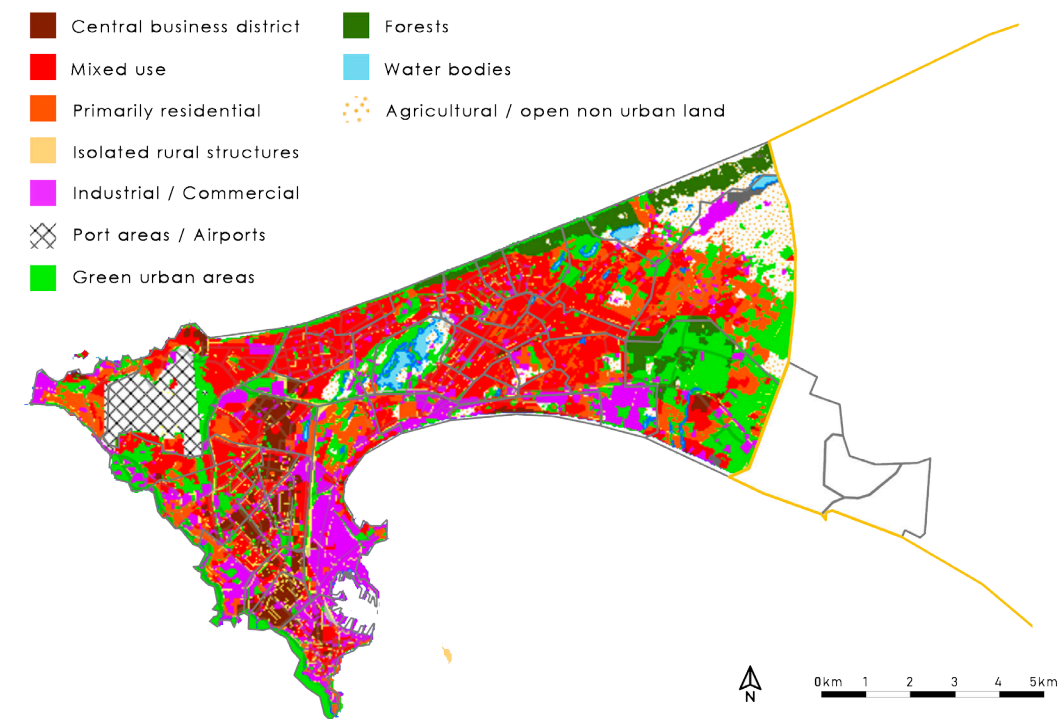
Source: Taken and adapted by the author from WANG, H. G., MONTOLIU – MUÑOZ, M., GUEYE, N. (2009)

Figure 7. Population Density in the Dakar Territory

Legend:
- 4001 - 10765 hab/km2
- 10766 - 20770
- 20771 - 37340
- 37341 - 55653
- 55654 - 102932

0km 1 2 3 4 5km
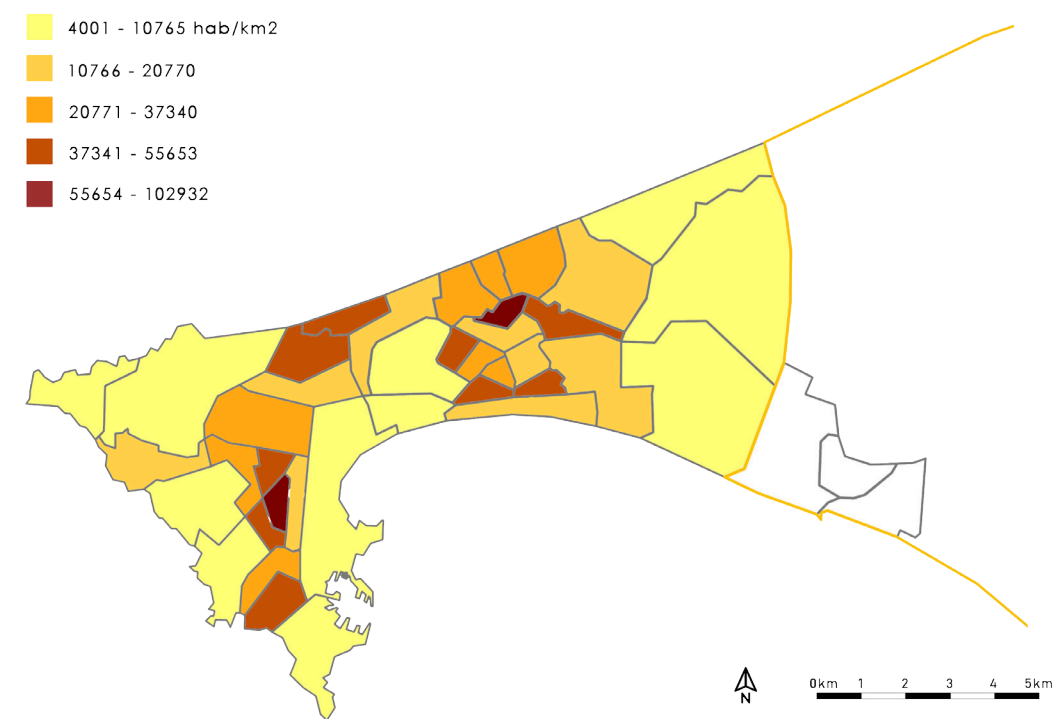
Source: Re-elaborated by the author based upon MBOUP, et al. (2015)

Figure 8. Topographic Map of the Dakar Territory

Legend:
- -1 to 7 m.a.s.l.
- 8 - 15
- 16 - 23
- 24 - 31
- 32 - 39
- 40 - 48

0km 1 2 3 4 5km

N
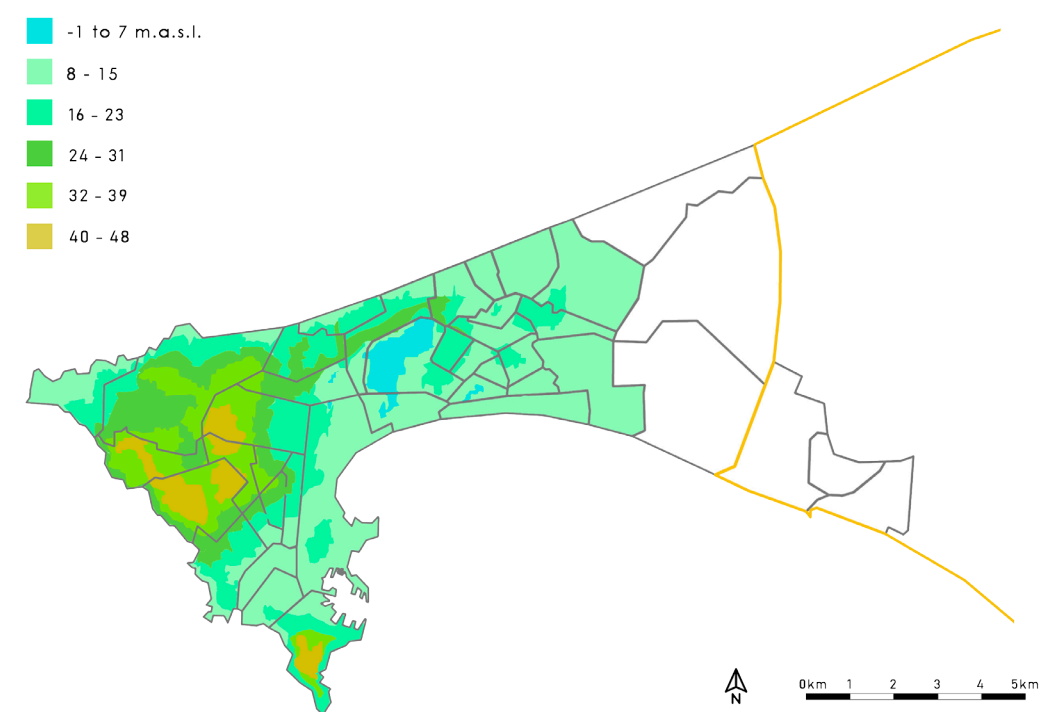
Source: Taken and adapted by the author from BURLE, S. (2018)

Figure 9. Flood Potential Map for the Dakar Territory

Legend:
- Low Potential
- Moderate Potential
- High Potential
- Permanent Water Bodies

0km 1 2 3 4 5km

N
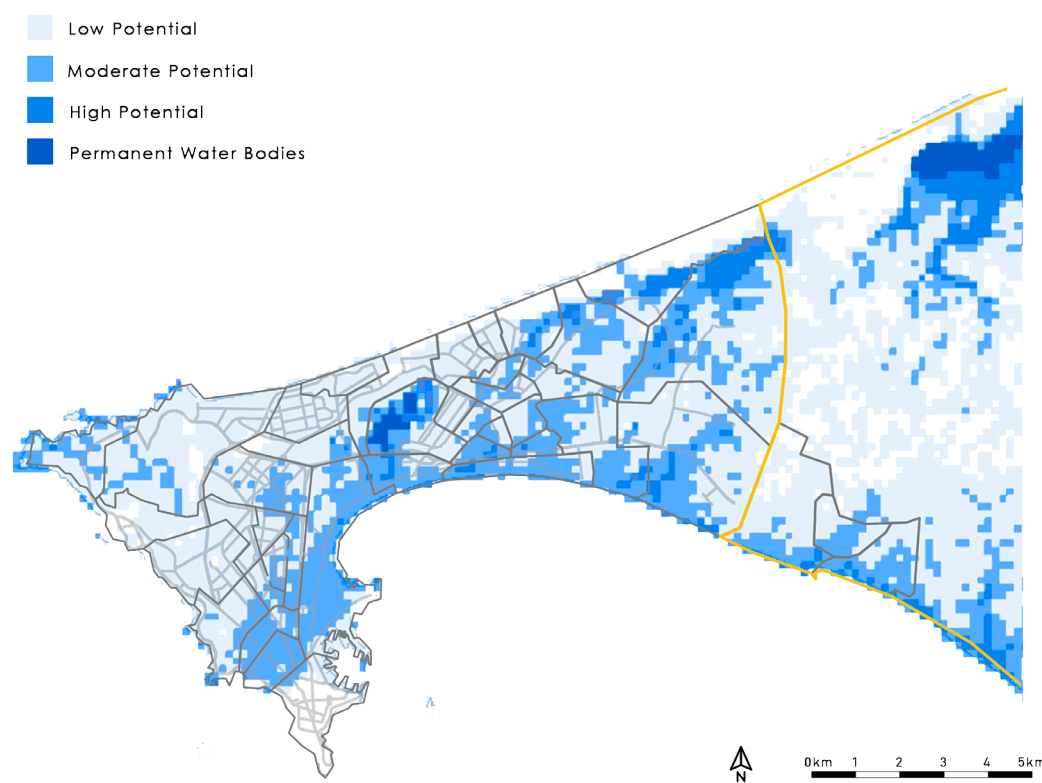
Source: Taken and adapted by the author from WANG, H. G., MONTOLIU – MUŃOZ, M., GUEYE, N. (2009)

Figures 6 and 7 consolidate as the evidence of an uneven distribution of urban services, a peri-urban area dominated by residential use, and the tendency to expect to live as near as possible to the business district (deduced from overlapping both maps). The following maps, on the other hand, simply prove that areas prone to flooding are linked to their height above sea level. It is important to add, however, how the study which originally published the map used for Figure 9 also used information about the soil quality, types, and conditions to arrive at its conclusions.

In fact, most of Dakar's peri-urban area is built over soil sealed land. This means that throughout history, wetlands have been artificially covered with soil in order to create new land to build, as near as can be to the city center, usually meaning as well that the area is overcrowded. This is the recipe for high vulnerability to natural hazards. In their document, Wang, Montoliu – Muñoz, and Gueye (2009) classify these hazards into Coastal Erosion Potential, Flood Potential, and Coastal Inundation Potential (divided into 1 meter and 5 meters rise of the sea level). Likewise, these hazards are evaluated and assigned with a risk level: none, low, moderate, and high. For this phase, we will only detain on understanding the Flood Potential area map (Figure 9), but for the purpose of this project, it is also pertinent to make use of the charts provided by the same source. They show the growth rate for urban, peri-urban, and rural areas in the Dakar territory[5], and groups the growth of each for the number of constructions settled in none or low-risk potential zones, and those settled in moderate or high-risk potential zones. The results are concerning when noticing the unregulated hazardous growth in the peri-urban area, sector of interest for our case study.

Figure 10. Built vs. Non-Built Areas in 2008 (above), Expansion in Hazardous Areas from 1998 - 2008 (below)

I Urban Areas   I Peri Urban Areas   I Rural Areas

77% Built
23% Non-Built

55% Built
45% Non-Built

6% Built
94% Non-Built

I Urban Areas   I Peri Urban Areas   I Rural Areas

Expansion in none - low hazard zones

Expansion in moderate - high hazard zones
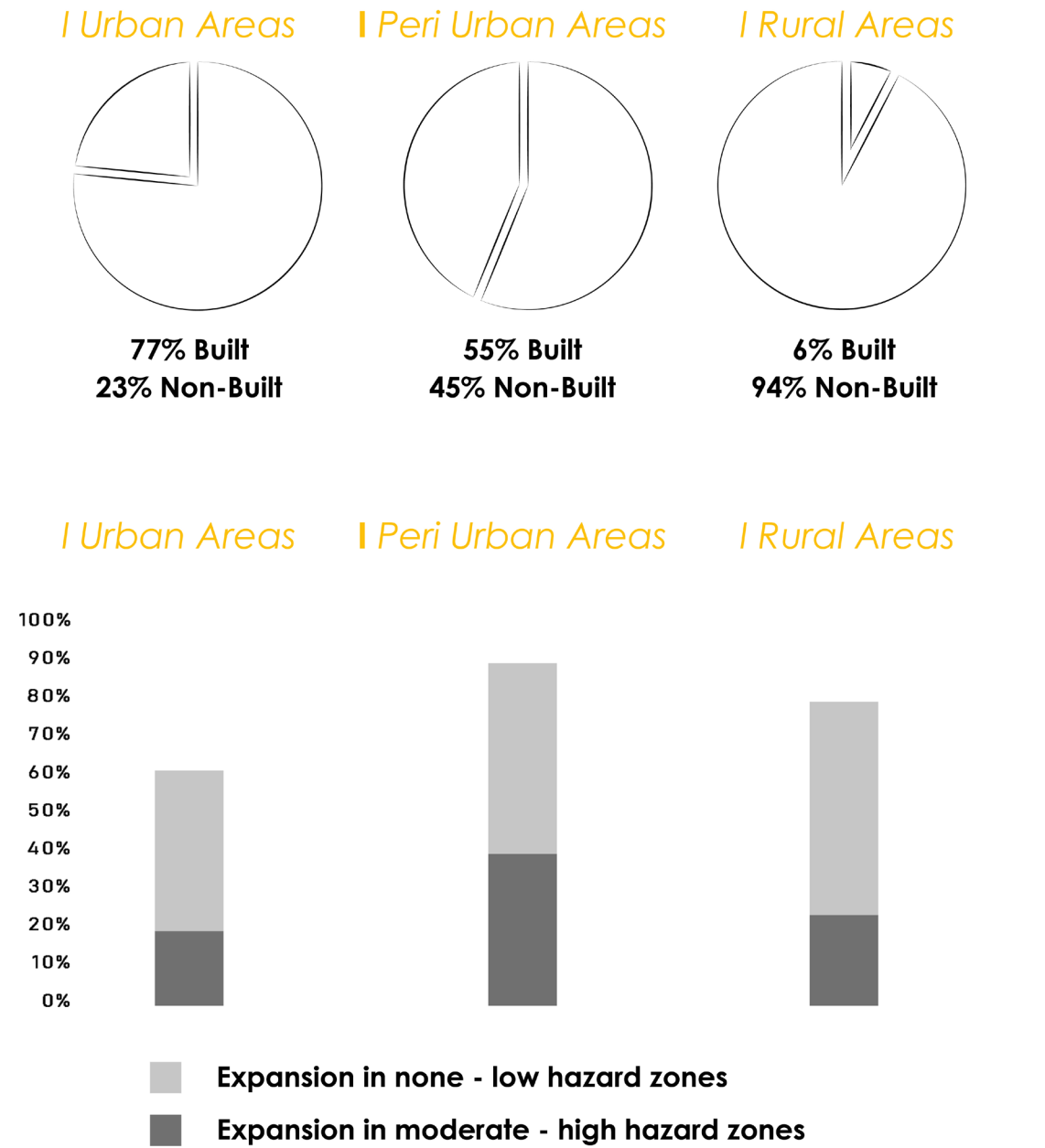
Source: Re-elaborated by the author based upon WANG, H. G., MONTOLIU – MUÑOZ, M., GUEYE, N. (2009)

After this initial approach to the research topic, problems, and current situation, I hope to have shed light on why migration is an issue that must be addressed on-site and to aid in understanding what a migrant person feels during his or her ordeals. It is not easy to leave a country, a land, and a family behind, but there are several social, economic, and (implicitly) urban motives to do so. Knowing as a result of this initial research that the chosen intervention strategy for the Case Study must focus on providing for youth and women (targeting economy, social inclusion, and scholar abandon), respond to environmental hazards, and prepare itself for the likeliness of having to welcome immigrants itself, the next chapters will be dedicated to illustrate which process was followed to arrive at the Final Project's solution.

1.2 Problem Statement

Upon examining the contents and conclusions of section 1.1, it is highly noticeable that the urban lacks in Pikine Est are directly affecting its inhabitants, to a point in which they opt for alternative ways to look for better conditions. This aggravates the general issue since there are no local people to promote community growth within. **The best resource for a developing community is its own inhabitants**, but only when they are settled in it comfortably enough, or when they are adequately motivated to participate individually in favor of the collective cause. They need a space in which their ideas may be appreciated and considered, just like spaces where they receive proper training and capacitation to perfect their own skills.

Since the problem faced by this Thesis affects citizens directly, we need to make use of research both general and specific to discover which are the major lacks destabilizing this community, especially from the urban front. However, being it so that Pikine Est is considered as an independent territory from Dakar since a relatively recent date, it is also common to find difficulties to acquire certain information only through off-site research. Research and interaction with the municipalities of Pino Torinese and Pikine Est then acquire great relevance for this project, obtaining insight on the problematics from external entities with lengthy experience in this context and from internal components dealing directly with these issues on-site. As a result, we discover **specific needs** from and for the population – to be naturally considered in the project formulation stage – **such as the creation of a new health center, the rehabilitation of the existent facilities, and the funding for one ambulance** (Commune de Pikine Est, 2019).

As additional complement source for problem identification besides the municipalities, we visited the Renken Association in Turin, a non-profit working in Senegal for over thirteen years in projects for the health and formation of children. Their experience repertoire,

however, covers also responsible tourism projects as well as ideas for innovation and creativity in business opportunities, where they held formation courses, promoted the creation of four start-ups, assisted in allocating resources for the operative costs, and provided technical assessment for at least six months. Despite these amazing experiences – or perhaps because of them – they are still aware of the predomination of bureaucratic barriers in project creation and financing. For instance, they explain how most of the documentation handled by the administrations outside Dakar is still hand-written and not digitalized, since even photocopies represent additional expenses. Most of the problems related by the Renken Association are from a social origin, making sense with most of the previous statements of this Thesis. To mention one, they say there is a general lack of nocturnal community activities, and that it is common to have problems while conducting group activities since fixing schedules for people with a variety of responsibilities at home with their kin represents a big challenge. These are all pertinent considerations to include in the project identification and formulation phases[6].

As a response to these issues and considering the limitations of this particular geographic and social context, in this thesis I will argue that it is possible to evaluate urban interventions using criteria selection analysis, focusing on life quality indicators in developing communities: The main strategy being to invest mainly on one axis per intervention and continuing then to promote smaller interventions in concordance with this first macro-layer. This will lead to the settlement of a development rhythm, in which the subsequent layers gradually improve together. Naturally, the macro-layer or axis of intervention will be defined according to the needs of the Pikine Est community, established through research, methodological development, and preliminary discussion with some of the project's stakeholders.

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6. Information collected during a personal meeting with Renken group members in September 18, 2019.

1.3 Research Questions and Objectives

General Question:

How can an urban proposal be deemed as the most convenient among a certain range of scenarios designed for a community with a strong vocation for emigration?

Secondary Questions:

Which are the indicators to be considered for the evaluation of said proposal?

How will these indicators be measured for each project scenario?

Which are the most adequate project strategies?

How can its design respond to the endemic problematics of the spatial context?

Can the numeric results be used as an appropriate tool to present the project to the community?

General Objective:

Identify aspects affecting the well-being of youth and women in the Pikine Est municipality and creating alternatives to counter these causes, using strategies that merge tradition with innovation to guarantee the project's cultural, financial, and technological success.

Secondary Objectives:

- Perform a detailed urban analysis of Pikine Est.

- Select adequate indicators to evaluate the scenario(s).

- Calculate the new value of the indicators promoted by the intervention.

- Study the preliminary performance of each project.

- Justify through the above the selection of one of the proposals (or the selection of groups of project strategies).

1.4 Proposed Methodology

The methodology employed for this research is based upon the **Project Design Manual: A Step-by-Step Tool to Support the Development of Cooperatives and other Forms of Self-Help Organizations** (2010). It was used since it is a complete guide for project planning, taking into consideration all actors involved, future predictions, project lifespan and feasibility, likeliness of social acceptance, and evaluation of the current strengths and weaknesses of the community studied. It is also highly pertinent with the topic and geographical context at hand, being drafted by the International Training Center for the International Labor Organization in association with the Cooperative Facility for Africa (COOP Africa), a regional technical cooperation program contributing to achieving the Millennium Development Goals and the Decent Work Agenda in Africa. Their scope with said document is to support cooperatives in finding the most effective way to locate scarce resources and reaching a balance between needs and economic challenges.

First off, the document sets the basis for the following content by defining what is a project, and what a project should be. Every project's starting point is the existence of a problem affecting a community. The strategies to address and solve said problem must be devised according to certain conditions in order to assure the project will be sustainable in all its aspects and therefore successful. Such conditions include **integration into broader development or business plans, being a participatory exercise, being gender-sensitive, being results-based**, adjusting to specific budgets, resources, and deadlines, and including a monitoring and evaluation system (Thomet & Vozza, 2010). Later on, the document explains the tools used both in project identification and formulation phases. These tools are directly linked with the concepts of an indicator – highly relevant to the general question proposed in this document – all of which will be explained in detail in Section 2.1.

1.5 Thesis Outline

This Thesis is divided into six main Chapters that structure its contents. Chapter 1 has been dedicated entirely to offer a general panorama of the situation in Senegal, arriving to the metropolitan scale of Dakar. It was introduced by a brief description of the decentralized cooperation project extended between Pino Torinese and Pikine Est, narrating the interests for doing so and the actions the project partners propose to pursue these objectives. It contains most of the necessary elements to understand the interests of this Thesis and the initial outcomes it expects.

Chapter 2 recapitulates what was explained in Section 1.4, but it also contextualizes each element, instrument, and tool used to gather information with the corresponding adequate timings and procedures needed to implement them correctly. This implies as well to describe how information collected will be filtered in order to be applied accurately for the project formulation. Using an example, it shows which were the investigative means to verify main documentary information collected. This is followed by the complete listing of the project identification and formulation tools that will come in handy in Chapter 3. The second chapter also tells how research methods responded to the limitation of not being able to physically visit the case study area. After this, the reader is presented with the Pikine scale of study, gradually reducing until arriving to the municipal scale of Pikine Est. Identifying three main axes of inadequacies at urban scale at merging them with the interests of the Pino Torinese – Pikine Est collaboration will lead to develop Chapter 3.

This third chapter puts into practice the methodological tools presented in Chapter 2. All of the tables are filled with information that, once structured, will assist in designing the project interventions, proposed at an urban scale and working with the three urban axes identified in order to improve well-being for the citizens of Pikine Est, focusing on the target group of youth and women identified in the decentralized cooperation program. In this chapter, crucial concepts such as "Life Quality Indicators" and "Incremental Development" are also elaborated. From these definitions, project indicators are selected and later applied in project formulation and evaluation. Project scenarios are also evaluated and discussed as an opener for conclusions. This chapter therefore contains the core developments and graphic material of the Thesis.

Final chapters are invested to extract final project conclusions and suggest developments that should follow if the Thesis project were to go further into detail. Questionnaires sent to project stakeholders and excel spreadsheets used to calculate Key Performance Indicator values are included in the end. This closes the project development, but leaves suggestions for continuing the work hand in hand with its stakeholders.

# METHODOLOGY

2. Methodology

2.1 Theoretical Approach

Documentary analysis composed the first step to approach the study subject, having, as a result, a remarkable importance in this Thesis. The project arrived at its expected end goal thanks to a large variety of bibliographical sources, although some were more pertinent to the matter at hand. Due mainly to the scarcity of data for such a specific case study in the context of a peri-urban settlement, the greatest challenge was to find the right information. This gap was filled in its majority by the results of two institutional team studies, one PhD Thesis, one official cartographic analysis, and an official document elaborated by the municipality of Pikine Est.

Chronologically, the first document examined was related to natural risks in Dakar, since this thematic is among the first ones to appear when initiating research on the area. This document was elaborated by the promotion of The World Bank, the GeoVille group, and the African Urban Management Institute, seeking to provide a preparation document against natural risks such as coastal erosion, flooding, and sea-level rise. Maps from Figures 6 and 9 in this document were taken from the document "Preparing to Manage Natural Hazards and Climate Change Risks in Dakar, Senegal", by Hyoung Gun Wang, Marisela Montoliu-Munoz, and Ndèye Fatou D. Gueye.

The following core documents work together somehow. The first one, a very complete investigation – applying methods straightly linked to the ethnography procedures explained in Section 2.1 – revolves around the topic of health in the city, considering Pikine as an urban agglomeration of its own years before the act of decentralization of 2013. As a matter of fact, this document was published and released in 1998. This implies, however, that despite its richness the information contained in it must be managed carefully, given that in such a spatial context it has probably changed considerably ever since. This is where the second document comes in, linked to the first one not because of the topic it treats, but because of the completion of the information regarding a specific area. Both documents include data that spins along a defined timeframe of several years, therefore showing the evolution of the Pikine settlement through the decades. In this way, we can understand which information is to be taken based upon its plausibility according to the precedent evolution course faced by the city. The former document is "*La Santé dans la Ville : Géographie d'un Petit Espace Dense : Pikine (Sénégal)*" (or "Health in the City: Geography of a Small Dense Space: Pikine (Senegal)"), by Gérard Salem, while the second one is Amadou Belal Diawara's PhD Thesis "*Les Déchets Solides à Dakar. Environnement, sociétés, et gestion urbaine*" (or "Solid Waste in Dakar. Environment, societies, and urban management. ").

The cartographic analysis mentioned before composes an actual verification phase. Continuing along the line established by the previous documentation, this one focuses on environmental issues, only this time examined through an institutional lens. In other words, the scope of this project was to identify the areas prone to flooding in the Pikine and Guédiawaye areas, in order to set a renovated source of information for future interventions to control these scenarios of natural risks. Despite this interest, however, Pikine Est is not considered to be an area vulnerable against said threats. The final document listed above – the presentation elaborated directly by the Pikine Est municipality – along with photographic material taken from Google Street View and the questionnaire sent with the Pino Torinese delegation actually show that it should be considered as a sector of intervention. This is where I underline the importance of confronting information sources in this Thesis.

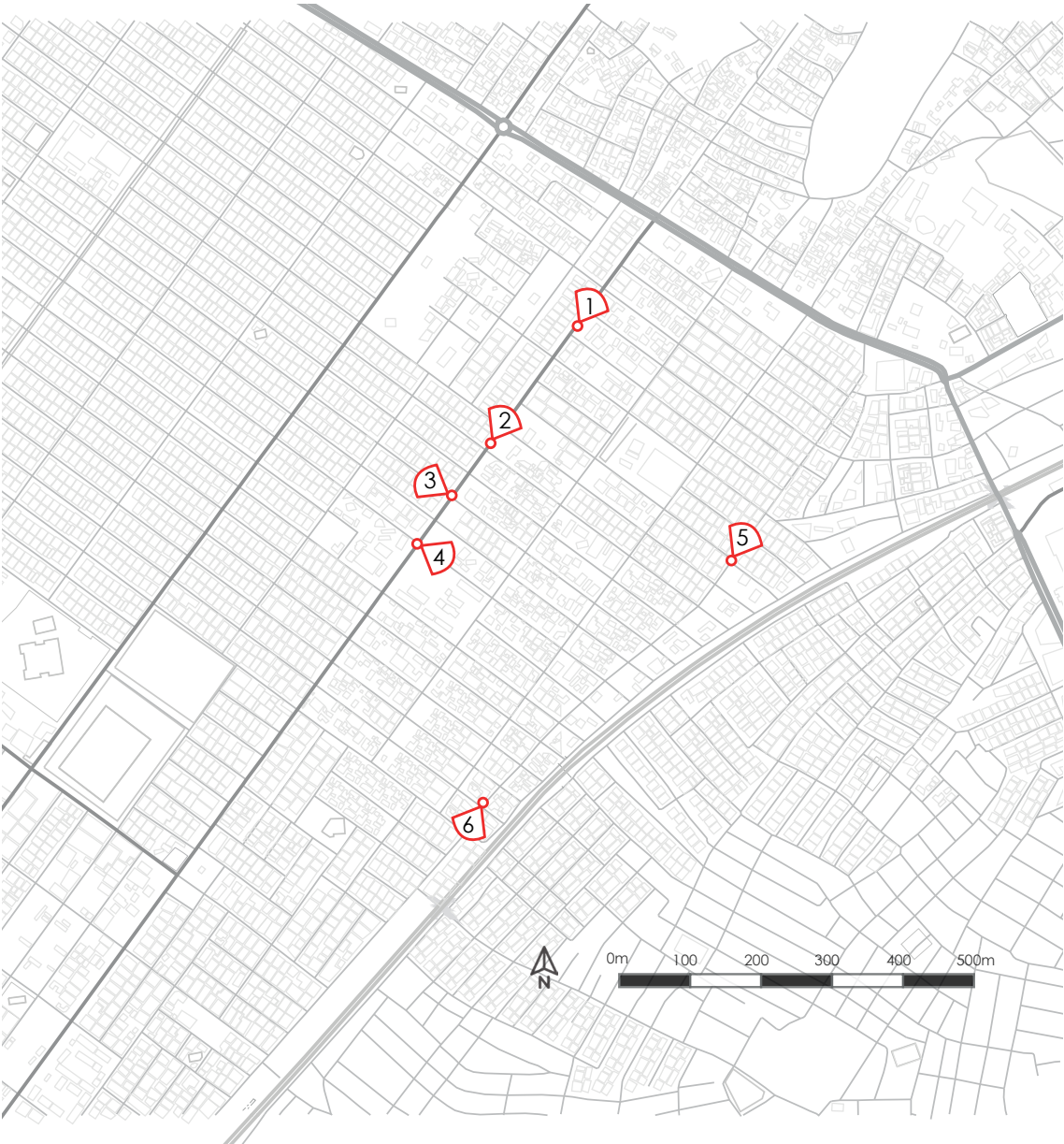Figure 11. General Map of Flooding Vulnerability Zones in Pikine
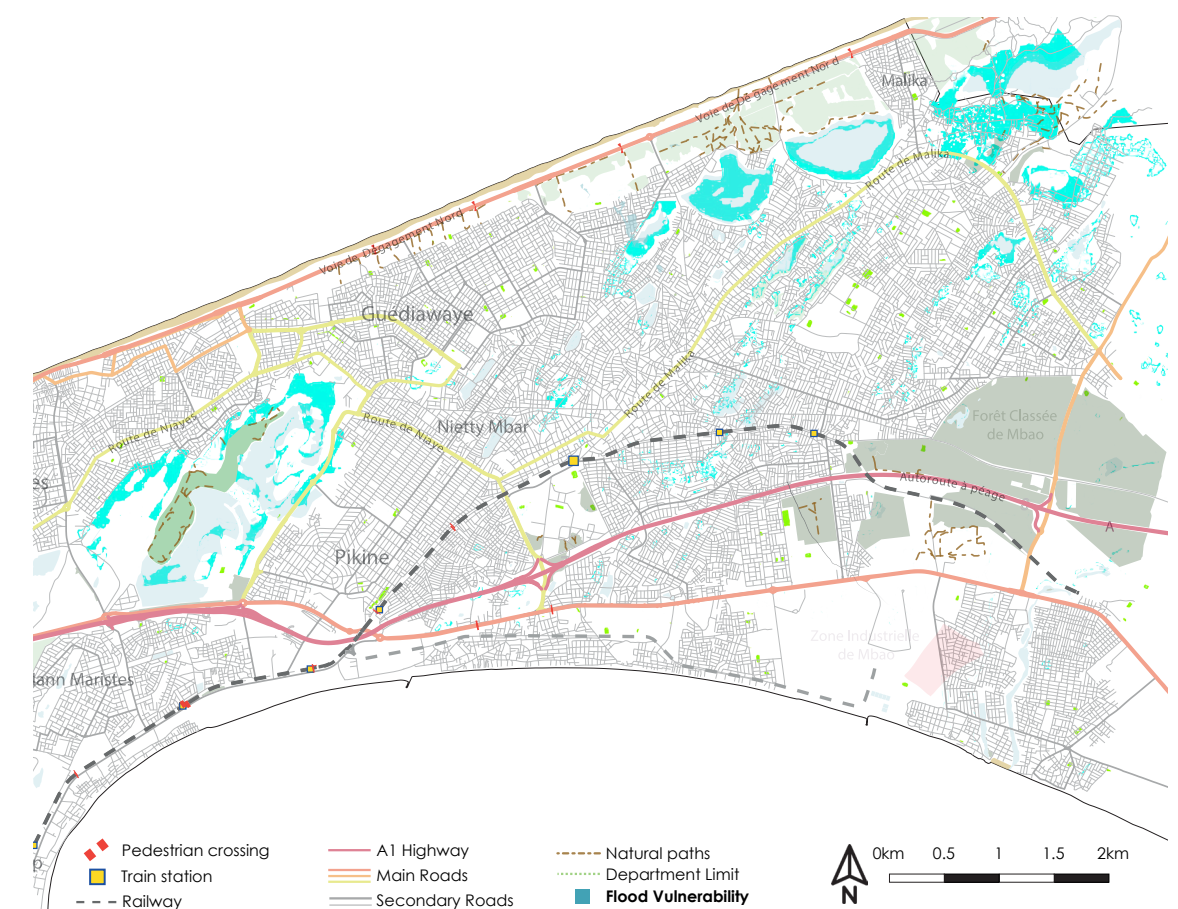
Source: Re-elaborated by the author based upon Open Street Map Contributors with cartographic data from République of Sénégal (2014)

Figure 12. Referential Map for Image 1. Streets of Pikine Est

Source: Elaborated by the author based upon Open Street Map Contributors

Image 1. Streets of Pikine Est

Source: Google Street View, September 2015

After studying the core documents that strengthen this thesis and support most of the content in the Background section, it is logical to introduce the tools suggested by the Project Manual (Thomet & Vozza, 2010) which act as a useful **connection between baseline scenario comprehension and project identification**. The first tool for project assessment proposed by the manual and pertinent for this project is a stakeholder matrix. It is helpful when drafting activities to be executed in order to know how and who to assign them to. These activities will then target the issues at hand. As a consequence, the stakeholder matrix also points out who is more affected by problems, both those that the project seeks to resolve as well as those that threaten the project.

Figure 13. Base Stakeholder Matrix
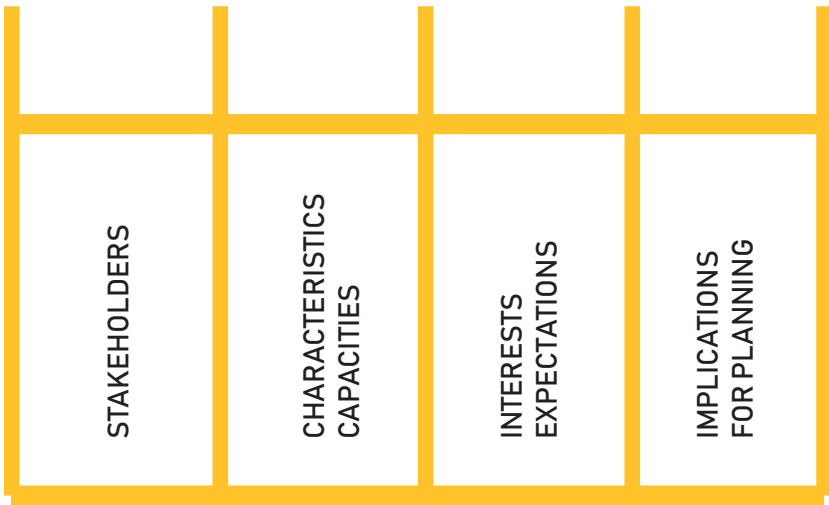
Source: Re-elaborated by the author based upon Thomet & Vozza (2010)

Following the Stakeholder Matrix, the document suggests conducting a SWOT Analysis. It is defined as the diagnosis of a target group – the recipients and beneficiaries – of the project. In this case, as already stated, the target group will be women and youth in Dakar, though the ultimate beneficiaries are still the citizens of Pikine Est. It requires, as most of these following tools do, a participative analysis, in this case gathered from the positions presented by the municipalities in Pikine Est and Pino Torinese in their respective documents. By addressing Strengths, Weaknesses, Opportunities, and Threats, the SWOT Analysis consolidates as the primary tool to develop a strategy to direct the project. Figure 12 shows the corresponding boxes for each element, its nature (internal or external to the target group), and a verb associated with the treatment it should receive.

Figure 14. Base SWOT Analysis

Source: Re-elaborated by the author based upon Thomet & Vozza (2010)

The Manual indicates we can now proceed with building the Problem and Objective trees. The interesting thing about these instruments is how they correspond to one another, being the latter a positive restatement of the former. As their names suggest, one studies a core problem from its causes (represented as the tree roots) and effects (represented as the upper part of the tree), while the other transforms the core problem into a desired scenario, the causes into objectives, and effects into impacts.

Figure 15. Base Problem Tree (left), Base Objective Tree (right)
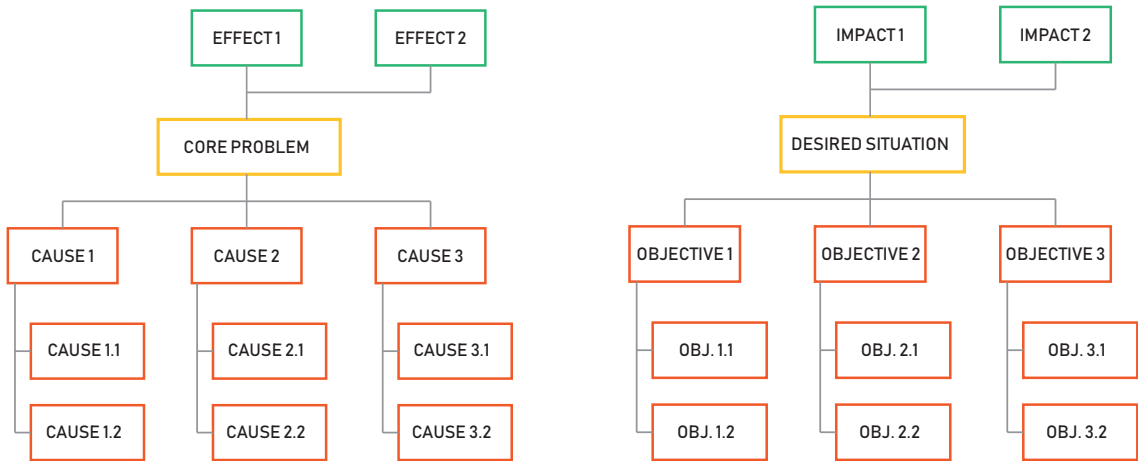
Source: Re-elaborated by the author based upon Thomet & Vozza (2010)

Another tool is included as part of the project formulation strategies: the logical framework matrix. It is the best possible way to deal with the core problem by being a mechanism to structure the project proposal, therefore giving it higher significance through a results-based management model (Thomet & Vozza, 2010). Being composed of several elements in a single matrix, it is worthwhile to deconstruct it and explain every single element. This explanation will follow the next figure.

Figure 16. Base Logical Framework Matrix

PROJECT STRUCTURE	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
DEVELOPMENT OBJECTIVE			
IMMEDIATE OBJECTIVE			
OUTPUTS			
ACTIVITIES			

Source: Re-elaborated by the author based upon Thomet & Vozza (2010)

Development Objectives are those that are fixed as long-term goals in the project structure. Immediate objectives, on the other hand, assign project responsibilities addressing the core problem and seeking sustainable benefits. Outputs are the products of Activities, therefore being linked to the quality of the results attained. These Activities must be born from a consensus among stakeholders. Returning to the horizontal axis of the matrix, we refer to Indicators, which may be quantitative or qualitative, and direct (linked to the objectives) or indirect (external to the project). Means of verification must answer questions regarding how to collect information, who should do it, and when should it be done. Assumptions are predictions that must be met in order to carry on with higher tier objectives. This leads to clarifying that this matrix is designed to be compiled from bottom to top.

It is also pertinent to dedicate a separate portion in this section to further explain the **concept of an indicator**, slightly introduced before. Once the project's objectives have been defined, and once base research has been conducted, the scenario proposal phase requires methods for verifying its real estimated impact. As a result, the chosen

methodology foresees the selection[7] of indicators. These can be classified into quantitative or qualitative according to the ways of measuring them. The former category is connected to the revision of targets and milestones through numerical data, while the latter is based more on perceptions or opinions from the target group or other stakeholders. On the other hand, indicators may be deemed direct or indirect in relation to their connection with the project's objectives: in other words, the first ones speak directly about the project's performance, while the second ones inform about external components working towards the milestones and goals set by the project. By general rule, the fewer indicators, the better it is (Thomet & Vozza, 2010). It is also worth mentioning that indicators must not depend one upon another. With these considerations, we can properly settle measurable outputs for the performance of our projects and examine their feasibility.

The most pertinent investigative method to describe the procedure conducted for this paper is the Participatory Action Research (PAR). It is a broad concept – highly promoted in Colombia by sociologist Orlando Fals Borda – which calls for reflection upon the fact that projects should be devised 'with' and not 'for' people. It is an ideal method for approaching a territory and its problematics. Its proposal to turn the studied community into 'subjects' and not 'objects' provides an accurate path for the improvement of the collective situation in the case study area. Upon years of application of this method, Fals Borda (1995) shares some of the advice and recommendations learned along the way:

"Do not monopolize your knowledge nor impose arrogantly your techniques but respect and combine your skills with the knowledge of the researched or grassroots communities, taking them as full partners and co-researchers. That is, fill in the distance between subject and object. Do not trust elitist versions of history and science which respond to dominant interests, but be receptive to counter-narratives and try to recapture them. Do not depend solely on your culture to interpret facts, but recover local values, traits, beliefs, and arts for action by and with the research organizations and do not impose your own ponderous scientific style for communicating results, but diffuse and share what you have learned together with the people, in a manner that is wholly understandable and even literary and pleasant, for science should not be necessarily a mystery nor a monopoly of experts and intellectuals.

Thus what you finally have in your hands with PAR is a purposeful life-experience and commitment combining academic knowledge with common people's wisdom and know-how."

7. Notice the intentional choice of words, since indicators are not invented or created, only selected by previously established criteria.

Breaking down the method into its three components, we can describe the procedures involved in applying it correctly. The "**Research**" component requires a commitment to being solid and critic while processing knowledge. Once it is possible for a researcher to analyze and interpret said knowledge, the project proposal and its results will have the necessary foundations to be presented. "**Action**" calls in consequence for the consideration of experiences and history in the collection of information. When the moment arrives to interact with the case study community, it is of vital importance to do so with the proper amount of historic information, and the adequate experience to apply the necessary practical instruments in order to work together with the inhabitants of a location. Finally, "**Participation**" promotes the democratization of gathered knowledge and history, and the capacity to use it for what the community needs.

The first approach for information collection – associated with the "**Research**" component – consists of a general literature review. Topics such as **migration, urban conditions in Senegal, gender inequality, lack of formative basis, main social, economic, and infrastructural problems, and alternative sources of income** are highly pertinent as research areas for this project. Since most of these documents are usually linked to the documentation of human aid interventions (as it can be appreciated in the Bibliography for this paper), their reliability can be guaranteed, as they tend to be drafted by high-renown organizations in favor of the promotion of human rights, with vast field experience. In other cases, documents used for the elaboration of this document have been drafted by or in assistance of the *Agence Nationale de la Statistique et la Démographie*, entity that holds information in constant change regarding the country's statistics.

A second approach -equivalent to the "**Action**" component – is the one already introduced in Section 1.4 of this paper. It essentially provides a set of tools to filter gathered information and put it in context with existing programs and people the project will be linked to. This helps the investigative component to become more realistic and to be thoroughly applied. It also helps to summarize the research and to select which material is pertinent for reaching the objectives previously established, setting a course for which information should be retrieved. In this phase, we also define a **target group, its strengths, weaknesses, and state a problem to address**.

Finally, arriving at the "**Participatory**" component, we include a more direct approach. This phase involves both final information collection in Pikine Est (possible thanks to the feasibility mission conducted by the Pino Torinese municipality in October 2019) and what would compose the final verification of the project should it arrive at that point. Due to the timings set by this Thesis and especially due to its limitations, this verification phase remains hypothetical.

Usually, the Participatory component works hand in hand with the concept of ethnography. This concept is divided into participant observation and field notes. The latter, likewise, is subdivided – in architectural application – into architectural surveys, social cartographies, conversations with the community and government entities, and specific assignments with focus groups. However, the restraint of not being able to physically visit Senegal during the elaboration of this Thesis makes it so that the complete set of tools applicable to the field notes cannot be used. Instead, we count upon a **questionnaire** sent to the visiting members of the Pino Torinese municipality, as well as the **meeting** held in September 2019 with the Renken Association, another group highly involved with Senegal and the peri-urban context. From such information, the project proposal will adapt its shape from solely research into more proper interventions, prioritizing the community's needs through form and function to provide architectural alternatives born from the people, by the people, and for the people. Information collected through questionnaires means may be found in Chapter 5: Appendix.

2.2 Case Study

This section will be dedicated to explaining in detail how all data collected was processed into defining a general base scenario that suitably describes Pikine Est. The contents of this Section will be divided in **two moments**: one giving the **description of the sectors in which Pikine as a city is most weak**, and another one going in-depth into **Pikine Est as a municipality, studied under the lens of said sectors**. To explain clearly the difference between both scales, I will make use of the following map.

Figure 17. Territorial Division for the City of Pikine

Pikine Nord
1.2 km²

Pikine Ouest
2.01 km²

Guinaw Rails
1.27 km²

Guinaw Rails Nord
0.59 km²
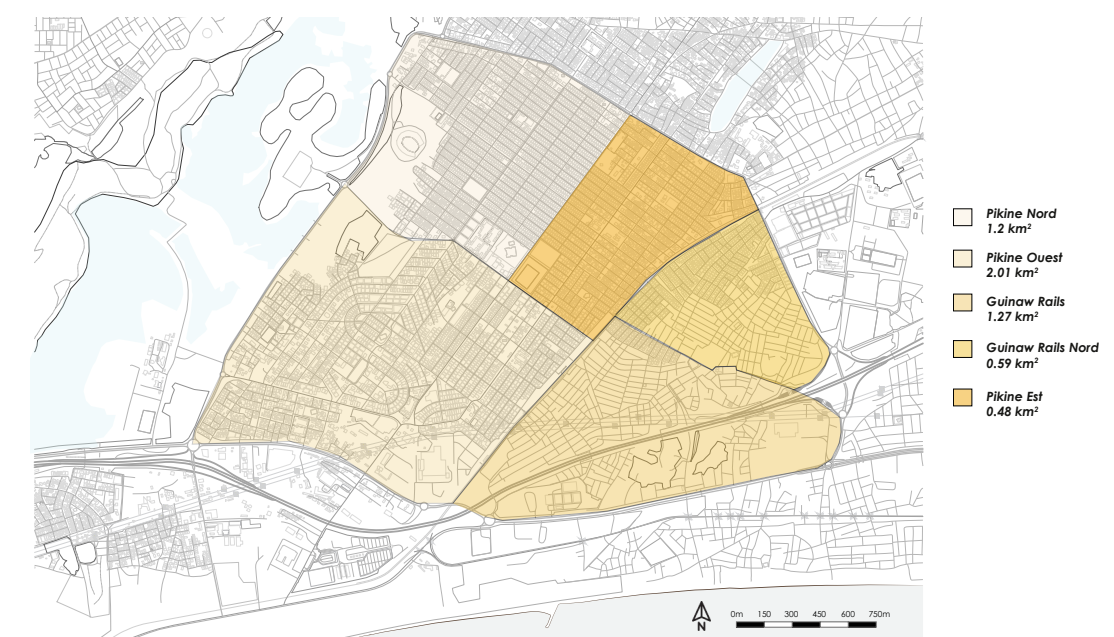
Pikine Est
0.48 km²

Source: Re – elaborated based upon Google Maps, 2019

Around 13 km away from the country's capital we can find the municipality of Pikine Est. Its story goes back as far as 1952 when construction began for peri-urban areas. These processes are bound to take place in such locations: high occupation rates at the Cape Vert Peninsula and an increasing need for space to continue growing were the two detonators that set into motion the displacement of people occupying irregular properties around Dakar (Prothmann, 2018). These families were relocated then in the zones considered back then as the outskirts of the capital. Many negative situations are generated as a result, from the most obvious one being uncontrolled urbanism, and going as far as social resent from inhabitants in peri-urban segregated areas towards those in the capital.

Despite this historical development, Dakar and Pikine (city) have recently initiated efforts to improve the connections among them. Most of the services are located in Dakar while peri-urban zones – though counting with an adequate number of services – do not count with proper means to vantage them. For instance, Salem mentions in his document "*La Santé dans la Ville : Géographie d'un Petit Espace Dense : Pikine (Sénégal)*" how funeral services could not be held in several areas of Pikine, since there was no way to carry the deceased to one of the distant cemeteries. On another more recent and direct example, by reading the document drafted by the municipality of Pikine Est we discover that one of their investment priorities includes the financing of an ambulance to facilitate access to health care and reduce the risks of situations such as having to give birth at home. Put into context, we can appreciate how important it is to connect services with transportation, given that within Pikine Est there are three medical centers, each dedicated to their own specialty, each facing challenges to reach out people in emergencies.

Transport in Pikine

Basic needs are normally covered by the services located within the Pikine locality, being so that several persons in Pikine have never been to Dakar[8]. This induces, however, to study the current condition of the existing means of transportation and to consider the possible outcomes of promoting a connection between both cities. As suggested by Figure 11, there are three main options to travel between Dakar and Pikine: by vehicle, bus, or train. Naturally, economic conditions are not optimal as to allow the average household in Pikine Est to afford a car[9], leaving, as a result, the **bus and the train as the most used means of transportation**.

Cars Rapides in Pikine Est are very distinguishable among the community. As part of what could be called a marketing strategy, owners of these buses decorate their cars with religious symbols and bright colors, adding as a final touch the charismatic youngsters announcing the bus's route (Salem, 1998). For better or worse, this community transport system is part of the local tradition: despite the usual technical flaws, polluting engines, arbitrary route changes, and usual uncomfortable conditions passengers must endure, people have expressed themselves as contrary to the implementation of a new state-financed system with larger capacity and better engines, since it presents fix prices and therefore takes away the commonly used possibility to bargain with the driver for discounts or even free rides (Darbouret, A. & Mayault, I., 2017).

Image 2. *Typical Car Rapide*

Source: PITARCH, B. / "Car rapide, Dakar" / https://www.flickr.com/photos/24991898@N02/4195507432

8. Reference to this section may be found in the questionnaire in Chapter 5. Appendix
9. In 1995, for instance, only 10% of the Pikinese households owned a car (Diawara, 2010)

Another issue that land transportation faces is the current condition of most roads. Busy with transit from cars rapides, taxis and taxi clandos[10], and even some horse-drawn carts (Salem, 1998), these roads usually suffer the stresses from these loads, and are therefore unpaved and flooded during rainfall seasons. It is important to create an image of what these conditions imply for the quality of life. For instance, if we return to the intention of the municipality to finance an ambulance, it would be advisable to invest as well in road improvement and accident reduction strategies. Images of the main road passing through Pikine Est may be seen in Image 1, giving a better idea of its condition. The following Figure, on the other hand, the classification of the roads in Pikine. It is worth mentioning how Pikine Est's main road is considered as a secondary type road, giving it a noticeable relevance at an urban scale despite its state.

Figure 18. Transport Map for Pikine (City)
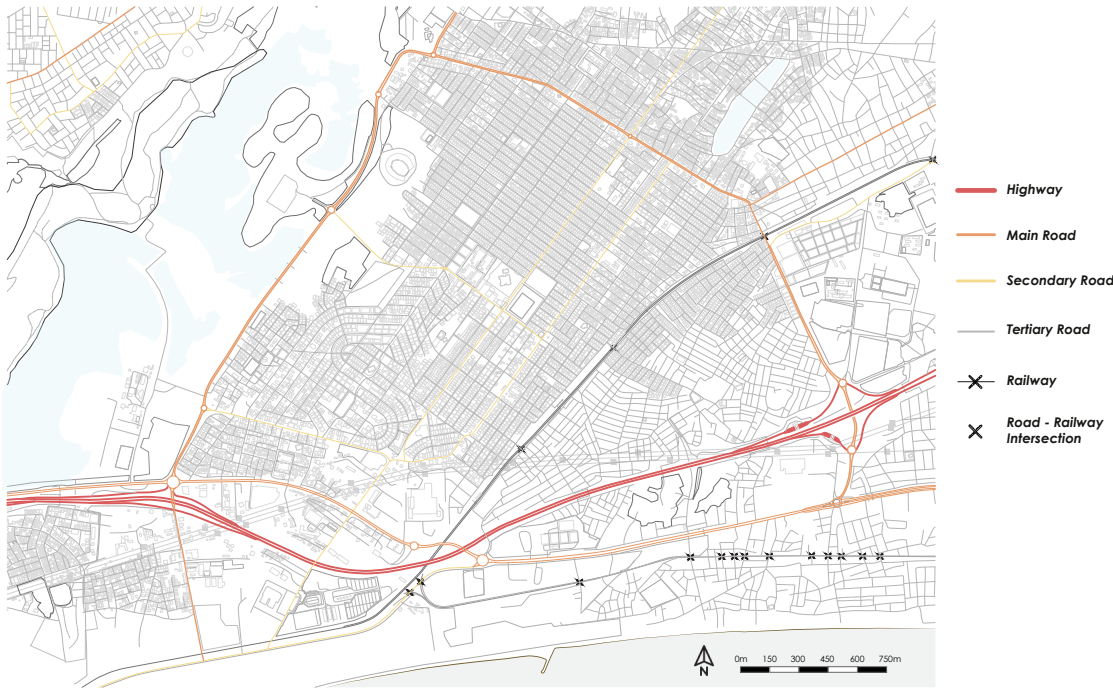
Source: Re – elaborated based upon Open Street Map contributors, 2019

10. Regular taxi service (approved by the state and designated with black and yellow colors on the vehicle) competes in Pikine with the irregular taxi service – or taxi clando – which is designated by yellow and green colors on the vehicle and charges lower prices on fares. However, by mutual agreement, taxi clandos can only operate within the area of Pikine (Salem, 1998).

Land Use in Pikine

It has been mentioned previously how Pikine's urbanization process has been mostly irregular, leading to an uneven distribution of land use which is largely composed by the residential use. The sudden need for housing near the city center forces to occupy most of the land available, paying in exchange the high price of reduced – or even non-existing – green areas. Such is the case of Pikine, which luckily counts upon an **adequate distribution of services including commerce, health, and education facilities, but is lacking green areas** within its urban design. These areas, besides improving citizens' health, act positively upon the collective well-being by acting as absorption patches for groundwater, reducing flooding risks and damages.

Figure 19. Land Use Map for Pikine (City)
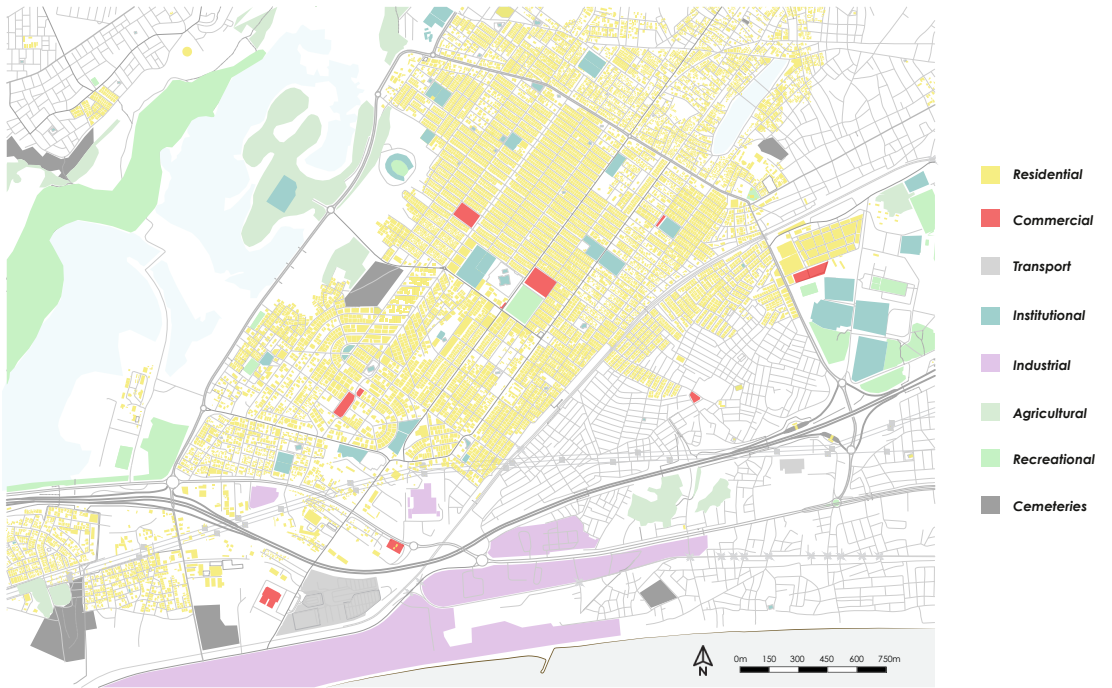
Source: Re – elaborated based upon Open Street Map contributors, 2019

The map above shows a general distribution of services in the urban agglomeration of Pikine. It could be described as predominantly residential, with a large potential for both industrial and natural activities, the former being characterized mostly by multinationals located within the purple area, and the latter made up mainly from hydrological natural sources, but not as many green spaces whatsoever. In fact, the industrial sector accounts for 8.1% of the jobs within the population of Pikine (Wang, Montoliu-Muñoz, & Gueye, 2009), and the wetland – better known as La Grande Niaye de Pikine – has a significant value for many families living from peri-urban agriculture in Pikine (Diop, Faye, Sow,

2019). It is important to mention that most of Pikine's residential use is also mixed with commercial use in the ground floors of each building, especially within those located over main roads. This acts as an adequate mean of subsistence for the family owning it, as they normally occupy the dwelling above said business. The available information didn't allow us to identify these mixed-use areas in the map, but they will be specified once the scale reduces to the Pikine Est base scenario. Notice as well on the map the presence of multiple cemeteries (mostly Muslim), several markets (denoted by the red sectors), and a transport hub to the south (better known as *Gare Routière Beaux* Maraichers) which facilitates important connections between Pikine and other municipalities.

Figure 20. Detailed Land Use Map for Pikine (City)

RESIDENTIAL
Regular Dwellings
Irregular Dwellings

COMMERCIAL
Markets

INSTITUTIONAL
Educational
Sanitary
Religious

INDUSTRIAL
Multinationals

AGRICULTURE
Orchards
Water Vegetation

RECREATIONAL
Sports
Green Areas

TRANSPORT
Gare Routière

CEMETERIES
Muslim Cemetery

0m 150 300 450 600 750m
N
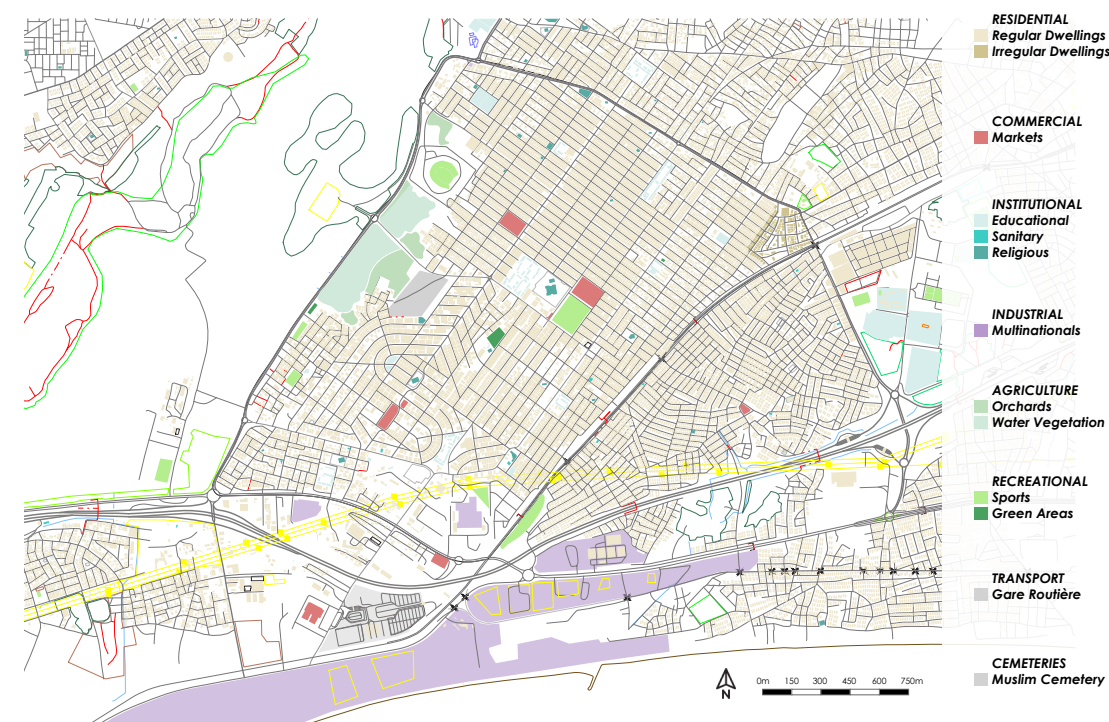
Source: Re – elaborated based upon Open Street Map contributors and Google Maps, 2019

In 2013 (year of the decentralization act) Pikine Est was around 0.770 km², with an estimated population density of **42,144 inhabitants per square kilometer**. The estimated amount of people living in the area was 32,451 (ANSD, 2013)[11]. This shows that Pikine Est is indeed a high-density community, a statement that is intensified when discovering that the average household in Pikine is composed on average by seven members (Diawara, 2010). It is of the essence to count upon this numerical data for the project formulation phase.

Just like urban Pikine, Pikine Est itself is divided into smaller zones. It shares many of the traits already reviewed at an urban scale, but naturally has specificities of its own which will be of the essence when formulating a project. These particularities are, again, identified from research, documentary analysis, examination of official documents, and questionnaires, following the principles of ethnographic investigation.

Figure 21. Sectorization of Pikine Est

1. Cité Pépinière Zone
28,766.88 m²
2. Cité Pépinière
60,869.46 m²
3. Cocotiers
30,887.86 m²
4. Touba Diack Sao
62,357.76 m²
5. Fass Marigot I
31,462.26 m²
6. Cité Stade I
74,025.58 m²
7. Allées Coursins I
43,887.97 m²
8. Allées Coursins II
21,800.65 m²
9. Wakhinane I
19,317.02 m²
10. Wakhinane II
41,236.82 m²
11. Wakhinane IIIA
25,347.97 m²
12. Wakhinane IIIB
56,898.75 m²
13. Champs de Course I
61,098.11 m²
14. Champs de Course II
55,081.26 m²
15. Nimzat II
61,646.15 m²
16. Wahkinane Nimzate I
19,212.05 m²
17. Cité Serigne Mansour Sy
81,944.22 m²

0m 100 200 300 400 500m
N

Source: Elaborated by the author based upon Commune de Pikine Est, 2019

11. According to the ANSD and the website for City Population (https://www.citypopulation.de/en/), the populational change from 2002 to 2013 was of 0.33%. Considering this time lapse, it could be possible to perform an estimative calculation of which could be the population density for 2020 (the year following the publication of this thesis), resulting in a change of 0.21% for the period between 2013 and 2020, and therefore obtaining a total population density of 44,150 inhabitants per square kilometer. However, since this information would not be supported by a reliable source, all considerations regarding population in this thesis will be done with the official data from 2013.

If we were to overlap Figures 20 and 21, it would be evident how sector 12 in Figure 21 is still considered as irregular property (République du Sénégal, 2014), statement to be considered during the Project Formulation stage. Neighborhoods originated from irregular expansion slowly begin to become regularized as the state provides these areas with public services (electricity, potable water, sewage, etc.), a process which usually takes several years. Considering that Pikine's urbanization process began in 1952, we might be inclined to conclude that the regularization process is not far down the road for sector 12. In fact, from the information gathered through the set of questions sent to the municipality of Pino Torinese[12], it is possible to know that most houses in Pikine Est are connected to public networks, except for the sewerage network, which is still in the works. Diawara (2010) gives us an insight into what the wastewater treatment looked like in 1997, according to surveys conducted on multiple households. This information, naturally, is to be considered only as a reference point, since it might already be outdated, and it is therefore used to draw a general panorama of how conditions were back then, highlighting upon the fact that only 4% of the households in Pikine were connected to the public network.

Table 2. Sewerage network conditions for Households in Dakar (1997)

DEPARTMENT	Connected WC	Septic Tank	Cesspool	External Construction	Outdoors	Other	No response
Dakar	47,2	32,1	5	6,8	3	1,9	4
Pikine	4,5	72	9	2,6	4	3,9	4
Rufisque	4	45,5	9	8	25	5,5	3
COMBINED	24,7	50,3	7	5	6	3	4

Source: Re-elaborated by the author based upon Diawara, 2010

Transport in Pikine Est

Zooming in on Pikine Est, we start to explore the situation concerning both public and private transport. As mentioned before, there is an ongoing discussion regarding the passage from private-owned cars rapides to state-financed buses. At an urban analysis, the main differences between both services lie on the routes each one takes and on whether they have designated bus stops or not. Three bus stops are identified within the Pikine Est community, thanks to online cartographic analysis. These serve the state-financed line, going to and from *Gare Routière Beaux Maraichers* (see Figure 15). Cars Rapides, on the other hand, are commonly found over Tally Icotaf Road (seen through Street View images in Figure 11). Figure 22 graphically represents all of this, including the railway design for the *Petit Train Blu*, and the location of three gas stations in the area, pertinent to the transport subject as well.

Figure 22. Transport Map for Pikine Est

Source: Elaborated by the author based upon Google Maps, 2019

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12. See Chapter 5. Appendix
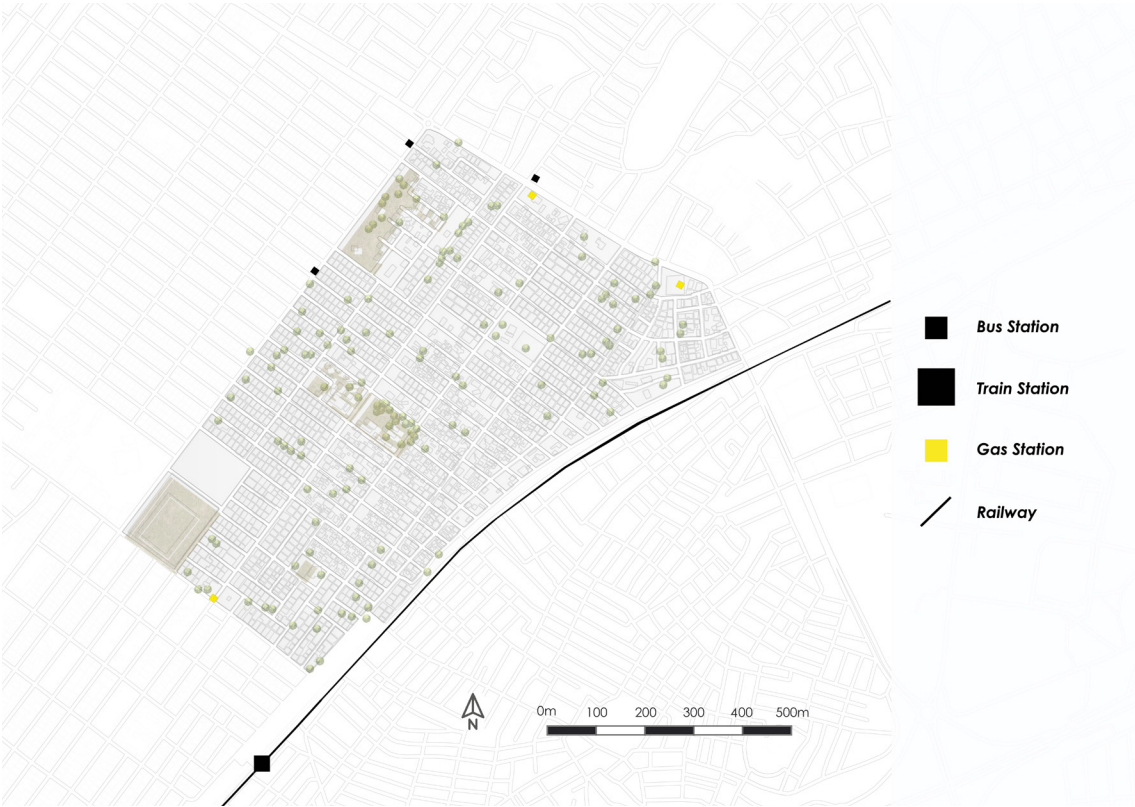
Land Use in Pikine Est

The two precedent maps featuring Pikine Est evidence how, at its center, it is characterized by a large open area. Within it, people can find the town hall, one cinema (Cinema Awa), a school, and the new sports area built this year together with the municipality of Pino Torinese. Another sports area, composed by a large soccer field and a smaller basketball field, may be identified to the south of the municipality. The urban layout is also completed by two large open-air markets and three other educational facilities, with the rest being mostly occupied by residential and mixed land uses. This can be graphically seen represented on the following figure.

Services and Facilities in Pikine Est

On a more specific level of detail, it is possible to identify educational, medical, cultural, religious, and sports facilities, as well as individual businesses in Pikine Est. Being aware that this is the most specific scale for the case study, it is a very pertinent exercise to conduct, carried along with information collected from research, documentation sent by the Pikine Est municipality, and Google Maps revisioning. The map below gathers most of this information, representing why – as mentioned before – many of Pikine Est's inhabitants have never had the need to visit Dakar.

Figure 23. Land Use Map for Pikine Est

Figure 24. Service Distribution Map for Pikine Est

Source: Elaborated by the author based upon Open Street Map contributors, 2019
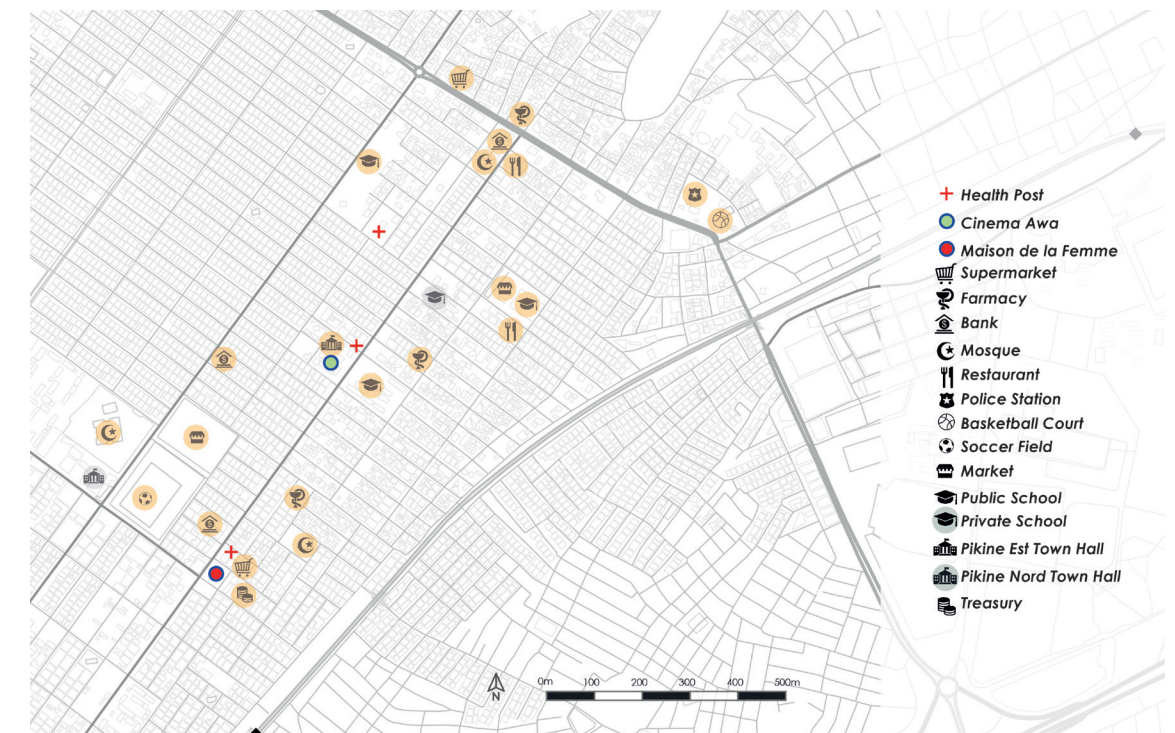
Source: Elaborated by the author based upon Google Maps, 2019 and Commune de Pikine Est, 2019

After having presented all previous maps and research, this map acts as the bridge between the methodological approach on the case study and the Project Identification section. We can appreciate from Figure 24 how, despite what might be common belief, the community of Pikine Est is well served. It is important, however, to list some of these services and to describe their specific characteristics as completely as research can allow, in order to identify in which points are they most lacking. Through this study and through the previous conclusions drawn from the other maps, it will be possible to identify project extension and magnitude for each layer.

Starting from the top of the list of conventions, we identify three **health posts in Pikine Est**. Thanks to the document received from the municipality of Pikine (Commune de Pikine Est, 2019) we have an accurate description of each health post, its role in the community, its capacities, limitations, and also its specific needs. From north to south, we can describe them as follows:

- *Centre de Santé de Pépinière*: This health post commonly treats diseases such as malaria, conjunctivitis, anemia, and general parasitic diseases. Despite its magnitude and relevance among the community, it has to be financed both from external partners' support and community collections. This money contributes to covering operational costs, paying health workers, and buying pharmaceuticals.

- *Poste de Santé Touba Diacksao*: This health post is the primary health care unit in Pikine Est, offering main services such as dispensary, maternity unit, and pharmaceutical depot. Although it is adequate to the current regulations the building itself must go through certain renovations in order to be able to respond to the high amounts of people that attend to it. Nonetheless, despite its infrastructural issues the unit is well supported by different entities worldwide such as ChildFund, IntraHealth and USAID, which prepare medical technicians to act upon the most common diseases in the area and promote reproductive health care among citizens.

- *Centre Bucco Dentaire*: This health unit is the only dental center in the municipality of the Pikine Est.

Limitations faced by the health care units in Pikine Est have already been mentioned before (Such as the financing of an equipped ambulance, the reinforcement of the supply of pharmaceuticals and medical material, and personnel capacitation). It is pertinent to add in this point that none of the aforementioned health units count as an official Medical Center, being this an additional requirement from the municipality in their presentation.

Following the list composing the legend, the next points to examine are cultural hubs such as Cinema Awa and *Maison de la Femme*. Naturally, the first one is likely private-owned while the second one is promoted by the town hall, which sponsors literacy programs in Wolof and Pulaar (national languages apart from French) to be carried out in this facility which features women sharing these skills with others. This structure also supports the creation of feminist groups within the community. While there is an undeniable cultural value on this structure it is also worth noticing how the cinema – despite being privately owned – might serve in future a double function as a cultural hub due to its size and its strategical position within the urban layout.

Two large markets serve the community of Pikine Est with fresh produce. The market to the North – better known as Marché Waxinaan – is the one with the smallest size and is located next to one of the public schools in the municipality while the market to the South – also known as Marché Syndicat – Is larger in size and even occupies a portion of a vehicular road. This seems to be an interesting example of community appropriation over unoccupied streets, an element that should be considered at the Project Formulation phase. It is also clever to take note from the documents of both Salem (1998) and Diawara (2010), which detained highly on the point that the two major concerns for markets in this kind of urban agglomeration are the difficulty of transporting fresh produce in and, in response, the lack of adequate spaces to dispose of the rotten or leftover produce.

These final conclusions drawn from the urban analysis show that it makes sense to include a study for the improvement of waste management conditions in the municipality of Pikine Est. As it was described in the initial sections of this document, one of the objectives of the Pino Torinese and the Pikine Est collaboration included a feasibility mission regarding this topic. To deepen into the general urban panorama of household waste management we make use of Diawara's (2010) document, seeking to comprehend better from where the problem takes its roots. It is important to clarify that this information concerns the entire urban agglomeration of Pikine as a city and not only Pikine Est as one of its municipalities.

The solution to the waste management issue must not be based only on situating containers for disposal. Instead, it calls upon reflection and investigation on how household waste is disposed of today and on why it is disposed of the way it is. Understanding this will help provide alternatives that best suit the current practices through slight improvements that promote general well-being in the long run. For instance, Salem (1998) explains how common thinking regarding waste disposal is directly linked to the collective perception of

common property in Pikine:

> "(…) household waste collection is directly related to environmental health. The problem is cultural, technical, and political at the same time.
>
> Cultural, because newly arrived Pikinese citizens must learn to live with populations from all origins in a small space which offers little to no solutions to household waste evacuation. In an anonymous environment, the common rule is to consider the limits of the plot as spatial cells where one is the only responsible. It is then frequent to see homes throwing their waste over the walls right behind their own land, as well as on the side of the road."[13]

Diawara (2010), puts this information into numbers somehow, measuring waste disposal in the department of Pikine. The following Table offers further information on the means of disposal and elimination of household waste, which helps in understanding to which extent the city of Pikine is connected to a public waste collection network. When this alternative is not present citizens turn to what the author denominates as anarchic containers: bins placed by the people themselves so the community can deposit their own household wastes. The other common use practices, however, present higher ecological problems, pushing researchers and project stakeholders to come up with an immediate solution, which implies intervention at cultural, technical, and political fronts.

Table 3. Means of Disposal of Household Waste for Pikine (Department)

MEANS OF DISPOSAL/ELIMINATION	PERCENTAGE
Collection and discharge in landfill	39
Anarchic Deposits	41
Released into the ocean	11
Bonfires	3
Manual burying	6
TOTAL	100

Source: Re - elaborated by the author based upon Diawara, 2010

13. Taken from Salem (1998), translated from French by the author

Along with this study of Common practices when disposing of household waste, it is also important to revise documentation regarding the composition of waste produced by families in Pikine. Using the same document from Amadou Bélal Diawara (2010), we can retrieve a study conducted specifically on the soil (in order to determine its quality) which concluded but there were high amounts of certain materials per square meter. Results of this experiment are shown as weights, measuring grams per each square meter. This gives an idea of which is the most common type of waste, the consumption patterns in Pikinese families (knowing from the same source that, on average, one person in Pikine produces 0,68kg of household waste per day) and it might also offer insight on which are the most common activities generating this waste.

Figure 25. Weight of Household Waste after Soil Screening processes
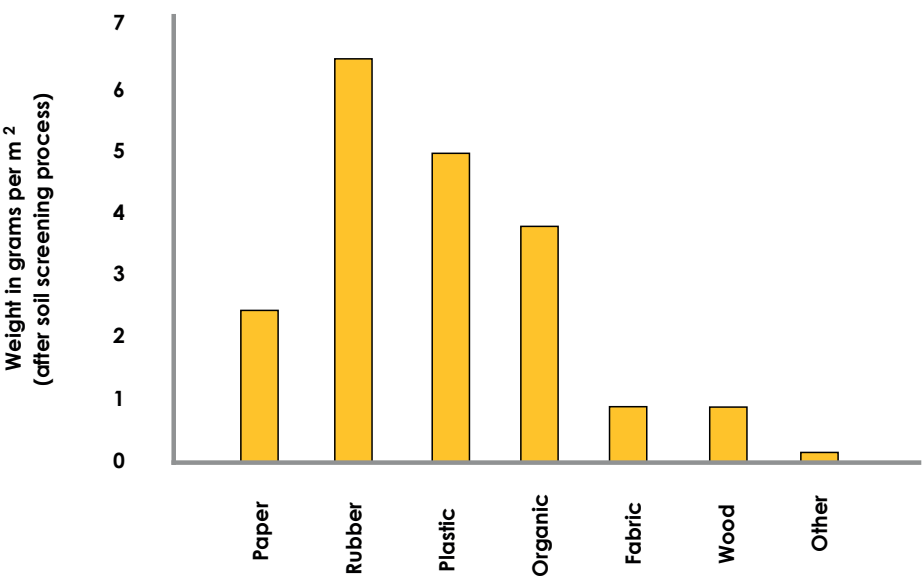
Source: Re - elaborated by the author based upon Diawara, 2010

Despite how recent the act of decentralization is, it is possible to appreciate from this Case Study section that there is enough information to assist in carrying on with the Project Identification phase, linking it to the initial objectives and actions proposed by the collaboration between the municipalities of Pikine Est and Pino Torinese. The information and research tools used to complete this chapter settle as a strong base to support the decisions that will be taken when formulating the project. Likewise, most of the results and conclusions that came from the case study analysis will be applied when measuring the impact of the project through the aforementioned indicators. These indicators will be identified throughout the next chapter, a process that begins from the statement of the Core Problem.

Case Study Conclusion

APPLICATION OF
THE METHODOLOGY

3. Application of the Methodology on the Case Study

3.1 Project Identification Tools

Born as a result of methodological research and case study selection, the Core Problem that best describes the symptoms that afflict Pikine Est (a diagnosis, in other words) is the **negative incidence of urban lacks and inadequacies in life quality indicators for the citizens of Pikine Est, especially its youth and women**. By stating a Core Problem that follows thorough research, it is possible to identify its causes and effects. This will help narrow down the objectives and set the parameters under which the results will be evaluated.

As introduced in Section 2.1, a well-structured Stakeholder Matrix should follow the Core Problem, trying to understand who can help resolve it and who is affected by it. Drafting actions will be an essential component to recognize how can partners intervene in favor of a feasible solution. Therefore, stakeholders usually take relevant decisions regarding the project itself. The stakeholder matrix elaborated for this Thesis is shown on the following page, in Table 4. It has – as an additional component to those proposed by the Project Manual (Thomet & Vozza, 2010) – a column to the left, which helps identify the macro groups which participate in one way or another in this Thesis. This is done hoping to facilitate the comprehension of the tasks pertinent to each stakeholder.

Table 4. Stakeholder Matrix

MACROGROUPS	STAKEHOLDERS	CHARACTERISTICS / CAPACITIES	INTERESTS / EXPECTATIONS	IMPLICATIONS FOR PLANNING / REQUIREMENTS
PEOPLE	Women of Pikine Est	_ Lower literacy rate than men _ Higher unemployment rate than men _ Lower monthly wage than men _ Low levels of formation _Will to become independent	_ High sense of community: the hope for the youth to choose to stay in their homeland _ Higher opportunities both socially and economic _ Easier access to jobs	_ Learning capacity in formation courses _ Capacity to share acquired knowledge _ Capacity to monetize said knowledge _ Active participation in project's phases
	Youth of Pikine Est	_ Exposed to a low job offer _ Low monthly wage (average: 100USD) _ Motivated by success stories from other migrants _ Needs for aggregative nodes (sports)	_ Provide for their families _ Prestige and honor in their community _ Improve life quality indicators to reduce irregular migration movements	_ Capacity to understand the importance of creating sense of belonging _ Active participation in project's phases _ Capacity to share knowledge acquired in formation courses
	Citizens of Pino Torinese	_ Indirectly involved in one of the main goals for the collaboration (sensibilization towards migration)	_ Extend their own knowledge regarding the Pikine Est socio economic situation	_ Capacity to comprehend the relevance of decentralized cooperation
	Citizens of Pikine Est (other than women and youth)	_ Main subjects and project beneficiaries	_ Improve life quality indicators	_ Active participation in project's phases
INSTITUTIONS	Pikine Est Municipality	_ Territory with strong migratory vocation _ Young population (average: 23 years)	_ Interest of keeping youth in the country _ Maintain relations with Pino Torinese _ Favor local development through personal growth	_ Provide area for sports plaza _ Provide counselor for international cooperation
	Pino Torinese Municipality	_ Territory with different associations willing to cooperate _ High percentage of adult population	_ Maintain relations with Pikine Est _ Stimulate reflection regarding migration and decentralized cooperation	_ Facilitate relations Italy - Senegal _ Sensibilization in the local territory _ Cofinancing of the project
INTERNAL PROJECT PARTNERS	Energia per i diritti umani	_ Active in Pikine Est since the year 2000 _ Capacity to monitor activities _ Association of Social Promotion	_ Create opportunities for formation and discussion	_ Coordinating activities in site _ Meetings for micro business management _ Feasibility mission _ Monitoring activities held in site
	_FIDAPA _LYCÉE FRANÇAIS JEAN GIONO	_ Formation agencies _ Academic institute from 3 to 18 years (Lycée)	_ Citizen sensibilization _ Income opportunity for local trainers	_ Formation courses for future trainers in small and medium enterprises _ Exposition and photographic sample _ Preparation of educational material _ Project's communication and diffusion
	_GS PINO VOLLEY _LIONS CLUB	_ Sportive association (GS) _ Non - governmental organization (ONG) (Lions Club)	_ Provide instruments to combat scholar abandon through sport _ Create activities in favor of active participation	_ Sportive and cultural activities _ Feasibility mission in favor of collaborating through sport
	_FORUM DEL VOLONTARIATO _UNITRE	_ Non-profit organization (Forum) _ Cultural association for social promotion (UNITRE)	_ Expand knowledge on the realities of migratory movements _Increase awareness on the importance of decentralized cooperation	_ Formation courses for voluntaries at Pino Torinese
EXTERNAL PROJECT PARTNERS	STRUCTURES IN AN INTERNATIONAL SCENARIO	_Support and aid funds for social and sustainable projects active in Senegal	_ Assistance to countries most vulnerable against said situations	_ Cofinancing of the urban project _Monitoring during the execution of the project

Source: Elaborated by the author

The first macro group covers the target group (women and youth) and includes the ultimate beneficiaries and physical persons which might aid the project in moving it forward (citizens of Pikine Est and Pino Torinese respectively). It might be noticed by an accurate reader how the column to the right (Characteristics and Capacities) signals mostly negative situations that affect women and youth. This does not mean at all that these groups have no positive capacities to provide for the project's development, it is simply a choice to express the population's needs in this column and to present their probable contribution to the project in the Implications for Planning / Requirements column, in order to show how people themselves can act upon resolving the issues concerning them. It is showing that citizens can, colloquially speaking, take matters on their own hands to a certain extent, which is a concept this Thesis focuses on.

The next macro group is assigned to the institutions involved in the project, presented before as the two municipalities carrying along with the decentralized cooperation program. Right below them, I propose the Internal Project Partners category, composed entirely by associations based in both territories with different jobs assigned according to their link with the objectives[14] of the collaboration. Their link to this work would eventually consist of supporting the project itself by teaching the community through formation courses and educational material, promoting aggregation through sport, and monitoring the project itself, with one of these entities being based in Senegal. Finally, the last macro group is inserted as a consideration upon project financing alternatives, through worldwide funds with the capacity to invest in social, economic, productive, and environmental development projects.

The stakeholder analysis is followed — as stated before — by the SWOT Analysis. This Analysis regards uniquely the target group. Strengths and Opportunities stated in it are sustained through research, and through the study of the outcomes from the previous project held as a result of the association between Pikine Est and Pino Torinese (which set in motion the decentralized cooperation amongst them), called "Partnership between Cultural Centers in Pino Torinese and Pikine Est", financed and concluded successfully in 2018. Weaknesses and Threats, on the other hand, are sustained primarily using the one-year revision of the UNESCO Global Partnership for Girls' and Women's Education (2012). This document (already used in precedence as source for Table 1), for instance, aids in explaining the fourth threat ("Preference" for male children when deciding who will receive proper education), since this one could likely seem confusing for readers:

> "In certain regions of the country, girls are commonly employed in economic activities and therefore parents from poor areas tend to keep their children, especially girls, out of school in order for them to earn some additional income."

---

14. Stated in Section 1. Introduction

Table 5. SWOT Analysis

S	O
- Strong sense of community among women in Dakar, vital in spreading knowledge and helping others - Proven capacity both in youth and women to learn new skills - Pikine as a convergence point of rural communities in the Dakar province (variety of knowledge)	- Youth make up for the largest population group - Initiatives to offer support to entrepreneurs - Support programs for sustainable development projects - Simple and economic alternatives in construction
W	T
- High rates of illiteracy - Low levels of formation - High rates of scholar abandon, mainly due to budget, the need to perform other labors, and social prejudice - Low sense of belonging for common property	- Low mean minimum wage - Gender gap in salary remuneration - Scarce employment offers - "Preference" for male children when deciding who will receive proper education - Lack of qualified medical personnel - Schools often lacking material and financial means

Source: Elaborated by the author

Since the scope of this Thesis is to promote well-being among members of the community, it cannot be limited to improving solely the financial situation of homes in Pikine Est. As it might be noticed, the SWOT Analysis gives more attention to Strengths and positive factors than the Stakeholder Analysis does. For instance, the SWOT Analysis deepens in and states how it would be useful to take advantage of Pikine's cultural mix in order to best merge rural tradition with urban innovation. This could later become a strategy to create a sense of social well-being through the diffusion of the project by its own inhabitants, and it could enrich following decision-making stages with stakeholders. The project capitalizes on its inhabitant's strengths.

The Opportunities listed in the matrix seek to provide examples for possible sources of financing, under the hypothesis of having to financially promote the project, since this section considers factors that are external and not pertaining to the target group. They account for NGOs and similar organizations who offer funding for sustainable and/or social aid projects. These are Opportunities to be exploited.

Project Weaknesses are slightly more challenging to approach. As stated before, they are factors intrinsic to the target group, only in this case they are deeply engraved in the ways of living, becoming a normalized situation. The more connected a practice is to culture, the harder it is to change it. As a conclusion from some of the Weaknesses listed here, it is fair to say that the project must incorporate strategies to combat gender gaps and inequities, and that it must promote the concept of communal or collective spaces which

are under everyone's responsibility. This strategy aims to remedy Weaknesses.

Finally, Threats are faced through the totality of the aforementioned strategies. Even more challenging than Weaknesses due to their external condition, they require a much more dedicated intervention. Threat mitigation is therefore connected to the job creation and economic opportunities promoted in the project.

Following the suggestions of the Project Manual's methodology, we continue with the Problem Tree. Its main intention is to structure the causes to one unique Core Problem, which in this case is in itself the cause for the negative effects around which this Thesis revolves: irregular migration and lack of internal growth since the community's inhabitants travel elsewhere to seek better opportunities. This means that by addressing the causes that generate the Core Problem, hypothetically, the project would be able to revert these situations, and eventually mold the Problem into a Scenario. In said moment, we arrive at the formulation of the Objective Tree.

The Objective Tree integrates what the project in its entirety must comprise. It showcases the ideal conditions that need to be in order to arrive at an ideal scenario. Less objectives might represent less ground to cover and may offer more time and resources to dedicate to preparing an in-depth solution. However, since these objectives are strictly linked to the previously considered causes, they must all be studied and solved for the project's feasibility. As usual, for topics concerning a larger magnitude than the one of an urban or architectural intervention (such as the gender gaps in formation and profession), the project offers a founding stone for future development of small-scale solutions (such as focusing on economic independence ideas for women). Both trees are presented on the following pages in order to facilitate their comparison.

Figure 26. Problem Tree

Effect 1.2
Internal growth slowdown

Effect 1.1
Irregular migration

Effect 1
Unfavorable living conditions
in the Pikine Est community

Core Problem
Negative incidence of urban lacks and inadequacies in life quality
indicators for the citizens of Pikine Est, especially its youth and women

Cause 1
High population density with
few free/common areas

Cause 2
Gaps in formative basis for the
youth

Cause 3
Inadequate spatial conditions for
cultural diffusion and teaching

Cause 1.1
Irregular distribution of services

Cause 2.1
Incomplete infrastructure in
schools in Pikine Est

Cause 3.1
Scarcity of functional premises

Cause 2.2
Unplanned urban structure

Cause 2.2
Scholar abandonment

Cause 3.2
Scarcity of teaching material

Source: Elaborated by the author

Figure 27. Objective Tree

Impact 1.2
Community development
thanks to its own inhabitants

Impact 1.1
Creating opportunities and
chains of knowledge

Impact 1
Conditions favoring personal
and collective growth

Desired Situation
Pikine Est as a community of Incremental development

Objective 1
Assignation of areas for densifi-
cation

Objective 2
Improvement of personal and
urban conditions

Objective 3
Creating spaces and material for
diffusion and teaching

Objective 1.1
Increasing the offer of services

Objective 2.1
Providing schools with
the lacking services

Objective 3.1
Creating aggregational areas

Objective 2.2
Urban restructuring

Objective 2.2
Improving opportunities and
conditions for the youth

Objective 3.2
Stakeholders provide ac-
ademic material

Source: Elaborated by the author

The choice to present both trees together is merely for graphic representation, but in reality, there's plenty of concepts and information contained in the passage from the first to the second. It is important to focus first – with higher detail – into the Core Problem. Indicators and their importance for this Thesis were already introduced in Section 2.1, yet the concept of **Life Quality Indicators** has not been properly introduced. Likewise, a keen reader might notice the concept of **Incremental Development** being introduced. The following blocks will explain them in detail.

Many authors have addressed Life Quality Indicators from different approaches and using different methods. In fact, there is no universal definition to what Life Quality is (Tesfazghi, 2009), and being such a wide concept, there is no fix or established framework to correctly assess its indicators (Stephen, 2013). Highlighting the intentions of this Thesis to focus on the person as a priority of the project itself, it is sensate to talk about life quality indicators. The definition that seemed most adequate to be applied to this work is suggested by Robert Rogerson (1999):

"As the research into quality of life and place promotion illustrates, within the setting of competitive cities quality of life has been adopted as one of the **array of attributes which can be employed to secure growth and development through the attraction and retention of means of economic production**."

One of the main premises of Rogerson's article relies on stating that higher Life Quality Indicators are linked to higher economic profit, since most of the times, results from surveys and research on the matter are published as lists or rankings. This attracts investment in the area and stimulates its growth. His definition is particularly pertinent for the subject of this Thesis, since he deepens into how this scenario works seen from the other side: people living in areas with low life quality indicators leave in order to be able to be closer to areas where they are at a peak. In a way, he justifies how growth in a community is stimulated by its inhabitants.

By researching authors whose papers contain topics on the same field as this Thesis such as measuring environmental quality (Marans, 2003), assessing quality of life in African cities (Tesfazghi, 2009), and mapping quality of life (De La Cruz 2011; Stephen, 2013), we find out how indicators are usually classified in domains. Those selected for the mentioned papers tend to oscillate on three axes: Physical, Social, and Economical. After tracing back some of these documents to the sources from which they did their own indicator selection, it is possible to see the root of this proposal in Dashora's (2009) study. Upon confronting publications with similar contents to those he treats (urban life quality at neighborhood level in The Netherlands), Dashora discovers that predominant domains are Physical,

Social, and Economical, so he uses them as his indicator domains too. He then consults project stakeholders in order to define the specific indicators to assess. These domains and indicators are later applied as well into De La Cruz's (2011) final dissertation, followed by Stephen's (2013) article.

Since we know the original source where these indicators were drafted from and the specific investigative context under which they were created, it is possible to filter them accordingly. Due to the timings set by this Thesis, it was not possible to conduct the same exercise with project stakeholders as Dashora (2009) did[15]. It is, however, the most adequate way to select indicators, since it involves both project partners and beneficiaries, guaranteeing almost completely a project's social, cultural, and economic acceptance (considering how it is a very extensive process if performed thoroughly). Instead, this Thesis proposes an experimental indicator measuring exercise, in which indicators are selected based on their pertinence according to research, the objectives in the decentralized cooperation program, and the future aspirations from the municipality of Pikine Est (Commune de Pikine Est, 2019). The following Table contains Dashora's indicators.

15. See Limitations, in Chapter 4. Conclusions and Future Developments

Table 6. Indicators proposed by the Literature

Indicators themes		Indicator	
Physical		Road asphalt quality (paving)	Parks and natural areas
		Road marking and traffic sign	The facilities in the parks
		Street cleanness	Graffiti issues
		Side walks	Playing areas for children
		Traffic quality and congestion	Noise pollution
		Vehicle parking	Air pollution
		Trees and landscaping	Housing quality
Social	**Safety**	Safety at home	
		Safety at street (brink)	
		Safety at public transportation	
		Safety at parks	
	Service accessibility	Health care facilities	Libraries/public readings facilities
		Food store or supermarket	Cinema or cultural centre
		Parks	Community centre
		Post office	Recycling facilities
		School	
		Public transportation	
	Community Participation/ Involvement	Interaction with neighbors	
		Participation in neighbourhood meetings	
		Contact with municipal officials	
		Participation in city council meetings	
Economical		Housing availability (rent/purchase)	
		Housing cost (rent/purchase)	
		Travel cost (public transport/own vehicle)	
		Income and income source	
		Housing quality (construction)	
		Job opportunity	
		Business opportunity	

Source: Taken from Dashora (2009) pg. 23

Table 6 shows the full array of indicators Life Quality Indicators for a case study in The Netherlands, but it could easily be extrapolated to other spatial contexts. In this scenario, the filtering and selection process will be done through the information collected until this point (following the aforementioned principles of Participatory Action Research). However, this selection process does not eliminate the "leftover" indicators; they will be used as strategies in the Project Formulation stage. This will be supported in Section 3.2.

It is also highly important to clarify that these indicators and their classification by domains will follow the same structure proposed by Dashora, since it consists of an exercise supported by actual project stakeholders. Due to the nature of this Thesis (elaborated in the context of a master's degree in Sustainable Architecture) it might be tempting to move indicators from category, and even replace the "Physical" domain for an "Environmental" category (consolidating the three main sectors of sustainability: environment, economy, and society). This could make sense, since, as evidenced, the Physical category includes air pollution, natural areas, and noise pollution among other indicators which would correspond in an Environmental category. However, considering the decision-making process behind the elaboration of Table 6 (involving stakeholders and beneficiaries) as well as the experimental nature of the case study in this Thesis, indicator selection will be the result of a filtering process.

Starting from the top of the list, we find several indicators regarding the conditions of vehicular and pedestrian mobility (road asphalt quality, marking and traffic sign, sidewalks, traffic quality and congestion, and vehicle parking). These indicators, for purposes of the project, will be grouped in the "**Quality of the roads**" category[16], based upon Street View image recollection showing that the condition of main roads is insufficient, leading to flooding and transit problems. "**Street cleanness**", however, will be considered as a separate category, due to its correspondence with a high-importance objective from the Pino Torinese – Pikine Est collaboration: waste management. The final indicators selected for the Physical category group the remaining elements regarding public spaces (trees and landscaping, parks and natural areas, the facilities in the parks, graffiti issues, and playing areas for children) into a single integrated indicator called "**Public Space Quality**", which treats each of them as individual strategies in the project. "Trees and landscaping", however, will be treated further in another Indicator Domain. Noise and air pollution are elements which are assumed to improve through the emphasis given to tree planting and landscaping. "**Housing Quality**" will be considered as a category of its own due to issues such as overpopulation and land pressure (**average of 7 persons per household**, in homes with less than 20 m² per person (Diawara, 2010)).

The next category (Social) will assume, on first place, that indicators regarding safety may be introduced in the project as strategies, since neither research nor the requests from the municipality of Pikine Est recall upon remarkable situations of unsafety in any layer of public life. In a similar way, service accessibility is proven by research and by the answers in the questionnaire to be well guaranteed within the municipality. The problems with services, however, are mostly due to the quality of the structures, so the first Social Indicator will be "**Quality of the Service Facilities**", grouping all services listed by Dashora except for Recycling Facilities and Public Transportation. Since the former is the only one linked directly with refuse management, it will be considered as "**Waste Management**"[17]. "**Public Transportation**", on the other hand, will be considered as separate due to research findings presented in Section 2.2. Community Participation and Involvement indicators are considered in this case to be improved as a result of the project itself, and (hypothetically) should be measured after the project is implemented.

Finally, the Economical domain will consider "**Income**" as its main indicator including Job Opportunity and Business Opportunity. The remaining elements listed by Dashora are not pertinent to the case study[18]. **The resulting list of Life Quality Indicators to be used in this project is shown below.**

Table 7. Resulting Life Quality Indicators

INDICATOR DOMAIN	INDICATORS	KPI'S FOR ASSESSMENT	SOURCE
PHYSICAL	STREET CLEANNESS	Cost of service per household User satisfaction Workforce costs Transport costs Percentage of waste recycled	Association for Public Service Excellence
	QUALITY OF THE ROADS	Environmental Impact Green corridor control	HORAK, E. et al.
	HOUSING QUALITY	Population density Demographic change	DICKINSON et al.
	PUBLIC SPACE QUALITY	User satisfaction Cost of management per resident Customer requests for street trees and parks	VIAL, D.
SOCIAL	QUALITY OF SERVICE FACILITIES	Availability and proximity Total GHG emissions from primary energy	MORO, A.
	WASTE MANAGEMENT	Saturation rate Percentage of reusable waste Percentage of waste reused in-site Cost of service per household Transport costs	KPI Dashboards
	PUBLIC TRANSPORTATION	Cost of the fares Environmental Impact Service availability Comfort Service performance	EBOLI, L.; MAZZULLA, G.
ECONOMIC	INCOME	Quantity of jobs created Investment costs	MAJALE, M.

Source: Elaborated by the author

17. This indicator will be kept in the Social domain to preserve Dashora's stakeholder-chosen organization and considering Salem's observation regarding the link between collective property (a social factor) and waste disposal. This justification is pertinent since such indicator could be likely inserted as well in an Environmental domain.
18. They will be considered (when possible) as strategies in the Project Formulation Section.

Table 7 features two additional columns of information for the indicator selection process: KPI's for assessment and Bibliographical Source. They correspond to the specific Key Performance Indicators to assess each of the individual Life Quality Indicators chosen previously, and to the source that suggests them as proper tools, respectively. KPIs highlighted in the color green indicate those which could be measured before the Project Implementation phase, since mostly all the rest are straightly linked to the impacts of the project. These will be those considered in the first stage as project evaluation tools.

Incremental Development

After having presented the Life Quality Indicators used for this project and their selection process, it is proper to explain the concept of Incremental Development for the field of architecture and urbanism, as well as the indicators that will derive from it. The main interest to promote said definition into this Thesis is to link it to current lines of thinking which critique Sustainability as an approach focused on mitigating negative impacts instead of increasing the production versus consumption ratio. In other words, Sustainable design – according to authors who venture to make an opinion on the matter – ignores the possibility of creating buildings and communities who can give in return more than what they need (Birkeland, 2018).

Such is the thinking of the Positive Development theory, promoted by Dr Janis Birkeland. In some way, Birkeland suggests that it is no longer sustainable to be 'only' sustainable. The rate in which the construction sector generates environmental impacts is far too accelerated in comparison to the rate in which these negative impacts are reduced. "We should be aiming for a positive influence – not just a zero outcome" (Birkeland, 2018). The idea is then to integrate community development and ecologic conservation to begin conceiving buildings as the solution, not the enemy. This calls for specific interventions in design per each construction, since each of them has different whole life cycle emissions to compensate for (and to produce for). For instance, a building can not only restrain its CO_2 emissions, but it can also even sequestrate CO_2 from its surrounding environment, therefore producing in favor. Through these statements, Birkeland argues that **current building assessment tools could be updated to measure new design strategies** and stimulate eco-positive development.

Eco – positive thinking may be linked, as a result, to a similar proposal of development: Incremental Development. Although there is no universally accepted term for this ground-gaining concept, most authors agree that incremental development seeks to **amplify the speed in which environmental services are generated in a community** through building scale interventions, which imply a much more personal and cost-restricted approach, but ensure an altogether community growth (Sturm, 2012; Stephens, 2016; Steuteville, 2017). Two definitions must be specified within this context: environmental

services and building. The United Nation's Glossary of Environment Statistics defines environmental services as functions performed by natural water, air, and land assets (United Nations, 1997):

"There are three basic types of environmental services: (a) disposal services which reflect the functions of the natural environment as an absorptive sink for residuals, (b) productive services which reflect the economic functions of providing natural resource inputs and space for production and consumption, and (c) consumer or consumption services which provide for physiological as well as recreational and related needs of human beings."

Common conception of "building", on the other hand, might be automatically linked to residential or commercial constructions, but Robert Steuteville (2017) suggests in one of his articles for Congress for the New Urbanism that it could also be applied – in the context of incremental development – to small scale urban interventions which also influence in the revitalization of a community. For instance, food trucks or trailers, which require minimum infrastructure, and can be even set up by the community's own inhabitants. It is an interesting approach to extrapolate building scale interventions to the context of an urban scenario.

As a result of the convergence between Birkeland's eco-positive development and incremental development, new indicators must arise if this Thesis seeks to be inserted into these lines of thinking. Birkeland, author of "Positive Development" proposes the Net Positive Development chart, which provides three layers of focus factors which are to be addressed in order to generate an adequate state of equilibrium between population needs and ecosystem thriving. The chart is shown below.

Figure 28. Birkeland's Net Positive Development
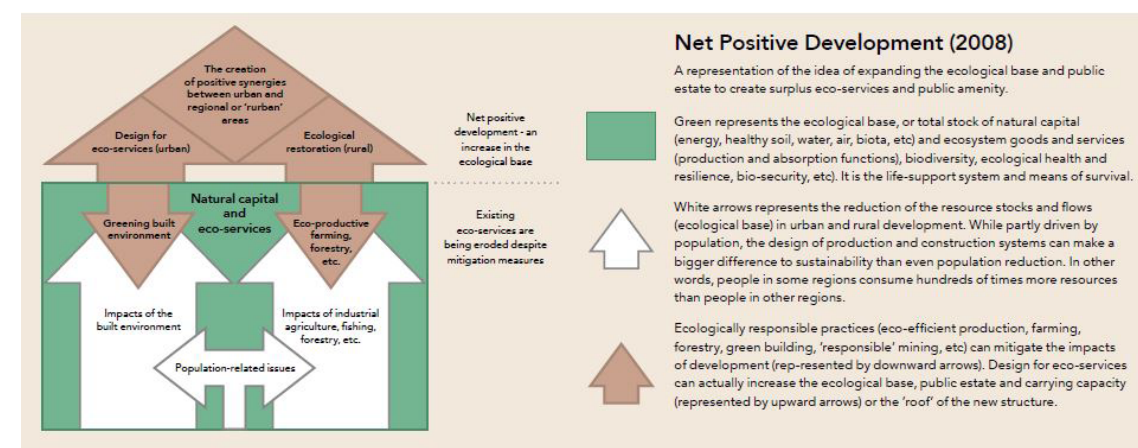
Source: Taken from Birkeland (2018) pg. 3

From Figure 23 we can easily extract the three main layers, explained in detail by the legend. Green areas contain the essential ecologic base for the healthy growth of every life form, listing some categories that pertain this subject such as energy, soil quality, water, air, biodiversity, and resilience. Research conducted for the case study phase suggests that the most pertinent yet measurable category to treat (from the green domain) could be "**Biodiversity**": reforestation programs in Senegal are directed towards soil quality improvement through select species, spreading their usage as nutritional sources, and even generating income with the produce, using species such as moringa, jatropha, and mango and lemon trees (Reforestaction, 2011). This way, it is safe to say that the approach on increasing biodiversity of tree species contributes to producing higher quality outputs in other aspects of ecological and community life.

White areas relate to the impacts of inhabitants on their environment, considering however that accurate design choices can positively overcome their rates of consumption. There is, however, one very interesting bullet point contained in one of the arrows named "Population related issues". Given that results from research and discussions with stakeholders did not point out any issue regarding exaggerated rates of consumption in any aspect of basic needs for the population of Pikine Est, an adequate element to target within this category could be destined to improve the collective conscience on production and consumption chains. In other words, stimulate education around the environmental impact of consumer choices that would hypothetically be introduced into the Pikinese lifestyle once the project is fully operational. This requires specific attention (in this case study) to topics such as "**Literacy**" and "**Heritage**". The former would revolve around unlocking the wide range of means of information that every person has the right to access, while the latter would focus on creating a sense of belonging especially among young people, making them aware of how helpful their contribution can be if they become active participants for their communities.

Finally, brown areas represent ecological practices linked to goods and services, working at their best when integrating rural and urban experiences. This factor will therefore be assessed as "**Water Management**", considering Pikine Est to be particularly afflicted by flooding risks, and retaining this category as an urban service which is somehow still lacking in the area (see Appendix 1). The final list containing indicator domains, indicator categories, KPI's and their bibliographic sources is shown on the next page.

Table 8. Final Indicator List

| INDICATOR DOMAIN	INDICATORS	KPI'S FOR ASSESSMENT	SOURCE
PHYSICAL	STREET CLEANNESS	Cost of service per household User satisfaction Workforce costs Transport costs Percentage of waste recycled	Association for Public Service Excellence
	QUALITY OF THE ROADS	Environmental Impact Green corridor control	HORAK, E. et al.
	HOUSING QUALITY	Population density Demographic change	DICKINSON et al.
	PUBLIC SPACE QUALITY	User satisfaction Cost of management per resident Customer requests for street trees and parks	VIAL, D.
SOCIAL	QUALITY OF SERVICE FACILITIES	Availability and proximity Total GHG emissions from primary energy	MORO, A.
	WASTE MANAGEMENT	Saturation rate Percentage of reusable waste Percentage of waste reused in-site Cost of service per household Transport costs	KPI Dashboards
	PUBLIC TRANSPORTATION	Cost of the fares Environmental Impact Service availability Comfort Service performance	EBOLI, L.; MAZZULLA, G.
ECONOMIC	INCOME	Quantity of jobs created Investment costs	MAJALE, M.
INCREMENTAL	WATER MANAGEMENT	Recharge of groundwater	MORO, A.
	LITERACY	Facility capacity Condition of the facilities	JACKSON, T.
	BIODIVERSITY	Surface of recovered habitats Impact on local species Freshwater quality	MAHY, G. et al.
	HERITAGE	Level of participation Quality of the interventions Level of "artealization"	FERRADA, M.

Source: Elaborated by the author

Once again, KPI's in green indicate those which – presumably – could be calculated prior to project implementation. The only exception is applicable to the final indicator (Level of "artealization"), which is highlighted because it brings up a concept to be considered as a strategy since it cannot be measured before the project is operational. Ferrada (2012) describes the level of artealization:

"(…) the outcomes that the [heritage dimensions of] border generates in cultural and artistic fields (visual arts, music, literature, performances in public areas, etc.) under the assumption that these expressions, in turn, enrich an understanding of the heritage dimension of the border."

In other words, it speaks about the different artistic ways in which citizens appropriate over a public space with a specific heritage connotation. This pushes the urban designer to think about the quality of the spaces to be proposed for public aggregation.

With an initial list of indicators and strategies destined to route the project and born from all the previous steps contained in this document, it is possible to have a conception of the project at hand. As stated by the Objective Tree (Figure 27), the main goal is to transform **Pikine Est into a Community of Incremental Development**. Theory exposed previously supports the idea that it is very time and budget consuming to actually transform a community into an urbanistic Incremental zone, which is why the word "**Development**" results essential to the definition of the goal: the idea is not to turn Pikine Est into an Incremental paradise. Instead, the proposal is to **provide an adequate set of tools and strategies which might direct this peripheric community to a healthier and more conscientious growth, from and for its inhabitants**. In this way, we return to close what we once opened at the beginning of this book: by acting positively in favor of the people, we can revert the Negative Cycle on Figure 1, and promote a healthier, eco-positive, and incremental cycle:

Figure 29. Positive Approach upon Opportunity Creation On-Site
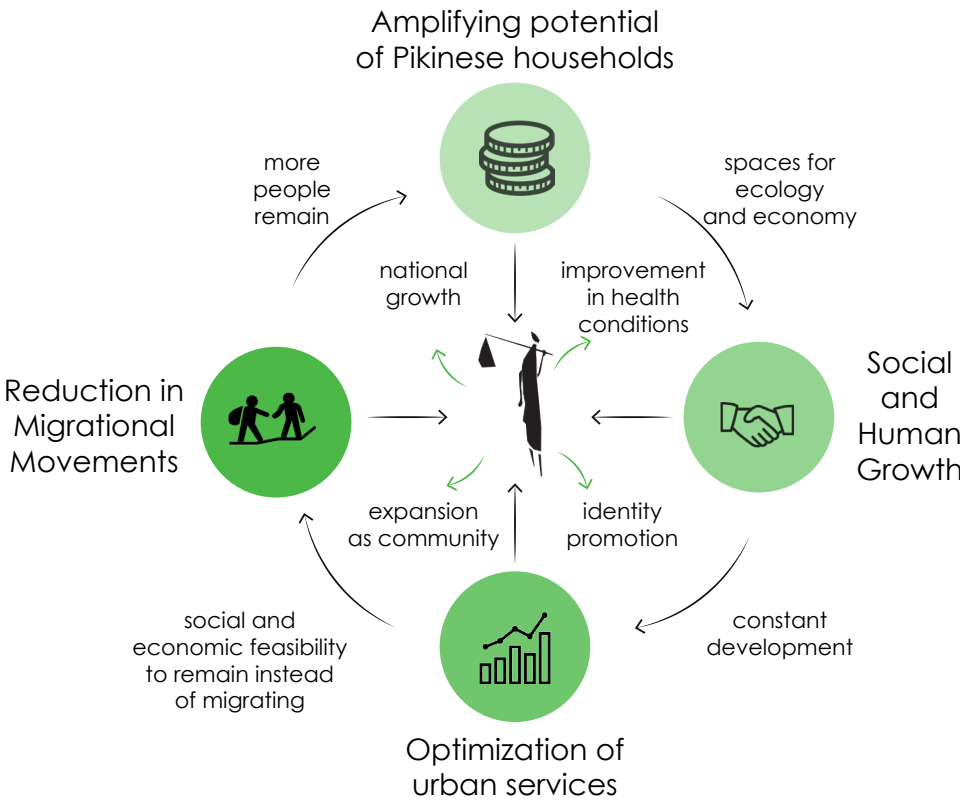
Source: Elaborated by the author

3.2 Project Formulation

Figure 24 represents graphically how Incremental Development would gain its strength when applied in the urban context of Pikine Est. Keeping the person as a priority, community and ecosystems grow together. In this section, research, discussions, indicators, and strategies take shape in Urban Interventions, rooted in smaller-scale actions which will lead to cyclic progress towards a large-scale change in favor of the community. Aware of the limitations – mostly in the financial aspect – that such interventions might face in this spatial context, they will be separated into three scenarios. Each intervention scenario will propose or adapt strategies around one of the lacking branches of urban life identified in Section 2.2: Case Study. This means one scenario will focus on improving life quality indicators by mediating on **Transportation**, another one will focus on **Collective Spaces**, and another one will be dedicated to the **Service Facilities**. It is essential to clarify that the division of scenarios does not mean that strategies cannot intersect in more than one scenario; it simply means that the chosen strategy set works best when applied in its corresponding scenario. In fact, one of the main reasons to conduct a project evaluation is due to the interest of determining which are the best strategies to apply in this case study.

Each of the following scenarios contains similar amounts of graphic material to facilitate comparison among them. The core representation tool chosen is a general planimetry, originally elaborated for a 1:5000 scale of detail. In this case, it has been reduced to fit the document's format. A corresponding legend, some specific side notes, and an isometric explosion divided into layers (one for each indicator domain) will accompany each Master Plan. Fix and variating strategies will follow, represented in 3D schematics: fix strategies are intended as those strategies that can be applied and overlapped to other scenarios, while the variating kind will refer to those chosen specifically for the Master Plan scenario at hand. The set of strategies will be completed by street sections to better illustrate the aspect of each proposal and to clearly evidence how one differs from another. Brief descriptions regarding specific design choices will ultimately close each section.

Master Plan

INCREMENTAL
- Green areas
- Existing trees
- Moringa trees
- Jatropha trees
- Educational (Schools, heritage hubs)

PHYSICAL
- Enlarged streets
- Densification areas

ECONOMIC
- Commercial / mixed-use

SOCIAL
- Health posts
- Bus stops
- Train stations
- Railway
- Waste container area
- Bus route direction
- Train station (today)
- Street section indicative line

Division of the bus route
(From *Gare*: through the neighborhood)
(To *Gare*: around the neighborhood)

Green corridors with low tier lighting

Park equipment as attractor

Riqualify existing medical center

Ambulance - waste truck lanes

External sale stands

Green space near Maison de la Femme as attractor

Reposition train station
(revitalize perpendicular road)

Jatropha, moringa, citrus x aurantifolia trees

0m 100 200 300 400 500

Exploded Isometric

INCREMENTAL

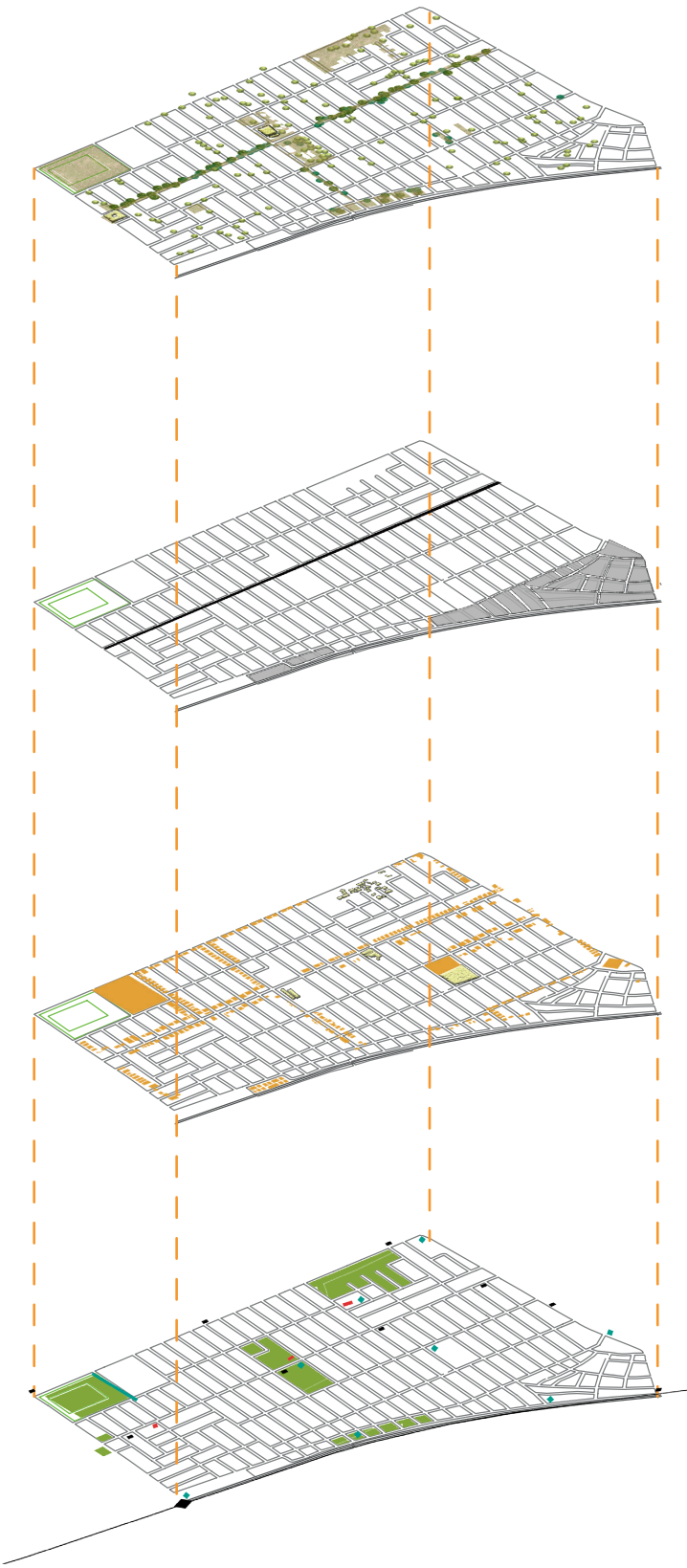Water Management

Literacy

Biodiversity

Heritage

PHYSICAL

Street Cleanness

Quality of the Roads

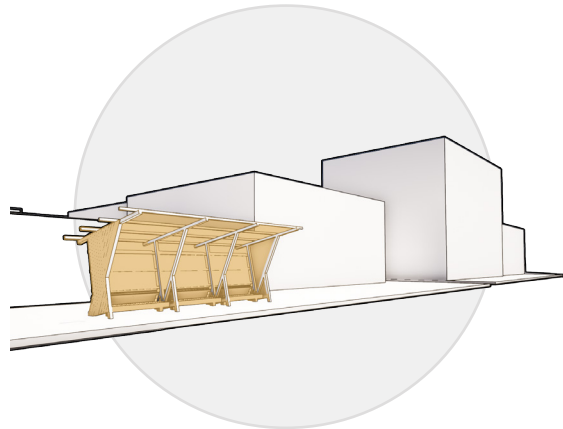Housing Quality

Public Space Quality

ECONOMIC

Income

SOCIAL

Public Transport

Waste Management

Quality of the Facilities
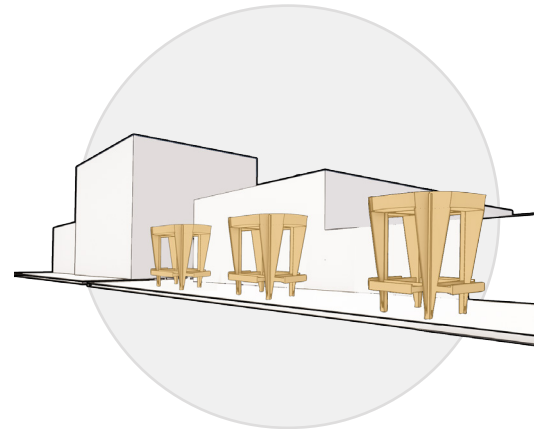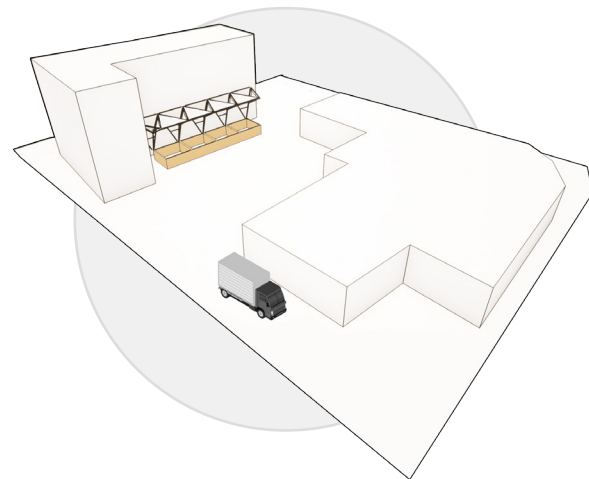
Bus stops
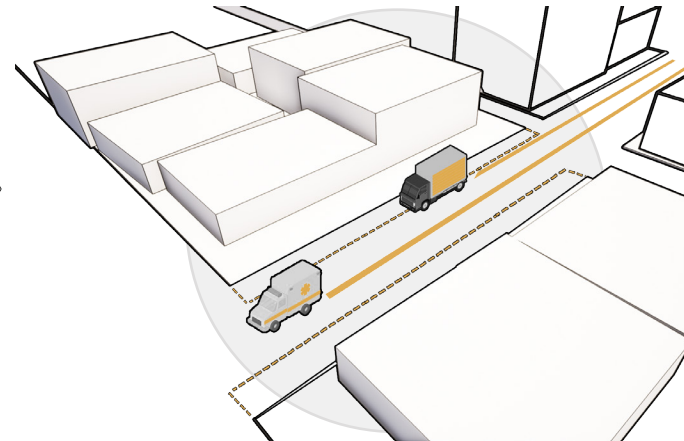built with local materials

External sale stands
over most concurred roads (commercial axes)

Densification
Floor area ratio = 2,22
Coverage = 0,59

Cinema Awa
Second purpose as heritage hub:
stories and showcases of relevant figures in
Senegal's history (create sense of belonging)

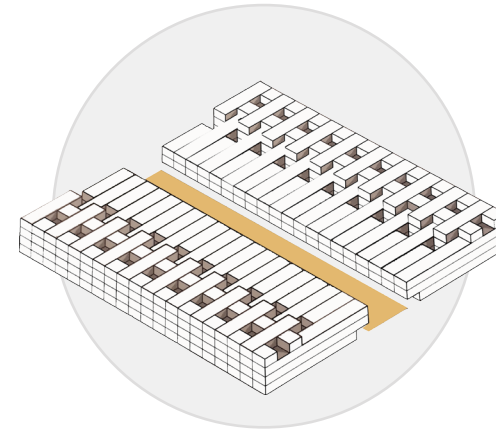## Waste containers
located within selected blocks, reducing
their exposure to passersby

Enlarged roads
for ambulances and waste trucks, using
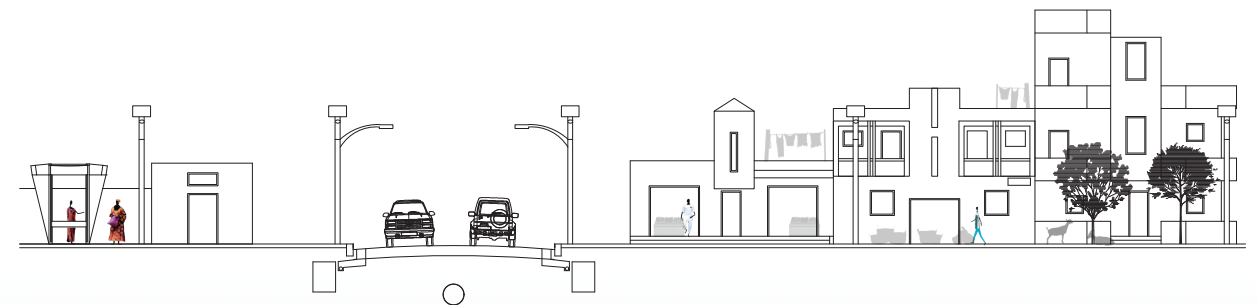oversized sidewalk areas

Street Section

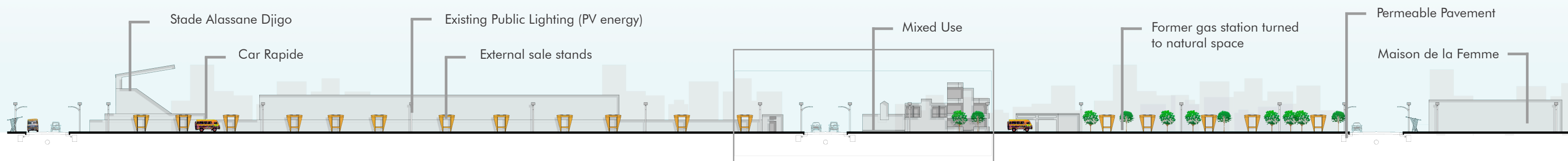Stade Alassane Djigo

Existing Public Lighting (PV energy)

Mixed Use

Former gas station turned
to natural space

Permeable Pavement

Car Rapide

External sale stands

Maison de la Femme

Parting from the basic premise that transportation can be an urban axis of intervention that makes a difference in the municipality, Scenario 1 seeks to construct a new urban life through punctual actions following the principles of Incremental Urbanism. Just like it will happen in most of the strategies chosen for the following scenarios, one core intervention will unleash the improvement for the rest of the urban and environmental services. In this case, we begin by the **displacement of the nearest Petit Train Bleu station**, currently located at approximately five blocks away from the southernmost point of the municipality (see Figure 25). It is worthy to mention that this decision would not require major infrastructural efforts, since the current state of consolidation of the existing station is not as high-end as one might expect from a regional railway station. This is why this initial intervention is, to some extent, a requalification.

The new position of the train station would reactivate transit in the perpendicular axis (Rue PO 02, where "PO" stands for Pikine Ouest). To further strengthen urban dynamics in this road, the other end of the road will host a bus stop belonging to an urban transit cycle. In this scenario we also foresee the division in the bus line, meaning essentially that buses coming from the *Gare Routière Beaux Maraichers* (important transport hub in the department of Pikine located at an estimated 1.2 km from the case study area) will cross Pikine Est through the middle (over Tally Icotaf Road), while buses heading to *Beaux Maraichers* will surround the municipality over Tally Boubess, as shown schematically in Figure 25. Bus stops are located at an approximate distance of 500 m from one another, seeking to optimize their coverage. This action, likewise, requires two existing stations to be moved further away from themselves.

Following these actions, it is possible to notice how the axis designated as commercial and mixed-use are weaved between opposing bus stops. This decision is based on the assumption that these streets will show an increase of urban flows, therefore allowing to host more commercial activities. Contrary to what common belief might indicate, many small-scale businesses bloom within the neighborhood, but lack of proper infrastructure is their most common challenge. Under this hypothesis, all three project scenarios propose the application of modular spaces built from economic yet durable materials in efforts to optimize and structure these commercial activities. Interestingly enough, these activities go from fruit sales stands to furniture selling kiosks.

Some of the roads in each scenario will be chosen as a natural axis. This means that they will see an increase in the number of trees that border them and that they will be requalified with new pavement (using permeable interlocking pavement). Both of these strategies intend to increase groundwater absorption and reduce flooding events and damages caused by them. On a parallel intention, tree planting will be done in

favor of local biodiversity, working with varieties of **lemon trees, mango trees, moringa, and jatropha**. Additional investment costs linked to such actions include tree monitoring during the first two years of their growth: the most delicate stage of their process (Reforestaction, 2011). Responding to the consequent increase of shadowing (and therefore the creation of darker areas prone to insecurity), these spaces in the project will also incorporate lower tier light posts.

Other urban axes within the municipality currently host major vehicular transit consisting of buses, cars rapides, taxis, cars, bicycles, motorbikes, and even horse-drawn carts. Bearing in mind that future growth in the area pretends to introduce ambulances (Commune de Pikine Est, 2019) and that optimization of waste collection services brings along additional vehicular flows, another project strategy must be designed to attend to these necessities. Taking advantage of oversized sidewalks in these roads, all three project scenarios propose the incorporation of two additional aisles to facilitate transit (and parking when needed). However, it can be seen later on how each scenario identifies different roads as ideal for enlarging.

Requalification plays an important role in this scenario on other aspects too. For instance, Cinema Awa, a recreational facility located in the center of the municipality, could accommodate a second function of **historical center**: a place where pictures and stories of significant people in the history of Dakar and Senegal are showcased for everyone to see, in an effort to stimulate **sense of belonging** in the community and especially among the youth. Similarly, *La Maison de la Femme*, already presented before, could hold alphabetization courses for the community, ideally led by groups of women (who already conduct similar activities in the teaching of Wolof). Adapting this structure to be able to welcome larger groups of people could be of great assistance in this mission.

Finally, each scenario tests different options for densification. Habitational typologies are taken from "50 Urban Blocks", by a + t research group. These blocks include floor area ratios and coverages for each suggested volume. For all three scenarios, they are chosen by balancing the amount of square meters they occupy with the quantity of space available for densification, usually composed by the area currently deemed as "irregularly occupied" (République du Sénégal, 2014) and additional blocks with poor states of housing consolidation. Once chosen, their calculations and volumes are adapted when needed in order to keep them at a maximum height of five floors to avoid disruption in the urban landscape. This will also be studied in the next scenarios.

Master Plan

INCREMENTAL
- Green areas
- Existing trees
- Moringa trees
- Jatropha trees
- Educational (Schools, heritage hubs)

PHYSICAL
- Enlarged streets
- Densification areas

ECONOMIC
- Commercial / mixed-use

SOCIAL
- Health posts
- Bus stops
- Train stations
- Railway
- Waste container area
- Bus route direction
- Train station (today)
- Street section indicative line

- New medical center
- Densify along the railway's edge
- Natural connection with wetland to the north
- Green corridors with low tier lighting
- Park equipment as attractor
- Ambulance - waste truck lanes
- External sale stands
- Green space near Maison de la Femme as attractor
- Jatropha, moringa, citrus x aurantifolia trees

0m 100 200 300 400 500

Exploded Isometric

INCREMENTAL

Water Management

Literacy

Biodiversity
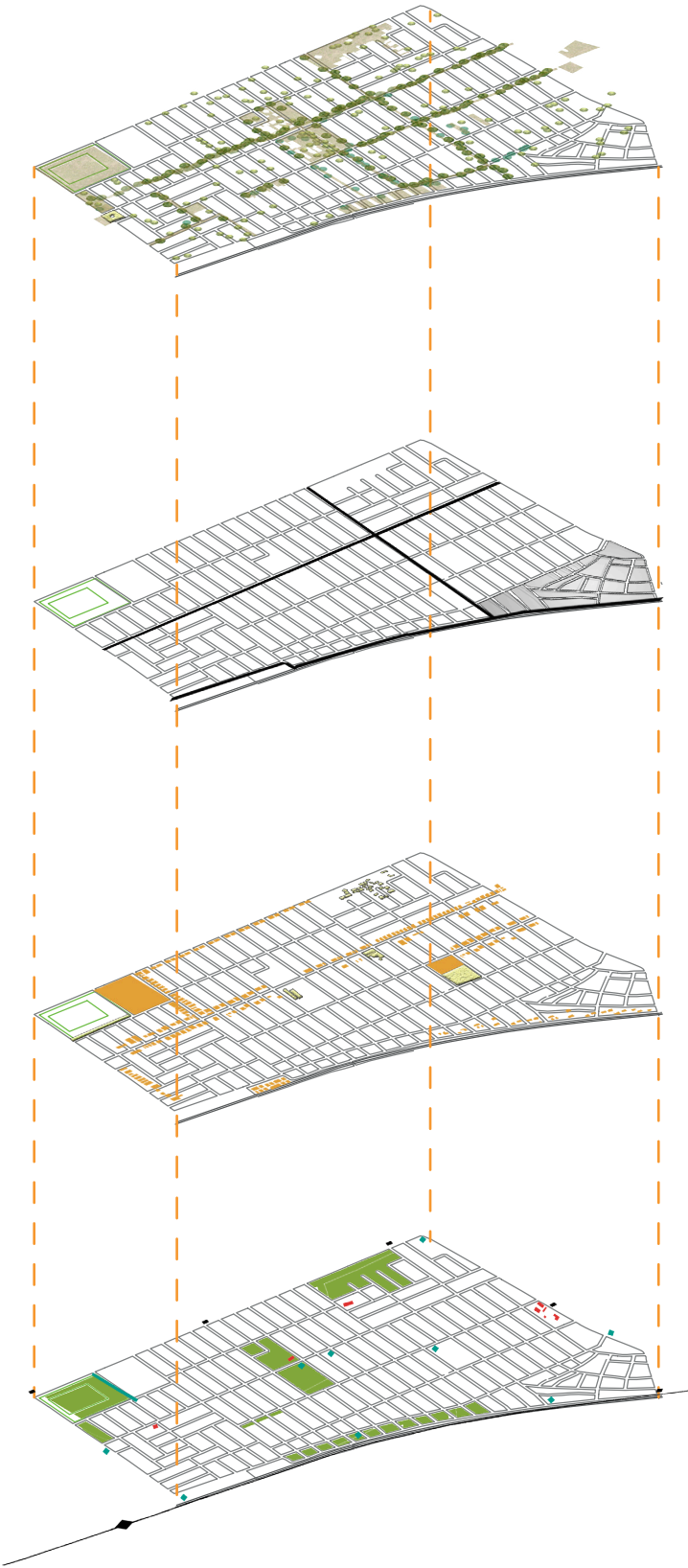
Heritage

PHYSICAL

Street Cleanness

Quality of the Roads

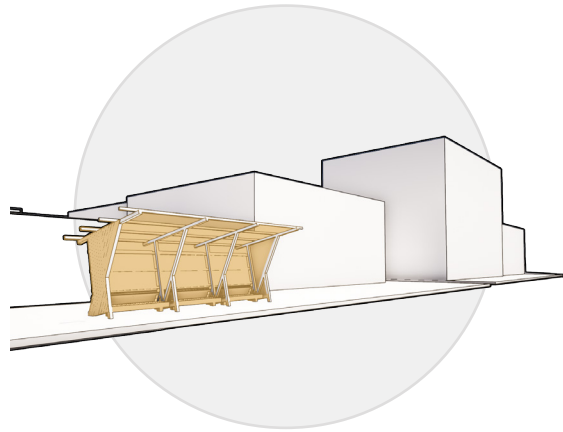Housing Quality

Public Space Quality

ECONOMIC

Income

SOCIAL
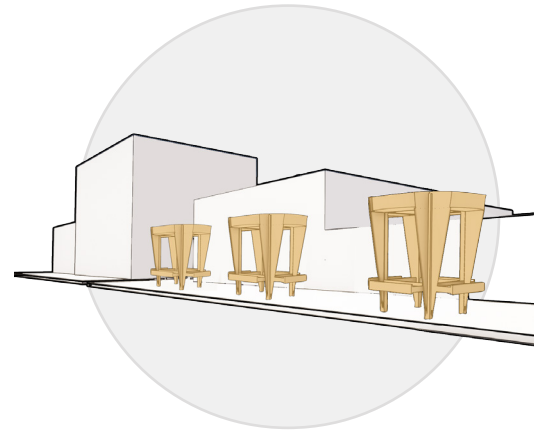
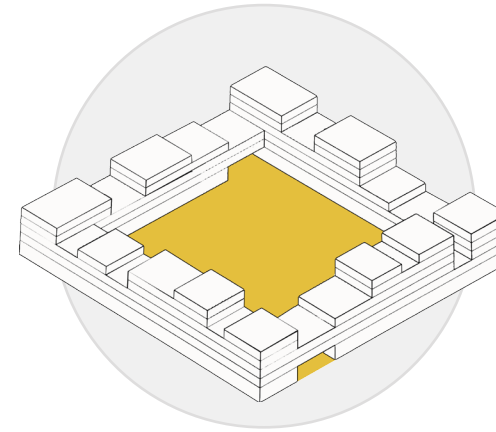Public Transport

Waste Management

Quality of the Facilities

Bus stops
built with local materials

External sale stands
over most concurred roads (commercial axes)

Densification
Floor area ratio = 2,22
Coverage = 0,47
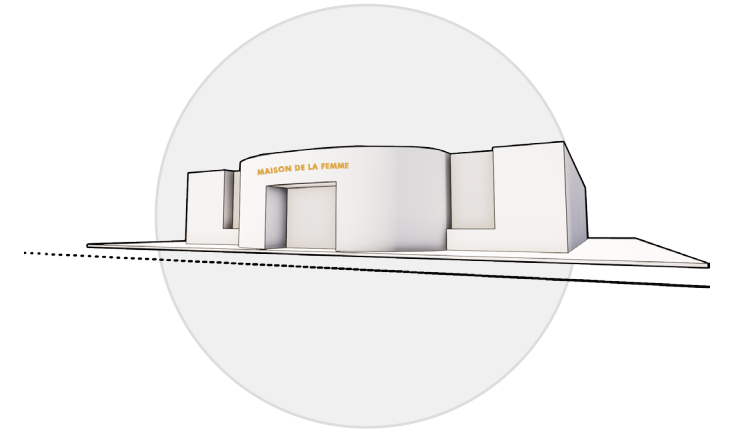
Maison de la Femme
increase its capacity to host alphabetization activities
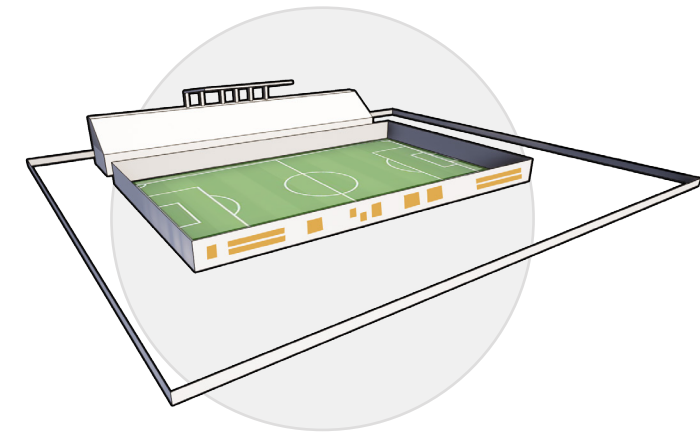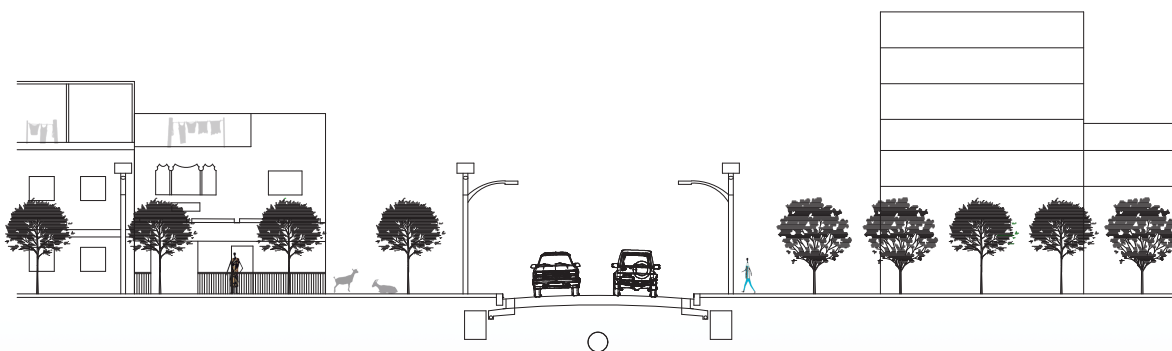
Historic wall - Stadium
Second purpose as heritage hub:
stories and showcases of relevant figures in
Senegal's history (create sense of belonging)

Street Section

Marché Waxinaan

École 8 (Public school)

Permeable Pavement

Densification Volume

Green corridor

External sale stands

Existing Public Lighting (PV energy)

Image 3. Typical sale stands in Pikine Est

Discussing Scenario 2

Scenario 2 focuses on the adaptation of collective spaces in Pikine Est. As seen before, general consciousness regarding the protection of public spaces is not yet well implemented in these contexts. Starting from the largest existing non-built space at the center of the municipality, natural corridors (introduced in the description of Scenario 1) are designed to connect the case study area with nearby natural bodies, such as the wetland to the north. On a 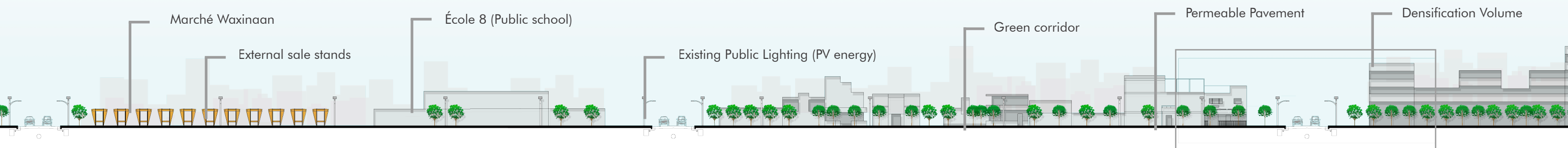similar way to Scenario 1, this alternative suggests that well-kept spaces with a wide diversity of trees would play a key role as a strategy to attract higher flows of people. From this initial premise, other services are located in proximity to these corridors. For instance, a new medical center is proposed on a plot where there is currently a gas station (abundant in the area), allowing the possibility to complement this section of green axis with commercial activities and exterior sale stands.

In this case, the train station is kept at its current location (though it must be requalified as needed, knowing that the train line serves 11,000 passengers per day (Diawara, 2010)). Natural open spaces would also act as a strategy to control disturbances from activities conducted in the railway. These would work well together with the areas of densification disposed next to the train line (selected under the same criteria presented before: housing levels of consolidation and regularity of land occupation). The housing typology selected for this scenario may be seen in the strategy schematics, evidencing clearly how there is an intent (shared as well in the other alternatives) to prioritize and spread the creation of shared spaces within urban blocks. The functionality of this strategy is simple: **create spaces which are privately owned by some, meaning they are of common responsibility**, hoping to begin the conscientization process at a smaller scale, by slightly altering ways of inhabiting.

Strategies regarding heritage change somehow from Scenario 1. Considering a case in which the possibility to use Cinema Awa with a secondary function of historical center should not be allowed, this alternative plans to use walls surrounding the soccer field to display these famous personalities from Senegalese history. This decision would also vantage from the strengthening of public space, acting as an attractor for the community. Should it be assessed by its investment costs, these would imply renewals from time to time to keep the collection interesting for the youth. The strategy to requalify *La Maison de la Femme* to use it as an alphabetization complex would apply just as it did for Scenario 1. It is therefore pertinent to clarify an essential here: **using a strategy in one case does not mean it can only be applied to said case**. In fact, the intention of evaluating the project proposals at the end seeks to extract the best strategies for each (under the evaluation criteria) for their future economic assessment.

Master Plan

INCREMENTAL

Green areas
Existing trees
Moringa trees
Jatropha trees
Educational
(Schools, heritage hubs)

PHYSICAL

Enlarged streets
Densification areas

ECONOMIC

Commercial / mixed-use

SOCIAL

Health posts
Bus stops
Train stations
Railway
Waste container area
Bus route direction
Train station (today)
Street section indicative line

Densification = Commerce
Waxinaan Market joined with Syndicat
In its place: school furniture workshop
Medical center, cultural center, green spaces (old market)
Reposition Marché Syndicat - trasformed into longitudinal
Ambulance - waste truck lanes
External sale stands
Jatropha, moringa, citrus x aurantifolia trees

0m   100   200   300   400   500

N

Exploded Isometric

INCREMENTAL

Water Management

Literacy

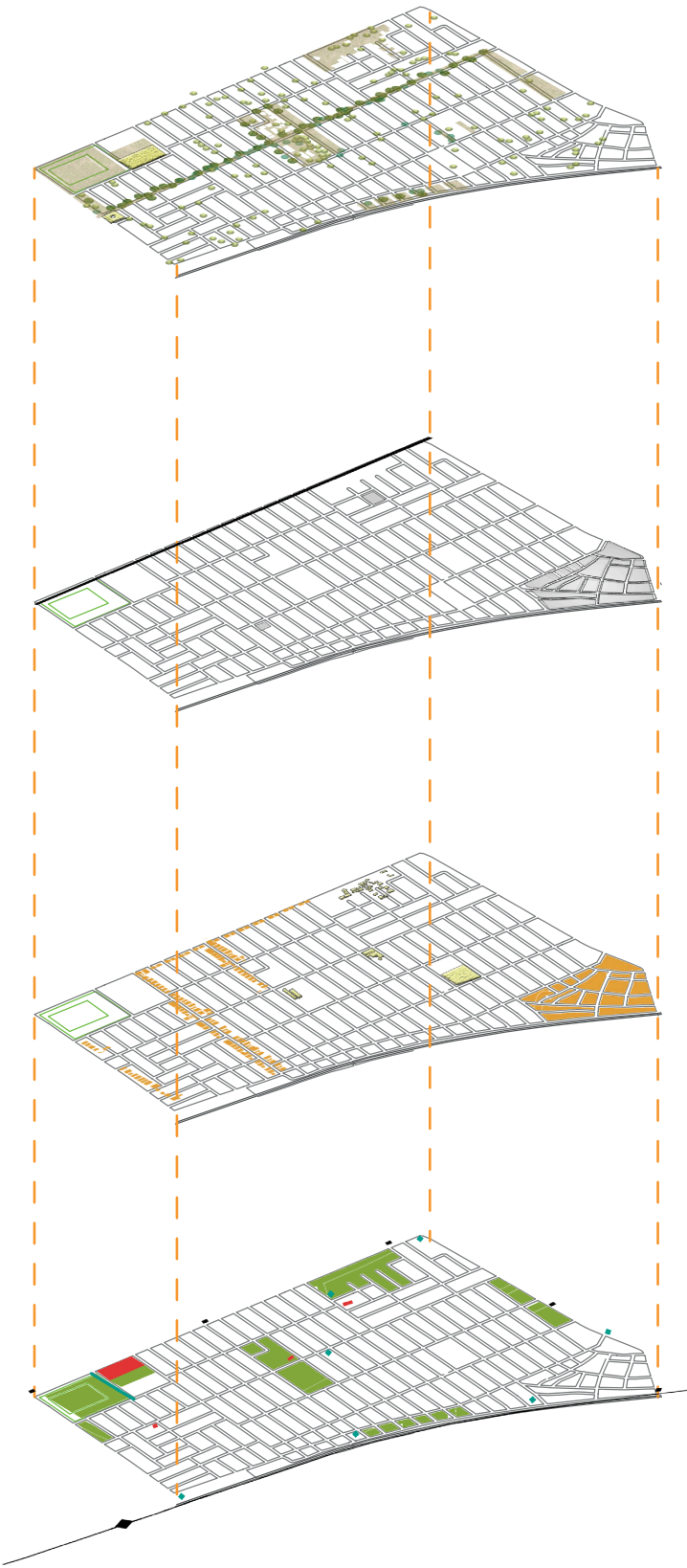Biodiversity

Heritage

PHYSICAL

Street Cleanness

Quality of the Roads

Housing Quality
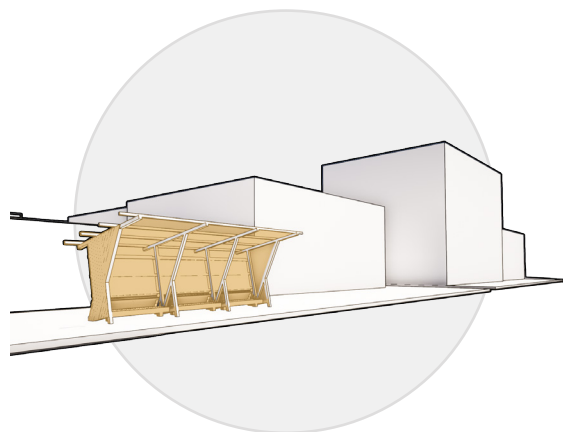
Public Space Quality

ECONOMIC

Income

SOCIAL

Public Transport

Waste Management

Quality of the Facilities

Bus stops
built with local materials
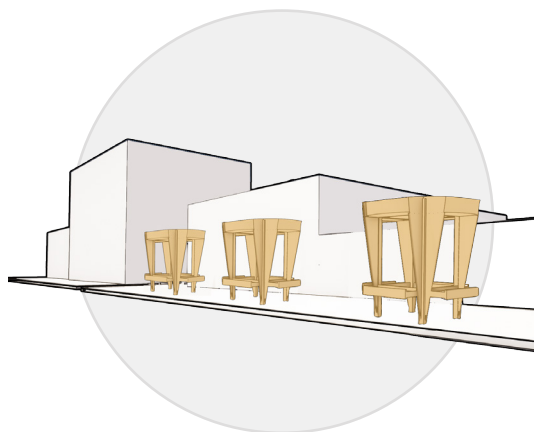
External sale stands
over most concurred roads (commercial axes)
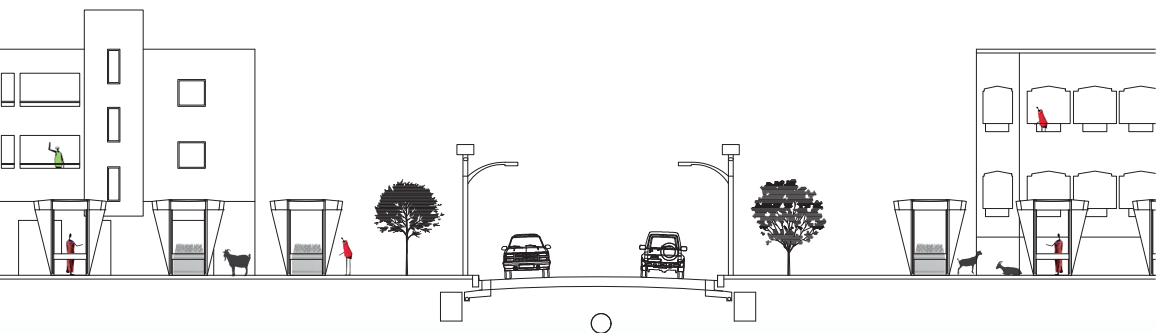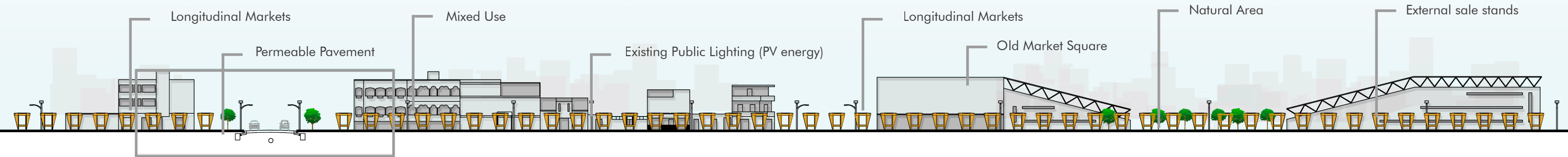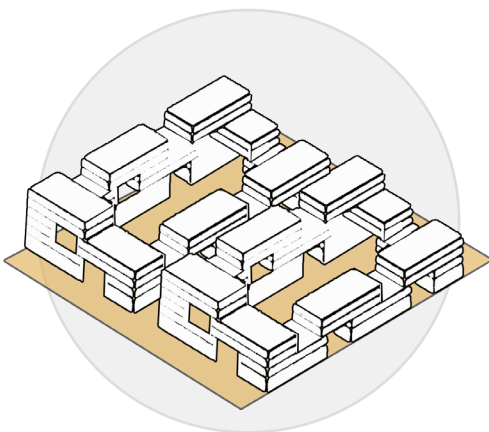
Densification
Floor area ratio = 1,90
Coverage = 0,35
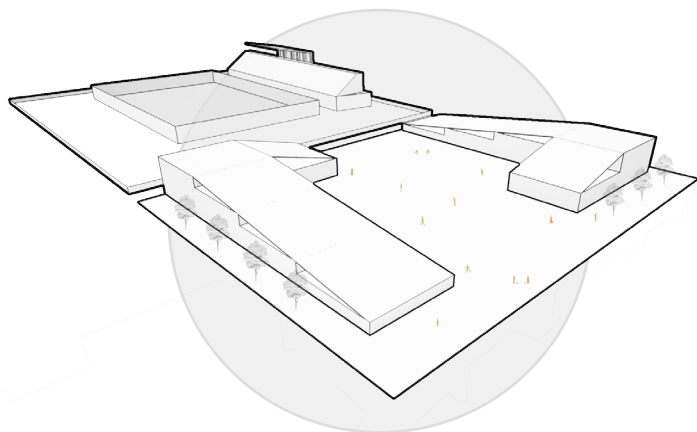
Old Market Square
becomes a medical center, cultural center,
and creates open natural spaces
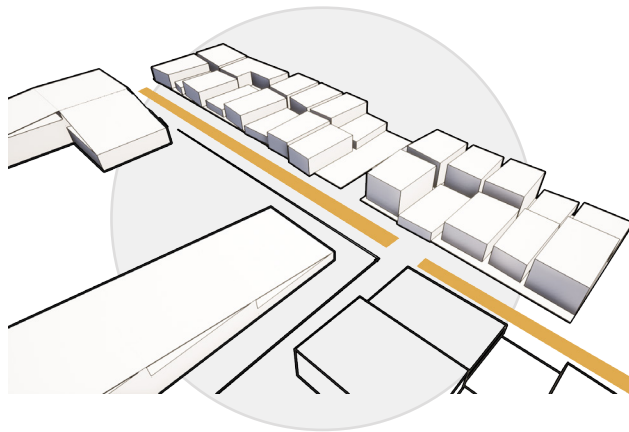
Longitudinal Market
distributed along one axis to liberate the square
for the medical and cultural centers, and for the
school furniture workshop to the north

Street Section

Longitudinal Markets

Mixed Use

Longitudinal Markets

Natural Area

External sale stands

Permeable Pavement

Existing Public Lighting (PV energy)

Old Market Square

The final scenario probably requires the largest interventions out of all three. The main action featured consists in joining *Marché Syndicat* with *Marché Waxinaan* and transforming them into linear markets. The spaces they currently occupy will then host the scenario's core structures: new medical and cultural centers will be built in the plot occupied by *Syndicat*, while *Waxinaan* will be moved to leave space for a workshop near the school grounds which will supply the local educational facilities with furniture, currently lacking according to the document from the Pikine Est municipality. Both activities are also addressed to **increase the number of jobs on-site**.

Thinking on a hypothetical scenario in which these strategies would actually have to be built, we would be facing major investment costs which should be balanced by reducing the scale of other usual interventions already applied in the other two cases. For this reason, natural vegetation corridors, street enlarging, and areas destined for densification are reduced in this stance. Mixed-use is specially promoted in this scenario's densification zones, expecting larger flows of people in this sector.

As closure for all presented scenarios, it is pertinent to return to one of the targets set by the decentralized cooperation program: waste collection. The department of Pikine is served by the collection ceded by the official body to subcontractors (Diawara, 2010). The idea is to vantage from the existing service, Pikine's transfer station, and the Mbeubeuss landfill to dispose of household waste. However, waste containers come in handy to classify material for its expected reuse in-site. As the strategy suggests, containers are placed in the inner spaces of the designated blocks, keeping them away from the sight of local passersby. Among the investment costs to be considered, it would be advised to include costs for information, covering the expenses required to let citizens know which days each waste container would be collected.

Beyond pavement requalification, other strategies were considered to combat sea level rising and flooding events. These, however, were not included in the Project Formulation stage because, according to research, an optimal solution would require large-scale infrastructure costs, not pertaining to the Pikine Est municipality. To list some of these actions, I use those included and evaluated by the Flood Prevention and Drainage Project (Jordy & Diou, 2011). Five main strategies contained in the document can be linked to this case study. **Institutional strengthening and capacity building** refer to urban management actions, divided into physical and communicational types. The former promotes planting trees as vegetal fences, while the latter is directed to creating early warning systems. **Drainage infrastructure**, with an estimated cost of 60 million USD, consists in pumping the region of Thiaroye (located in proximity of the case study area) to transport to the ocean some of the water located in this deposit. On another

layer, **community participation** plays an important role when assessing population response and ideas on the subject. Finally, a **monitoring** stage refers to keeping under control local wetland recovery.

3.3 Project Evaluation

As mentioned before, one of the core limitations[19] of this project comes from the impossibility of visiting the location in person. This composes a first filter for the final indicators which are to be in fact measured in the project. As a result, an indicator of high relevance such as (estimated) Investment Costs becomes much more difficult to calculate, since there is no clear conception of the budgets usually handled by the municipality or even a general idea of costs materials may have in the area. Something similar happens to the Impact on the Local Species KPI, rendered challenging to calculate since it would imply knowing the species of trees which would be removed, included, or replaced with the new intervention. This is precisely the second filter applied, linked to the difficulty of KPI assessment calculation. KPI's such as Environmental Impacts, Transport Costs, and Quantity of Jobs Created are to be considered as part of what would compose the project's future developments. Finally, since research shows us that Service Proximity and Availability in Pikine Est is at adequate levels, it is not pertinent to make such calculations. As a result, the final indicators used for the Project Evaluation are: **Population Density**, waste containers' **Saturation Rates**, Public Transportation **Service Performance**, **Recharge of Groundwater**, and Literacy **Facility Capacities**. One indicator sheet per each Key Performance Indicator will follow, using the model taken from Moro (2018).

19. See Chapter 4

Population Density

Intent:

To estimate the future demographic change that comes along with the different habitational typologies chosen for each scenario.

Description:

Population density is a widely used term at urban scale planning and in general case study analyses, used to refer to a number of people in a designated surface area. Within the context of this document, it is a pertinent factor to be assessed due to its proximity with environmental impact: high population densities usually mean higher land pressures and therefore fewer natural spaces, leading to the degradation of rural and urban symbioses. However, the habitational typologies sought by the different project scenarios exposed in the previous section contemplate the promotion of natural, collective spaces, increasing the general conscience of inhabitants of Pikine Est regarding the maintenance required by these plots and the environmental value they give in return. This way it is possible to **achieve higher densities** – in order to respond to overcrowding – and **promote healthier built and non-built relations**.

Data Requirements:

INDICATOR	UNIT	DATA SOURCE
Current Population density in Pikine Est	habitants/km^2	ANSD, 2013
Total area for Pikine Est	km^2	Commune de Pikine Est, 2019
Total area destined for densification	km^2	
Housing typology density floor area ratio	-	a + t research group, 2017
Housing typology land coverage	%	
Ideal floor area per person	m^2	United Nations, 1996
Average amount of members/household	habitants	Diawara, 2010

Assessment Method:

To characterize the indicator's value:

1. With the current population density, calculate the number of people already living in the area planned for future densification.

2. Using the total built area in the 100m * 100m example plot (a + t research group, 2017) for the selected housing typology, determine which would be the total built area in the densification plots.

3. Considering approximately 8% of the total built area resulting from Step 2 to be destined for circulation, divide the remaining amount by the number of square meters for the ideal case study household (this case: 140m^2 = 7 habitants/

household * 20m^2). This division will give as a result the number of new dwellings.

4. Divide the number of dwellings by the average amount of inhabitants per household. This will determine the densification area's capacity.

5. Subtract the number of people currently living in the planned area for densification (who are to be relocated in some of the new dwellings)

6. Calculate the new population density from the addition of the resulting number in Step 5 and the case study population today.

Waste Container Saturation Rate

Intent:

To estimate (on average) how often will waste collection containers reach their maximum capacity.

Description:

Typical household waste will be separated into containers in the areas designated by every project scenario. By designing a ratio of coverage per each container zone, it is possible to estimate how many people are served by it and how often should waste be collected. A higher number will indicate the most feasible option, since it signifies fewer trips for the collection company. Though the whole assessment process shows at the end specific data per every single container, the decisive result for each scenario will be an average of all saturation rates.

Data Requirements:

INDICATOR	UNIT	DATA SOURCE
Population density per Scenario	habitants/km^2	Population density indicators
Total area for Pikine Est	km^2	Commune de Pikine Est, 2019
Waste produced per habitant	kg	Diawara, 2010
Percentage of waste per type	%	
Density per type of waste	kg/m^3	Quinn, 2016

Assessment Method:

To characterize the indicator's value:

1. Design a Voronoi grid using the container zones as centroids.

2. Calculate the area of each Voronoi block

3. Using the population density obtained for each scenario, determine the number of people living in each Voronoi block as corresponding.

4. Calculate the total amount of waste produced per block (number of habitants * average kilograms of waste per person).

5. Using the percentages of waste per type, separate the resulting number of Step 4 into the corresponding kilograms per percentage.

6. Divide each waste type weight (result of Step 5) by its material density. This will give us the number of cubic meters each one will occupy per day.

7. Divide the number of cubic meters per empty container by the number of cubic meters filled per day (Step 6). The result will be the saturation rate (in days) for every single container.

8. Calculate the average of the multiple results obtained in Step 7.

Public Transportation Service Performance

Intent:

To foresee the population coverage of public transportation means.

Description:

One of the three scenarios proposed for Pikine Est chooses bold strategies that alter the current state of public transportation, seeking to optimize it. The other two scenarios also take action on the matter but do so in a more restricted way. This category includes both railway systems and bus transport, being means of transportation which already make part of the culture in the case study. A higher percentage of coverage naturally means a better result, but it also means that the quality of the service will be higher due to less overcrowding.

Data Requirements:

INDICATOR	UNIT	DATA SOURCE
Population density per Scenario	habitants/km^2	Population density indicators

Assessment Method:

To characterize the indicator's value:

1. Calculate the percentage of inhabitants located within a 400-meter radius from each public transport station for the whole case study area.

References and Standards:

Global Platform for Sustainable Cities – Urban Sustainability Network (used by Moro (2018) in the Testing Protocol)

Recharge of Groundwater through Permeable Paving or Landscaping

Intent:

To determine the new ground permeability for the area.

Description:

In an area with soil quality such as the one for the Pikinese territory, it is important to formulate strategies to increase groundwater absorption, at least as a first instance. The ideal for the project would be also to reuse this collected water, implying a much larger structure. For the time being, this key performance indicator will focus on determining the improvement of the permeability capacity with different types of paving chosen for the scenarios.

Data Requirement:

INDICATOR	UNIT	DATA SOURCE
Permeable areas	km²	Project scenario formulations
Permeability coefficients	%	Moro, 2018

Assessment Method:

To characterize the indicator's value:

1. Calculate – individually – each area of the urban grid by type of paving.

2. Determine the effective permeability of each type of soil according to the area occupied: multiply each area by its permeability coefficient (coefficients used in this case: Grass = 100%, Gravel = 90%, Permeable interlocking pavement = 30%, Asphalt and built areas = 0%).

3. Divide the total sum of surfaces calculated in Step 3 by the total urban area. The result is the percentage of final permeability.

Literacy Facility Capacities

Intent:

To estimate the number of people that may simultaneously vantage from the use of alphabetization structures.

Description:

Some cultural facilities within the municipality of Pikine Est require requalification processes. Once these investments and improvements are conducted, they may host larger activities linked to literacy and heritage. In fact, *La Maison de la Femme* currently promotes teaching for young people in one of the most used tongues in Senegal: Wolof. Increasing their capacities and optimizing these spaces may lead to better fruition, calculated through this indicator.

Data Requirements:

INDICATOR	UNIT	DATA SOURCE
Total area per facility	m²	Open Street Map contributors
Minimum area requirement per person	m²	Engineering toolbox, 2003

Assessment Method:

To characterize the indicator's value:

1. Calculate the useful area per structure (accounting approximately 15% for circulation and technical equipment)

2. Divide the useful area per structure by the minimum area required per occupant. The result will be the number of total people that facilities in the sector may host.

Using the procedures suggested by Zukowska (2014), we can aid indicator assessment with a feasibility matrix. This table essentially gathers general information for each KPI, consolidating as a great tool to explain project stakeholders which could be the possible challenges faced when trying to evaluate each factor. Should any kind of project require an indicator filtering process, this tool would come in quite handy. It is important to clarify that terminology was kept from Zukowska's main model, making it necessary to say to unfamiliar readers that the "Beneficial / Non-Beneficial" column indicates whether a high or low result is more desirable, respectively. In this case, all KPI's are beneficial.

Table 9. KPI Assessment Feasibility

DOMAIN	INDICATOR	KPI FOR ASSESSMENT	UNIT	QUALITATIVE / QUANTITATIVE	BENEFICIAL / NON - BENEFICIAL	ASSESSMENT METHOD	MAIN DATA SOURCE	EASINESS OF DATA ACCESS
Physical	Housing Quality	Population density	habitants/km^2	Quantitative	Beneficial	Calculation	ANSD, 2013	Easy
Social	Waste Management	Container saturation rate	days	Quantitative	Beneficial	Calculation	Diawara, 2010	Medium
	Public Transportation	Service Performance	%	Quantitative	Beneficial	Calculation	Moro, 2018	Easy
Incremental	Water Management	Recharge of groundwater	%	Quantitative	Beneficial	Calculation	Moro, 2018	Easy
	Literacy	Facility Capacity	number of occupants	Quantitative	Beneficial	Calculation	Engineering toolbox, 2003	Easy

Source: Elaborated by the author based upon Zukowska, 2014

All of the previously presented KPI sheets include an assessment method. Once applied to each of the Project Scenarios, it is possible to obtain the results for each. Excel spreadsheets containing the detailed calculations will be included in the Appendix Chapter. Synthetic assessment results, however, will be shown below.

Table 10. KPI Performance Matrix

SCENARIO / KPI's	HOUSING QUALITY POPULATION DENSITY (HAB / KM^2)	PUBLIC TRANSPORTATION PERFORMANCE (%)	WASTE MANAGEMENT AVERAGE SATURATION (DAYS)	WATER MANAGEMENT PERMEABILITY (%)	LITERACY FACILITY CAPACITY (people)
SCENARIO 1 Public Transportation	46429	100	2,83	11,13	3187
SCENARIO 2 Collective Spaces	46097	78	3,16	14,76	2215
SCENARIO 3 Structuring Common Services	44594	80	2,82	15,38	8748

Source: Elaborated by the author

When working with this kind of projects, the usual approach is to discuss with stakeholders which are the degrees of importance for each indicator assessed. To counterbalance the limitation of not being able to contact all project stakeholders, I use **Visual PROMETHEE** as a decision assistance software. Its purpose in this Thesis is to support the final scenario choice under the selected criteria. Though it does not replace stakeholder discussions, it is an optimal tool for mathematical evaluation and for viewing in real-time the different

shifts in indicator weights and how they influence project results. Basic functioning of this tool will be developed in the next paragraphs.

PROMETHEE stands for Preference Ranking Organization Method for Enrichment Evaluations. It is classified as an outranking method, meaning that it assigns positions to a set of actions according to certain criteria: in other words, it follows the principles of **Multicriteria Analysis**. In practice, this kind of analysis would require several revisions and verifications. In this case, it is done in a much more experimental way under the supervision of Sara Torabi, who has worked with this method in precedence and who was of great support for the elaboration of this Thesis. **Five main steps are needed for any basic PROMETHEE method application**. The first step is to create an **Impact Matrix** using Visual PROMETHEE. The matrix designed for the project scenarios is shown next, and a brief description of its contents will follow.

Table 11. Impact Matrix

| MASTER PLANS		Population D...	Public Trans...	Waste Cont...	Water Perm...	Facility Capa...
Unit		hab/km2	%	days	%	persons
Cluster/Group		■	■	■	■	■
Preferences						
Min/Max		max	max	max	max	max
Weight		0,20	0,20	0,20	0,20	0,20
Preference Fn.		Linear	V-shape	V-shape	Linear	Linear
Thresholds		absolute	absolute	absolute	absolute	absolute
- Q: Indifference		645	n/a	n/a	1,59	2425
- P: Preference		1835	22	0,34	4,25	6533
- S: Gaussian		n/a	n/a	n/a	n/a	n/a
Statistics						
Minimum		44594	78	2,82	11,13	2215
Maximum		46429	100	3,16	15,38	8748
Average		45707	86	2,94	13,76	4717
Standard Dev.		798	10	0,16	1,87	2878
Evaluations						
Scenario 1	■	46429	100	2,83	11,13	3187
Scenario 2	■	46097	78	3,16	14,76	2215
Scenario 3	■	44594	80	2,82	15,38	8748

Source: Elaborated by the author using Visual PROMETHEE

Columns contain information per Key Performance Indicators. From left to right, they are listed: Population Density, Public Transportation Service Performance, Waste Container Saturation Rate, Water Permeability (Recharge of Groundwater), and Facility Capacity. Measuring units are specified under these titles. Clusters and groups, right underneath, help specify categories and domains, such as the ones handled in this case. Only domains are inserted in this file, where blue squares stand for Physical, red for Social, and green for Incremental. Preferences compose a high relevance section for the project. On the first place, we must let the software know whether an indicator is beneficial or non-beneficial using the "Min/Max" row. After that, weights (ideally discussed with project stakeholders) are assigned. Their total sum in the software must always be 1, standing for 100%.

The following row establishes the **Preference functions** and actually constitutes Step 2 of the five-step PROMETHEE method. These are graphical representations according to the indicator's means of evaluation, which, in the end, make the clear difference in KPI assessment through PROMETHEE methods. Those functions contemplated by Visual PROMETHEE are exposed below.

Figure 30. *Preference Functions in Visual PROMETHEE*
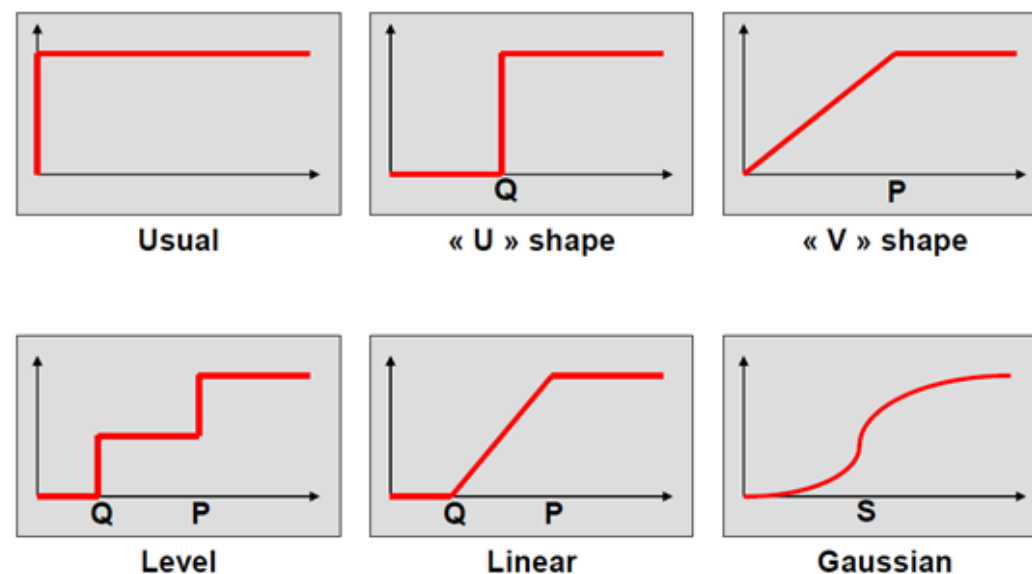
Source: Taken from Torabi, 2019

The two functions selected for this project are "Linear" and "V-Shape", since they are the ones best fit to treat quantitative information (being all of our KPI's of a quantitative assessment). The remaining functions work best with qualitative information. The main difference between Linear and V-Shape is whether an indifference is accounted for or not, respectively. Indifferences (Q in PROMETHEE) are mostly applied when indicator results are widely different one from another, since they express which is the minimum amount that a decision-maker would find negligible. Preferences (P), on the other hand, stands for a value which would weigh on the chosen scenario. The preference function assistant featured in Visual PROMETHEE helps determine Preferences and Indifferences (when applied) in the absence of stakeholders or decision-makers. In the case of Preferences, it does so by inserting the value of the difference between the highest and the lowest indicator value. For Indifferences, it uses the standard deviation for the differences. The following steps of the five-step procedure to apply in PROMETHEE methods are the **calculation of the overall preference index**, **calculation of outranking flows**, and the **comparison of outranking flows** to define the ultimate ranking of scenarios. These will be further developed in the next section: Results and Discussion.

3.4 Results and Discussion

One of the conveniences of using decision-support software such as Visual PROMETHEE lies in its dynamism. Tasks like comparing alterations among project scenarios become much easier through the different tools it offers. Knowing that preferences and indifferences are already set with the preference function assistant's criteria, the chance for experimentation lies in altering KPI weight percentages. This section features a simple exercise, proving the stability of the final results. First off, it is easier to explain the basic functioning of the **preference index calculation**. This index represents the intensity of preference of one option (a) over another(b). It is calculated through the following equation (Torabi, 2019):

$$\prod(a,b) = \sum_{j=1}^{k} w_j P_j(a,b)$$

Where:

Π(a,b) = preference index

W = weight of criterion j

P_j (a, b) = preference function of "a" over "b" regarding criterion j

By simple mathematics behavior, altering the weight percentage in each scenario will affect the preference index. Due to this reason, this subject was treated on a separate section as the Project Evaluation: altering a single factor on Step 3 alters the Project Results. As it might be supposed, the preference index is used to **calculate outranking flows**. Two kinds of flows are assessed in this step. Leaving Flows determines the "positive" ranking for each scenario, while the Entering Flows would correspond to a more "negative" outcome. Therefore, a winning scenario would result in a high Leaving Flow supported by a low Entering Flow (Torabi, 2019). Equations for each are presented below (left for leaving, right for entering).

$$\Phi^+(a) = \frac{1}{(n-1)} \sum_b \prod (a,b) \qquad \Phi^-(a) = \frac{1}{(n-1)} \sum_b \prod (b,a)$$

Main results will therefore be expressed in these terms. The decisive element, called Net Flow, is calculated as the difference between leaving and entering flows. With this introductory information to this Project Evaluation Tool, it is now possible to present the **baseline impact matrix results**.

Baseline Results

Rank	Action	Phi	Phi+	Phi-
1	Scenario 2	0,1368	0,3459	0,2091
2	Scenario 1	-0,0562	0,2939	0,3501
3	Scenario 3	-0,0805	0,2854	0,3660
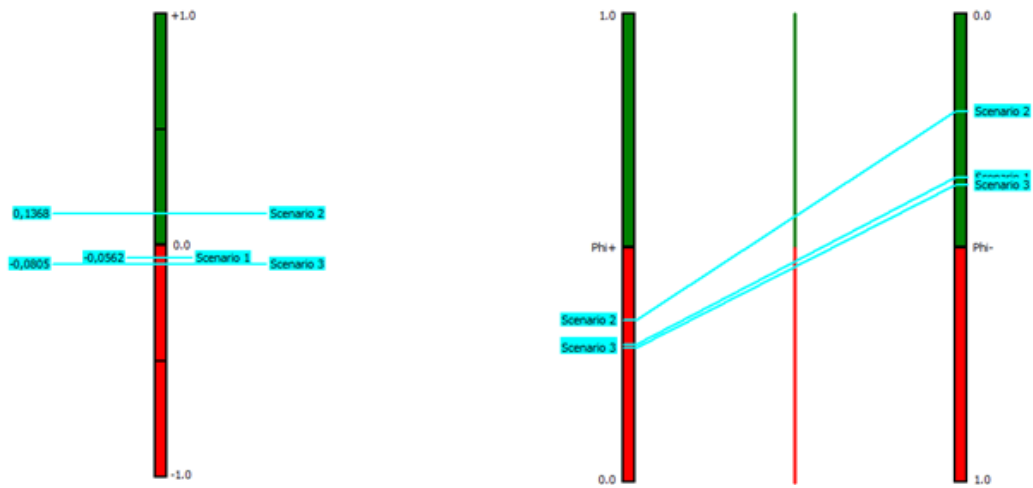
Initial results prove the radical triumph of **Scenario 2 – focused on strategies for Collective Spaces** – over the other two alternatives. Before jumping to any conclusions, it is of the essence to remark that this decision is the result of an evaluation including only five Key Performance Indicators, and is not under any circumstance implying that it will be the most successful of all interventions if they were to be implemented. As mentioned before, this evaluation shows out the best combination of strategies applied in the Project Formulation stage. However, it is possible to observe a very interesting factor: out of all five KPI's tested, Scenario 2 was first in only one (waste container saturation rate), while the other two scenarios each ranked best in two categories. This shows how useful it is to apply this kind of software, since not always the winning choice is the most obvious one.

There are yet more decisive factors in the ranking process that go beyond numerical data. Additional tools within the software allow us to place all KPI's on the same dimensional level despite the difference in the units used for their assessment. This turns out to be really helpful to graphically represent the strengths and weaknesses of each scenario. Web charts for each scenario under the baseline evaluation are presented below.

Figure 31. Web Charts for each Project Scenario (1, 2, 3 from left to right)
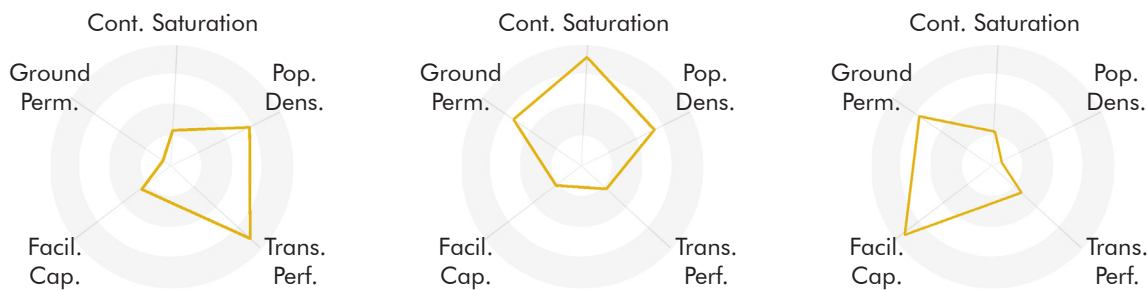
As seen from the charts, all three project scenarios are very distant from one another, at least under the selected criteria. This shows that the model created is effective when confronting different project alternatives which excel at different fields and placing them on one same level of comparison. Model stability – understood as the strength of one scenario when confronted to others – is shown in the next page through final schematics representing the use of the **walking weights** tool, which allows to alter KPI weights in real-time and see how much an alternative outranks another. These graphics will start at equal percentages and will show the moment in which one scenario outranks another, by assigning larger weights to one indicator.

Figure 32. Walking Weights Charts
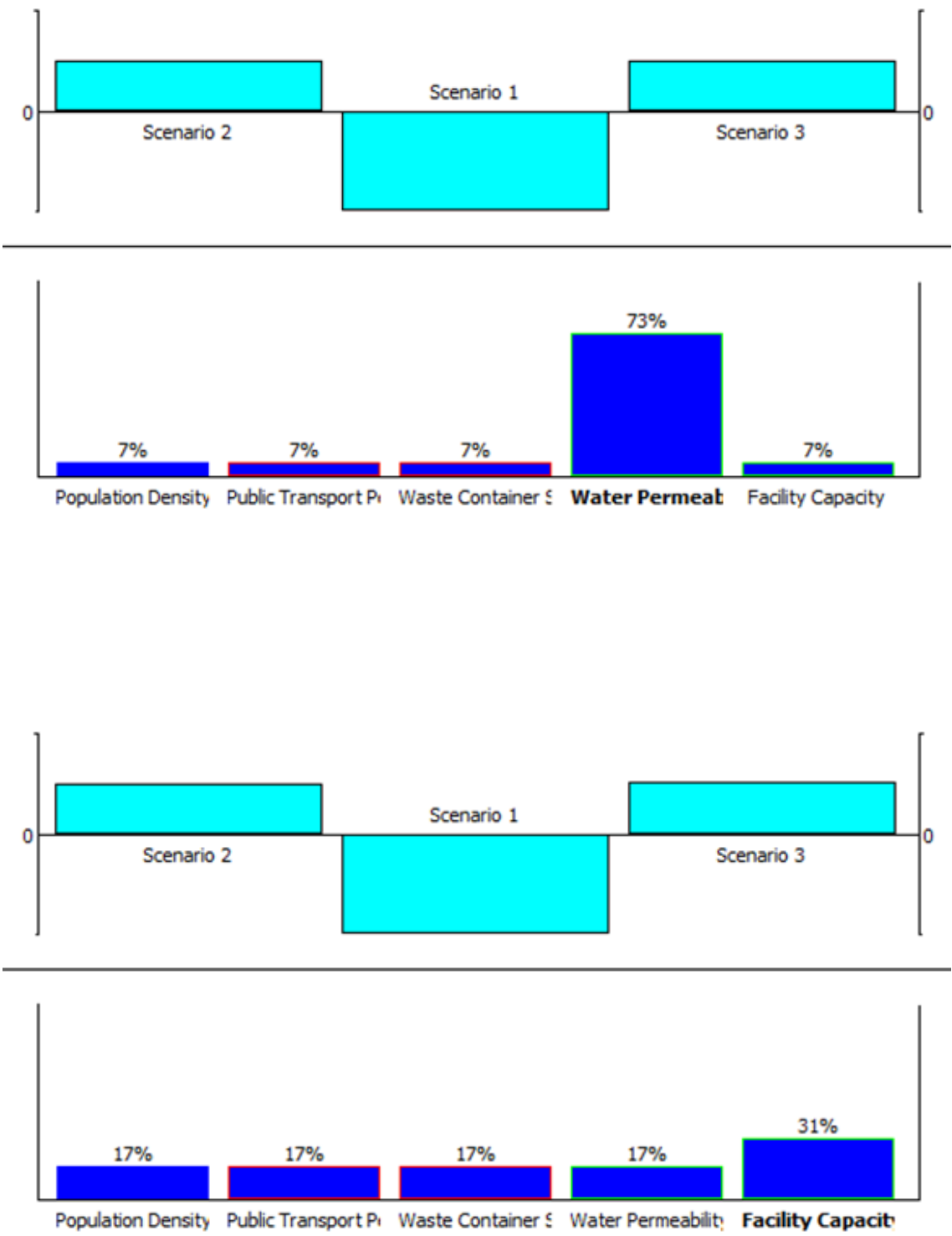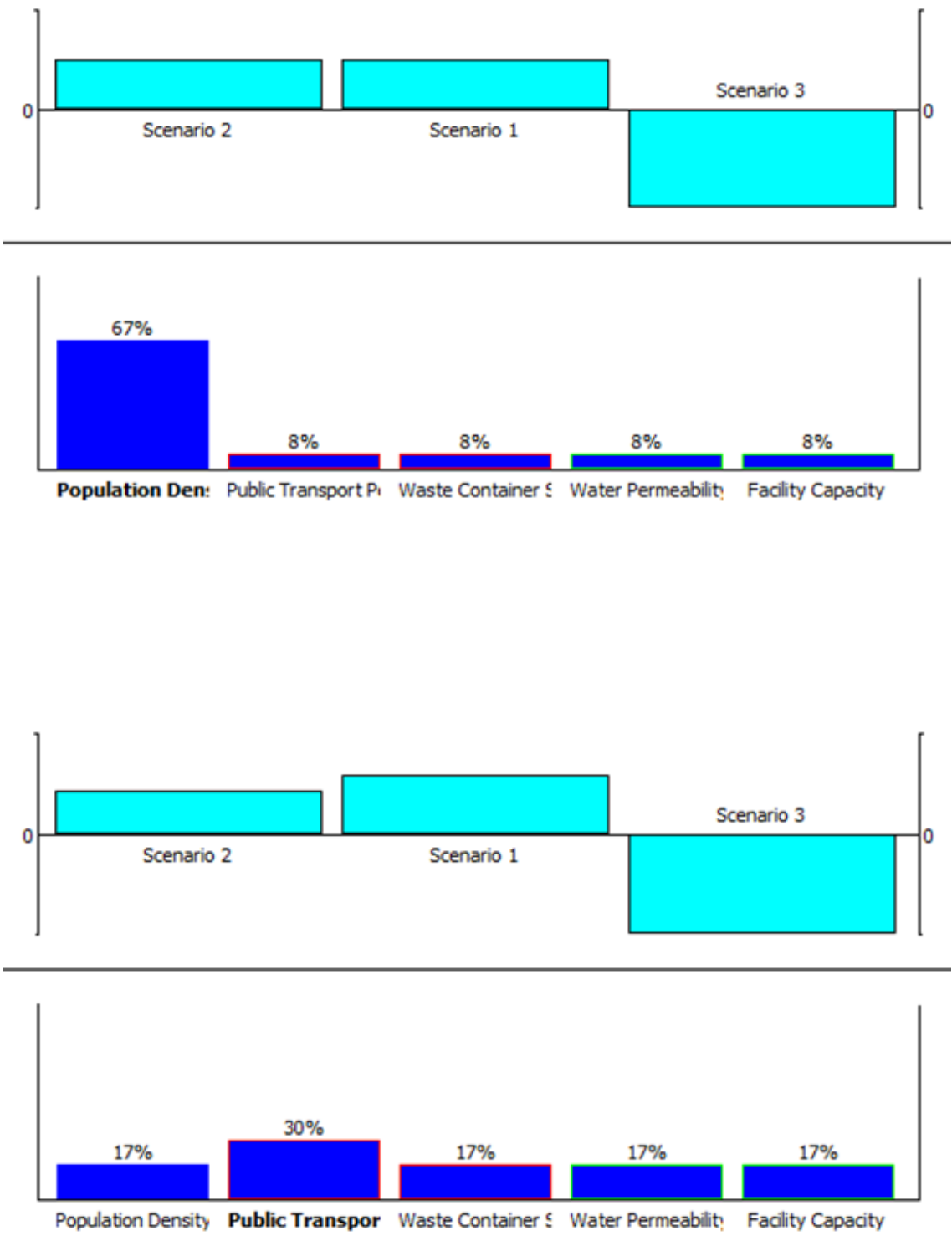
Source: Taken from Visual PROMETHEE model elaborated by the author.

Needless to say, there is no chart for waste container saturation rate, since Scenario 2 already ranks best under this criterion, and the other two results are extremely close to each other. Regarding weight assignation, we could say that the one which would make more sense to be assessed with much more consideration would be the Population Density KPI, since, as a keen reader might have noticed, it is used to calculate other two KPI's, influencing them directly. It would, therefore, make sense either to raise Population Density's weight in a final evaluation or lower the percentages assigned to Public Transport Service Performance and Waste Container Saturation Rates, being the ones depending directly from this indicator. This would somehow place all Project Scenarios at an equal level. However, for the reasons and limitations previously presented, project evaluation will reach this level of results.

4. Conclusions and Future Developments

The most important consideration to make out of this Thesis lies in its very own title. The research, analyses, tools, and strategies applied here are all devoted to promoting scenarios for Incremental **Development**. This basic implication suggests that the scenarios formulated here are not to be taken as final results of an Incremental Pikine Est. They simply offer the initial steps to unleash incremental growth processes within the municipality, and they should be constantly monitored and assessed. Here lies the main premise for the requirements of future developments.

Following these same principles, it is pertinent to consider therefore that the indicators presented here are part of initial evaluation processes and assess very specific strategies. A future inclusion and calculation of other Key Performance Indicators will continuously enrich the results of this project, up to a point of determining which is the ultimate **combination of strategies** that compose the best scenario for Incremental Development. This being said, we can evaluate the content presented here to determine which answers were offered to the Research Questions and Objectives.

First off, we may observe that the general question is not as simple to answer as it may seem. It actually required an extensive process of indicator identification, selection, assessment, and finally their application on a software specialized for decision making. Observations from the software also proved that not always the scenario ranking best in individual indicator categories is the best one, proving that it is necessary to follow a strict method of assessment to obtain veridic results.

Another interesting topic of discussion in this chapter is presented in the last secondary question. Being this project so close and so devoted to the improvement of well-being for the citizens of Pikine Est, it is only logical to also discuss which could be the ways do divulge these project proposals to stimulate **community participation**. This is another point where indicator results are highly useful. Having the possibility to communicate through actual data how often would waste be collected in the area, or how far away would citizens be from the nearest public transport station is an actual privilege which should facilitate project implementation and acceptance. It would be interesting to measure community participation levels in the project's future developments.

Considerations regarding project data should also be included. If this project were to be carried further on, it would be advisable to try to update main bibliographical documentation used. Sources such as Salem (1998) could present information that has

widely shifted with the passing of time. Changes in this kind of data could also influence project results. Project limitations have been mentioned in repeated occasions throughout the text, so it is only a precision to say that this Thesis and its contents would involve a future stage of in-site verification.

Keeping in line with the project's main goal on creating opportunities in-site as an alternative for migration, measurements following a project implementation phase acquire a higher degree of relevance. Aware that there would naturally still be flows of people seeking better conditions elsewhere (hopefully through regular means), a highly decisive factor for **project performance evaluation** would consist on calculating both the average duration of stay abroad and the number of people returning yearly to the country. Numerical data helps verify the success of the whole project in this stage.

After the entire development of this process, it is only left to say that there could be a wonderful potential for growing communities to become incremental neighborhoods. The future of these communities could be one of minimal infrastructural investments, and with strategies focused on the individual household and service facility improvement. If people are presented with the right opportunities for growth both at a plot and at a community scale, it could unleash a process of collective growth in which everyone is beneficiated, without having to sacrifice traditional ways and customs of living. Incremental development could be an alternative to urbanism as we have known it until today.

5. Appendix

Q: Is the plot next to the Citè Icotaf 3 Mosque currently occupied?

A: The land next to the indicated Mosque is of their property, and it is used for both religious and non-religious purposes, and they intend to keep it as such.

Q: What is the current state of the public networks in the municipality? Are all houses connected to the electric grid, to the potable water network, sewerage, etc.?

A: I would say the majority of the houses is attached to electric and drinking water networks, but I'm not certain if all of them indeed are. About a year ago, the state began works for a sewerage network, absent for the moment.

Q: Are flooding events perceived all throughout the year? Or are they only experienced during rainy months? (Intending to understand if it is a problem generated from the quality of the soil or the climate itself)

A: Floods, naturally, are issues that take place only during the rainy months (I would point out that heavy rains this year went until the middle of October, signifying an extension in the rainy season).

Q: What is the most common means of transportation to arrive to Dakar? Is it important to go often to the capital or are most of the services already offered in Pikine?

A: The most used means of transportation are cars rapides, since they are the cheapest. Many people have never even been to Dakar.

Q: (From Gloria Tessarin's set of questions) Would it be possible to have demographic data regarding population within Pikine Est?

A: The mayor says they lack a functioning registry office, so population in the municipality might oscillate between 50,000 and 80,000 inhabitants. Naturally, there are no demographic analysis.

*Questions originally sent in Italian and French, translated to English by the author for their inclusion in this thesis. Some questions are not included here, being considered as irrelevant to the final subject treated, since they were elaborated during the Project Identification phase.

Population Density Calculations

Initial Population Density (hab/km^2)	42144
Estimated number of people in Pikine Est	31089
Pikine Est's Total Area (km^2)	0,7377

SCENARIO 1

Area destined for densification (km^2)	0,0527
Inhabitants in the area	2222
Chosen Urban Block (a+t research group)	31
Floor Area Ratio	2,22
Coverage Index	0,59
Total built area in 100*100 plot example (m^2)	22198
Built area in project (m^2)	117016,76
Non-built area in project (m^2)	21613,15
Dwellings in the project	769
Project inhabitants	5383
NEW DENSITY	49441

SCENARIO 2

Area destined for densification (km^2)	0,0483
Inhabitants in the area	2035
Chosen Urban Block (a+t research group)	42
Floor Area Ratio	2,22
Coverage Index	0,47
Total built area in 100*100 plot example (m^2)	22289
Built area in project (m^2)	107642,50
Non-built area in project (m^2)	25595,82
Dwellings in the project	707
Project inhabitants	4952
NEW DENSITY	48856

SCENARIO 3

Area destined for densification (km^2)	0,0399
Inhabitants in the area	1682
Chosen Urban Block (a+t research group)	42
Floor Area Ratio	1,90
Coverage Index	0,35
Total built area in 100*100 plot example (m^2)	19008
Built area in project (m^2)	75843,82
Non-built area in project (m^2)	25935,65
Dwellings in the project	498
Project inhabitants	3489
NEW DENSITY	46873

Transport Service Performance Calculations

Pikine Est's Total Area (km^2)	0,7377

SCENARIO 1

Population density (hab/km^2)	46429
Total area covered (km^2)	0,7377
Habitants in Pikine Est	34250
Habitants within the covered area	34250
SERVICE PERFORMANCE	1,00

SCENARIO 2

Population density (hab/km^2)	46097
Total area covered (km^2)	0,7377
Habitants in Pikine Est	34005
Habitants within the covered area	26642
SERVICE PERFORMANCE	0,78

SCENARIO 3

Population density (hab/km^2)	44594
Total area covered (km^2)	0,7377
Habitants in Pikine Est	32897
Habitants within the covered area	26167
SERVICE PERFORMANCE	0,80

Waste Container Average Saturation Rate Calculations

Waste composition percentages

Rubber	32,99
Plastic	25,77
Organic	19,59
Paper	12,37
Fabric	4,64
Wood	4,64

Material Densities (kg/m^3)

Rubber	130
Plastic	65
Organic	290
Paper	85
Fabric	65
Wood	240

m3 per container	4

SCENARIO 1

Population density (ab/km^2)	46429
Average weight of waste per person (kg/day)	0,68

	Block A	Block B	Block C	Block D	Block E	Block F	Block G	Block H	Block I
Area per container coverage (km^2)	0,0398	0,0527	0,0849	0,1160	0,0591	0,1223	0,0866	0,1246	0,0517
Habitants per coverage area (persons)	1847	2448	3942	5385	2742	5678	4021	5783	2401
WASTE PER HABITANT (kg/day)	1256,176	1664,808	2680,660	3662,130	1864,531	3861,216	2734,143	3932,573	1632,826
Rubber	414,41	549,22	884,35	1208,14	615,11	1273,82	901,99	1297,36	538,67
Plastic	323,72	429,02	690,81	943,73	480,49	995,04	704,59	1013,42	420,78
Organic	246,08	326,14	525,14	717,41	365,26	756,41	535,62	770,39	319,87
Paper	155,39	205,94	331,60	453,01	230,64	477,63	338,21	486,46	201,98
Fabric	58,29	77,25	124,38	169,92	86,51	179,16	126,86	182,47	75,76
Wood	58,29	77,25	124,38	169,92	86,51	179,16	126,86	182,47	75,76
m^3 AL GIORNO PER MATERIALE									
Rubber	3,19	4,22	6,80	9,29	4,73	9,80	6,94	9,98	4,14
Plastic	4,98	6,60	10,63	14,52	7,39	15,31	10,84	15,59	6,47
Organic	0,85	1,12	1,81	2,47	1,26	2,61	1,85	2,66	1,10
Paper	1,83	2,42	3,90	5,33	2,71	5,62	3,98	5,72	2,38
Fabric	0,90	1,19	1,91	2,61	1,33	2,76	1,95	2,81	1,17
Wood	0,24	0,32	0,52	0,71	0,36	0,75	0,53	0,76	0,32
SATURATION PER DAY PER CONTAINER	1,25	0,95	0,59	0,43	0,85	0,41	0,58	0,40	0,97
	0,80	0,61	0,38	0,28	0,54	0,26	0,37	0,26	0,62
	4,71	3,56	2,21	1,62	3,18	1,53	2,17	1,51	3,63
	2,19	1,65	1,03	0,75	1,47	0,71	1,01	0,70	1,68
	4,46	3,37	2,09	1,53	3,01	1,45	2,05	1,42	3,43
	16,47	12,43	7,72	5,65	11,10	5,36	7,57	5,26	12,67

SCENARIO 2

Population density (ab/km²)	46097
Average weight of waste per person (kg/day)	0,68

	Block A	Block B	Block C	Block D	Block E	Block F	Block G	Block H	Block I
Area per container coverage (km²)	0,0735	0,0510	0,0625	0,1490	0,1284	0,1004	0,1022	0,0423	0,0284
Habitants per coverage area (persons)	3388	2353	2879	6868	5921	4626	4709	1951	1310
WASTE PER HABITANT (kg/day)	2303,771	1599,710	1957,712	4670,078	4026,232	3145,849	3202,241	1326,718	891,134
Rubber	760,01	527,74	645,85	1540,66	1328,25	1037,82	1056,42	437,68	293,99
Plastic	593,68	412,25	504,50	1203,48	1037,56	810,69	825,22	341,90	229,65
Organic	451,31	313,38	383,52	914,87	788,74	616,27	627,32	259,90	174,57
Paper	284,98	197,88	242,17	577,69	498,04	389,14	396,12	164,11	110,23
Fabric	106,89	74,23	90,84	216,69	186,82	145,97	148,58	61,56	41,35
Wood	106,89	74,23	90,84	216,69	186,82	145,97	148,58	61,56	41,35
m³/day per material									
Rubber	5,85	4,06	4,97	11,85	10,22	7,98	8,13	3,37	2,26
Plastic	9,13	6,34	7,76	18,52	15,96	12,47	12,70	5,26	3,53
Organic	1,56	1,08	1,32	3,15	2,72	2,13	2,16	0,90	0,60
Paper	3,35	2,33	2,85	6,80	5,86	4,58	4,66	1,93	1,30
Fabric	1,64	1,14	1,40	3,33	2,87	2,25	2,29	0,95	0,64
Wood	0,45	0,31	0,38	0,90	0,78	0,61	0,62	0,26	0,17
SATURATION PER DAY PER CONTAINER	0,68	0,99	0,81	0,34	0,39	0,50	0,49	1,19	1,77
	0,44	0,63	0,52	0,22	0,25	0,32	0,32	0,76	1,13
	2,57	3,70	3,02	1,27	1,47	1,88	1,85	4,46	6,64
	1,19	1,72	1,40	0,59	0,68	0,87	0,86	2,07	3,08
	2,43	3,50	2,86	1,20	1,39	1,78	1,75	4,22	6,29
	8,98	12,93	10,57	4,43	5,14	6,58	6,46	15,59	23,22

SCENARIO 3

Population density (ab/km²)	44594
Average weight of waste per person (kg/day)	0,68

	Block A	Block B	Block C	Block D	Block E	Block F	Block G	Block H	Block I
Area per container coverage (km²)	0,0442	0,0578	0,0731	0,1137	0,0644	0,1275	0,1022	0,1236	0,0515
Habitants per coverage area (persons)	1973	2577	3262	5071	2873	5684	4556	5514	2297
WASTE PER HABITANT (kg/day)	1341,348	1752,298	2218,073	3448,618	1953,770	3864,996	3097,831	3749,249	1562,167
Rubber	442,51	578,08	731,74	1137,70	644,55	1275,06	1021,97	1236,88	515,36
Plastic	345,67	451,57	571,60	888,71	503,49	996,01	798,31	966,18	402,57
Organic	262,77	343,28	434,52	675,58	382,74	757,15	606,87	734,48	306,03
Paper	165,92	216,76	274,38	426,59	241,68	478,10	383,20	463,78	193,24
Fabric	62,24	81,31	102,92	160,02	90,65	179,34	143,74	173,97	72,48
Wood	62,24	81,31	102,92	160,02	90,65	179,34	143,74	173,97	72,48
m³/day per material									
Rubber	3,40	4,45	5,63	8,75	4,96	9,81	7,86	9,51	3,96
Plastic	5,32	6,95	8,79	13,67	7,75	15,32	12,28	14,86	6,19
Organic	0,91	1,18	1,50	2,33	1,32	2,61	2,09	2,53	1,06
Paper	1,95	2,55	3,23	5,02	2,84	5,62	4,51	5,46	2,27
Fabric	0,96	1,25	1,58	2,46	1,39	2,76	2,21	2,68	1,12
Wood	0,26	0,34	0,43	0,67	0,38	0,75	0,60	0,72	0,30
SATURATION PER DAY PER CONTAINER	1,18	0,90	0,71	0,46	0,81	0,41	0,51	0,42	1,01
	0,75	0,58	0,45	0,29	0,52	0,26	0,33	0,27	0,65
	4,41	3,38	2,67	1,72	3,03	1,53	1,91	1,58	3,79
	2,05	1,57	1,24	0,80	1,41	0,71	0,89	0,73	1,76
	4,18	3,20	2,53	1,62	2,87	1,45	1,81	1,49	3,59
	15,42	11,81	9,33	6,00	10,59	5,35	6,68	5,52	13,24

Recharge of Groundwater Calculations

Pikine Est's Total Area (km^2)	0,7377
Permeability coefficient built areas	0
Permeability coefficient non-built areas	0,9
Permeability coefficient green areas	1
Permeability coefficient interlocking pavement	0,3

SCENARIO 1

Built area (km^2)	0,644
Non-built area (km^2)	0,055
Green area (km^2)	0,030
Filtering area (km^2)	0,009
Permeability sum	0,082
FINAL PERMEABILITY (%)	**11,13**

SCENARIO 2

Built area (km^2)	0,614
Non-built area (km^2)	0,055
Green area (km^2)	0,056
Filtering area (km^2)	0,013
Permeability sum	0,109
FINAL PERMEABILITY (%)	**14,76**

SCENARIO 3

Built area (km^2)	0,613
Non-built area (km^2)	0,055
Green area (km^2)	0,062
Filtering area (km^2)	0,008
Permeability sum	0,113
FINAL PERMEABILITY (%)	**15,38**

Facility Capacity Calculations

SCENARIO 1

Number of facilities (#)	2
Total Area (m^2)	2249,75
Net Area (m^2)	1912,29
Minimum area per person (m^2)	0,60
MAXIMUM CAPACITY (# persons)	**3187**

SCENARIO 2

Number of facilities (#)	1
Total Area (m^2)	1563,75
Net Area (m^2)	1329,19
Minimum area per person (m^2)	0,60
MAXIMUM CAPACITY (# persons)	**2215**

SCENARIO 3

Number of facilities (#)	2
Total Area (m^2)	6174,95
Net Area (m^2)	5248,71
Minimum area per person (m^2)	0,60
MAXIMUM CAPACITY (# persons)	**8748**

6. Bibliography

- a + t research group / "50 Urban Blocks" / a + t architecture publishers / June 2017

- Agence Nationale de la Statistique et de la Démographie / République du Sénégal / Consulted on 2019
  http://www.ansd.sn/

- AMAYA, M. / "Merchandise Display" / July 2, 2013 / Retrieved from
  https://grabcad.com/library/merchandise-display-1

- ANACKER, C. / "Dakar, Senegal (1857 -)" / June 01, 2010 / Retrieved from:
  https://www.blackpast.org/global-african-history/dakar-senegal-1857

- ANTOINE, P., MBOUP, G. / "Senegal" / Urbanization in Africa: A Handbook /April 24, 1995/ Edited by TARVER, J. / Retrieved from:
  http://horizon.documentation.ird.fr/exl-doc/pleins_textes/pleins_textes_6/b_fdi_35-36/41320.pdf

- Association for Public Service Excellence / "Street Cleansing Performance Indicators" / Retrieved from:
  http://www.apse.org.uk/apse/assets/File/Street%20Cleansing.pdf

- BAIZÁN, P. / "We asked Senegal Migrants why they leave Home. Here's what they told us." / The Conversation / March 19, 2019 / Retrieved from:
  https://theconversation.com/we-asked-senegalese-migrants-why-they-leave-home-heres-what-they-told-us-113760

- BAIZÁN, P. & GONZÁLEZ-FERRER, A. / "What drives Senegalese migration to Europe? The role of economic restructuring, labor demand, and the multiplier effect of networks" / Demographic Research, Volume 35, Article 13, Pages 339 – 380 / August 18, 2016 / Retrieved from:
  https://www.demographic-research.org/volumes/vol35/13/35-13.pdf

- BIGGS, L. / "School Bus Shelter" / June 1, 2015 / Retrieved from:
  https://grabcad.com/library/school-bus-shelter-1

- BIRKELAND, J. / "Eco – Positive design: Moving beyond ecological restoration" / Thrive Research Center / October 3, 2018 / Retrieved from:
  https://www.researchgate.net/publication/27477673_Positive_development_designing_for_net_positive_impacts

- BRINKHOFF, T. / "Pikine Est – Commune in Senegal" / City Population / 2013 / Retrieved from:
  https://www.citypopulation.de/en/senegal/dakarcity/admin/pikine_dagoudane/SN01031212__pikine_est/

- BURLE, S. / "Dakar, Senegal, Elevation Map" / 2018 / Retrieved from:
  http://www.floodmap.net/Elevation/ElevationMap/?gi=2253354

- CAMARA, C.; CLARK, A.; HARGREAVES, J. / "Senegal" / Encyclopedia Britannica / Retrieved from:
  https://www.britannica.com/place/Senegal / February 28, 2019

- CHINOIS, Y. / "La Gare routière des Beaux Maraichers de Dakar est en function" / Au Senegal / September 29, 2014 / Retrieved from :
  https://www.au-senegal.com/la-gare-routiere-des-baux-maraichers-de-dakar-est-en-fonction,10180.html?lang=fr

- CINGOLANI, P., PASTORE, F., SALIS, E. / "Measuring Migration Costs of West Africans to Italy" / Fieri Working Papers / July 2017 / Retrieved from: https://www.fieri.it/wp-content/uploads/2018/03/Migration-Costs-Italy-FIERI-14Mar2018-1.pdf

- Commune de Pikine Est / "Presentation de la Commune de Pikine - Est" / 2019 / Courtesy of Anna Valesano

- DARBOURET, A. & MAYAULT, I. / "Les Cars Rapides, une institution sénégalaise en sursis" / LeMonde Afrique / August 24, 2017 / Retrieved from : https://www.lemonde.fr/afrique/article/2017/08/24/les-cars-rapides-une-institution-senegalaise-en-sursis_5176151_3212.html

- DASHORA, L. K. / "Visualization of Urban Quality of Life at Neighbourhood Level in Enschede" / International Institute for Geo-Information, Science, and Earth Observation / March 2009 / Retrieved from: https://webapps.itc.utwente.nl/librarywww/papers_2009/msc/gem/dashora.pdf

- DE LA CRUZ, P. / "Mapping the Quality of Life Experience in Alfama. A Case Study in Lisbon, Portugal" / Universidade Nova / March 2011 / Retrieved from: https://run.unl.pt/bitstream/10362/5621/1/TGEO0050.pdf

- DIAWARA, A. B. / "Les Déchets Solides à Dakar. Environnement, sociétés et gestion urbaine" / Université Michel de Montaigne / 2009

- DICKINSON et al. / "Development of Key Performance Indicators for Housing Market Renewal New Build" / Fraunhofer-Informationzentrum Raum und Bau IRB / Retrieved from: http://www.irbnet.de/daten/iconda/CIB1860.pdf

- DIRUTIGLIANO, DELMASTRO, TORABI / "Energy efficient urban districts: A multi-criteria application for selecting retrofit actions" / International Information and Engineering Technology Association / International Journal of Heat and Technology, Vol. 35, Special Issue 1, pp. S49 – S57 / September 2017

- DIOP, K.; FAYE, C.; SOW, S. / "La Grande Niaye de Pikine, un espace humide à haute valeur agronomique au cœur de l'agglomération urbaine de Dakar: analyse des enjeux socioéconomiques" / Belgeo / January 21, 2019 / Retrieved from: https://journals.openedition.org/belgeo/31319

- DOVI, E. A. / "Migration: Taking Rickety Boats to Europe" / UN Africa Renewal / 2017 / Retrieved from: https://www.un.org/africarenewal/magazine/special-edition-youth-2017/migration-taking-rickety-boats-europe

- EBOLI, L.; MAZZULLA, G. / "Performance Indicators for an Objective Measure of Public Transport Service Quality" / University of Calabria / Retrieved from: https://core.ac.uk/download/pdf/41174771.pdf

- Engineering Toolbox / "Building Area per Person" / 2003 / Retrieved from: https://www.engineeringtoolbox.com/number-persons-buildings-d_118.html

- FALS-BORDA, O. / "Research for Social Justice: Some North – South Convergences" / April 8, 1995 / Retrieved from: http://comm-org.wisc.edu/si/falsborda.htm

- FERRADA, M. / "Landscape of the urban shoreline of Valparaíso: towards the establishment of indicators for the dynamic preservation of change" / In Zancheti, S. M. & K. Similä, eds. *Measuring heritage conservation performance* pp. 236 – 243. Rome / International Centre for the Study of the Preservation and Restoration of Cultural Property / 2012 / Retrieved from:

https://www.iccrom.org/sites/default/files/ICCROM_19_Measuring-Heritage-Performance03_en.pdf

-   Glossary of Statistical Terms / "Environmental Services" / United Nations / 1997 / Retrieved from:
    https://stats.oecd.org/glossary/detail.asp?ID=843

-   Google Maps / Pikine Est / Retrieved from:
    https://www.google.com/maps/place/Pikine+Est,+Pikine,+Senegal/@14.7572924,-17.39202ata=!3m1!4b1!4m5!3m4!1s0xec10c9f77e8097d:0x3ad6f01f7e1a8b4a!8m2!3d14.7581085!4d-17.3863615

-   HORAK, E.; EMERY, S.; AGAIENZ, A. / "Key Performance Indicators for Road Infrastructure Asset Management by a Roads Agency in a Large Local Authority" / Johannesburg Roads Agency / July 2001 / Retrieved from:
    https://repository.up.ac.za/bitstream/handle/2263/7970/2a7.pdf?sequence=1

-   HUNGERFORD et al. / "Coping with Floods in Pikine, Senegal: An Exploration of Household Impacts and Prevention Efforts" / May 18, 2019 / Retrieved from:
    https://www.researchgate.net/publication/333226775_Coping_with_Floods_in_Pikine_Senegal_An_Exploration_of_Household_Impacts_and_Prevention_Efforts

-   JACKSON, T. / "Key Performance Indicators for Schools & Education Management" / Clear Point Strategy / Retrieved from:
    https://www.clearpointstrategy.com/key-performance-indicators-in-education/

-   JORDY, D. J.; DIOU, C. / "Flood Prevention and Drainage Project" / Global Facility of Disaster Reduction and Recovery / 2011

-   KPI Dashboards / "KPI Examples: Administrative and Support; Waste Management and Remediation Services" / Retrieved from:
    https://kpidashboards.com/kpi/industry/administrative-and-support-waste-management-and-remediation-services/

-   LIVESAY, C. / "Rejected by Italy, Thousands of Migrants from Africa risk the Alps to reach France" / National Public Radio / January 1, 2019 / Retrieved from:
    https://www.npr.org/2019/01/01/679840656/rejected-by-italy-thousands-of-migrants-from-africa-risk-the-alps-to-reach-franc?t=1555777365132

-   MAHY, G. et al. / "Performance indicators framework for biodiversity management in gypsum quarries throughout Europe" / Eurogypsum / 2015 / Retrieved from:
    http://www.eurogypsum.org/wp-content/uploads/2015/04/EUROGYPSUMPERFORMANCEINDICATORSBD.pdf

-   MAJALE, M. / "Employment Creation through Participatory Urban Planning and Slum Upgrading: The case of Kitale, Kenya" / Habitat International / June 2008 / Retrieved from:
    https://www.researchgate.net/publication/248524278_Employment_creation_through_participatory_urban_planning_and_slum_upgrading_The_case_of_Kitale_Kenya

-   MARANS, R. / "Understanding Environmental Quality through Quality of Life Studies: the 2001 DAS and its use of Subjective and Objective Indicators" / Landscape and Urban Planning 65 (2003) 73 – 83 / 2003 / Retrieved from:
    http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.452.8285&rep=rep1&type=pdf

-   MBOUP et al. / "Bulletin: Smart Economy in Smart Cities" / October 2015 / Retrieved from:
    http://www.gora4people.org/uploads/2/9/5/7/29574827/smart_economy_in_smart_cities_-_bulletin_10_-_october.pdf

-   MORO, A. / "Testing Protocol: Key Performance Indicators Urban Scale" / iiSBE Italia R&D / February 2018

- © OpenStreetMap contributors / Open Database License / Consulted on 2019
  https://www.openstreetmap.org/copyright/en
  opendatacommons.org
  creativecommons.org

- PITARCH, Beatriz / "Car-rapide, Dakar" / December 18, 2009 / Retrieved from:
  https://www.flickr.com/photos/24991898@N02/4195507432

- PROTHMANN, S. / "Urban Identities and Belonging: Young Men's Discourses about Pikine (Senegal)" / Graduate Institute of International and Development Studies of Geneva / African Cities and the Development Conundrum / October 2018 / Retrieved from:
  https://journals.openedition.org/poldev/2749

- QUINN, G. / "EN6501 Municipal Solid Waste Management Objectives: To make the students conversant with different aspects of the types, sources, generation, storage" / Retrieved from:
  https://slideplayer.com/slide/11693843/

- RÉPUBLIQUE DU SÉNÉGAL / "Projet de Gestion des Eaux Pluviales et d'adaptation au Changement Climatique" / Prestige; L'Atelier Urbain / August 2014

- RÉPUBLIQUE DU SÉNÉGAL / "PUD de Pikine - Guédiawaye: mode d'habitat" / Prestige; L'Atelier Urbain / 2016

- Reforestaction / "Reforestation in Senegal" / 2011 / Retrieved from:
  https://www.reforestaction.com/en/reforestation-senegal

- ROGERSON, R. / "Quality of Life and City Competitiveness" / Urban Studies, vol. 36, Nos 5-6, 969 – 985 / 1999

- ROUHANA, S. & RANARIFIDY, D. / "Cities for an emerging Senegal" / Africa Can End Poverty / June 14, 2016 / Retrieved from:
  http://blogs.worldbank.org/africacan/cities-for-an-emerging-senegal

- SALEM, G. / "La santé dans la ville : géographie d'un petit espace dense : Pikine (Sénégal)" / Éditions Karthala et Orstrom / 1998

- SANÉ, Y. / "La décentralisation au Sénégal, ou comment réformer pour mieux maintenir le statu quo" / 2016 / Retrieved from :
  https://journals.openedition.org/cybergeo/27845

- SAUNDERS, D. / "The real reasons why migrants risk everything for a new life elsewhere" / The Globe and Mail / April 24, 2015 / Retrieved from:
  https://www.theglobeandmail.com/news/world/the-real-reasons-why-migrants-risk-everything-for-a-new-life-elsewhere/article24105000/

- SCOTT-RAILTON, J. / "Dormant Lakes return as Floods. Pikine, Dakar, Senegal" / July 17, 2010 / Retrieved from:
  https://www.flickr.com/photos/52248383@N05/4818596356 / July 17, 2010

- SEARCEY, D., BARRY, J. / "Why Migrants keep Risking all on the 'Deadliest Route'" / New York Times / June 22, 2017 / Retrieved from:
  https://www.nytimes.com/2017/06/22/world/africa/migrants-mediterranean-italy-libya-deaths.html

- STEPHEN, O. E. / "Assessment of quality of life using GIS" / Geospatial World / April 15, 2013 / Retrieved from:
  https://www.geospatialworld.net/article/assessment-of-quality-of-life-using-gis/

- STEPHENS, T. / "Incremental Urbanism. Small-scale, historically sensitive and economically feasible development as a driver for a more vibrant downtown Louisville" / Louisville Downtown Partnership / 2016

- STEUTEVILLE, R. / "Transect of Incremental Urbanism" / Congress for the New Urbanism / October 20, 2017 / Retrieved from:
  https://www.cnu.org/publicsquare/2017/10/20/transect-incremental-urbanism

- STURM, T. / "Incremental Urbanism and the Art of Revitalization" / Buildipedia / February 2, 2012 / Retrieved from:
  http://buildipedia.com/aec-pros/urban-planning/incremental-urbanism-and-the-art-of-revitalization

- TANDIAN, A. / "Senegalese Migration: Between Local Motives and International Factors" / Heinrich Böll Foundation / October 2018 / Retrieved from:
  https://za.boell.org/sites/default/files/perspectives_oct_2018_web.pdf

- TESFAZGHI, E. S. / "Urban Quality of Life and its Spatial Distribution in Addis Ababa: Kirkos sub-city" / International Institute for Geo-Information, Science, and Earth Observation / Enschede, The Netherlands / March 2009 / Retrieved from:
  https://webapps.itc.utwente.nl/librarywww/papers_2009/msc/upm/tesfazghi.pdf

- The World Bank / "The World Bank in Senegal"/ April 13, 2019 / Retrieved from: https://www.worldbank.org/en/country/senegal/overview

- THOMET, N.; VOZZA, A. / "Project Design Manual: A Step-by-Step tool to Support the Development of Cooperatives and other Forms of Self-Help Organizations" / December 2010 / International Labour Organization

- TORABI S. / "Workshop. Multi-Criteria Analysis (MCA) Application" / May 8, 2019

- UNESCO / "UNESCO Global Partnership for Girls' and Women's Education – One Year On" / United Nations Educational, Scientific, and Cultural Organization / May 2013 / Retrieved from:
  http://www.unesco.org/eri/cp/factsheets_ed/SN_EDFactSheet.pdf

- United Nations / "Charting the Progress of Populations. United Nations Population Division" / United Nations Centre for Human Settlements / 1996 / Retrieved from:
  https://www.un.org/en/development/desa/population/publications/pdf/trends/ProgressOfPopulations/14.pdf

- VIAL, D.; PRIOR, M. / "Use of Key Performance Indicators in the Planning Management of Public Open Space" / Integrated Open Space Services / October 2003 / Retrieved from:
  https://www.researchgate.net/publication/295010492_Use_of_Key_Performance_Indicators_in_the_Planning_and_Management_of_Public_Open_Space

- VP Solutions / "Visual PROMETHEE 1.4 Manual" / September 5, 2013 / Retrieved from:
  http://www.promethee-gaia.net/files/VPManual.pdf

- WANG, H. G., MONTOLIU-MUÑOZ, M., GUEYE, N. / "Preparing to Manage Natural Hazards and Climate Change Risks in Dakar, Senegal, A Spatial and Institutional Approach" / June 2009 / Retrieved from:
  https://reliefweb.int/sites/reliefweb.int/files/resources/GFDRR_Climate_and_Natural_Hazard_Risks_Dakar_Senegal.pdf

- ZUKOWSKA et al. / "Deliverable D2.4: IDST Key Performance Indicators" / Friendly and Affordable Sustainable Urban Districts Retrofitting / July 10, 2014