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INFORMA IS THE NEW FORMAL RESTRUCTURING DAKAR

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ABSTRACT (English)

The city of Dakar being capital of Senegal is largely attracting the people around the country due to its job opportunities. Hence the city is facing a large number of informal settlements. The problem of informal settlements is not particular to this city, the major developing cities across the world as a similar issue.

The informal settlements as become the neighbourhood for most the cities. Therefore, the world needs to except the informal settlements and try to improve the lively hood of their people with sustainable developments and meeting the necessary needs of the people.

In this project we use Integrated modification methodology to understand the state of the present informal settlements and identify the problems needs to be addressed. Integrated Modification Methodology, an innovative design methodology based on a specific process with the main goal of improving the CAS' (complex adaptive systems) environmental performance, through the modification of its constituents and optimization the architecture of their ligands. Its approach is fundamentally Holistic, Multi-Layer, Multi-scale. In this methodology, the city is a dynamic Complex Adaptive System comprised of the superimposition of an enormous number of interrelated components, categorized in different Layers or 'Subsystems', (also complex adaptive systems) which through their inner arrangement and the architecture of their ligands provide a certain physical and provisional arrangement of the CAS. Cities are very complex. They involve many systems, including energy, water and sewerage, food, transport, health, and biodiversity, as well as economic, social, and cultural systems. This network of systems, interconnections and flows can be described as a system of systems. The IMM investigates the relationships between urban morphology and environmental performance by focusing mostly on the 'Subsystems' characterized by physical characters and arrangement. The main object of this design process is to address a more sustainable and better performing urban arrangement.

Restructuring the Dakar gave us the opportunity to give the sustainable design solution for the city by addressing identified problems. And also introducing the NZEB building design technologies to achieve the sustainable development goals and improving the life standard of the people.

ABSTRACT (Italian)

La città di Dakar, capitale del Senegal, attira in gran parte le persone di tutto il paese grazie alle sue opportunità di lavoro. Quindi la città si trova ad affrontare un gran numero di insediamenti informali. Il problema degli insediamenti informali non è specifico di questa città, poiché le principali città in via di sviluppo in tutto il mondo hanno un problema simile.

Gli insediamenti informali sono diventati il quartiere per la maggior parte delle città. Pertanto, il mondo deve escludere gli insediamenti informali e cercare di migliorare la vivacità della popolazione con sviluppi sostenibili e soddisfacendo i bisogni necessari delle persone.

In questo progetto utilizziamo la metodologia di modifica integrata per comprendere lo stato degli attuali insediamenti informali e identificare i problemi che devono essere affrontati. Metodologia di modifica integrata, una metodologia di progettazione innovativa basata su un processo specifico con l'obiettivo principale di migliorare le prestazioni ambientali dei CAS (sistemi adattativi complessi), attraverso la modifica dei suoi costituenti e l'ottimizzazione dell'architettura dei loro ligandi. Il suo approccio è fondamentalmente Olistico, Multistrato, Multiscala. In questa metodologia, la città è un sistema adattivo complesso dinamico costituito dalla sovrapposizione di un numero enorme di componenti interrelati, classificati in diversi strati o "sottosistemi" (anche sistemi adattivi complessi) che attraverso la loro disposizione interna e l'architettura dei loro ligandi fornire una certa disposizione fisica e provvisoria del CAS. Le città sono molto complesse. Coinvolgono molti sistemi, tra cui energia, acqua e fognature, cibo, trasporti, sanità e biodiversità, nonché sistemi economici, sociali e culturali. Questa rete di sistemi, interconnessioni e flussi può essere descritta come un sistema di sistemi. L'IMM indaga le relazioni tra morfologia urbana e prestazioni ambientali concentrandosi principalmente sui "Sottosistemi" caratterizzati da caratteri fisici e disposizione. L'obiettivo principale di questo processo di progettazione è quello di affrontare un assetto urbano più sostenibile e più performante.

La ristrutturazione della Dakar ci ha dato l'opportunità di fornire una soluzione di progettazione sostenibile per la città affrontando i problemi identificati. E introducendo anche le tecnologie di progettazione degli edifici NZEB per raggiungere gli obiettivi di sviluppo sostenibile e migliorare lo standard di vita delle persone.

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1. Fundamental Definitions

1. Slums:

“Slums” there is no single, universal definition in use. The only characteristic that is generally accepted is that slums are neighbourhoods that are in some respect substandard. A global definition may fail to account for the nuances of particular slums in certain cities and countries.

Slum Households are defined as one in which the inhabitants suffer from one or more of the following:

- 1) Lack of access to improved water source
- 2) Lack of access to improved sanitation facilities
- 3) Lack of sufficient living area
- 4) Lack of housing durability and
- 5) Lack of security of tenure.

UN-Habitat defines a slum household in operational terms, as lacking one or more of the following indicators: a durable housing structure; access to clean water; access to improved sanitation; sufficient living space; and secure tenure. The first four rely on conventional definitions; the last is the most difficult to assess and is not currently used in slum measurement (UN-Habitat, 2003).

There is some evidence that the elements that make up the slum definition feature among slum dwellers’ chief concerns.

UN-Habitat puts the global estimate of slum populations at 881 million as of 2014 and just under a third of all urban dwellers in the developing world (UN-Habitat, 2014). Sub-Saharan Africa is the region with the highest proportion of the urban population living in slums – over 50% compared to figures ranging between 20% and 31% for other regions of the world.

Access to improved water

A household is considered to have access to an improved drinking water source if the household members use a facility that is protected from outside contamination, in particular from faecal matters’ contamination. Improved drinking water sources include piped water into dwelling, plot or yard; public tap/stand pipe; protected spring; rainwater collection; bottled water (if secondary source is also improved); bore hole/tube well; and, protected dug well.

Access to improved sanitation

A household is considered to have access to improved sanitation if household members have access to a facility with an excreta disposal system that hygienically separates human waste from human contact. Improved sanitation facilities include: flush/pour-flush toilets or latrines connected to a sewer, septic tank or pit; ventilated improved pit latrine; pit latrine with a slab or platform which covers the pit entirely; and, composting toilets/latrines.

Sufficient living area

Household dwelling unit provides sufficient living area for the household members if not more than three people share the same habitable room.

Slum households are typically squeezed, having more than three individuals sharing the same habitable room.

Structural quality/durability of dwellings

A house is considered as ‘durable’ if it is built on a non-hazardous location and has a permanent and adequate structure able to protect its inhabitants from the extremes of climatic conditions such as rain, heat, cold, and humidity. In order to determine the household durability, consider the following elements:

1. Permanency of structure (permanent building material for the walls, roof and floor; compliance with building codes; the dwelling is not in a dilapidated state; the dwelling is not in need of major repair); and
2. Location of house (The house is not located on or near toxic waste, in a flood plain, not located on a steep slope, not located in a dangerous right of way of rail, highway, airport, and power lines).

Houses in slums are mostly made of transitory corrugated iron sheets, sacks, wood and are located on or near toxic waste, steep slope, or dangerously in the way of transport lines.

Security of tenure

A housing structure should be accompanied by security of tenure. This means that the members of the household should have a legal status against arbitrary unlawful eviction, harassment as well as any other threats. The housing structure should have statutory or customary law or informal or hybrid arrangements that safeguard the house members against forced evictions.

Most slum residents lack security of tenure for their housing units.

2. Informal Settlements:

Informal settlements are residential areas where:

1. Inhabitants have no security of tenure vis-à-vis the land or dwellings they inhabit, with modalities ranging from squatting to informal rental housing,
2. The neighbourhoods usually lack, or are cut off from basic services and formal city infrastructure,
3. The housing may not comply with current planning and building regulations, situated in geographically and environmentally hazardous areas, and may lack a municipal permit.



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- Habitability, as housing is not adequate if it does not guarantee physical safety or provide adequate space, as well as protection against the cold, damp, heat, rain, wind, other threats to health and structural hazards;

- Accessibility, as housing is not adequate if the specific needs of disadvantaged and marginalized groups are not taken into account (such as the poor, people facing discrimination; persons with disabilities, victims of natural disasters);

- Location, as housing is not adequate if it is cut off from employment opportunities, health-care services, schools, child-care centres and other social facilities, or if located in dangerous or polluted sites or in immediate proximity to pollution sources;

- Cultural adequacy, as housing is not adequate if it does not respect and take into account the expression of cultural identity and ways of life.

4. Adequate Housing:

The UN-Habitat definition is therefore strongly underpinned by a rights-based approach to the universal fulfilment of the right to adequate housing.

Durable housing

A permanent structure providing protection from extreme climatic conditions

- Sufficient living area No more than three people sharing a room.

- Access to improved water, that is sufficient, affordable and can be obtained without extreme effort.

- Access to improved sanitation facilities.

- A private toilet, or a public one shared with a reasonable number of people.

- Secure tenure De facto or de jure secure tenure status and protection against forced.

5. Slum Upgrading:

The narrow definition of slum upgrading refers to improvements in housing and/or basic infrastructure in slum areas.

In a broader sense, upgrading also includes enhancements in the economic and social processes that an bring about such physical improvements (UNHabitat,2004: 3).

The term 'slum upgrading' covers a wide range of potential interventions. Any specific upgrading projects or programme may include one or more interventions though it is increasingly recognised that the broader and more integrated the approach the more successful, it is likely to be.

At its most comprehensive it consists of physical, social, economic, organizational and environmental improvements undertaken cooperatively and locally among citizens, community groups, businesses, and national governments and city authorities.

Slum upgrading interventions typically include the following:

- installation or improvement of basic infrastructure such as water reticulation, sanitation, waste collection, road networks, storm drainage and flood prevention, electricity, security lighting and public telephones;
- regularisation of security of tenure;
- relocation of and compensation for the residents (both men and women) dislocated by the improvements;
- housing improvement;
- construction or rehabilitation of community facilities such as nurseries, health posts and community open spaces;
- improvement of access to health care, education and social support programmes to address issues of security, violence, substance abuse, etc;
- removal or mitigation of environmental hazards;
- provision of incentives for community management and maintenance;
- enhancement of income-earning opportunities through training and micro-credits;
- building of social capital and the institutional framework to sustain improvements



Four key conclusions:

- The participation of slum dwellers and community organizations is critical. Projects need to be designed from the 'bottom up,' working with households and communities so that they can have an input into decisions regarding what levels of service they receive.
- The long-term success of upgrading interventions requires that consideration be given to the costs involved and to designing a level of service that is affordable to the community and to the local government.
- Upgrading cannot be the only component of a housing policy and upgrading programmes must be integrated with city level and country policies, programmes and strategies to achieve synergies with other supporting interventions addressing poverty, vulnerability and promoting economic growth.
- Upgrading programmes are most effective when led by the municipal authority and implemented at the community level through a broad set of intermediaries including community-based organizations, NGOs, and UN agencies such as UNICEF



1.1. The African context

A. Is urbanization in Africa "pathological"?

In the past two decades, researchers, economists and analysts have tended to view urbanization in Africa through a prism of "abnormality" or "exceptionalism". They have described the continent's rapid urban growth – averaging approximately 4 per cent per year in the 1980s and 1990s – as "pathological" or "dysfunctional"; this suggests that, unlike the rest of the world, urbanization in Africa has often not been accompanied by sustained economic growth or reduced poverty. Furthermore, African countries experiencing what has been termed "urbanization without growth" have been diagnosed as either "failed states" or underindustrialized. A UNHABITAT review of data from 36 African countries shows that half of the countries, including Angola, Ethiopia, Liberia, Malawi, Mozambique and Sudan, experienced relatively high (over 5 per cent) economic growth rates in 2006 and 2007, with Angola, Ethiopia and Sudan growing at double-digit rates of 21.1 per cent, 11.1 per cent, and 10.2 per cent, respectively. In many of these countries, average annual urban growth rates between 2005 and 2010 were not significantly higher than the continental average of 3.3 per cent. In fact, in South Africa and Botswana, where more than 60 per cent of the population is urban and which featured GDP growth rates of more than 5 per cent in 2006 and 2007, annual urban growth rates between 2005 and 2010 (estimate) were significantly lower than the continental average, at 1.35 per cent and 2.51 per cent, respectively. Growth in the formal economy of many African countries has been fuelled mainly by the industrial (including construction and mining) and services sectors, which tend to be urban-based. Of all the economic sectors, including agriculture, the services sector has grown the fastest in Africa since the 1990s.

Despite robust economic growth in several countries, though, approximately one-third of the 36 African countries under review have experienced substantial shifts in population without commensurate poverty reduction. This would point to a pattern of "pathological" urban growth which, fundamentally, reflects a lack of political will to tackle urban poverty in a systematic way, but can also derive from the poor performance of policies and programmes in many countries.

As discussed in Part 2 of this Report, development strategies and High slum prevalence in many African cities can also be attributed to structural and political failures in the distribution of public goods, as well as to lack of human and financial resources to address urban poverty. In the fastest growing African economies, such as oil-rich Angola and Sudan, slum dwellers constitute the majority – more than 80 per cent – of the urban population. Poor agricultural yields and civil war have been blamed for the high urban and slum growth rates in these countries, as rural migrants have flocked to cities to escape hunger or conflict. While natural population growth in African cities is increasingly the norm (more people are born in cities than migrate to them), continued civil strife and environmental crises in some countries are still pushing rural populations to urban areas, where the majority of the migrants end up in slums or poorly-serviced neighbourhoods.

However, statistics often fail to reflect Africa's underground economies, where the bulk of the urban population works in the informal sector. In fact, many African cities that may appear as "a patchwork of shantytowns, refugee camps, industrial zones and gated residential communities" are actually clusters of economic activities that are linked through both formal and informal networks. One study showed that in the years 1999 and 2000, the informal economy accounted for 42 per cent of 23 African countries' gross national product (GNP). Evidence from several African countries has also shown that the informal economy keeps growing even as the formal sector is stagnant (Programme 2010).

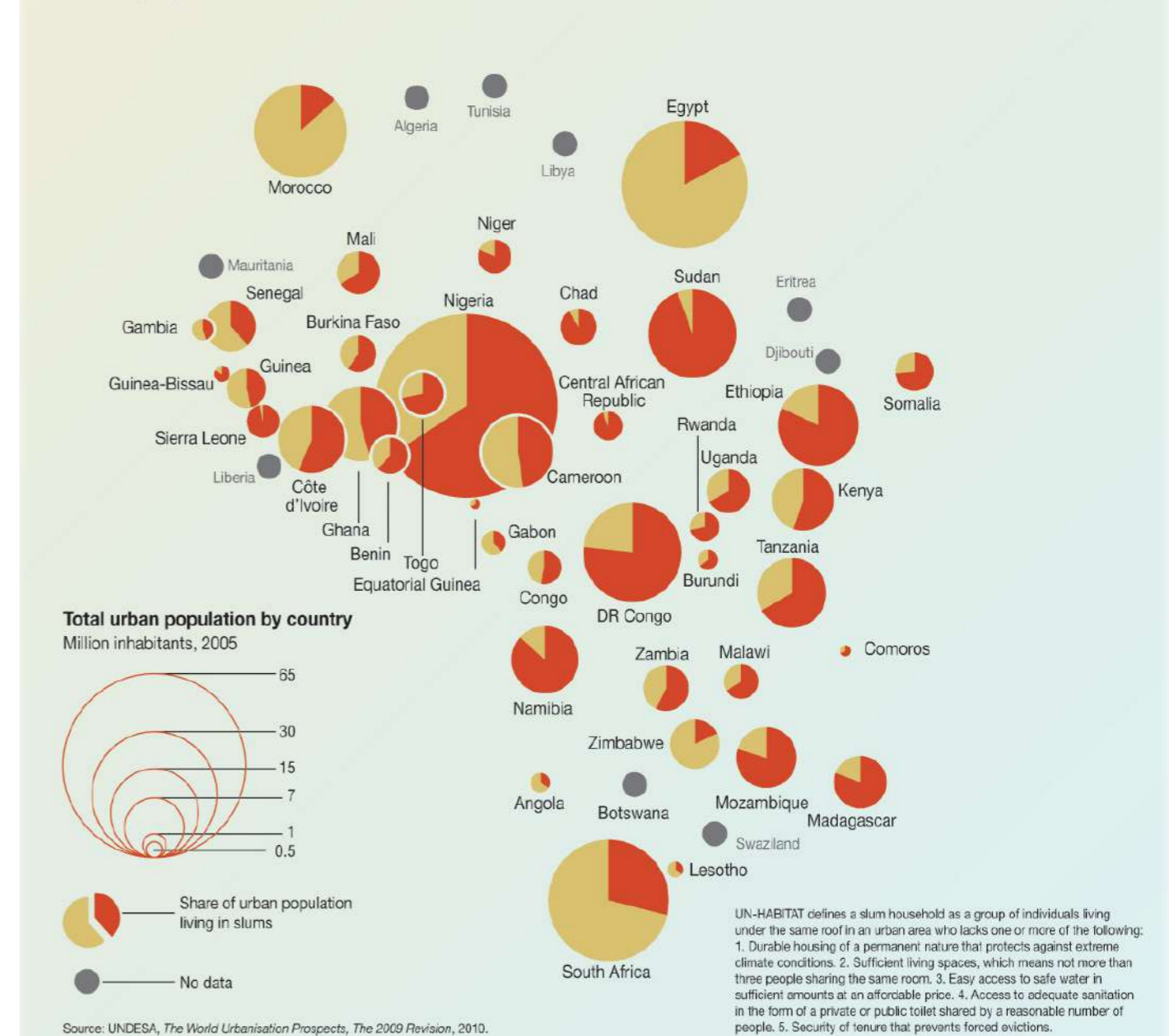
B. Political lessons

Colonial investments in urban infrastructure, housing, and economic diversification were limited, and the systems of urban governance that were established were highly centralized and ad hoc. Towns and cities were essentially designed to facilitate the extraction of primary commodities and protect the interests and lifestyles of a European minority, the variation in colonial investment and institutional development is correlated with contemporary variation in slum incidence. The proliferation of slum settlements in Africa is de facto evidence of persistent government failure to invest in urban development and cultivate effective institutions for urban management. Understanding this failure is the key to developing a genuinely causal explanation of the slum phenomenon in Africa (Fox 2014). However, a deeper understanding of the scale and diversity of the phenomenon requires an appreciation of the historical and political dynamics that have shaped urban development trajectories.

Drawing on evidence from sub-Saharan Africa, I have demonstrated that the colonial era represents a critical juncture in the history of urban development. Colonizers set Africa's urban transition in motion, but (generally speaking) left in their wake a legacy of underinvestment and ad hoc urban governance structures. African cities were consequently ill prepared to absorb accelerated urban population growth in the early independence period, resulting in the proliferation of unplanned, informal settlements. These settlements have provided opportunities for the cultivation of politically instrumental patron-client networks and rent-seeking opportunities that generate strong incentives to maintain the status quo. Moreover, African governments have shown signs of internalizing the anti-urbanization bias that emerged in development discourse in the 1970s, which has served to encourage laissez-faire approach to urban governance in recent decades despite the rapid and persistent growth of urban populations in the region (Fox 2014)

1.2 CURRENT SITUATIONS

Slum population in urban Africa



One billion slum dwellers worldwide of a total world population of slightly under seven billion (UN, Department of Social and Economic Affairs, 2011).

Sixty per cent of the global population will live in cities by 2030, with 90% of urban growth in coming decades likely to occur in low- and middle-income countries. Current urbanization trends indicate that an additional three billion people will be living in cities by 2050, increasing the urban share of the world's population to two-thirds. Infact, 95% of the growth in urban areas in the next two decades will occur in cities, making them home to more than 4 billion people, and translating to about 80% of future urban population.

The steady trend towards urbanization will influence virtually every facet of human endeavour in the coming years, including health, economic, social, and environmental. In many parts of the world, especially in developing countries, high rates of urbanization have unfolded in context of stagnating economies and poor planning and governance, creating a new face of

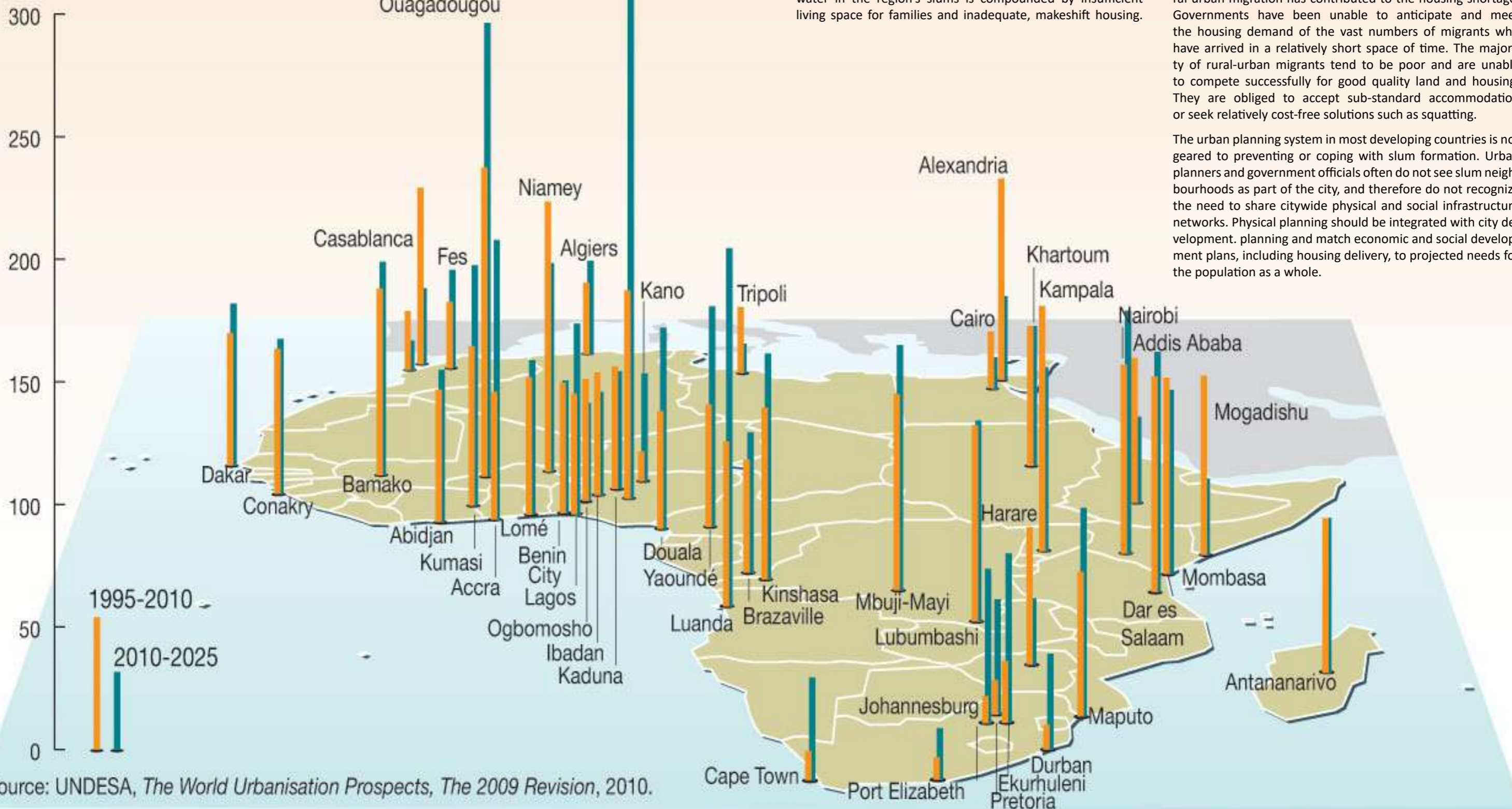
abject poverty concentrated in slums or informal settlements in major cities. Indeed, the unprecedented proliferation of slums and informal settlements in the world especially in developing countries, and a chronic lack of adequate housing, continue to be among the major challenges of urbanization today. Slums, informal settlements and inadequate housing remain the visible manifestations of poverty and inequality in cities.

At present, it is estimated that one in eight people in the world live in slums or experience slum-like conditions around their housing environments. Over the next 15 years, it is estimated that more than three billion people will need adequate housing.

The housing and slum challenge therefore remains a critical factor in the persistence of poverty in the world, depriving millions of urban residents their right to an adequate standard of living and housing, excluding them from the benefits of sustainable urbanization.

Urban growth rate in Africa

Current and projected urban population growth for selected cities for the periods 1995-2010 and 2010-2025
Percentage

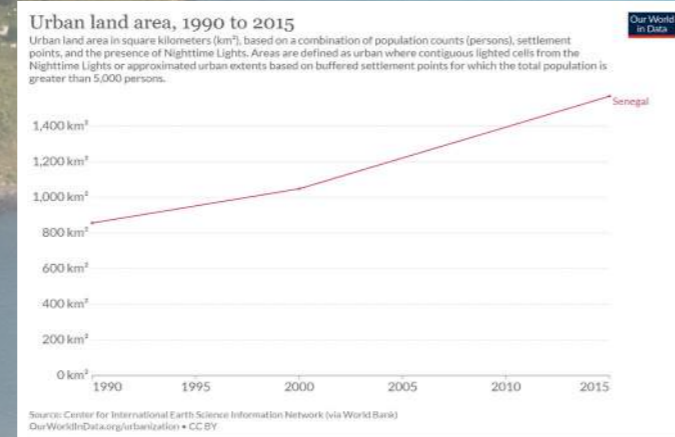
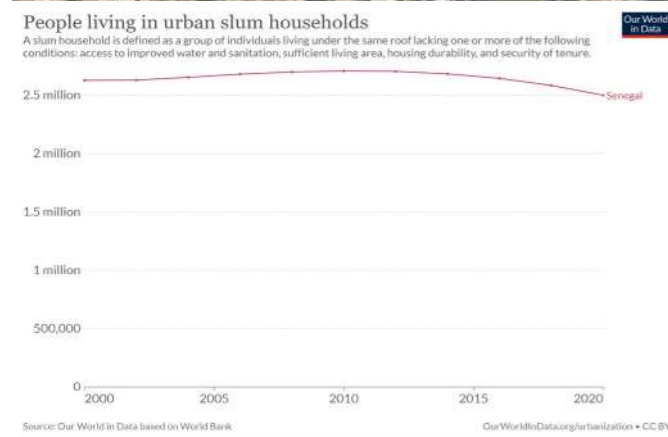


UN-HABITAT analyses show that Sub-Saharan Africa's slums are the most deprived; over 80 per cent of the region's slum households have one or two shelter deprivations, but almost half suffer from at least two shelter deprivations. Approximately one-fifth of slum households live in extremely poor conditions, lacking more than three basic shelter needs. Generally, the lack of sanitation and water in the region's slums is compounded by insufficient living space for families and inadequate, makeshift housing.

Slum formation has a number of causes. Poor government policies, the failure of the market and government to meet the enormous demand for decent and affordable housing, low state investment in infrastructure, an ineffective urban planning system and a misdirected regulatory system as well as the more general causes of urbanisation and poverty, are often cited as causes of slum formation. Rural-urban migration has contributed to the housing shortage. Governments have been unable to anticipate and meet the housing demand of the vast numbers of migrants who have arrived in a relatively short space of time. The majority of rural-urban migrants tend to be poor and are unable to compete successfully for good quality land and housing. They are obliged to accept sub-standard accommodation or seek relatively cost-free solutions such as squatting.

The urban planning system in most developing countries is not geared to preventing or coping with slum formation. Urban planners and government officials often do not see slum neighbourhoods as part of the city, and therefore do not recognize the need to share citywide physical and social infrastructure networks. Physical planning should be integrated with city development, planning and match economic and social development plans, including housing delivery, to projected needs for the population as a whole.

Source: UNDESA, *The World Urbanisation Prospects, The 2009 Revision*, 2010.



Senegal's annual population growth (1995-2000) is 2.6 percent and more than 4 percent in the capital, Dakar. Dakar is the largest city and the principal port and commercial center; it has 50 percent (about two million) of the total urban population of the country.

This rapid growth has caused the spread of urbanization beyond the border of the city jurisdiction. The Dakar metropolitan area is now comprised of three municipalities, each one with an indirectly elected mayor: Dakar, Pikine, and Rufisque-Bargny. The rural exodus has been toward Dakar, in which the population of unplanned settlements grew by 45 percent between 1965 and 1972. The Dakar urban and industrial areas expanded to Rufisque and Thiès, and, very quickly, were ringed by informal settlements. Local authorities periodically applied the slum clearance policy and pushed the poor population towards the periphery. These areas are under-equipped and, because they are considered illegal, no infrastructure has been built.

Senegal has been implementing a national urban upgrading and land legalization policy since 1987 in order to respond to the rapid and uncontrolled urban growth of its sprawling squatter areas. In the past, the Government applied a policy of successive slum evictions. In 1985, there was strong reaction against the massive slum clearances implemented in Dakar. Faced with the magnitude of the growing informal areas and the negative social reaction to the clearance policy, the Government decided to apply a new "urban upgrading and land legalization policy". This upgrading policy has over time become one of the main components of the national urban policy developed in order to resolve the strong demand for housing for the poor.

1.3 PAST PRACTICES

1. Country & city: Dar es Salaam, TANZANIA (1995 - present)

- Community managed water systems
- Provision of basic infrastructures and services with the aim of increasing employment and income generation.
- Solid waste management and the protection of Water sources.



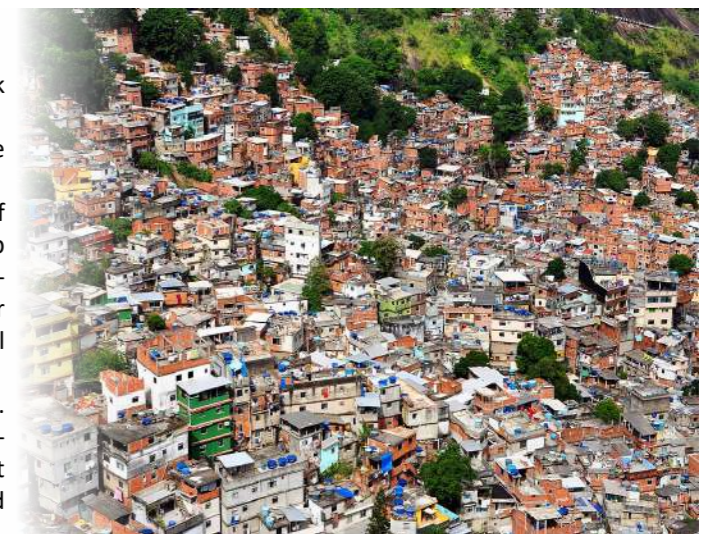
2. Kampung Improvement Program, INDONESIA (1969-present)

- Infrastructure: roads, footpaths, sanitation, drainage, collective water supply, public latrines, refuse disposal
- Social facilities: clinics, primary schools.
- Land and housing: land certification, building Permission, housing improvement.
- Community contracting is favoured as a means to developing the community and generating local incomes.



3. Favela Bairro, Rio de Janeiro, BRAZIL (1995-2006)

- To resettle the few families who had to be relocated out of risk areas.
- The programme generally included construction of flats in the same area or near the beneficiary settlement.
- The programme utilised a unique mechanism of security of tenure: the concession of the right to use but not full ownership of land. Municipal planning authorities declared those favelas undergoing improvements as Special Social Interest Areas with their own special planning processes and building codes and the usual regulations were suspended.
- This was the process for favelas built on publicly owned land. For those on private land the municipal government provided assistance in claims where the land had been occupied for at least five years. This kept the land in the public domain and prevented displacement and marketisation of land.



4. Program improvement of Sub-Normal Neighbourhoods in Medellin, COLOMBIA (1993-2000)

- Access roads, footpaths and public stairways
- Stabilisation of slopes prone to landslides
- Drainage
- Schools, health centres, sports fields, parks and other public spaces and community centres
- Extended access to drinking water and sanitation.
- Improved housing and the provision of land titles.



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5. Baan Mankong, THAILAND (2003-Present)

- a. Each city programme is launched with a big event to which the Mayor and all the slum communities come. This aims to promote confidence and belief amongst participants.
- b. The form of implementation is decided by communities themselves. They may hire an outside contractor to undertake the work but this tends to be more expensive than community contractors.
- c. Baan Mankong projects have provided many community members with construction skills which they can use as contractors in their own right. According to CODI: "community builders better understand the needs of the community and are less likely to cheat." (CODI, 2008: 8).
- d. What is interesting is that there is no incremental housing; the projects tend to produce completed houses. (Yap & de Wandeler, 2010: 339)



6. Slum Networking in Ahmedabad, INDIA (1995-Present)

- a. The main objective of SNP is to integrate slum dwellers with the mainstream of society through the provision of basic, physical infrastructure which is connected to city networks and to improve their socio-economic conditions.
- b. New infrastructure provided in individual slums is linked to that of other slums and to the existing city systems in order to bring about significant improvements to the city as a whole.
- c. SNP is open to all slums in the city under two conditions:
 - (i) all households in the slum must agree to contribute to the cost of making individual water supply, sewerage and drainage connections as well as a small contribution towards maintenance expenses and.
 - (ii) the community must form an association.
- d. The Project has improved the health and well-being of beneficiary households. For example, communal water supply and sanitation has become individual, underground drainage has reduced flooding, solid waste management systems have reduced public health risks and over 80% of households now spend less on health care.
- e. Incomes have increased in almost 60% of families while over 30% have made significant improvements to their houses.
- f. Slum dwellers have also participated more in the formal financial system, after SEWA Bank had got them use to saving and using banking services. Many of the Neighbourhood Associations which were formed have continued their work and some have developed livelihood activities such as solid waste management.



5. Cities Without Slum, MOROCCO (2004-2014)

- a. Where the slum is considered to be in good enough condition, upgrading is carried out in situ and provided with services and improved access. This would cover about 30% of cases.
- b. Slums which are declared to be in very poor condition or represent a hazard to the inhabitants are demolished and residents are relocated to partially serviced sites and service areas (35%), fully serviced sites (15%) or are re-housed in new, subsidised apartments (20%). It was estimated that half of those receiving new apartments would be vulnerable households, such as the aged or single parents, who would pay little or nothing



1.4 AIM OF THE STUDY

1. Sustainable urban development.



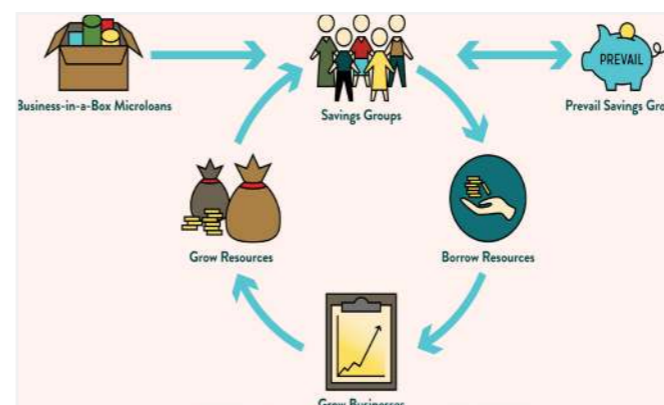
3. An affordable housing facility.



5. Provide a proper transportation network and more green spaces.



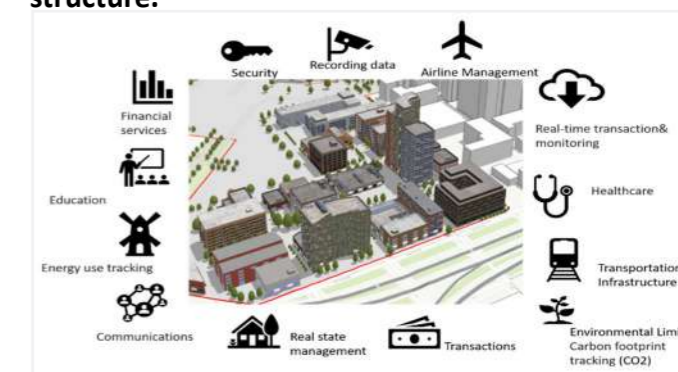
7. Improve the wellbeing of communities and strengthen their livelihood.



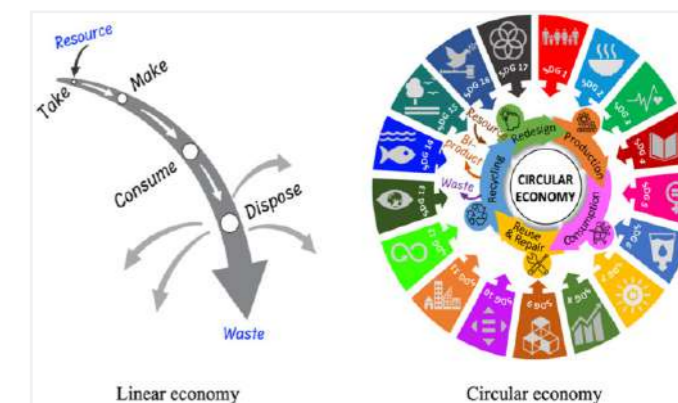
2. Employment opportunities.



4. Provide access to basic necessities and infrastructure.



6. Economical stability for the city.



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1.5 SCOPE OF THE STUDY.

Dieuppeul-Derklé is one of the 19 districts of the city of Dakar Senegal. It is part of the district of Grand Dakar. In the 2002 census, Dieuppeul-Derklé had 35,452 inhabitants, 4,128 concessions, and 5,211 households. In 2007, according to official estimates, the population of the municipality amounted to 39,891 people.

- Most African cities face a more or less similar slum problem. By extension, it also challenges the idea that one approach to—or template for—the upgrading of slums can work in all African cities.
- In Dakar, slum residents have fairly decent living conditions, even though they have low levels of educational attainment and high levels of income poverty.
- There are heterogeneity levels in the slums, the findings are not all slum households are poor. Second, slum residents have heterogeneous living conditions, depending on their welfare/poverty status and on the neighborhood in which they reside.
- the poor often lagging behind their nonpoor neighbors in access to some basic infrastructure and they endure worse living conditions. Poor are systematically less likely to have an electricity connection or a mobile phone. Water-connection rates are similar for the two groups, but water use is lower among poor households.

Monetary welfare

- Dakar, the 2004 official poverty line was 27,705 F CFA (US\$53) per adult equivalent, including rent. The discrete wealth indicator suggests that about 18 percent of the individuals have expenditures above the poverty line, while about 82 percent fall below the poverty line.

Education

- In Dakar, about a third of adults have a primary-level education, and fewer than 10 percent completed high school.

Employment

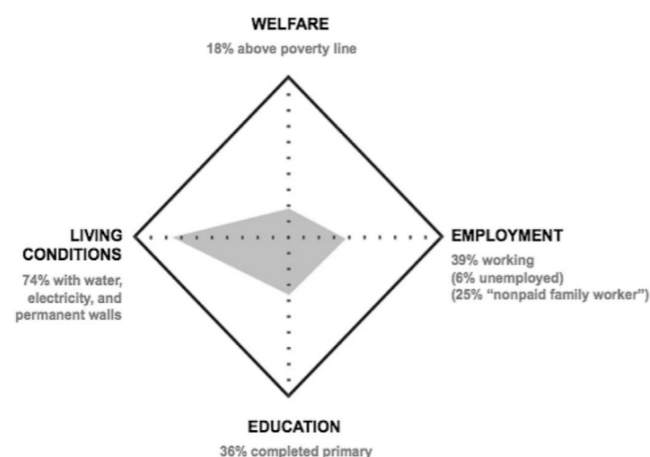
- The unemployment rate is only 6 percent in Dakar. a typical household in Dakar will have one-twentieth of adult members are unemployed.
- At the same time, the proportion of regularly employed adults are only 8 percent in Dakar. Self-employment or work in household-owned microenterprises is common In Dakar.

Living conditions

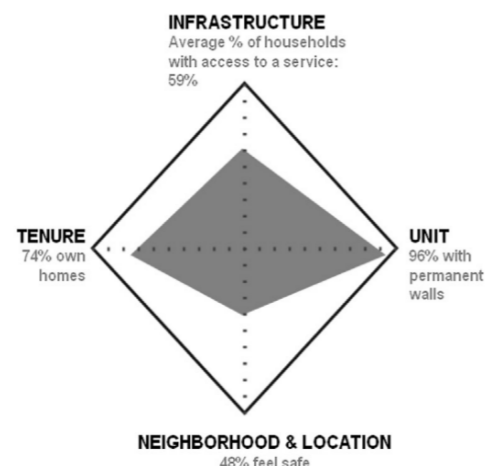
- Dakar’s slum households have both piped water and electricity compared with other slums. about 74 percent of Dakar’s slum households have access to piped water and electricity and reside in houses constructed with permanent external walls. Less than 1 percent of Dakar slum households have none of three—piped water, electricity, permanent external walls. Dakar needs more infrastructure and transportation access.

Toilets and sewage disposal services

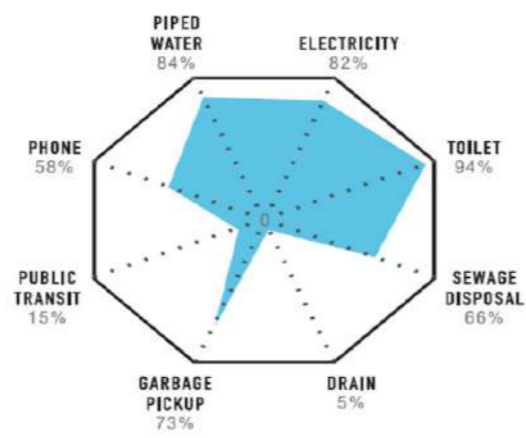
- Dakar’s slum households have better access to toilet facilities, with the mean number of households sharing a toilet facility at about 1.4 With 60 percent of households relying on public toilets, these are the most commonly used facility in the slums.



DAKAR
1. Development dimond.



DAKAR
2. Living condition dimond.



DAKAR
3. Infrastructure polygon.

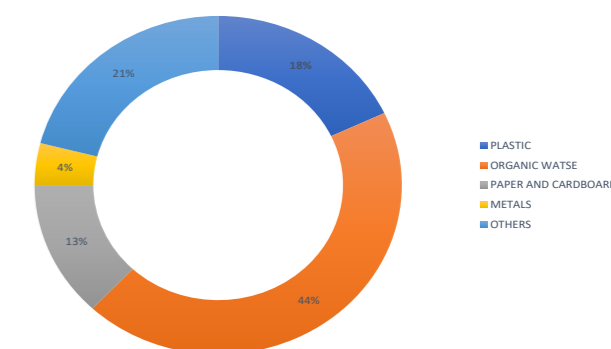
Solid waste and grey water disposal

- For Dakar, 70 out of the total 76 percent of slum households with access to organized collection systems, depend on city/ municipal collection systems. As for those households without any access to an organized garbage disposal system, the predominant method is “dumping in the neighborhood”.
- the most prevalent method in Dakar’s slums (used by about 62 percent of households) is “pouring on the road or pavement.” Different graywater disposal practices are not surprising given that slum households report some kind of drain outside their house; the figure is only about 7 percent of Dakar households.
- The lack of drainage infrastructure in Dakar seriously compromises the potential gains from improvements

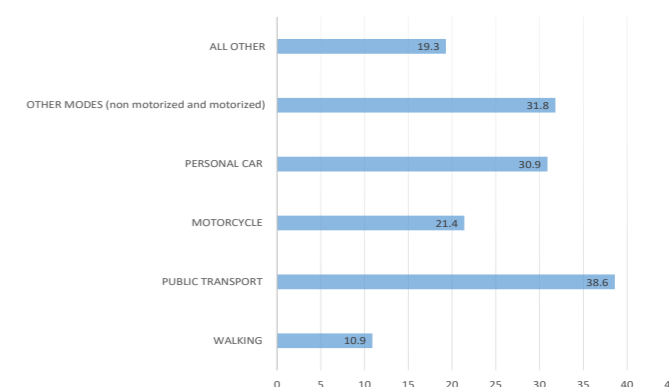
Transportation

- In Dakar, most slum residents walk. walking is the most common form of transport: the primary transportation mode is walking for about 40 percent of the residents, while about 16 percent use public transportation.
- Dakar is less likely to use water (although connection rates are similar) or have access to basic infrastructure (such as electricity or a mobile phone). Neighborhood location is also a powerful explanatory variable for electricity and water connections, even after controlling for household characteristics and poverty. Finally, tenants are less likely than homeowners to have water and electricity connections.

All the above-mentioned problems in different kinds and phases will be analyses and a study will be made to better understand the problem causes and solutions to make a better living place.



4. Fraction occupied by each component of Municipal solid waste in Dakar.



5. Average duration of trips by transport mode in Dakar (2015).

1.6 RESEARCH QUESTIONS

1. SLUMS AS A MEASURE OF URBAN GROWTH:



In developing countries, there are more slum dwellers in the city. “How to convert the slum dwellers of poor conditions to standard level with proper urban growth”.

The slum question is not marginal to urban development – it is at its very heart. Urban growth takes place primarily in developing countries in which populations move from rural to urban regions at a very fast pace. In both territorial and demographic terms, the world is becoming more and more urban. This process now affects above all the development. The rate of urban growth in many countries in the South continues to be high, and invariably leads to serious degradation of living conditions for the majority of city dwellers.

2. SLUMS AND SUSTAINABLE URBAN DEVELOPMENT IN THE AGE OF GLOBALISATION:



“how to create a concerted policy to combat inequitable slums for the urban development”.

The urbanization of the world is not a new phenomenon; it is a long-term process that has transformed our societies over the centuries. People congregated in towns and cities, took up increasingly diverse economic activities, and there was a shift from agriculture and husbandry to crafts, trades, and industry. Historically speaking, these social and economic changes implied the consolidation of human activities in ever more concentrated human settlements, which facilitated production, trade, and other forms of exchange between individuals. Improved communication technology is paving the way for a new spatial distribution of individuals – connected ‘virtually’, but sometimes physically remote.

1.7 STAKEHOLDERS

Municipality of Dakar.



GOS Government of Senegal.



The world bank.



SDI, Slum Dwellers International.



UN habitat.



CUD Communate Urbaine de Dakar
(Greater Dakar authority)

Cities Alliance .

Cities Alliance
Cities Without Slums

FDV Foundation Droit a la Ville
(Rights to the City Foundation)

2. HISTORY OF DAKAR

Dakar is the capital and the Largest City of Senegal. The City of Dakar has a population of the Dakar metropolitan area is estimated at 3.94 million in 2021.

The Cap-Vert peninsula was settled no later than the 15th century, by the Lebou people, an aquacultural ethnic group related to the neighboring Wolof and Serer. The original villages—Ouakam, Ngor, Yoff, and Hann—still constitute distinctively the Lebou neighborhoods of the city today.

In 1444, the Portuguese reached the Bay of Dakar, initially as slave-raiders. Peaceful contact was finally opened in 1456 by Diogo Gomes, and the bay was subsequently referred to as the “Angra de Bezeguiche” The bay of “Bezeguiche” would go on to serve as a critical stop for the Portuguese India Armadas of the early 16th century, where large fleets would routinely stop, both on their outward and return journeys from India, to repair, collect fresh water from the rivulets and wells along the Cap-Vert shore and trade for provisions with the local people for their remaining voyage.

The Portuguese eventually founded a settlement on the island of Gorée which by 1536 they began to use as a base for slave exportation. A new Lebou village, called Ndakaaru, was established directly across from Gorée in the 17th century to service the European trading factory with food and drinking water.

Gorée was captured by the United Netherlands in 1588, which gave it its present name (spelled Goeree, after Goeree-Overflakkee in the Netherlands). The island was to switch hands between the Portuguese and Dutch several more times before falling to the English under Admiral Robert Holmes on January 23, 1664, and finally to the French in 1677.

The slave trade was abolished by France in February 1794. However, Napoleon reinstated it in May 1802, then finally abolished it permanently in March 1815. Despite Napoleon’s abolition, the clandestine slave trade continued at Gorée until 1848, when it was abolished throughout all French territories. To replace trade in slaves, the French promoted peanut cultivation on the mainland. As the peanut trade boomed, tiny Gorée Island, whose population had grown to 6,000 residents, proved ineffectual as a port. Traders from Gorée decided to move to the mainland and a “factory” with warehouses was established in Rufisque in 1840.

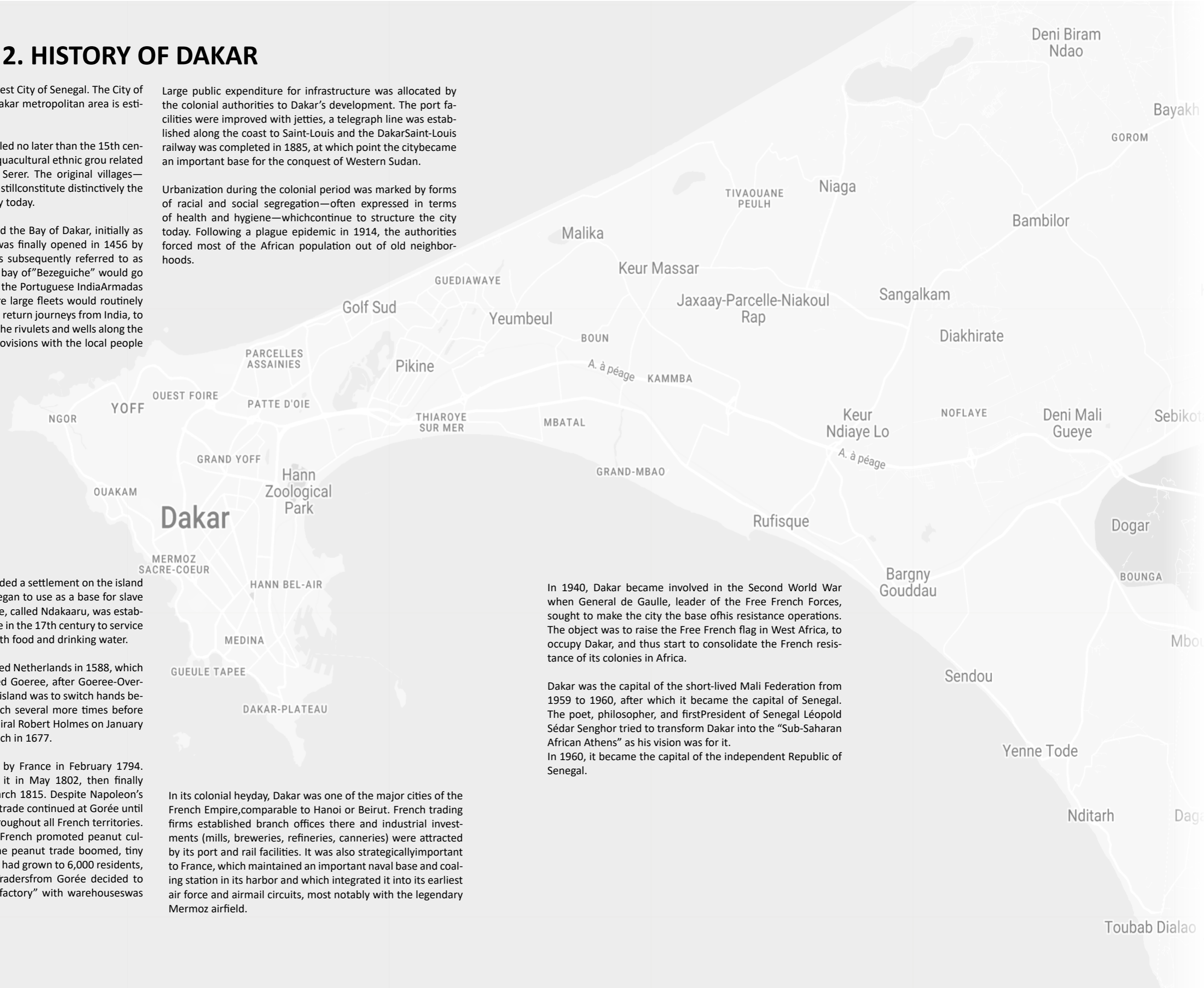
Large public expenditure for infrastructure was allocated by the colonial authorities to Dakar’s development. The port facilities were improved with jetties, a telegraph line was established along the coast to Saint-Louis and the Dakar-Saint-Louis railway was completed in 1885, at which point the city became an important base for the conquest of Western Sudan.

Urbanization during the colonial period was marked by forms of racial and social segregation—often expressed in terms of health and hygiene—which continue to structure the city today. Following a plague epidemic in 1914, the authorities forced most of the African population out of old neighborhoods.

In its colonial heyday, Dakar was one of the major cities of the French Empire, comparable to Hanoi or Beirut. French trading firms established branch offices there and industrial investments (mills, breweries, refineries, canneries) were attracted by its port and rail facilities. It was also strategically important to France, which maintained an important naval base and coaling station in its harbor and which integrated it into its earliest air force and airmail circuits, most notably with the legendary Mermoz airfield.

In 1940, Dakar became involved in the Second World War when General de Gaulle, leader of the Free French Forces, sought to make the city the base of his resistance operations. The object was to raise the Free French flag in West Africa, to occupy Dakar, and thus start to consolidate the French resistance of its colonies in Africa.

Dakar was the capital of the short-lived Mali Federation from 1959 to 1960, after which it became the capital of Senegal. The poet, philosopher, and first President of Senegal Léopold Sédar Senghor tried to transform Dakar into the “Sub-Saharan African Athens” as his vision was for it. In 1960, it became the capital of the independent Republic of Senegal.



2.1.1 GEOGRAPHY OF DAKAR

It is located on the Cap-Vert peninsula on the Atlantic coast and is the westernmost city on the African mainland.

North of Dakar on the Cap-Vert Peninsula, the coast forms almost a straight line; farther south it is indented by many estuaries and is often marshy. Four major rivers, Senegal, Saloum, Gambia, and Casamance, flow almost parallel from east to west and each is navigable for a good distance inland.

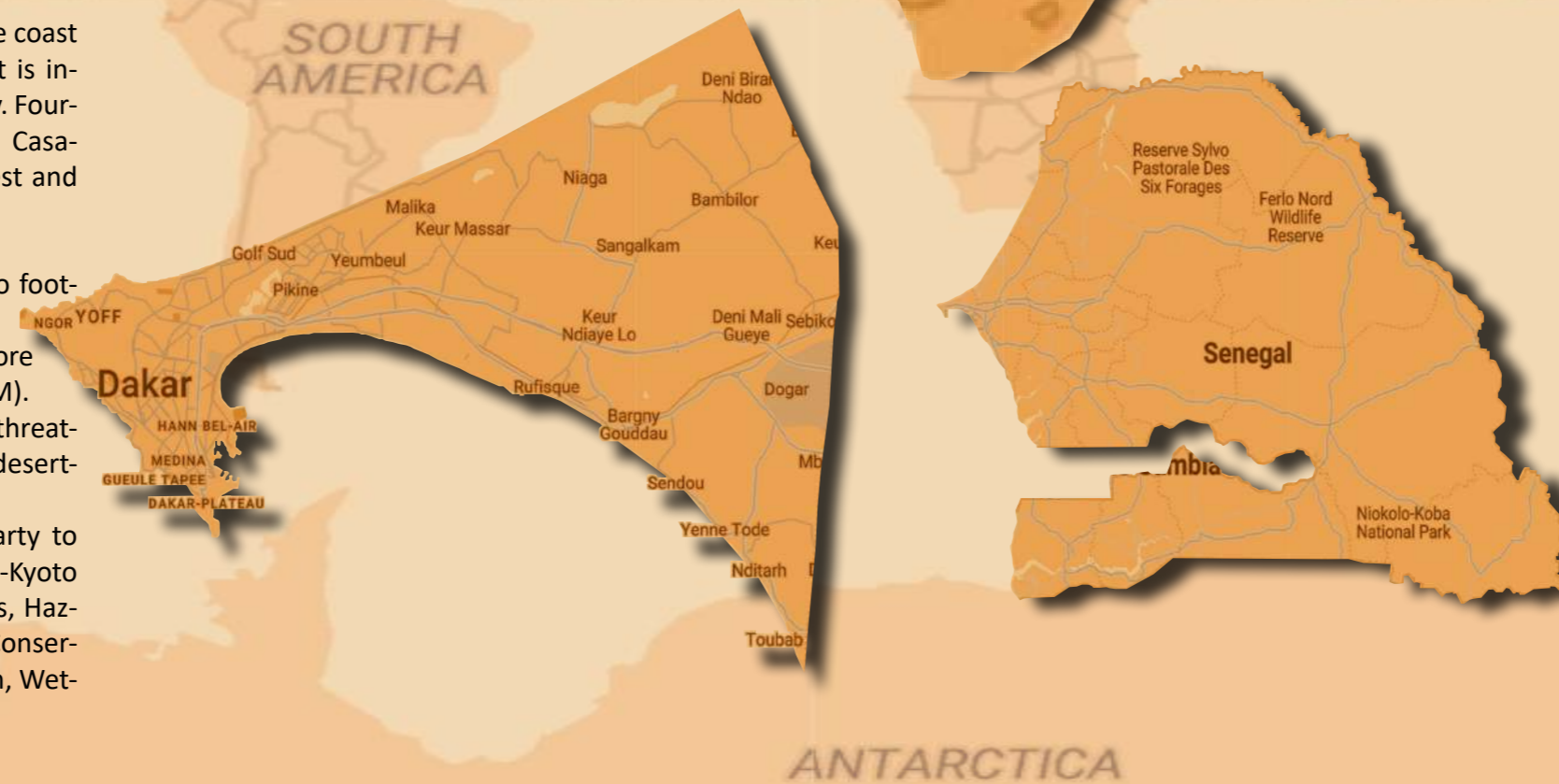
Terrain: Generally low, rolling, plains rising to foothills in the southeast.

Natural Resources: Fish, Phosphate and Iron ore

Irrigated lands: 462 square miles (1,197 sq KM).

Environmental Issues: wildlife populations threatened by poaching, overgrazing, soil erosion, desertification, and overfishing.

Environment - International Agreements: party to Biodiversity, Climate Change, Climate Change-Kyoto Protocol, Desertification, Endangered Species, Hazardous Wastes, Law of the Sea, Marine Life Conservation, Ozone Layer Protection, Ship Pollution, Wetlands, Whaling.



The Republic of Senegal is located on the bulge of West Africa and covers 196,000 square kilometers (76,000 square miles). The independent, English-speaking state of The Gambia, straddling the Gambia River, is a fingerlike enclave that protrudes more than 200 miles into Senegal.

Averaging less than 650 feet in elevation, Senegal is mostly flat or rolling plains with savanna-type vegetation. In the southeast, however, plateaus 1640 feet high form the foothills of the Fouta-Djallon Mountains. Marshy swamps interspersed with tropical rain forests are common in the southwest.

2.1.2 HISTORICAL SCENARIO

In the mid-15th century, the Portuguese landed on the Senegal coastline, followed by traders representing other countries, including the French. Various European powers — Portugal, the Netherlands, and Great Britain competed for trade in the area from the 15th century onward.

In 1677, France gained control of what had become a minor departure point in the Atlantic slave trade: the island of Gorée next to modern Dakar, used as a base to purchase slaves from the warring chiefdoms on the mainland. French colonial authorities sought to transform Dakar into a French city that visually displayed France's cultural superiority and imperial power.

2.2 CULTURE AND ARCHITECTURE HISTORY

Architecture is an important component of cultural identity. There is a distinct correspondence between an architectural style and an ethnic identity.

Though there is a lack of reference available on the vernacular style of architecture prior to French colonisation of Senegal, the architecture of villages in eastern Senegal, at a first glance, gives an impression of monotony: houses are mostly circular and all have earthen walls and conical roofs covered with straw. Nonetheless, a closer observation of the chaînes opératoires (sometimes translated as 'operational sequences') of wall and roof construction reveals considerable variability. Following the description and mapping of different construction techniques, this study outlines the patterns.



Figure. Photograph of a Malinke compound at Daloto

Observed, as well as the mechanisms that can explain them. This approach provides evidence of the borrowing of techniques in relation to the various historical contexts of the past few centuries in the studied area. It further shows that technical choices are influenced not only by cultural identity, but also by environmental constraints and matrimonial practices between groups, which play a crucial role in the adoption of new techniques. With urbanisation followed a greater migration of masses to the capital.

Types of wall construction techniques followed in Senegal.

1. Cob construction.

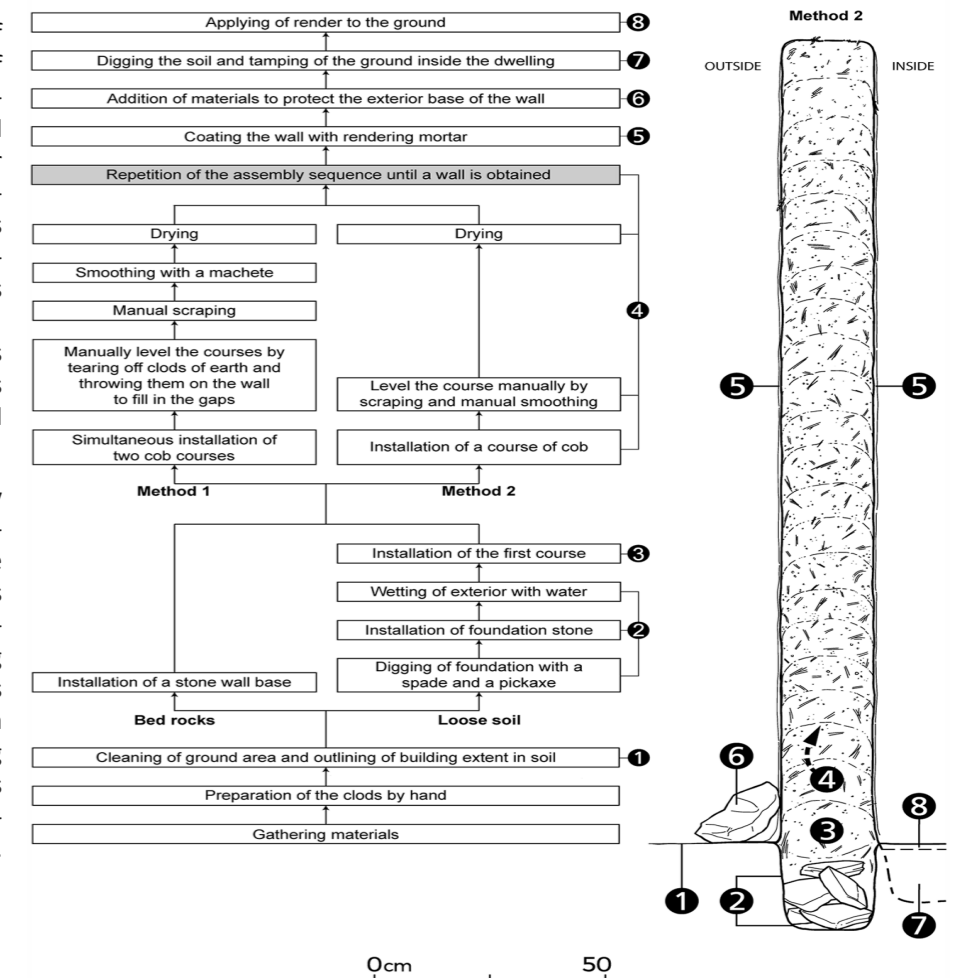
In West Africa, people refer to the technique of earth construction by the generic term of 'banco' (Prussin, 1970), which is somewhat ambiguous as it may apply to constructions in both cob and brick. Cob or 'piled earth' constructions may be undertaken simply by building up clumps of earth in successive levels without any formwork (Aurenche et al., 2011).

In eastern Senegal, the preparation of the material takes place at one end of the compound. This material is made of earth, sometimes mixed with other elements such as temper. The raw material can be clayey or lateritic sediments, or come from termite mounds. To this material are often added vegetal elements such as chopped grasses, or more occasionally a concoction of the sap of *Cissus populnea*.

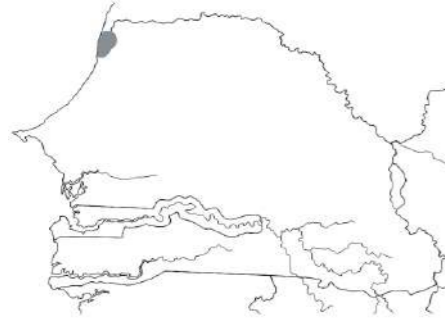
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Once the ground has been swept, it may be prepared in one or two ways, according to the kind of soil upon which the structure is to be built. If the ground is rocky and impossible to dig, it is often decided to lay a foundation of small paving slabs, 10 cm high and 20 cm thick, so as to isolate the wall. If the ground is soft, a foundation trench of 20 to 50 cm is dug with a shovel and pickaxe. The bottom is filled with 10 to 20 cm of rubble. The upper part is filled by the first course of cob.

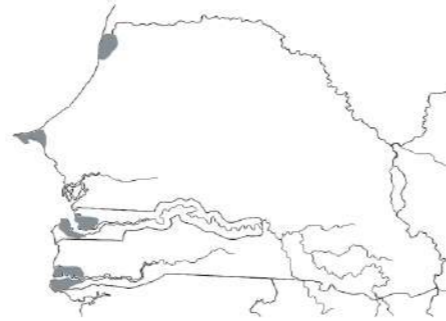
Building a cob wall



1659: First European settlement



1800–1890: Other European ports



1930–1990: Expansion of overland trade



1990: Extension of tarred roads to the north



1995: Extension of tarred roads to the southeast



European missionaries introduced Christianity to Senegal and the Casamance in the 19th century. It was only in the 1850s that the French began to expand onto the Senegalese mainland, after they abolished slavery and began promoting an abolitionist doctrine, adding native kingdoms like the Waalo, Cayor, Baol, and Jolof Empire. French colonists progressively invaded and took over all the kingdoms, except Siné and Saloum, under Governor Louis Faidherbe.

Senegalese resistance to the French expansion and curtailing of their lucrative slave trade was led in part by Lat Dior, Damel of Cayor, and Maad a Sinig Kumba Ndoffene Famak Joof, the Maad a Sinig of Siné, resulting in the Battle of Logandème. In 1915, over 300 Senegalese came under Australian command, ahead of the taking of Damascus by Australians, before the expected arrival of the famed Lawrence of Arabia. French and British diplomacy in the area were thrown into disarray.

On 25 November 1958, Senegal became an autonomous republic within the French Community.

2. Moulded brick construction

Also known as 'banco', the moulded brick technique is widespread in the area. This method consists of filling a bottomless parallel-sided mould with earth, then turning it out and allowing it to dry in the sun (Aurenche et al., 2011). In eastern Senegal, multiple kinds of soil can be extracted with a shovel and pickaxe to make the bricks. Using lateritic earth does not require any additional materials. In contrast, the use of a clayey earth, generally sourced from river banks or dried swamps, requires the addition of finely-chopped grasses. More rarely, this clayey earth is mixed with termite earth and *Cissus populnea* sap. Termite dirt can also be used on its own, or mixed with chopped grasses. These various materials are mixed with water to form the construction earth.

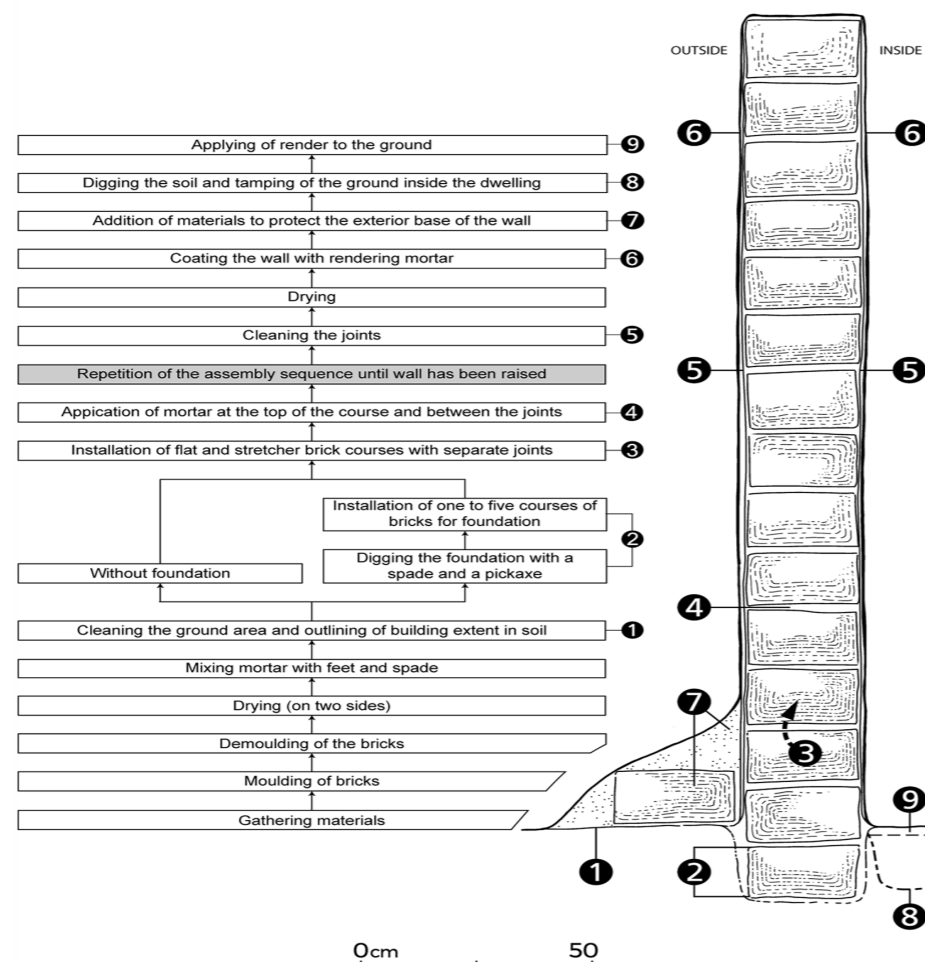
It is possible to make the bricks at the mining site, once the earth has been mixed and left to settle. In this case, a wooden mould is placed on the ground and filled manually with the construction earth. The earth is packed by hand, then levelled off and immediately turned out of the mould by drawing it upwards. These bricks are then allowed to dry on their bed, then on their stretcher faces for approximately 15 days, before being taken back to the compound. On the day of construction or the day before, a pit is dug within or outside the compound in which earth and water are mixed to make an earthen mortar (Figure 4). The ground surface intended for construction is then swept and the wall foundations are outlined in the soil with a rope attached to a branch. Brick structures are for the most part built on foundations. These are simple and allow the wall to be well anchored in the soil. They are dug with shovel and pickaxe, and laid as one to five courses of bricks sealed with an earthen mortar.

Building a brick wall

The raising of the wall is quick and can be completed in several hours. Community members lay the bricks on a bed, leaving very loose joints (2 to 5 cm) between each brick. The space between the bricks is filled with mortar, then a thick bed of mortar is spread on the surfaces of the bricks in order to prepare them for a second course. This operation is repeated until the wall is built. Any mortar squeezed out from the bed is used to fill in badly sealed joints. The builders then leave the wall to dry for several days.

A wall primer may be made either of clayey earth, termite earth, or organic earth, but these are never mixed. *Cissus populnea* sap and/or cow dung is almost always added. Following this primary coating, a second decorative and protective coat may also be applied. This is typically made of natural white earth or earth whitened with ash. The exterior wall base is generally buttressed with bricks or stones, or by packing in a bevelled earthen reinforcement.

The interior ground surface, whether it be natural soil or coated with a render of termite earth, is packed down with a plank of wood. This packed surface is then given a protective coating of white, black, or clayey earth, in all cases mixed with cow dung and also occasionally with *Cissus populnea* sap. Today, the ground surface is more and more frequently coated with cement.



3. Wattle-and-daub construction

This method consists of protecting a wooden scaffold with a mixture of clayey earth and various other materials, primarily plant fibres. In contrast to the cob and brick methods, here the earth is not load bearing, it is used only for its insulating qualities (Dewulf, 2015).

In eastern Senegal, wattled walls are constructed solely of 'humid' bamboo, which has been freshly cut not far from the village.

As with the other construction techniques, the ground is cleaned and the outline of the building is drawn in the soil. Bamboo construction requires a deep base in the form of a series of narrow postholes 30 to 60 cm deep, dug with a pickaxe. In each posthole, two bamboo stalks are positioned vertically before the hole is filled. Once the circumference is completed with vertical poles, the bamboo stalks are woven horizontally, forming the wattling. At this stage, the door is cut with a machete.

In this region, the wattling is often filled in with rubble. In a pit near the construction area, this temper is prepared by mixing clayey earth with termite earth and, almost always, with the addition of straw and occasionally cow dung and water. This mixture is sometimes left to soak for several days. When the material is ready, the builders take the clumps of mud in their hands and throw them against the wattling until it is completely covered. Then they flatten and scrape the surface with the palms of their hands.

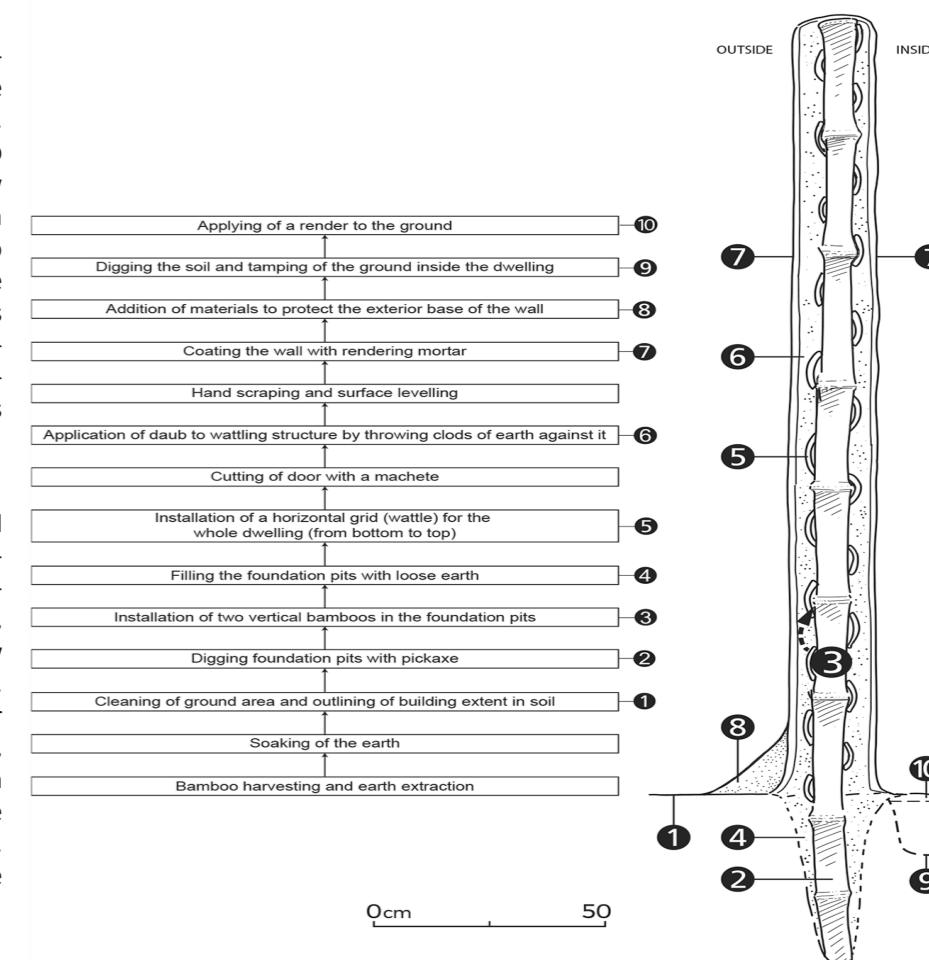
Following this, the wall is rendered with back, clayey, or termite earth. Cow dung is sometimes added to the mixture, as well as *Cissus populnea* sap. This surface may be further protected with a new layer of ashy or white earth. Finally, the exterior wall base is buttressed by bricks or packed earth. The interior ground surface is prepared similarly to that of the brick dwellings previously described.

Roof construction techniques followed in Senegal.

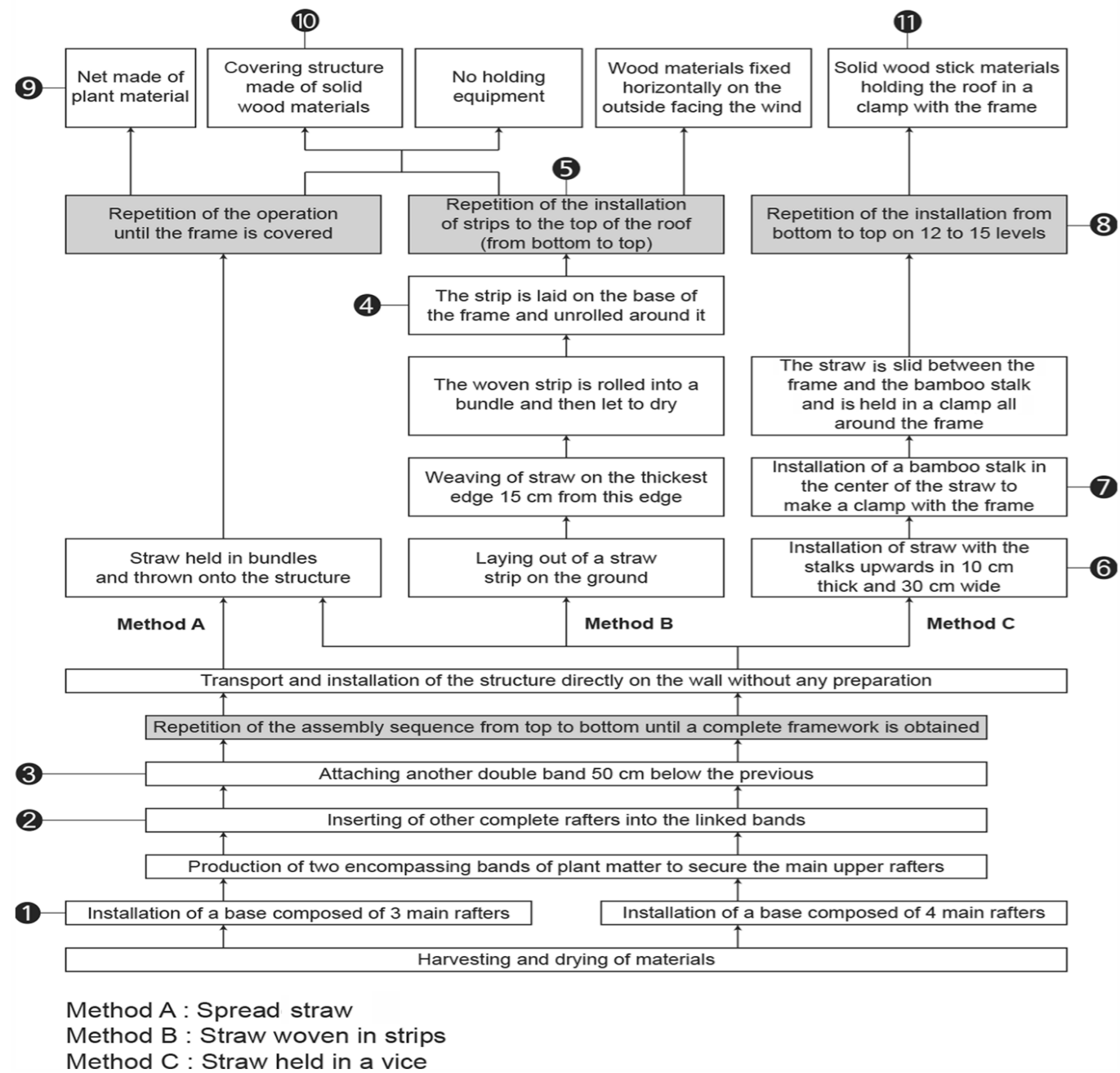
The roofs are of common rafter construction, covered with plant fibres (Figures 6 and 7). The roofs are simply placed on the walls, without any special preparation. The roof frames are commonly made of 'dry' bamboo. If this is not available, the builders gather straight, non-ramified wood of various species (*Anogeissus leiocarpus*, *Bombax costatum*, *Borassus flabellifer*, *Erythrophleum guineense*, *Mitragyna inermis*, *Pterocarpus erinaceus*, *Strophantus hispidus*, etc.). The assembly takes place on the ground, beginning with the laying out of three or four bamboo stalks, which serve as rafters, lashed together at the top with a double-ring of braided plant fibres.

Once this base is fortified, additional bamboo stalks are slid into place. Next, a second ring is fixed 50 cm below the previous one. This procedure is repeated until the roof frame is complete. Once finished, it is installed on top of the dry building walls. With regard to the covering, there are three principal methods. The first consists of throwing bundles of straw on the frame, before spreading them evenly across the entire structure from the bottom to the top. Once the entire frame is covered, the straw is fixed in place by a cord made of plant matter and simple bamboo scaffold. The life expectancy for such a covering is one to five years. This method occasionally replaces straw with palm leaves.

Building a wattle-and-daub wall

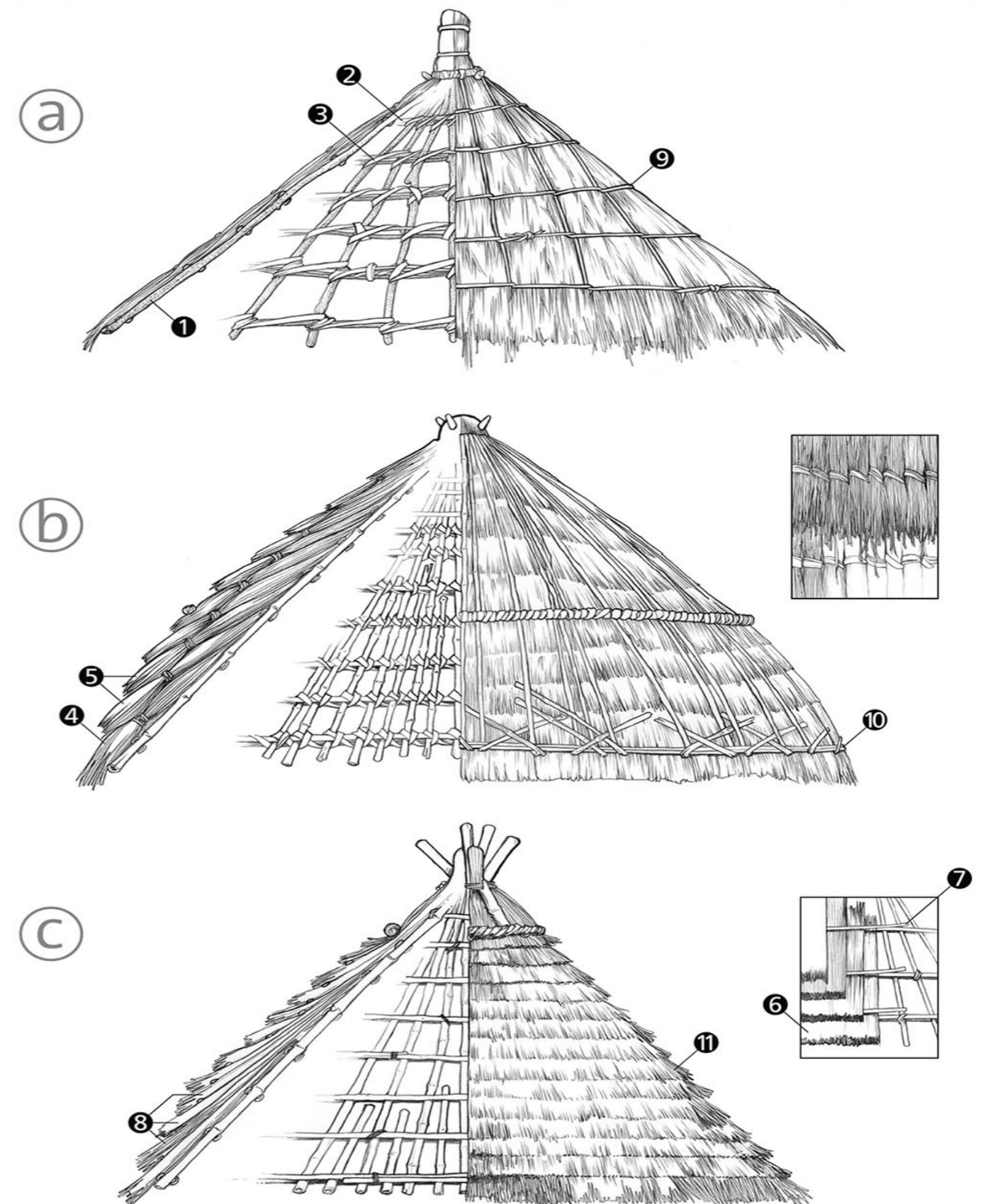


Building a roof framework and covering



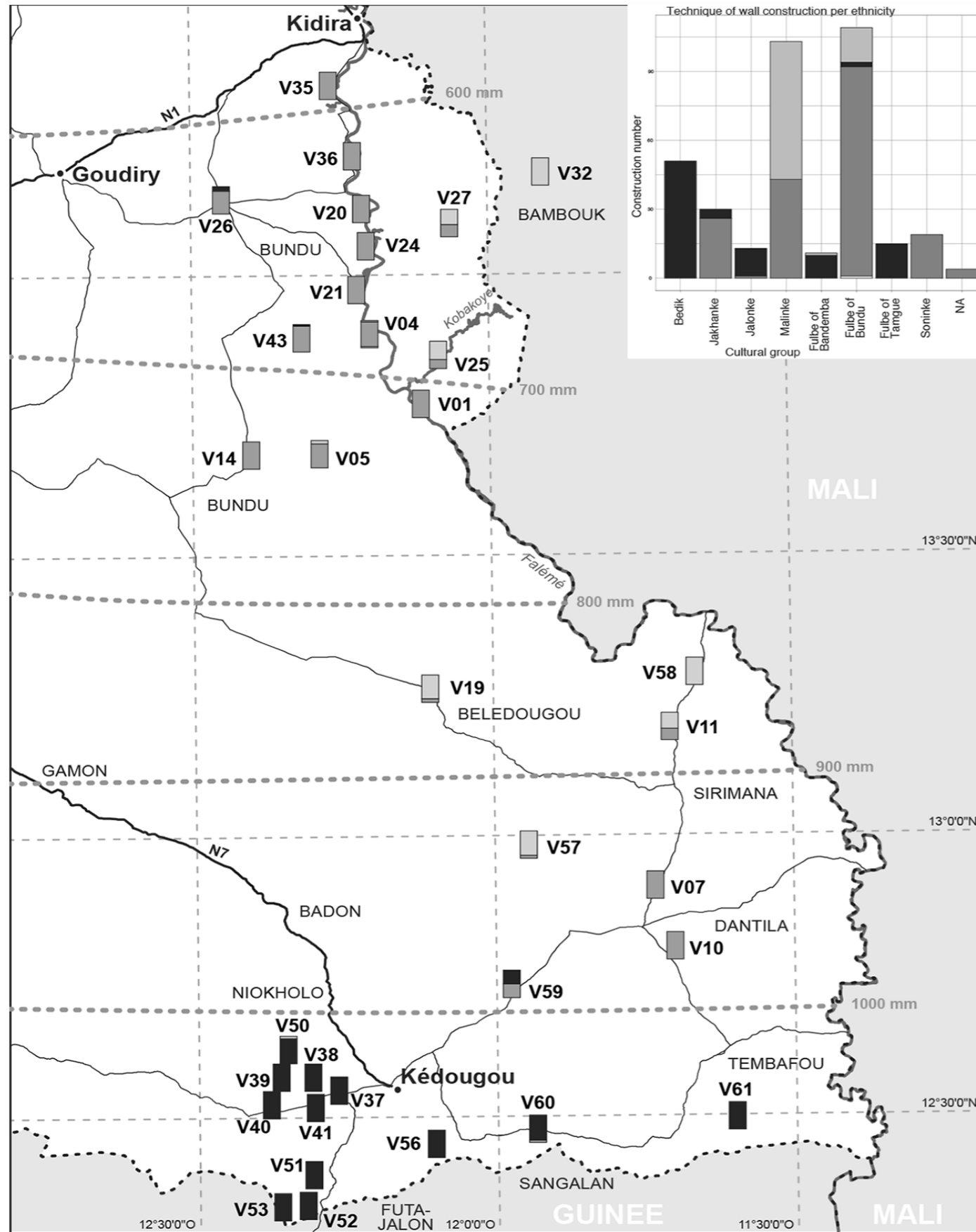
The second method (method B) takes longer to build, but is more solid. Straw is laid out on the floor in a long strip two to four cm thick. Plant fibres (or wire) are woven around the most solid part of the grasses. The strip is then rolled up and allowed to dry, before being unrolled on the base of the roof frame. Subsequent strips are laid from the bottom to the top of the frame, with each new one covering two thirds of the strip below. Once the frame is covered, the covering may be left as such, or can be fixed in place by one or two bamboo stalks attached to the top in order to prevent the wind blowing it away. In method A, it is also possible to make a cord net for this same purpose. The covering has a life expectancy of some 3 to 8 years.

The third method (method C) is the most solid. A sheaf of durable straw, 10 cm thick, is packed together and placed, grain facing upwards, on the lower part of the roof frame. Next, a stalk of bamboo, cut lengthways, is placed in order to clamp the straw between itself and a ring of the roof frame below. Then, the additional straw is slid under the stalk all around the roof. A second layer may then be placed on the first, covering at least two thirds of the latter. The builders repeat this operation until they have 12 to 15 layers. The life expectancy of this type of covering varies between 7 and 20 years, depending on the quality of the straw and the thickness of the installation.



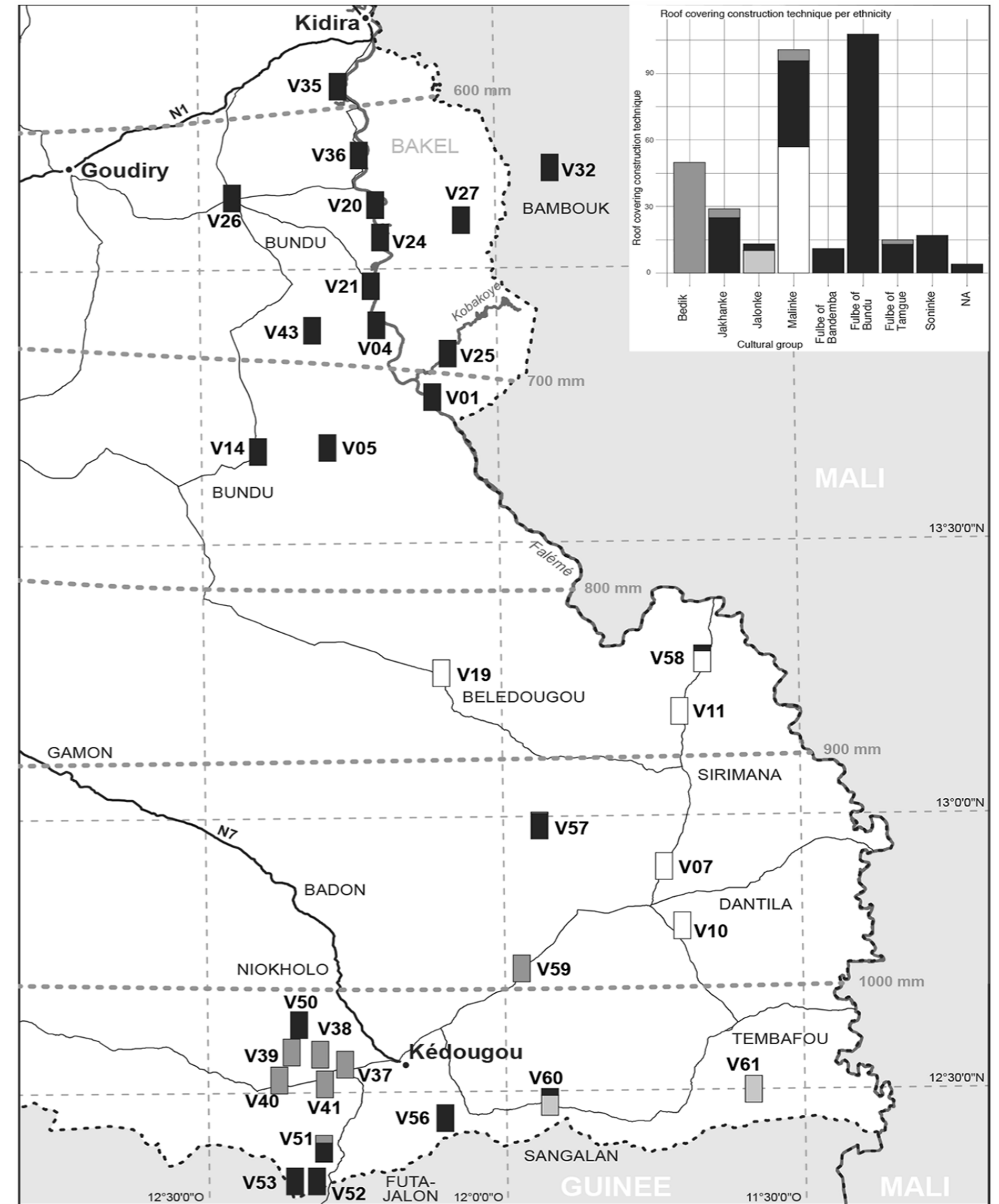
Drawing of the three roof-covering construction methods: (a) straw spread on the roof, covered by a net of plant fibre; (b) straw woven in strips covered by a solid wood frame; (c) straw held in a clamp. The numbers in black circles refer to the elements and steps of the 'chaîne opératoire' described in Figure. © T. Pelmoine & D. Glauser.

Spatial distribution of the techniques



Wall construction techniques

- Cob
- Wattle and daub
- Pluviometry
- Brick
- Straw
- DANTILA Kingdom



Roof covering construction techniques

- Straw spread (A)
- Straw held in a clamp and woven in strips in same roof (B+C)
- DANTILA Kingdom
- Straw held in a clamp (C)
- Straw woven in strips (B)
- Pluviometry

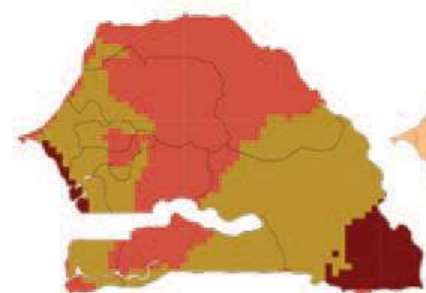
INFORMAL IS THE NEW FORMAL

2.3. CLIMATE ANALYSIS :

Dakar has an ocean-influenced hot semi-arid climate generally warm with a short rainy season and a lengthy dry season. Dakar receives precipitation below potential evapotranspiration, but not as low as a desert climate There are different kinds of semi-arid climates, depending on variables such as temperature, and they give rise to different biomes.

Hot semi-arid climates tend to be in the 20s and 30s latitudes of the tropics and subtropics, typically in proximity to regions with a tropical savanna or a humid subtropical climate. These climates tend to have hot, sometimes extremely hot summers and warm to cool winters, with some to minimal precipitation. Hot semi-arid climates are mostly found around the fringes of subtropical deserts.

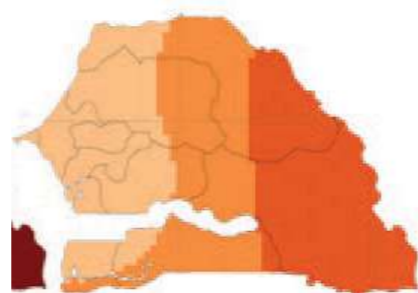
Dakar's rainy season lasts from July to October while the dry season covers the remaining eight months. The city sees approximately 495 mm (19.5 in) of precipitation per year.



EXPLANATION

Change in rainfall, in millimeters

- Less than -150
- Less than -10
- Less than -50



EXPLANATION

Change in temperature, in degrees Celsius

- Less than 0.75
- Less than 1.0
- Less than 1.25

Figure: Change in Rainfall and Change in Temperature of Senegal

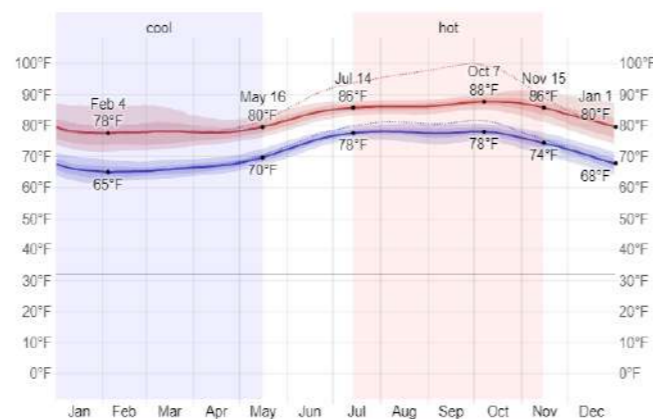
Since 1975, temperatures have increased by almost 0.9° Celsius (°C) across much of Dakar. This transition to an even warmer climate could reduce crop harvests and pasture availability, amplifying the impact of droughts. Dakar is becoming substantially hotter. It is estimated that the 1975 to 2009 warming has been more than 0.7°C for Dakar during the June–September rainy season. Given that the standard deviation of annual air temperatures in these regions is low (0.4°C), these increases represent a very large (+1.2 standard deviations) change from the climatic norm. Such warming, in regions with very high average air temperatures, can amplify the impact of water shortages.

Average Temperature in Dakar

Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	78°F	78°F	78°F	78°F	80°F	84°F	86°F	86°F	87°F	88°F	85°F	81°F
Temp.	71°F	70°F	71°F	71°F	74°F	79°F	81°F	82°F	82°F	82°F	79°F	75°F
Low	66°F	65°F	66°F	67°F	70°F	75°F	78°F	78°F	78°F	77°F	74°F	70°F

The hot season lasts for 4.0 months, from July 14 to November 15, with an average daily high temperature above 86°F. The hottest month of the year in Dakar is October, with an average high of 88°F and low of 77°F.

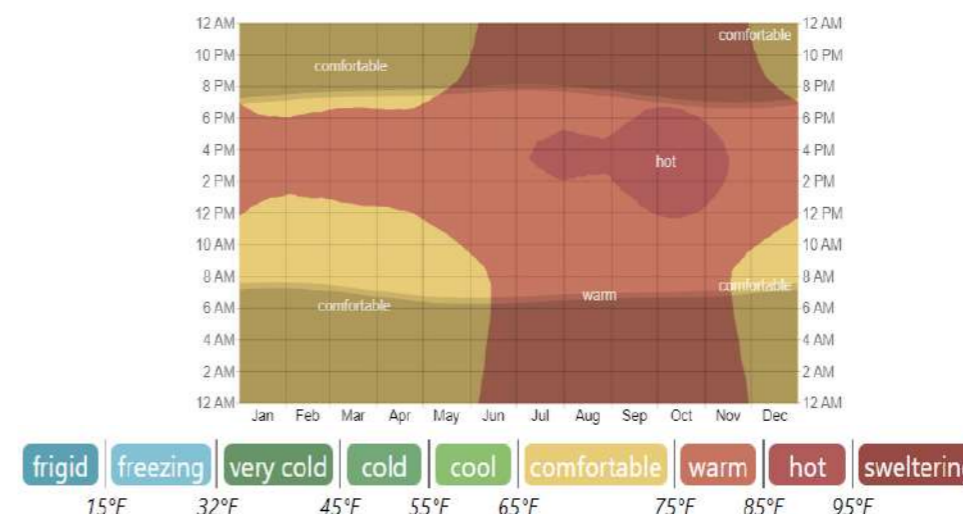
The cool season lasts for 4.5 months, from January 1 to May 16, with an average daily high temperature below 80°F. The coldest month of the year in Dakar is February, with an average low of 65°F and high of 78°F.



The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures.

Average Hourly Temperature in Dakar

The figure shows you a compact characterization of the entire year of hourly average temperatures. The horizontal axis is the day of the year, the vertical axis is the hour of the day, and the color is the average temperature for that hour and day.



The average hourly temperature, color coded into bands. The shaded overlays indicate night and civil twilight.

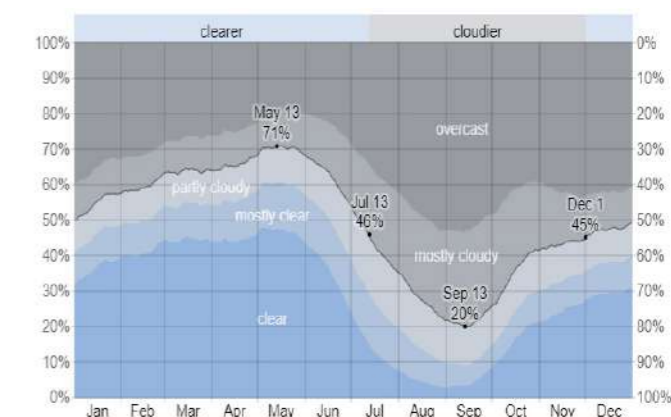
Cloud Cover Categories in Dakar

Fraction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cloudier	45%	40%	36%	34%	30%	38%	57%	73%	78%	64%	57%	52%
Clearer	55%	60%	64%	66%	70%	62%	43%	27%	22%	36%	43%	48%

In Dakar, the average percentage of the sky covered by clouds experiences extreme seasonal variation over the course of the year.

The clearer part of the year in Dakar begins around December 1 and lasts for 7.4 months, ending around July 13.

The clearest month of the year in Dakar is May, during which on average the sky is clear, mostly clear, or partly cloudy 70% of the time. The cloudier part of the year begins around July 13 and lasts for 4.6 months, ending around December 1. The cloudiest month of the year in Dakar is September, during which on average the sky is overcast or mostly cloudy 78% of the time.



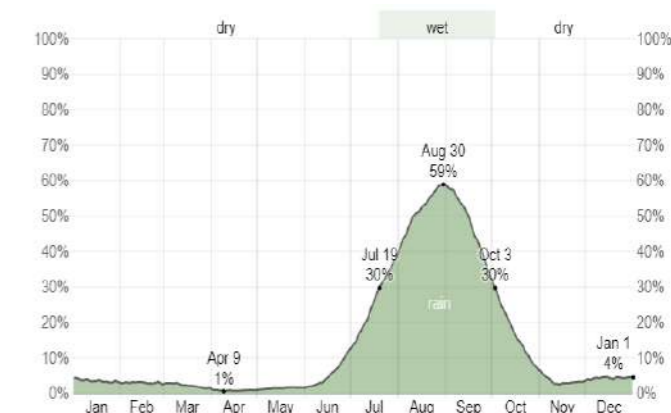
The percentage of time spent in each cloud cover band, categorized by the percentage of the sky covered by clouds.

Daily Chance of Precipitation in Dakar

A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Dakar varies very significantly throughout the year.

The wetter season lasts 2.5 months, from July 19 to October 3, with a greater than 30% chance of a given day being a wet day. The month with the most wet days in Dakar is August, with an average of 16.2 days with at least 0.04 inches of precipitation. The drier season lasts 9.5 months, from October 3 to July 19. The month with the fewest wet days in Dakar is April, with an average of 0.2 days with at least 0.04 inches of precipitation.

Among wet days, we distinguish between those that experience rain alone, snow alone, or a mixture of the two. The month with the most days of rain alone in Dakar is August, with an average of 16.2 days. Based on this categorization, the most common form of precipitation throughout the year is rain alone, with a peak probability of 59% on August 30.



The percentage of days in which various types of precipitation are observed, excluding trace quantities: rain alone, snow alone, and mixed (both rain and snow fell in the same day).

Days of	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain	1.1d	0.8d	0.7d	0.2d	0.5d	1.7d	8.3d	16.2d	14.1d	5.2d	1.0d	1.3d

INFORMAL IS THE NEW FORMAL

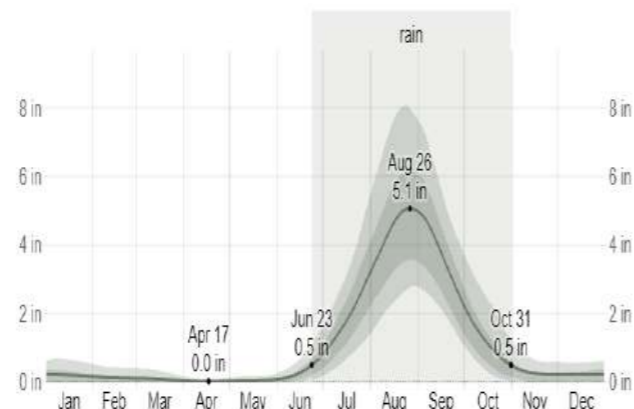
Average Monthly Rainfall in Dakar

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	0.2"	0.1"	0.1"	0.0"	0.0"	0.3"	1.8"	4.7"	3.8"	1.1"	0.3"	0.2"

To show variation within the months and not just the monthly totals, we show the rainfall accumulated over a sliding 31-day period centered around each day of the year. Dakar experiences extreme seasonal variation in monthly rainfall.

The rainy period of the year lasts for 4.2 months, from June 23 to October 31, with a sliding 31-day rainfall of at least 0.5 inches. The month with the most rain in Dakar is August, with an average rainfall of 4.7 inches.

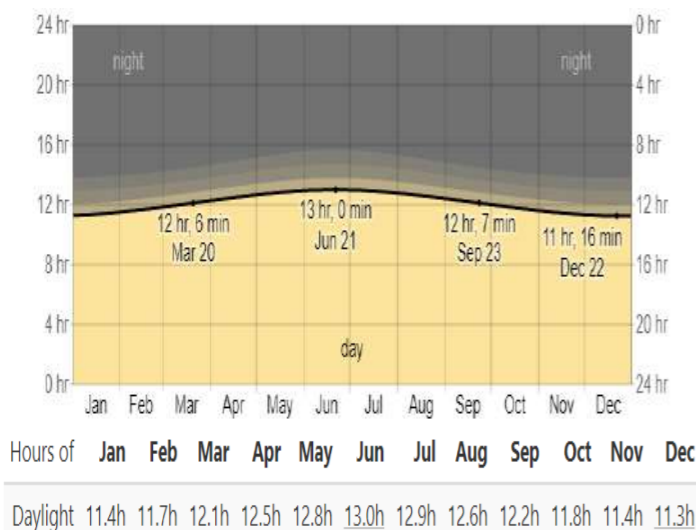
The rainless period of the year lasts for 7.8 months, from October 31 to June 23. The month with the least rain in Dakar is April, with an average rainfall of 0.0 inches.



The average rainfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25th to 75th and 10th to 90th percentile bands. The thin dotted line is the corresponding average snowfall

Hours of Daylight and Twilight in Dakar

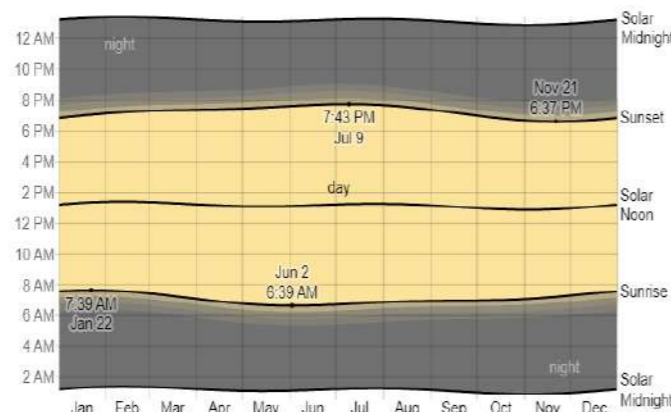
The length of the day in Dakar varies over the course of the year. In 2023, the shortest day is December 22, with 11 hours, 16 minutes of daylight; the longest day is June 21, with 13 hours, 0 minutes of daylight.



The number of hours during which the Sun is visible (black line). From bottom (most yellow) to top (most gray), the color bands indicate: full daylight, twilight (civil, nautical, and astronomical), and full night.

Sunrise & Sunset with Twilight in Dakar

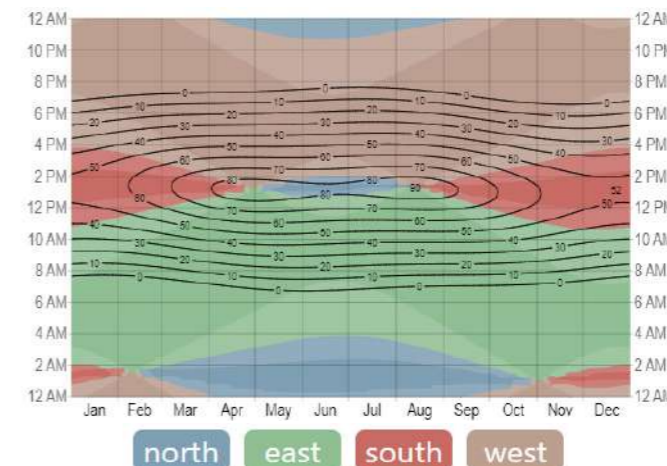
The earliest sunrise is at 6:39 AM on June 2, and the latest sunrise is 1 hour, 0 minutes later at 7:39 AM on January 22. The earliest sunset is at 6:37 PM on November 21, and the latest sunset is 1 hour, 6 minutes later at 7:43 PM on July 9. Daylight saving time (DST) is not observed in Dakar during 2023.



The solar day over the course of the year 2023. From bottom to top, the black lines are the previous solar midnight, sunrise, solar noon, sunset, and the next solar midnight. The day, twilights (civil, nautical, and astronomical), and night are indicated by the color bands from yellow to gray.

Solar Elevation and Azimuth in Dakar

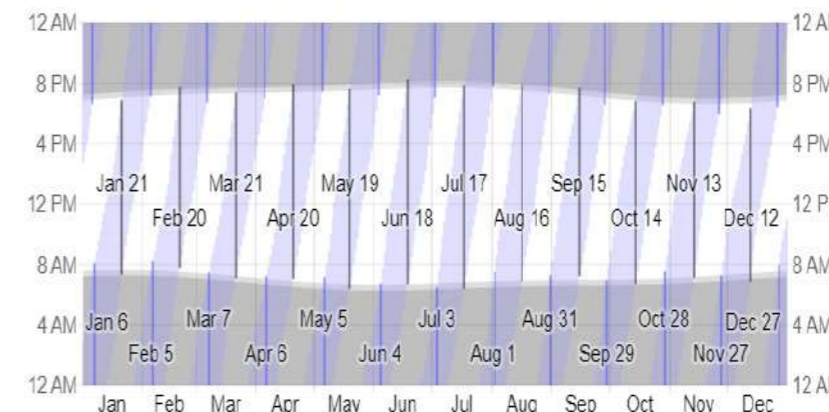
The figure presents a compact representation of the sun's elevation (the angle of the sun above the horizon) and azimuth (its compass bearing) for every hour of every day in the reporting period. The horizontal axis is the day of the year and the vertical axis is the hour of the day. For a given day and hour of that day, the background color indicates the azimuth of the sun at that moment. The black isolines are contours of constant solar elevation.



Solar elevation and azimuth over the course of the year 2023. The black lines are lines of constant solar elevation (the angle of the sun above the horizon, in degrees). The background color fills indicate the azimuth (the compass bearing) of the sun. The lightly tinted areas at the boundaries of the cardinal compass points indicate the implied intermediate directions (northeast, southeast, southwest, and northwest).

Moon Rise, Set & Phases in Dakar

The figure below presents a compact representation of key lunar data for 2023. The horizontal axis is the day, the vertical axis is the hour of the day, and the colored areas indicate when the moon is above the horizon. The vertical gray bars (new Moons) and blue bars (full Moons) indicate key Moon phases.



The time in which the moon is above the horizon (light blue area), with new moons (dark gray lines) and full moons (blue lines) indicated. The shaded overlays indicate night and civil twilight.

Humidity Comfort Levels in Dakar

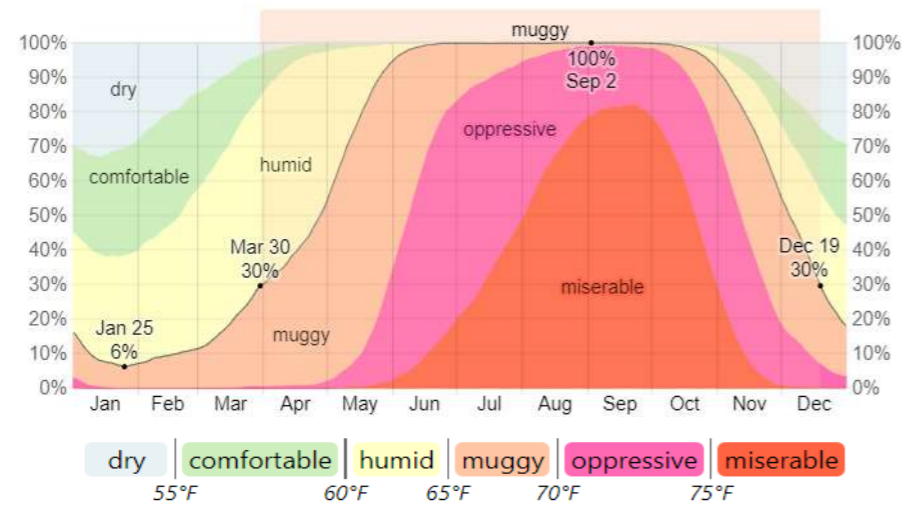
We base the humidity comfort level on the dew point, as it determines whether perspiration will evaporate from the skin, thereby cooling the body. Lower dew points feel drier and higher dew points feel more humid. Unlike temperature, which typically varies significantly between night and day, dew point tends to change more slowly, so while the temperature may drop at night, a muggy day is typically followed by a muggy night.

Dakar experiences extreme seasonal variation in the perceived humidity.

The muggier period of the year lasts for 8.6 months, from March 30 to December 19, during which time the comfort level is muggy, oppressive, or miserable at least 30% of the time. The month with the most muggy days in Dakar is August, with 31.0 days that are muggy or worse.

The month with the fewest muggy days in Dakar is February, with 2.6 days that are muggy or worse

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Muggy days	2.7d	2.6d	6.2d	12.2d	24.4d	29.6d	31.0d	31.0d	30.0d	30.2d	22.4d	10.4d

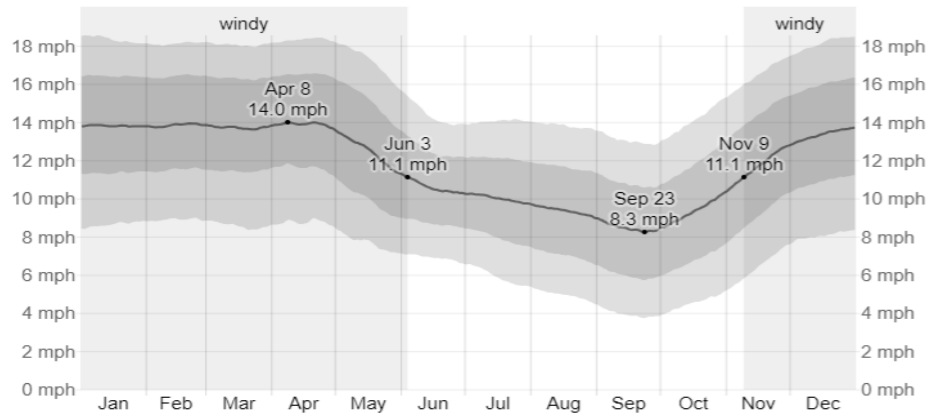


The percentage of time spent at various humidity comfort levels, categorized by dew point.

Average Wind Speed in Dakar

This section discusses the wide-area hourly average wind vector (speed and direction) at 10 meters above the ground. The wind experienced at any given location is highly dependent on local topography and other factors, and instantaneous wind speed and direction vary more widely than hourly averages.

The average hourly wind speed in Dakar experiences significant seasonal variation over the course of the year. The windier part of the year lasts for 6.8 months, from November 9 to June 3, with average wind speeds of more than 11.1 miles per hour. The windiest month of the year in Dakar is April, with an average hourly wind speed of 13.9 miles per hour. The calmer time of year lasts for 5.2 months, from June 3 to November 9. The calmest month of the year in Dakar is September, with an average hourly wind speed of 8.5 miles per hour.

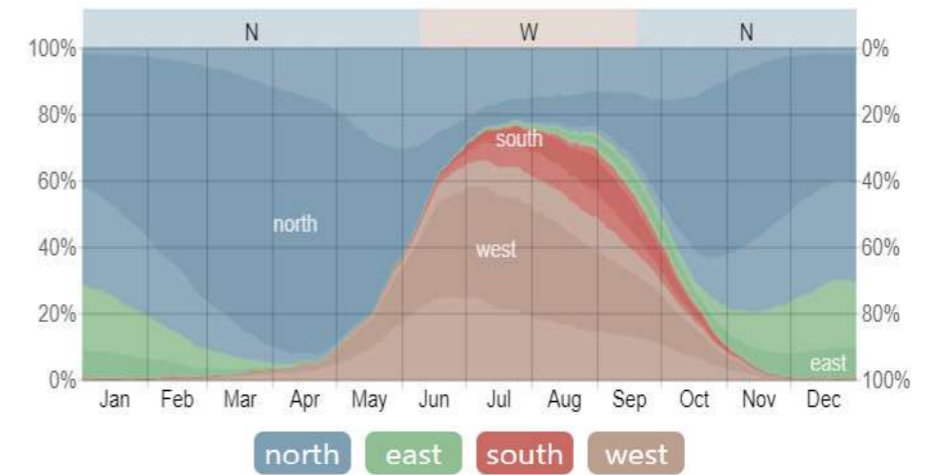


The average of mean hourly wind speeds (dark gray line), with 25th to 75th and 10th to 90th percentile bands.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind Speed (mph)	13.8	13.9	13.7	13.9	12.4	10.6	10.0	9.4	8.5	9.4	11.8	13.4

Wind Direction in Dakar

The predominant average hourly wind direction in Dakar varies throughout the year. The wind is most often from the west for 3.3 months, from June 9 to September 19, with a peak percentage of 67% on July 8. The wind is most often from the north for 8.7 months, from September 19 to June 9, with a peak percentage of 71% on January 1

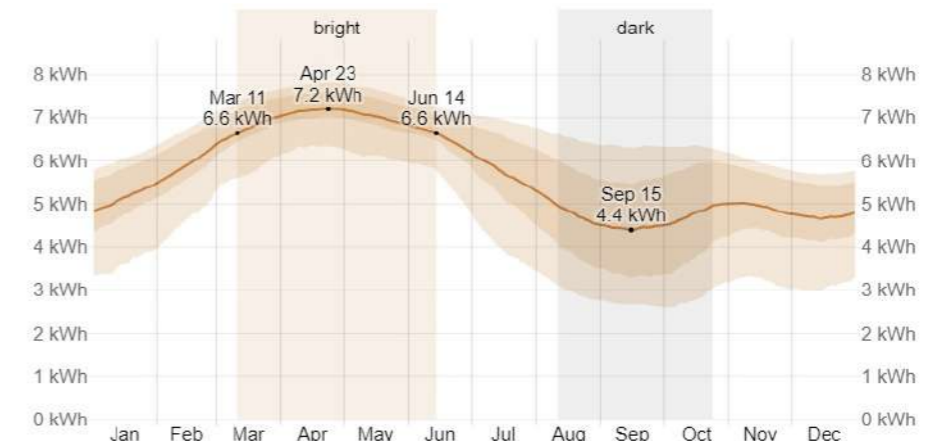


The percentage of hours in which the mean wind direction is from each of the four cardinal wind directions, excluding hours in which the mean wind speed is less than 1.0 mph. The lightly tinted areas at the boundaries are the percentage of hours spent in the implied intermediate directions (northeast, southeast, southwest, and northwest).

Average Daily Incident Shortwave Solar Energy in Dakar

This section discusses the total daily incident shortwave solar energy reaching the surface of the ground over a wide area, taking full account of seasonal variations in the length of the day, the elevation of the Sun above the horizon, and absorption by clouds and other atmospheric constituents. Shortwave radiation includes visible light and ultraviolet radiation.

The average daily incident shortwave solar energy experiences some seasonal variation over the course of the year. The brighter period of the year lasts for 3.1 months, from March 11 to June 14, with an average daily incident shortwave energy per square meter above 6.6 kWh. The brightest month of the year in Dakar is April, with an average of 7.2 kWh. The darker period of the year lasts for 2.4 months, from August 11 to October 24, with an average daily incident shortwave energy per square meter below 5.0 kWh. The darkest month of the year in Dakar is September, with an average of 4.5 kWh.



The average daily shortwave solar energy reaching the ground per square meter (orange line), with 25th to 75th and 10th to 90th percentile bands.

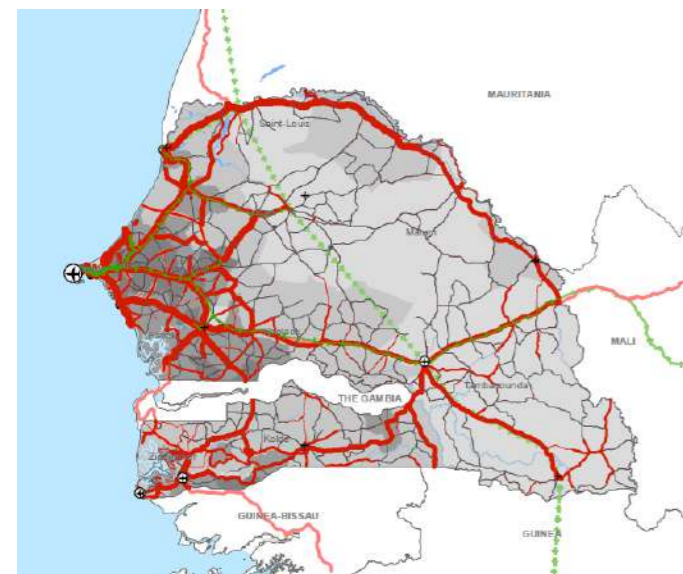
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar Energy (kWh)	5.1	5.9	6.8	7.2	7.0	6.5	5.7	4.8	4.5	4.8	4.9	4.7

2.4 The state of Senegal's infrastructure :

Senegal has had a privileged position compared to its neighbors with regards to transit, trade, external markets, and political stability. With an economy heavily focused on international markets, in particular trade and tourism, Senegal is highly competitive compared to other African countries. The costs of exporting and importing are considerably lower than in other coastal countries in the region, but significant progress is still needed to achieve the average international competitiveness of developing countries in general.

Most of Senegal's population is concentrated in the Dakar area. The remaining part of the country, by contrast, is sparsely populated and characterized by fragmentary infrastructure coverage. Density varies from about 77 inhabitants per square kilometer (inhabitants/km², 199 inhabitants/square miles) in the west-central region to 2 inhabitants/km² (5 inhabitants/square miles) in the eastern section. The rapid pace of urbanization—6 out of 10 people are forecasted to live in urban areas by 2015 (World Bank 2007a)—has made it difficult to balance the provision of infrastructure between urban and rural areas in Senegal. Population growth averaged 2.7 percent annually over the period 2000–08, above the average of other low-income countries (2.3 percent per year).

a. Road infrastructure of Senegal



Road Type & Condition
 Good Fair Poor Unknown
 Paved
 Unpaved

Senegal's main road corridor runs from Dakar to Bamako, bordering Mauritania (figure a). This corridor is one of the three international trade corridors in this subregion and became particularly important after the security situation deteriorated in Côte d'Ivoire, forcing a major shift in transit patterns to other subregional corridors. The modernization of the country's one main port and airport, both at Dakar (figure a), has improved the subregion's access to international markets. The railway line, shared by Senegal and Mali, runs from Dakar to Bamako, mainly through the southern parts of the country.

The deteriorated state of the rail network and equipment, however, has curtailed its capacity to respond to increasing demand. A major power line connects the northern part of the country (figure b), and projects are under way to bring power to the south.

The existing network of 18,063 km of roads is adequate to provide basic regional, national, and international connectivity, linking Dakar to international border crossings and provincial capitals in the interior. This is generally true even if Senegal's road density indicators, both for classified and total network, are lower than African averages for low- and middle-income countries (table 3). This reflects an efficient network design that has given priority to connecting Dakar and other relatively large cities (with a population of 50,000 or more) to major ports as well as provincial capitals and cities (with populations of over 25,000).

b. Power infrastructure of Senegal



POWER
Power Plants | Type and Capacity (MW)
 HYDRO THERMAL OTHER
 <10
 10 - 100
 > 100
Power Lines (KV)
 Medium High

2.5 Dakar - Intervention Area

2.5.1. Dakar

The peninsula was settled as early as the 1400s. It quickly became famous as a booming center of the Atlantic slave trade. The Portuguese, Dutch and English all seized the area in turn until the French made it a jewel in its global empire comparable to Beirut and Hanoi. Today, Dakar is the capital of the West African nation of Senegal, and is facing a new and decidedly modern challenge in its long, colorful and exotic history: rapid urbanization

The capital is the largest city of Senegal and has a population of 1,030,594, whereas the population of the Dakar metropolitan area is estimated at 3.94 million in 2021. Official language is French, several other native languages are spoken, mainly Wolof, and Fula (Fulbe).



Dakar is a primate city, a major city that is the financial, political, and the most populous center of a country. It is the home to a dozen national and regional banks, and to numerous international organizations, NGOs and international research centers. The city is the country's primary administrative center, home to the National Assembly of Senegal and the Presidential Palace, formerly the French colonial government palace, rebuilt as the presidential palace. Dakar has a large Lebanese community (concentrated in the import-export sector) that dates to the 1920s, a community of Moroccan business people, as well as Mauritanian, Cape Verdean, and Guinean communities. The city is home to as many as 20,000 French expatriates. France still maintains an air force base at Yoff and the French fleet is serviced in Dakar's port.

Main attractions in Dakar are the Dakar Grand Mosque (built in 1964), one of the most important religious building in the city. Gorée Island, is the destination for people interested in the Atlantic slave trade. IFAN Museum of West African culture, one of the oldest art museums in West Africa, the African Renaissance Monument, a 49 m (160ft) high bronze statue. Other attractions are cliff top walks, beaches, major markets, and Hann Park, home to Senegal Zoo.

2.5.2. Floods in Senegal

Like many countries in sub-Saharan Africa, Senegal has experienced more and more episodes of flooding in the last decade. Since 1989, the issue of flooding has come up repeatedly, becoming a major concern by 2000. Especially since 2005, the economic and above all social consequences have become clearly evident in the country and specifically in the capital.

Saint-Louis, the old colonial capital, a city of 230,000 and a Unesco world heritage site, is nestled between the mouth of the Senegal river and the Atlantic.

Climate change and an engineering mistake contributed to the deterioration of the Languede Barbarie in Saint-Louis. In 2003, heavy rainfall caused the Senegal river to rise rapidly, putting Saint-Louis at risk of flooding. As a quick fix, local government dug a four-metre-wide breach, or canal, cutting through the Languede Barbarie. The effect has been the opposite of the one intended. Although at first the river level dropped, the breach quickly started to expand. It is now 6km wide and has cut off part of the peninsula, turning it into an island – and flooding Doun Baba Dieye



Like many countries in sub-Saharan Africa, Senegal has experienced more and more episodes of flooding in the last decade. Since 1989, the issue of flooding has come up repeatedly, becoming a major concern by 2000. Especially since 2005, the economic and above all social consequences have become clearly evident in the country and specifically in the capital.

It has also upset the delicate balance of the local ecosystem. The canal brought seawater into the river, increasing its salinity level. This has affected the population of rare bird species and river fish – forcing fishermen to venture into Mauritanian waters, which is dangerous and illegal – as well as wiping out the coconut trees and mangroves that once protected the shores. Local crops, already destabilized by irregular rainy seasons and sand storms, were further damaged.



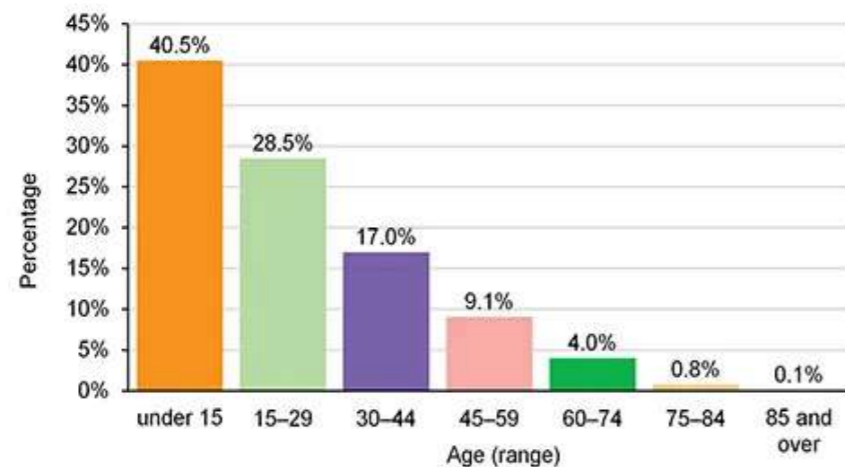
Inhabitants of the Langu de Barbarie have been fishing for centuries

Dakar, the floods are not the result of exceptional rainfall in annual terms, although hourly intensity has increased. The upturn in rainfall has simply revealed the inadequacies of urban planning. The suburbs of Dakar, which absorbed most of the new arrivals who migrated to the city during drought years, also suffered most from the flooding. The social and economic vulnerability of suburban residents was coupled with exposure to flood risk, aggravated by the lack of planning and the occupation of wetlands.

The state and municipalities need to offer help with building techniques appropriate to flood-prone areas. The authorities should set up awareness-raising programmes in partnership with local stakeholders, aimed at discouraging the practice of banking up, which exacerbates flooding in the medium and long term.

2.5.3. Social data of Senegal

Senegal age breakdown (2019)



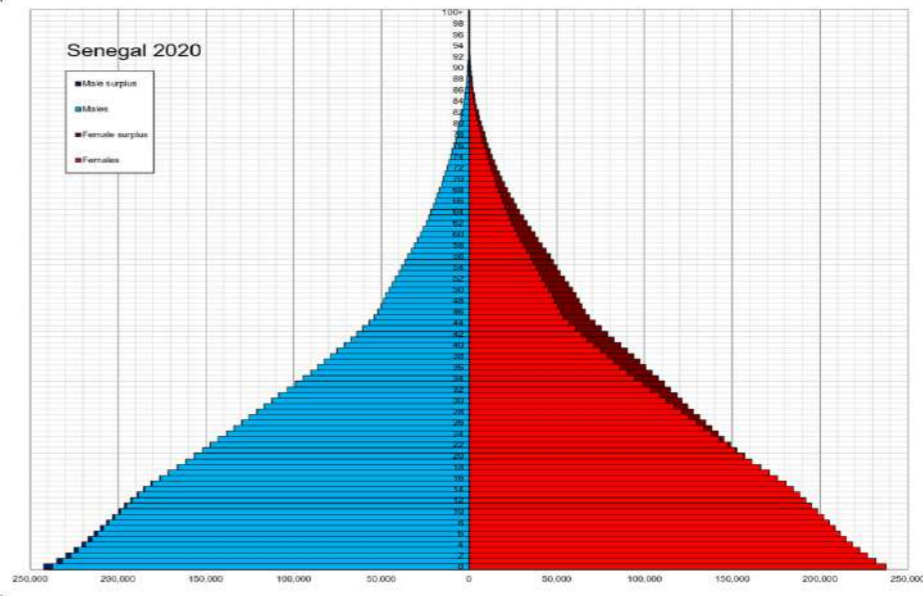
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In 2020, population for Dakar was 3.84 million persons. Population of Dakar increased from 3.23 million persons in 2014 to 3.84 million persons in 2020 growing at an average annual rate of 2.88% and its population density is 4,849 inhab/km². Almost half of Senegal's population live in urban areas; over 76 percent of these areas are classified as unplanned settlements.

The capital of the country, Dakar, occupies only 0.3 percent of the territory of Senegal (2011) yet concentrates 22 percent of the country's population, around 3.8 million people (2020), as well as most public services and economic activity.

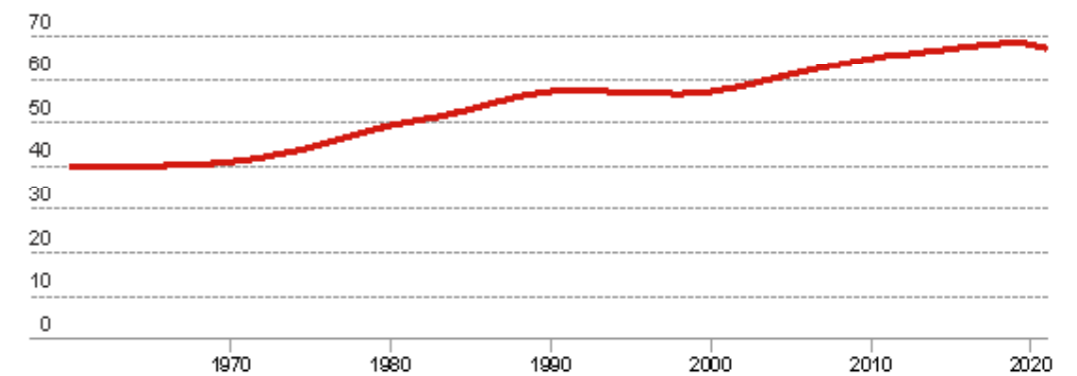
The Wolof comprise about two-fifths of the total population, and their language is the most widely used in the republic. Some 39 languages are spoken in Senegal, including French (the official language) and Arabic. Linguists divide the African languages spoken there into two families: Atlantic (on the western half) and Mande (eastern half).

Senegal is a secular state, although Islam is the predominant religion in the country, practiced by approximately 95.9% of the country's population; the Christian community, at 4.1% of the population, are mostly Catholics but there are also diverse Protestant denominations. One percent has animist beliefs, particularly in the southeastern region of the country. Some Serer people follow the Serer religion.



2.5.5. Health Data

Life expectancy (years) in Senegal



Life expectancy at birth was estimated to be 66.8 years in 2016 (64.7 years male, 68.7 years female). Public expenditure on health was at 2.4 percent of the GDP in 2004, whereas private expenditure was at 3.5 percent.

2.5.5. Economic Growth

Gross domestic product per capita in Senegal

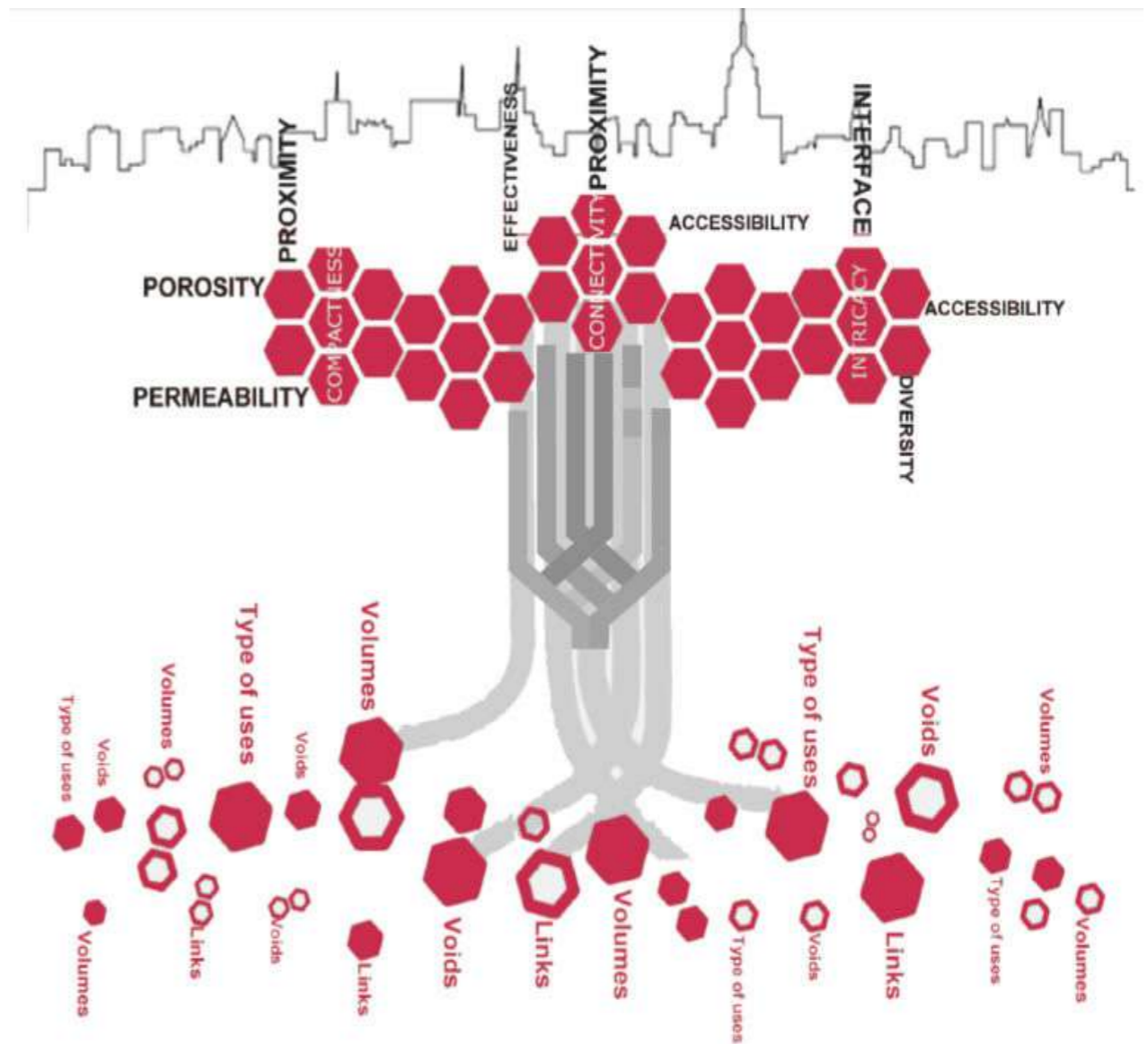


The Senegalese economy has traditionally revolved around a single cash crop, the peanut. The government, however, has worked to diversify both cash crops and subsistence agriculture by expanding into commodities such as cotton, garden produce, and sugarcane as well as by promoting nonagricultural sectors. The government was successful in making fishing, agriculture phosphates, and tourism major sources of foreign exchange at the beginning of the 21st century, although the condition of the transportation and power infrastructure placed limits on the amount of expansion possible. Exploitation of mineral resources such as gold, iron, phosphates, petroleum, and natural gas also diversified the economy.

Since the late 1970s a population explosion, uncontrolled migration to the city, and declining prices for primary materials have depressed the economy. Only substantial foreign aid has prevented a decline in the standard of living. Foreign assistance has also allowed the government to revitalize its deteriorating transportation infrastructure.

Senegal also has one of the best developed tourist industries in Africa. Senegal's economy depends on foreign assistance. It is a member of the World Trade Organization. The main obstacles to the economic development of the country are among others a great corruption with inefficient justice, very slow administrative formalities, a failing education sector. Industrial production in Senegal is more developed than in most Western African countries. Both foodprocessing and handicraft industries are well established. Most of the former is located in the Cape Verde area, where many plants produce peanut oil. Senegal's known mineral deposits consist primarily of phosphates of lime.

3. IMM METHODOLOGY



3.1. IMM Methodology

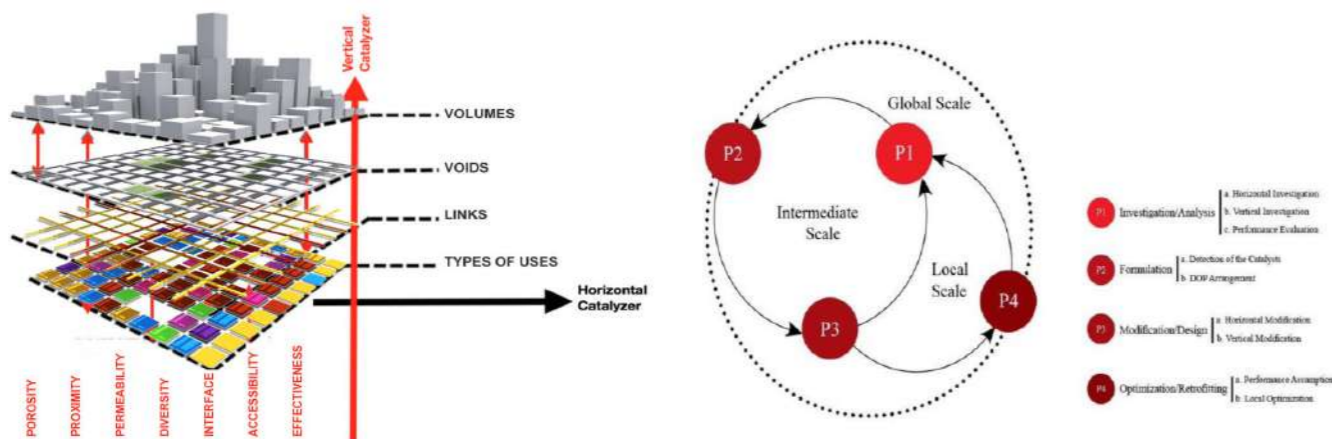
IMM is the acronym of Integrated Modification Methodology, an innovative design methodology, developed by IMMdesignlab, based on a specific process with the main goal of improving the CAS' (complex adaptive systems) energy performance, through the modification of its constituents and the optimization of the architecture of their ligands. Its approach is fundamentally Holistic, Multi-Layer, Multi-scale.

This methodology considers the city as a dynamic CAS comprised of the superimposition of an enormous number of interrelated components, categorized in different Layers or "Subsystems", (Themselves CAS) which through their inner arrangement and the architecture of their ligands provide a certain physical and provisional arrangement of the CAS.

The IMM investigates the relationships between urban morphology and energy consumption by focusing mostly on the 'Subsystems' characterized by physical characters and arrangements. The main object of this design process is to address a more sustainable and better performing urban arrangement, aligned to the UN Sustainable Development Goals 2030.

Accordingly, IMM focuses on the systemic arrangements of the built environment and proposes holistic procedures to transform urban systems into better performing entities, based on the unique qualities that each context offers. According to the system theory, there are four properties common to all types of systems:

- They are composed of elements;
- There is a relationship between elements;
- There is a certain function associated with any system (however, many systems including the built environment are multi-final systems, meaning that numerous functions are associated with them);
- There is a boundary defined for any system Bentivegna et al. 2002.



The general scheme of the methodology's procedure applied in the research project is based on the iterative and nonlinear phasing process of IMM

- Phase I. Investigation: Analysis and synthesis
- Phase II. Assessment and formulation
- Phase III. Intervention and modification
- Phase IV. Optimization

Synergic integration of the components; the first level of integration (FLI) creates the measurable key categories.

IMM aims at providing quantitative measures (metrics) that can pinpoint significant features of the spatial organization of the urban elements in order to characterize the concept of key categories.

The first phase, Investigation, is a synthesis-based inquiry into the systemic structure of the urban form. It begins with Horizontal Investigation in which the area under study is being dismantled into its morphology-generator elements, namely Urban Built-ups, Urban Voids, Types of Uses, and Links. It follows with Vertical Investigation that is a study of integral relationships between the mentioned elements. The output of Vertical Investigation is a set of quantitative descriptions and qualitative illustrations of certain attributes named Key Categories. The Formulation phase is a technical assumption of the most critical Key Category and the urban element within the area deduced from the Investigation phase. These critical attributes are being interpreted as the Catalysts of transformation and are to come to the designer's use to set a contextual priority list of Design Ordering Principals.

1	1.a.	Horizontal Investigation	Dismantling the system to investigation	Investigation/Analysis	Observation & Measurements
	1.b.	Vertical Investigation	The actual value of key categories		
	1.c.	Actual performance of the system based on 135 indicators		Data Collection	
2	2.a.	Detection of the transformation's Catalyst		Assumption and Interpretation/Hypothesis	Formulation
	2.b.	Assumption of the 12 IMM Ordering principles		Assumption	
3	3.a.	Horizontal Modification	The catalyst drives the local transformation; Changing the structure of the layers/Ligands	Modification	Intervention & Design
	3.b.	Vertical Modification	Local transformation acts globally, changing the entire system's configuration		
4	4.a.	Performance of the new CAS based on 135 indicators		Contextual Evaluation	Retrofitting
	4.b.	Local modification/optimization is a process involving again the first level of superimposition for improving locally their performance. Local optimization works using selected tools/features:		Local Design	Optimization
	1. Volumes/Voids = Solar gain; Wind tunnel				
	2. Volume/Function = Level of mixed use;				
	3. Function/Voids = Function distribution				
	4. Transports/Voids = Number of intersection;				
	5. Transports/Function = Service area control;				
	6. Transport/Volume = Catchment area control.				

The IMM methodology described in its four phases

The Formulation phase is a technical assumption of the most critical Key Category and the urban element within the area deduced from the Investigation phase. These critical attributes are being interpreted as the Catalysts of transformation and are to come to the designer's use to set a contextual priority list of Design Ordering Principals.

The third phase is the introduction of the modification/design scenarios to the project and advances with examining them by the exact procedure of the Investigation phase in a repetitive manner until the transformed context is predicted to be acceptable in arrangement and evaluation.

The fourth phase, Retrofitting and Optimization, is a testing process of the outcomes of the modification phase, then a local optimization by technical strategies.



3.2 SDG Report for senegal 2023

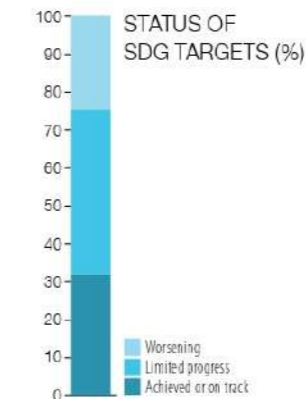
According to IMM approach cities are regarded as complex adaptive systems and the focus is on simulating their operative mechanisms involving both the internal subsystems and the external systems that the cities are part of. The result will be a methodological interpretation of the SDG Number 11 suggesting locally based actions robustly linked with SDG indicators and evaluation methods. Moving from the SDG 11, as the main catalyzer of our action IMM systematically correlates all the other SDGs in a holistic way.



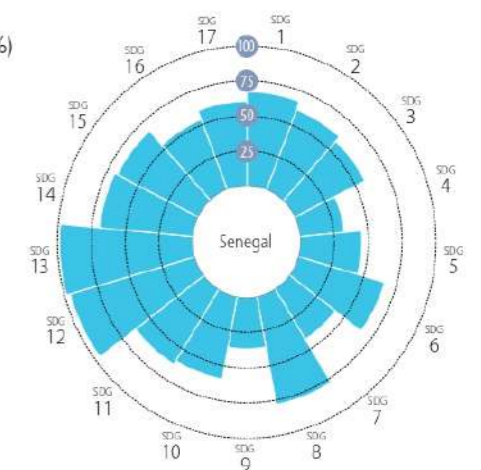
SENEGAL

Sub-Saharan Africa

OVERALL PERFORMANCE



AVERAGE PERFORMANCE BY SDG



SDG DASHBOARDS AND TRENDS



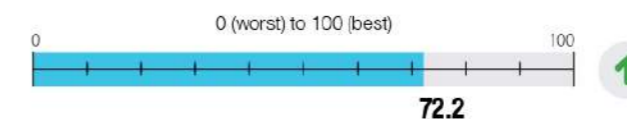
■ Major challenges ■ Significant challenges ■ Challenges remain ■ SDG achieved ■ Information unavailable
↓ Decreasing → Stagnating ↗ Moderately improving ↑ On track or maintaining SDG achievement ● Information unavailable

Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

INTERNATIONAL SPILLOVER INDEX



STATISTICAL PERFORMANCE INDEX



MISSING DATA IN SDG INDEX

1%

1 NO POVERTY

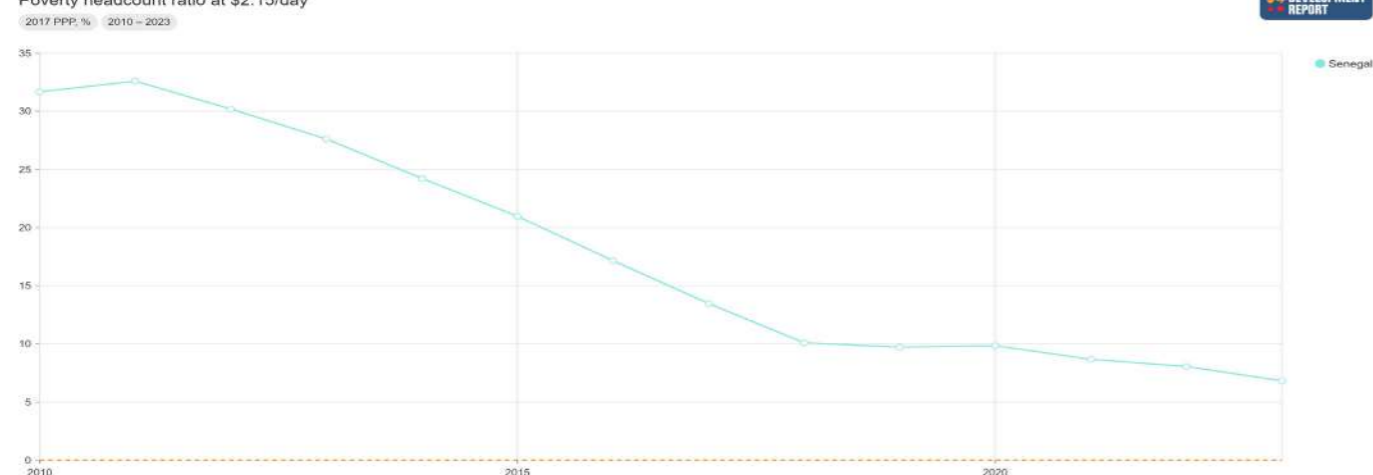
SDG1 – No Poverty

	Value	Year	Rating	Trend
Poverty headcount ratio at \$2.15/day (2017 PPP, %)	6.8	2023	●	↑
Poverty headcount ratio at \$3.65/day (2017 PPP, %)	28.3	2023	●	↔

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

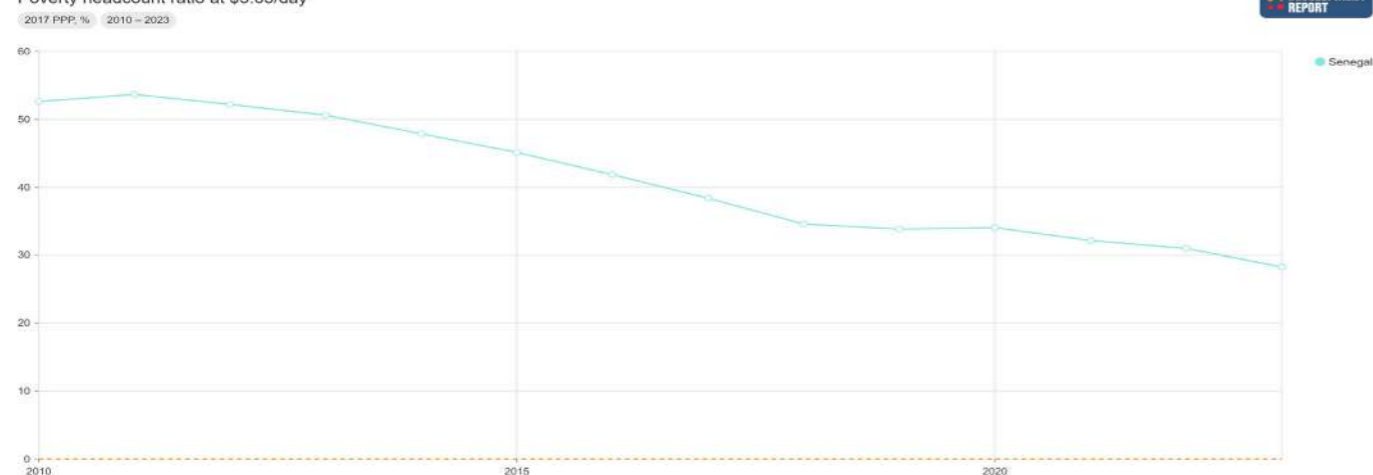
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Poverty headcount ratio at \$2.15/day



Source: World Data Lab

Poverty headcount ratio at \$3.65/day



Source: World Data Lab

Results of implementing SDG 1

- 3% The proportion of mothers with newborns receiving maternity cash benefit was 3.0 % in 2019.
- 32% In 2019, 32.0 % of the country's poor population were receiving social assistance cash benefit.
- The proportion of vulnerable population receiving social assistance cash benefit was 17.0 % in 2019.
- The proportion of employed population covered in the event of work injury was 10.0 % in 2019.
- The proportion of population covered by at least one social protection benefit was 20.0 % in 2019.

2 ZERO HUNGER

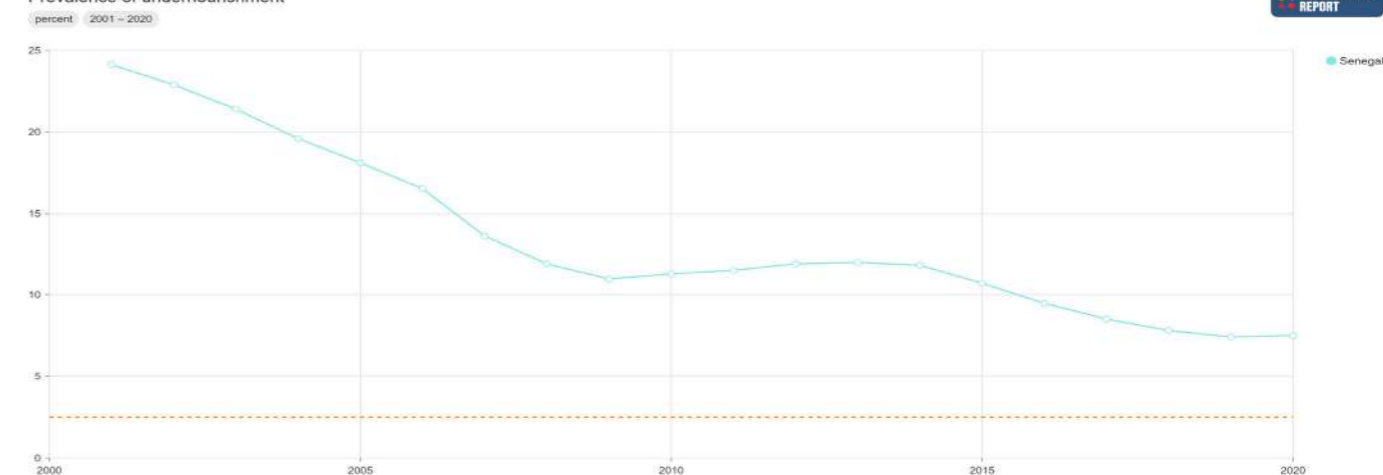
SDG2 – Zero Hunger

	Value	Year	Rating	Trend
Prevalence of undernourishment (%)	7.5	2020	●	↑
Prevalence of stunting in children under 5 years of age (%)	17.0	2022	●	→
Prevalence of wasting in children under 5 years of age (%)	8.1	2019	●	↓
Prevalence of obesity, BMI ≥ 30 (% of adult population)	8.8	2016	●	→
Human Trophic Level (best 2–3 worst)	2.1	2017	●	↑
Cereal yield (tonnes per hectare of harvested land)	1.9	2021	●	↑
Sustainable Nitrogen Management Index (best 0–1.41 worst)	1.1	2018	●	↓
Exports of hazardous pesticides (tonnes per million population)	0.3	2020	●	●

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

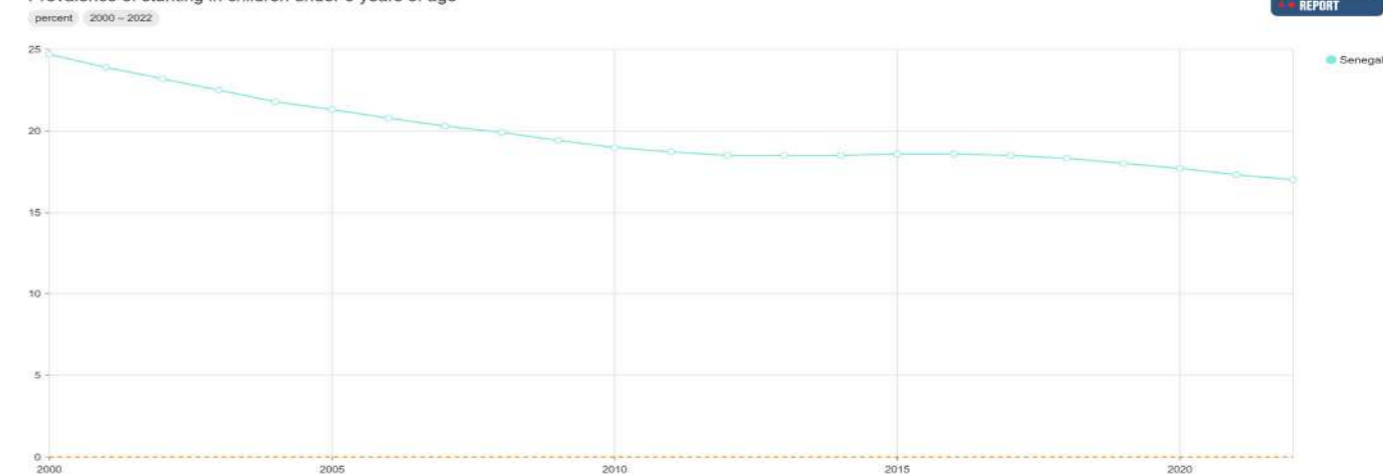
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Prevalence of undernourishment



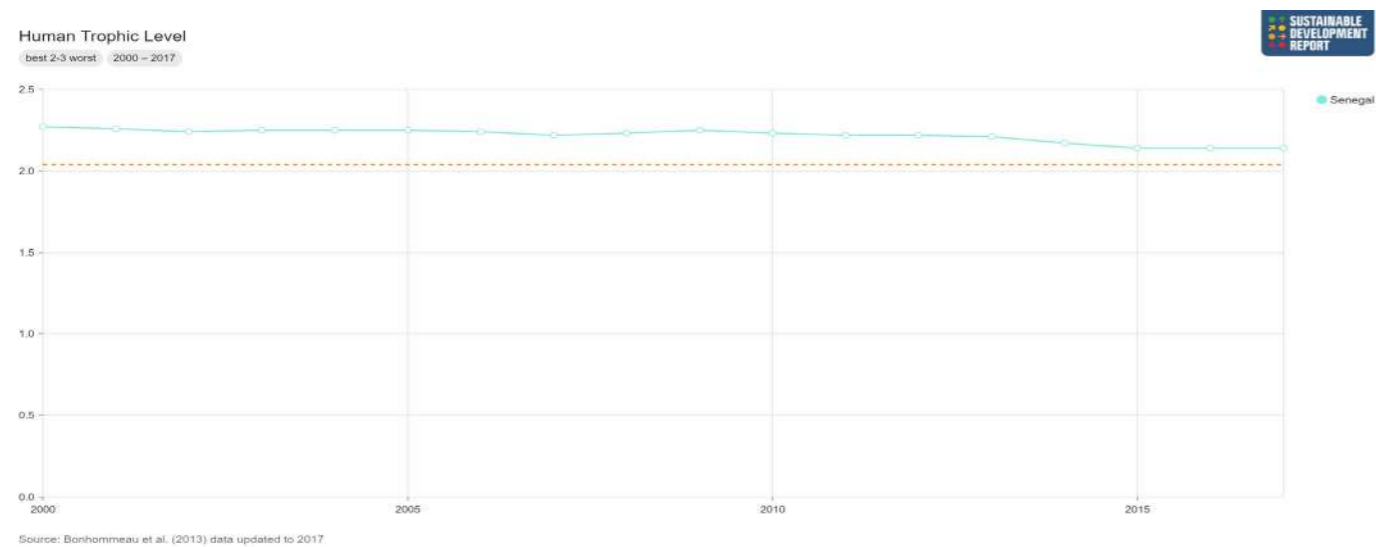
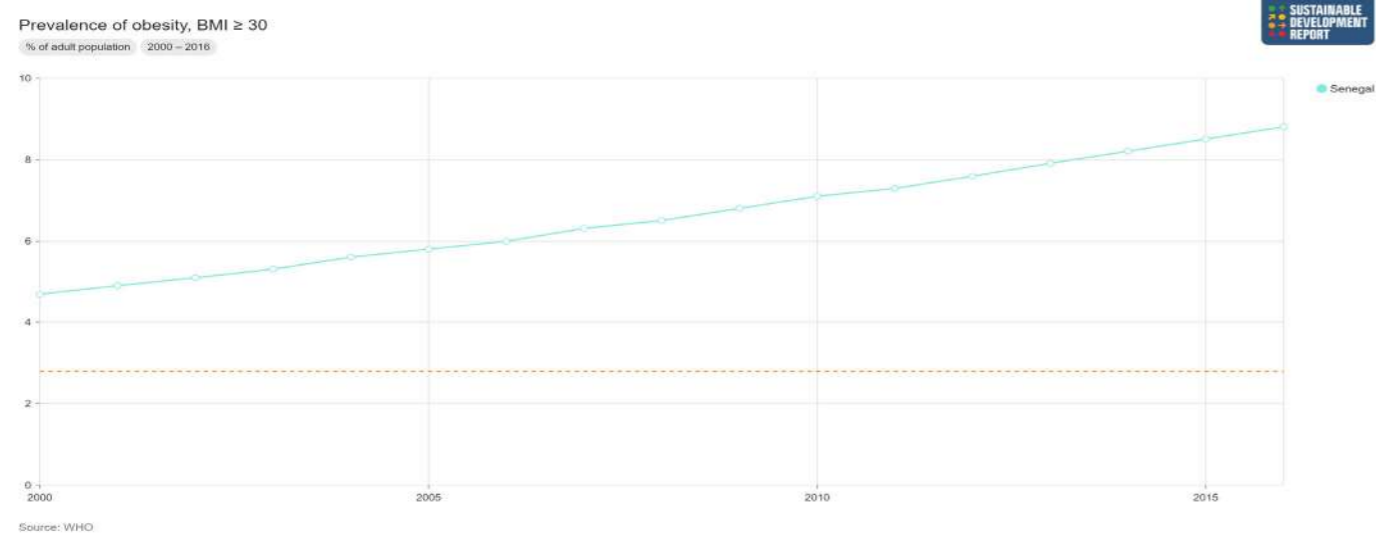
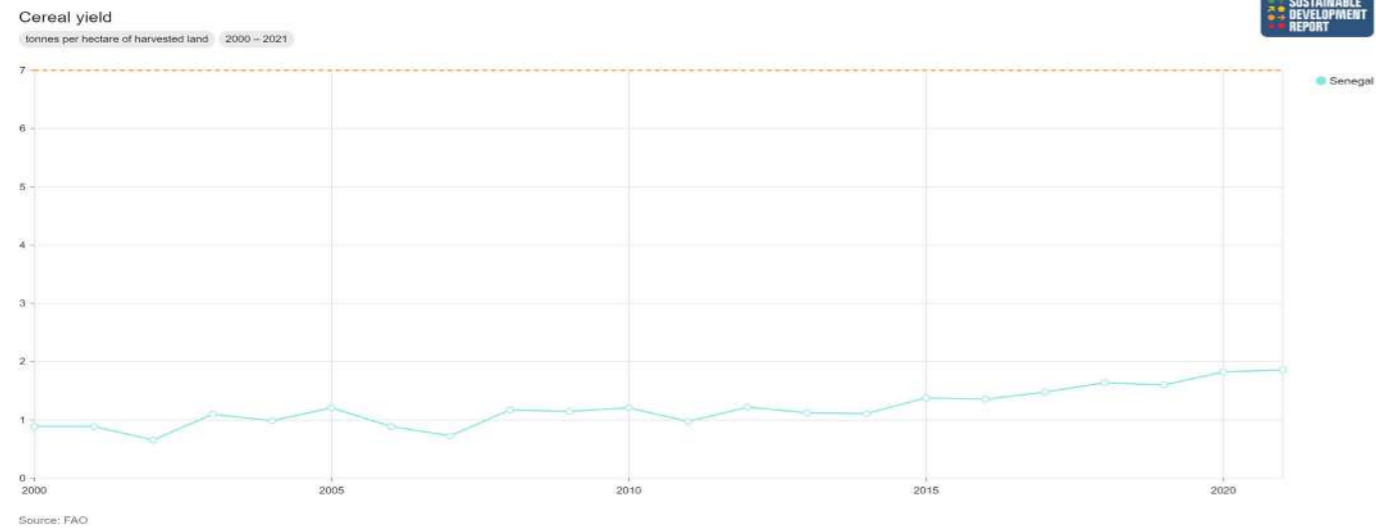
Source: FAO

Prevalence of stunting in children under 5 years of age

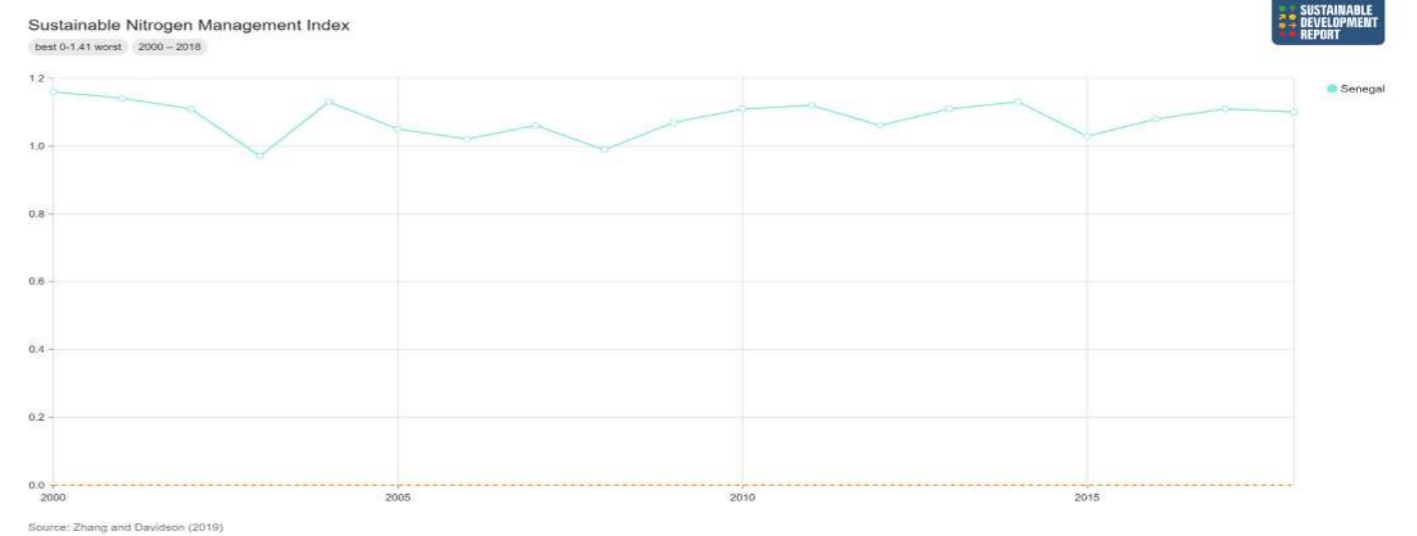


Source: UNICEF et al.

2 ZERO HUNGER



2 ZERO HUNGER



Results of implementing SDG 2

- The indicator of Food Price Anomalies (IFPA) for rice was 0.1 in 2017.
- The Consumer Food Price Index was 0.2 in 2017.
- In 2019, there were 0.0 local breeds with sufficient genetic resources stored for reconstitution.

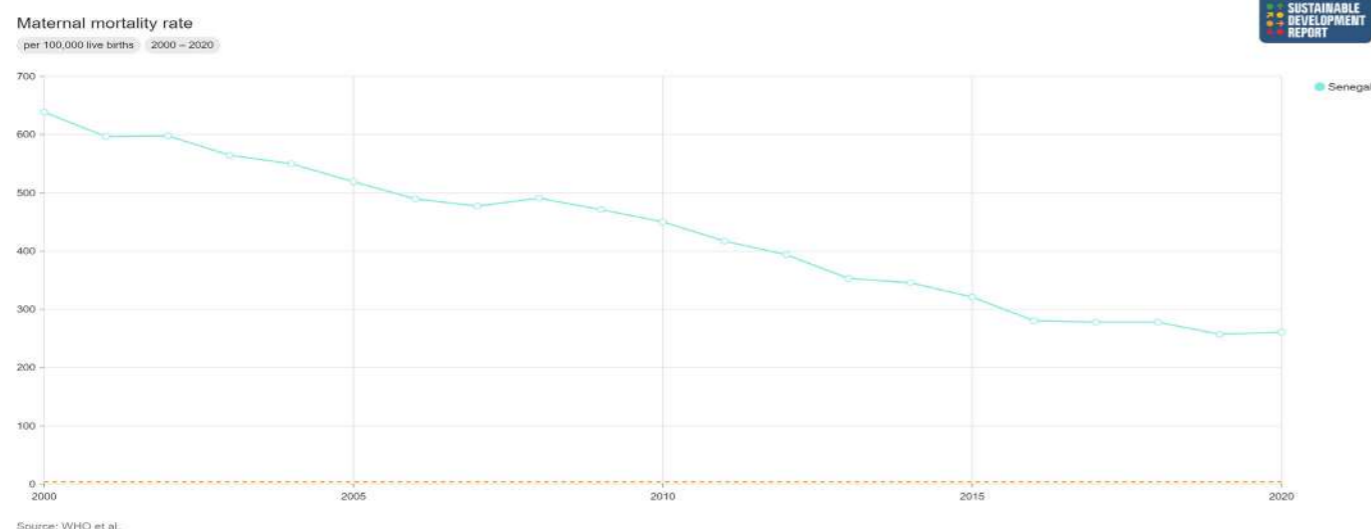
3 GOOD HEALTH AND WELL-BEING

SDG3 – Good Health and Well-Being

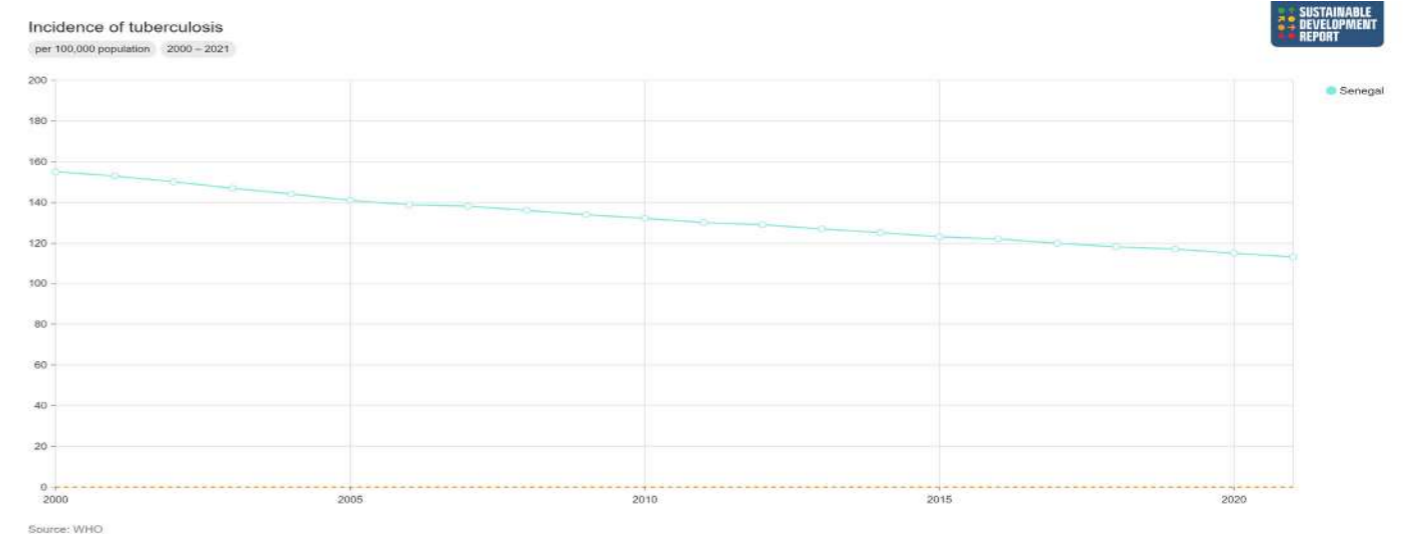
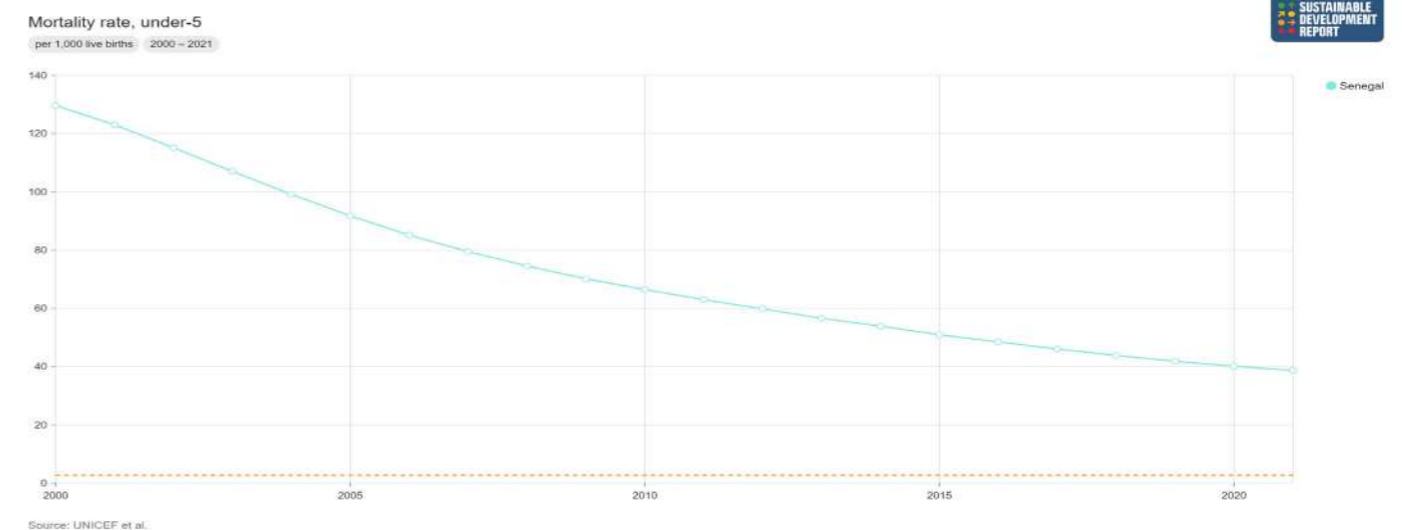
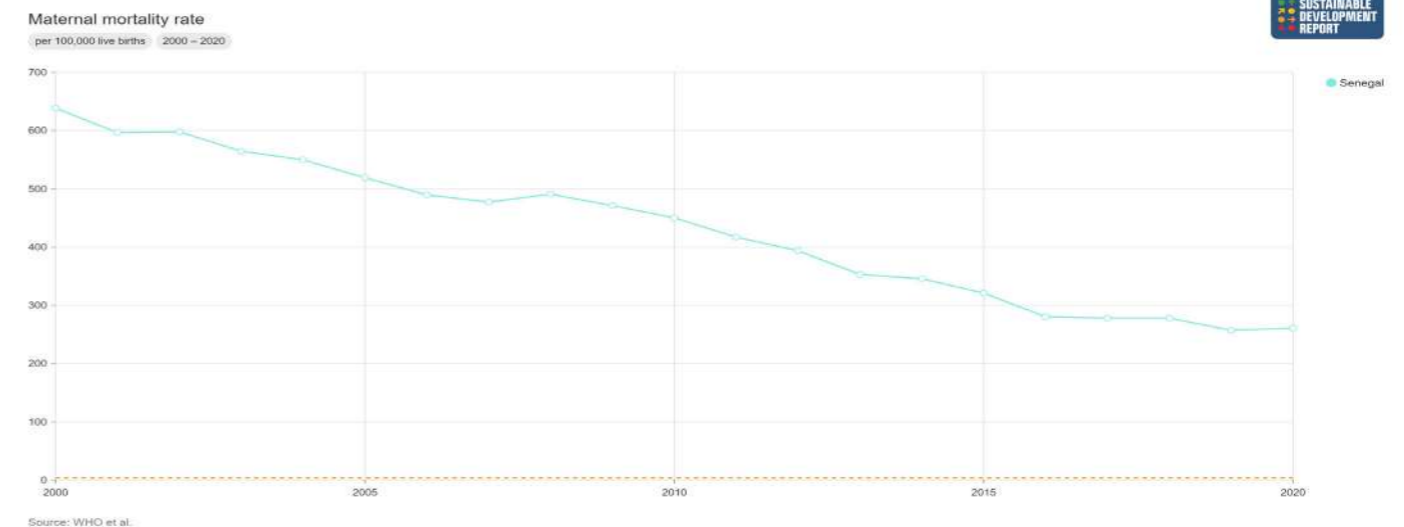
	Value	Year	Rating	Trend
Maternal mortality rate (per 100,000 live births)	260.9	2020	●	↗
Neonatal mortality rate (per 1,000 live births)	21.1	2021	●	↗
Mortality rate, under-5 (per 1,000 live births)	38.6	2021	●	↕
Incidence of tuberculosis (per 100,000 population)	113.0	2021	●	→
New HIV infections (per 1,000 uninfected population)	0.1	2021	●	↕
Age-standardized death rate due to cardiovascular disease, cancer, diabetes, or chronic respiratory disease in adults aged 30–70 years (%)	19.5	2019	●	↗
Age-standardized death rate attributable to household air pollution and ambient air pollution (per 100,000 population)	146.4	2019	●	●
Traffic deaths (per 100,000 population)	23.5	2019	●	→
Life expectancy at birth (years)	68.6	2019	●	→
Adolescent fertility rate (births per 1,000 females aged 15 to 19)	71.3	2018	●	●
Births attended by skilled health personnel (%)	74.5	2019	●	↕
Surviving infants who received 2 WHO-recommended vaccines (%)	85	2021	●	↕
Universal health coverage (UHC) index of service coverage (worst 0–100 best)	49	2019	●	→
Subjective well-being (average ladder score, worst 0–10 best)	4.9	2022	●	→

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↕ On track or maintaining SDG achievement
 ● Information unavailable

Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

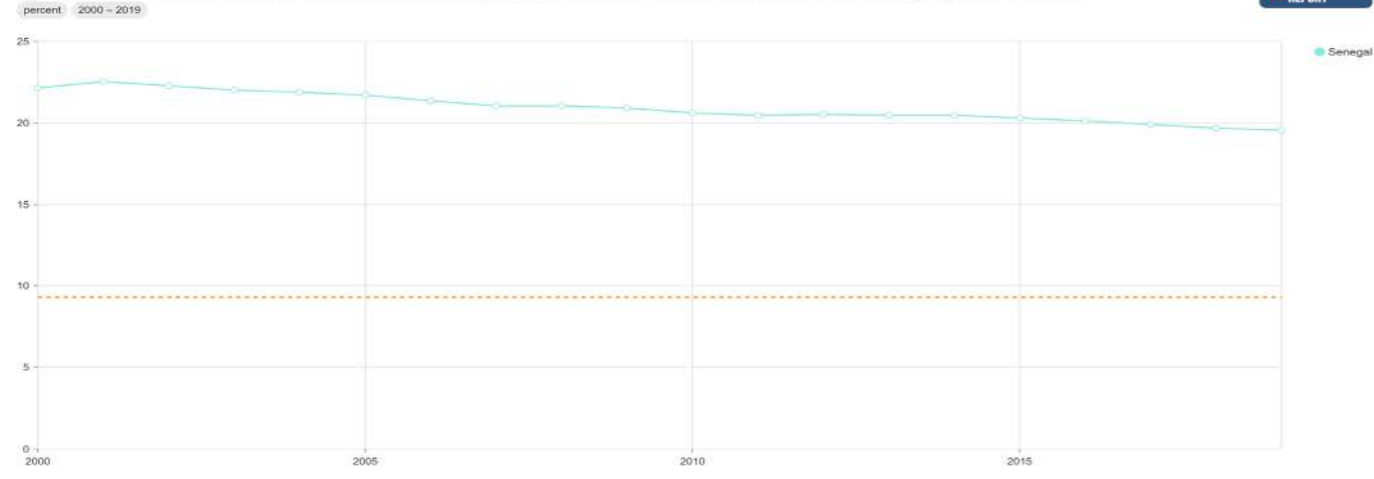


3 GOOD HEALTH AND WELL-BEING



3 GOOD HEALTH AND WELL-BEING

Age-standardized death rate due to cardiovascular disease, cancer, diabetes, or chronic respiratory disease in adults aged 30–70 years

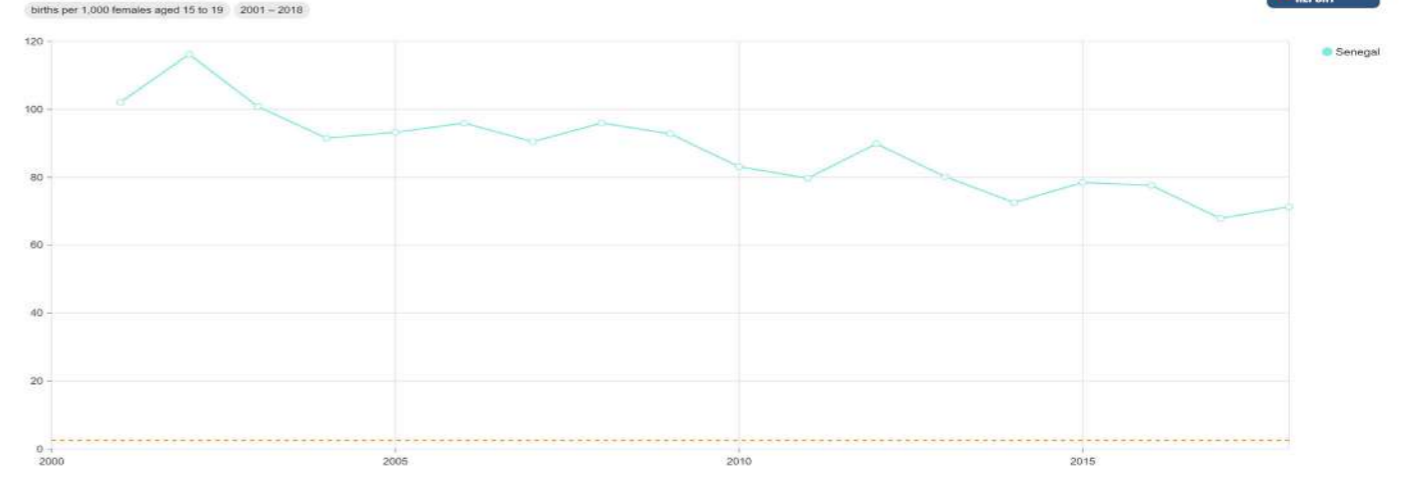


Source: WHO



3 GOOD HEALTH AND WELL-BEING

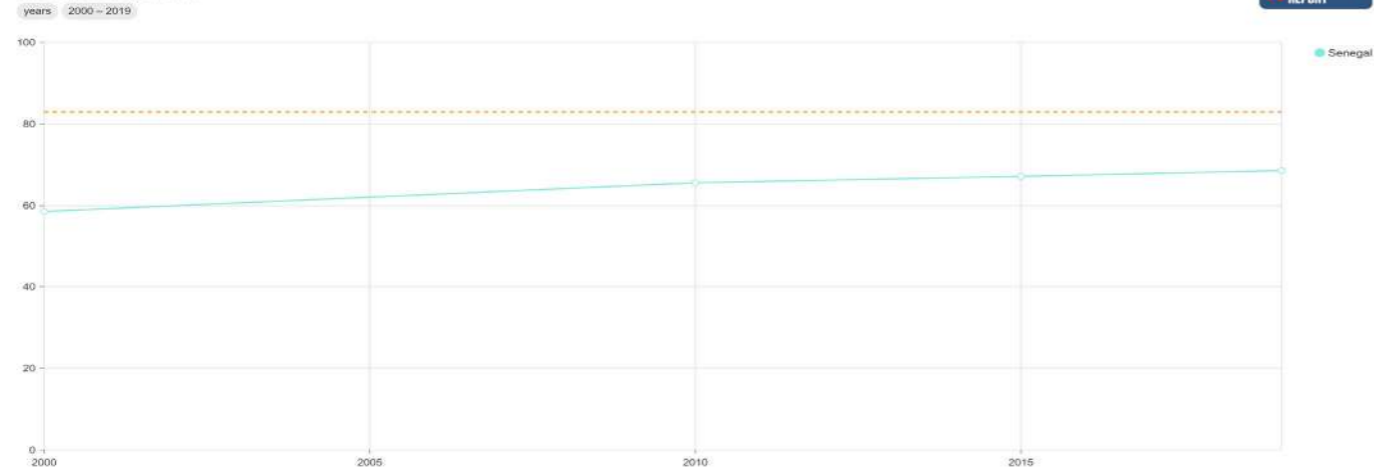
Adolescent fertility rate



Source: WHO



Life expectancy at birth



Source: WHO



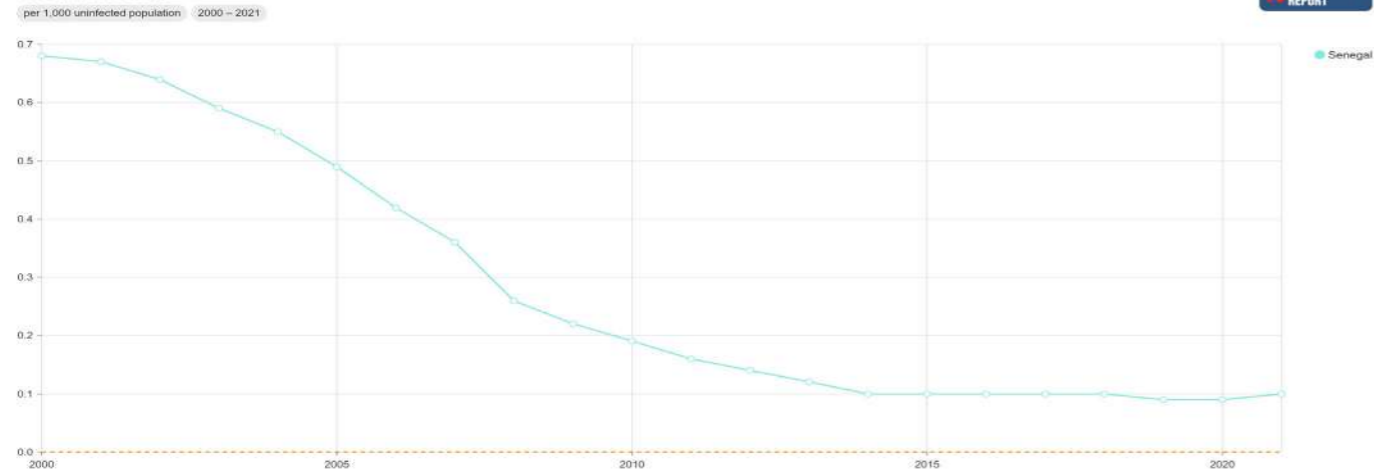
Births attended by skilled health personnel



Source: UNICEF



New HIV infections



Source: UNAIDS



Surviving infants who received 2 WHO-recommended vaccines

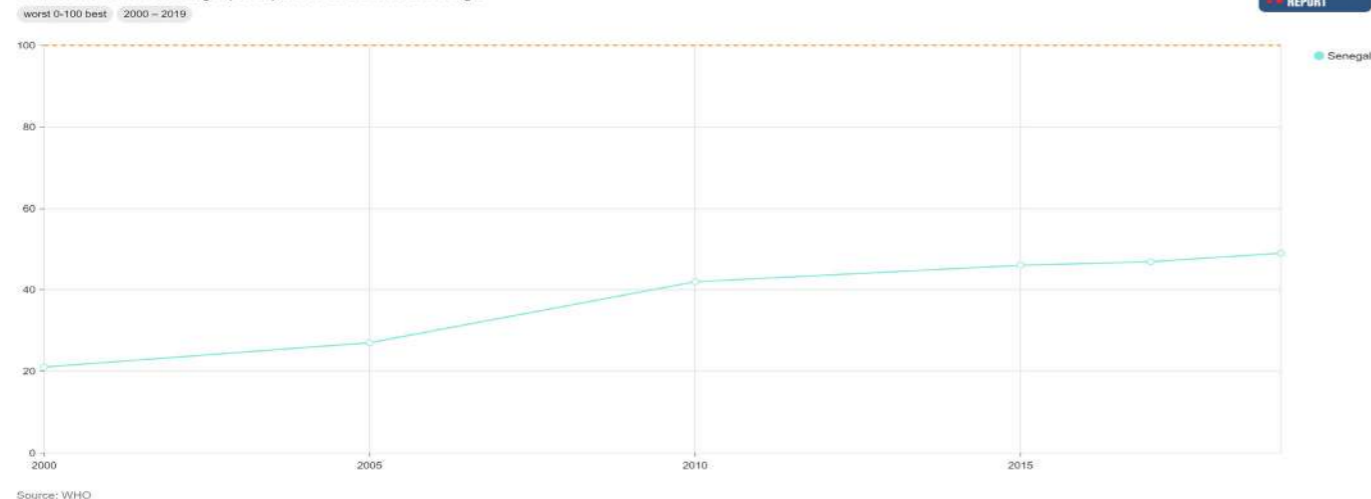


Source: WHO and UNICEF

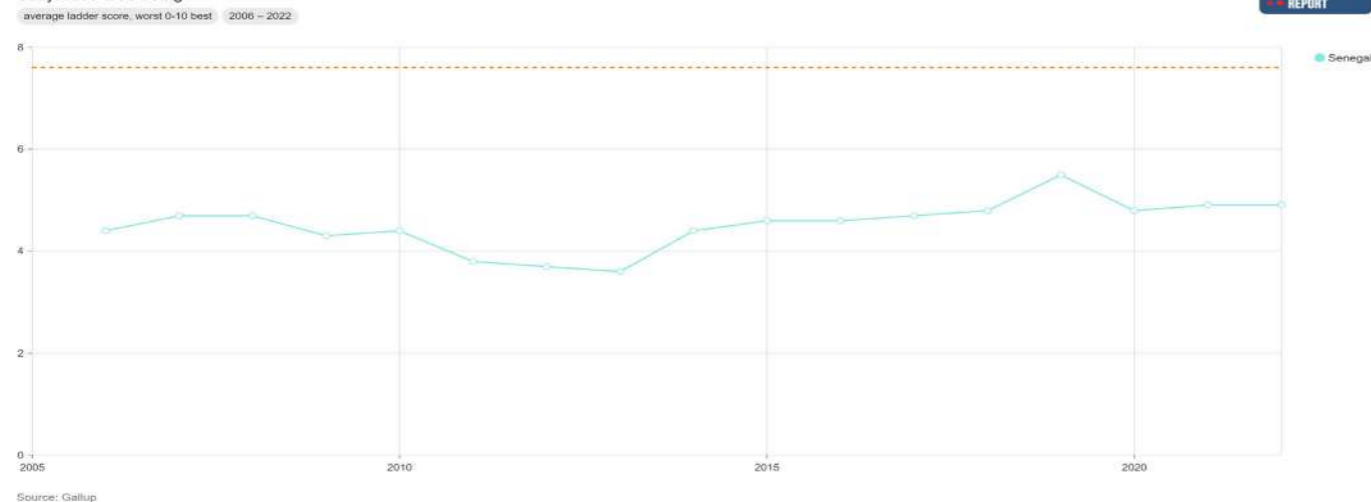


3 GOOD HEALTH AND WELL-BEING

Universal health coverage (UHC) index of service coverage



Subjective well-being



Results of implementing SDG 3

- The prevalence of hepatitis B surface antigen (HBsAg) was 3.5 % in 2015.
- The 12-month prevalence of alcohol use disorders was 0.7 % in 2016. The age-standardized mortality rate attributed to household air pollution was 110.0 deaths per 100,000 population in 2016.
- The age-standardized mortality rate attributed to ambient air pollution was 75.0 deaths per 1,000 population in 2016.
- The mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene was 23.9 deaths per 1,000 population in 2016.

4 QUALITY EDUCATION

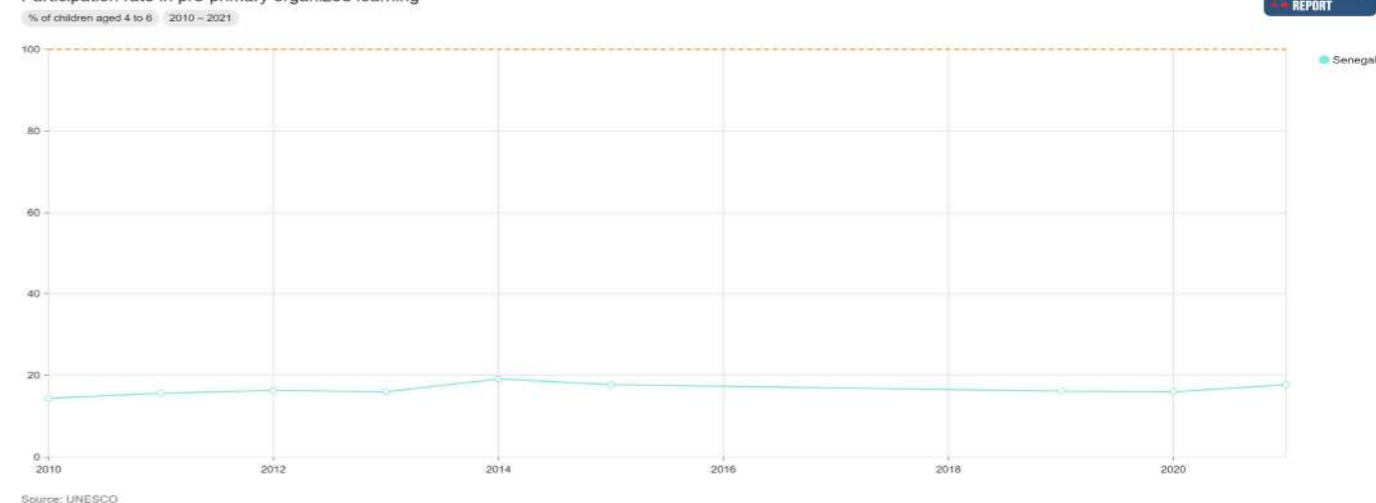
SDG4 – Quality Education

Indicator	Value	Year	Rating	Trend
Participation rate in pre-primary organized learning (% of children aged 4 to 6)	17.8	2021	●	→
Net primary enrollment rate (%)	72.6	2021	●	↓
Lower secondary completion rate (%)	41.8	2021	●	→
Literacy rate (% of population aged 15 to 24)	76.4	2021	●	↑

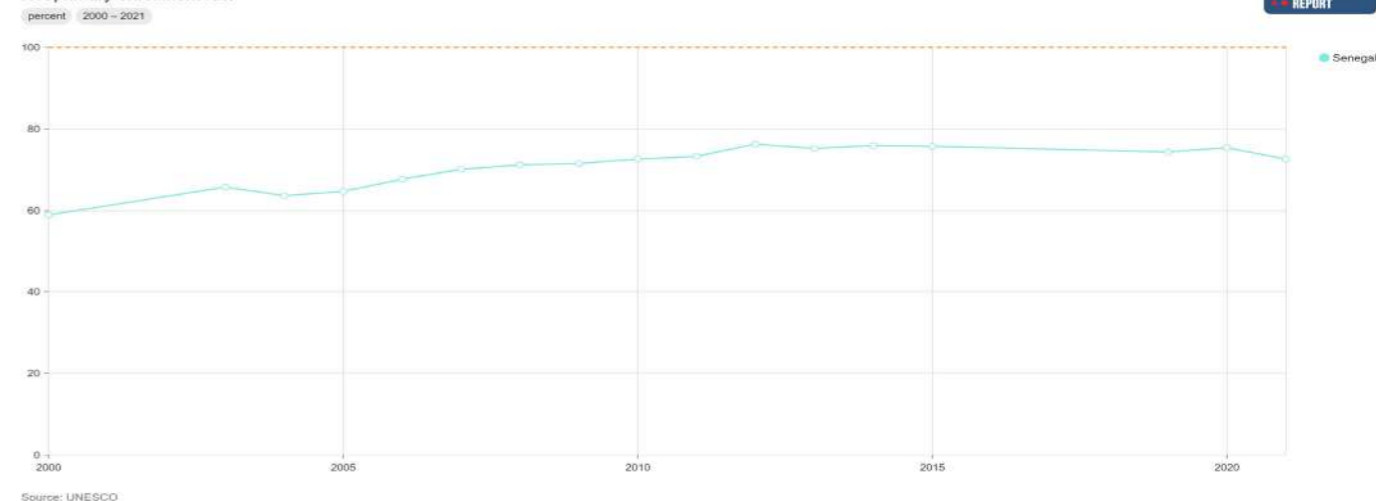
■ Major challenges ■ Significant challenges ■ Challenges remain ■ SDG achieved
↓ Decreasing → Stagnating ↗ Moderately improving ↑ On track or maintaining SDG achievement ● Information unavailable

Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Participation rate in pre-primary organized learning

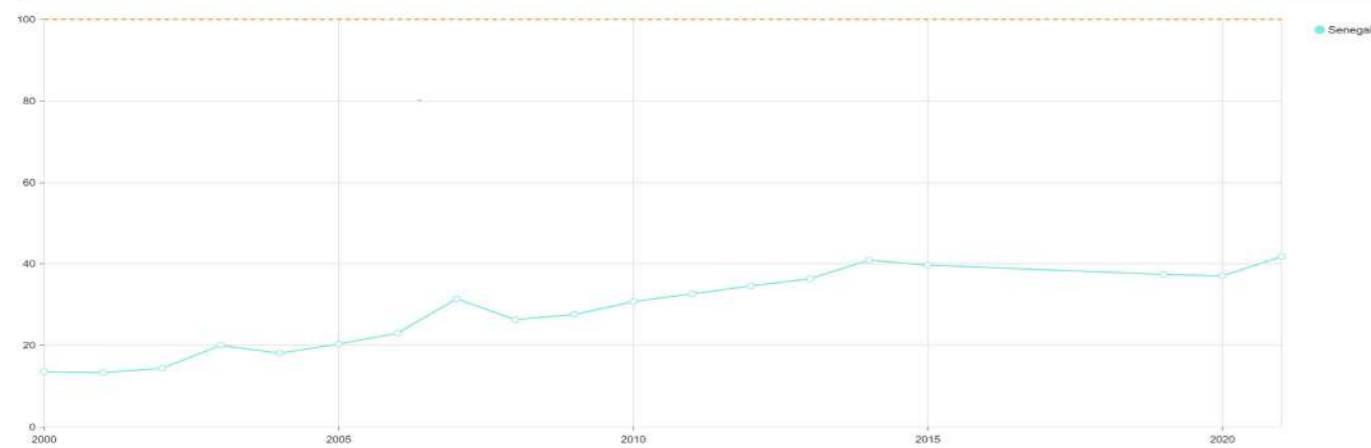


Net primary enrollment rate



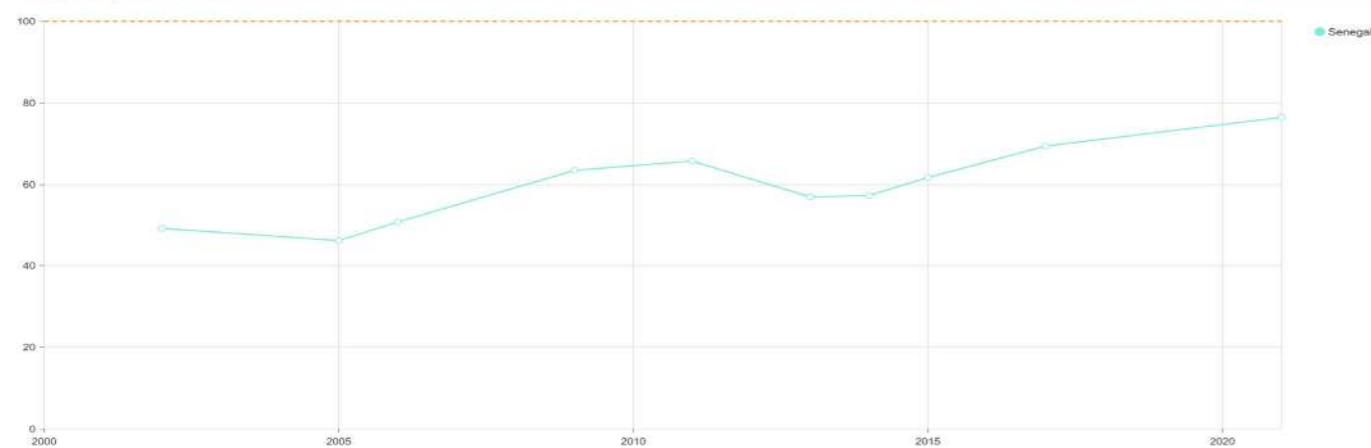
4 QUALITY EDUCATION

Lower secondary completion rate
percent 2000 - 2021



Source: UNESCO

Literacy rate
% of population aged 15 to 24 2002 - 2021



Source: UNESCO

Results of implementing SDG 4

- The gender parity index for participation rate in organized learning (one year before the official primary entry age) was 1.1 in 2018.
- The participation rate in formal and non-formal education and training was 5.6 % in 2015.
- The gender parity index for participation rate in formal and non-formal education and training was 0.6 in 2015.
- The gender parity index for achievement of minimum proficiency in reading in lower secondary education was 1.0 in 2014 , meaning 100.0 girls per 100 boys in lower secondary education had this level of achievement .
- The proportion of primary schools with access to basic drinking water was 77.6 % in 2018.
- The proportion of primary schools with access to single-sex basic sanitation was 9.4 % in 2017.

5 GENDER EQUALITY

SDG5 – Gender Equality

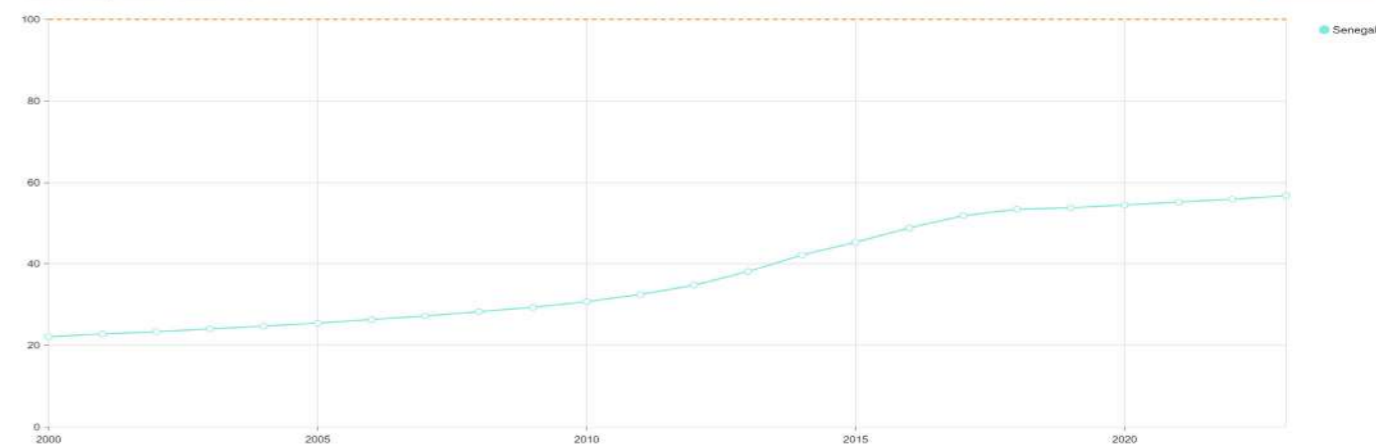
Value Year Rating Trend

Demand for family planning satisfied by modern methods (% of females aged 15 to 49)	53.2	2019	●	↗
Ratio of female-to-male mean years of education received (%)	35.2	2021	●	↓
Ratio of female-to-male labor force participation rate (%)	59.4	2022	●	↓
Seats held by women in national parliament (%)	43.0	2021	●	↑

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
■ Information unavailable
● Information unavailable

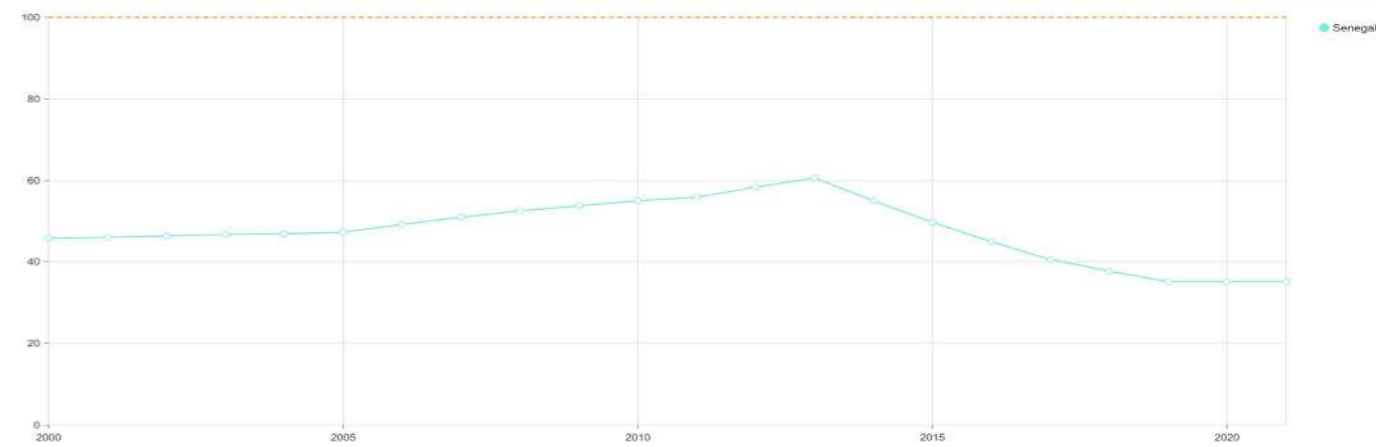
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Demand for family planning satisfied by modern methods
% of females aged 15 to 49 2000 - 2023



Source: UNDESA

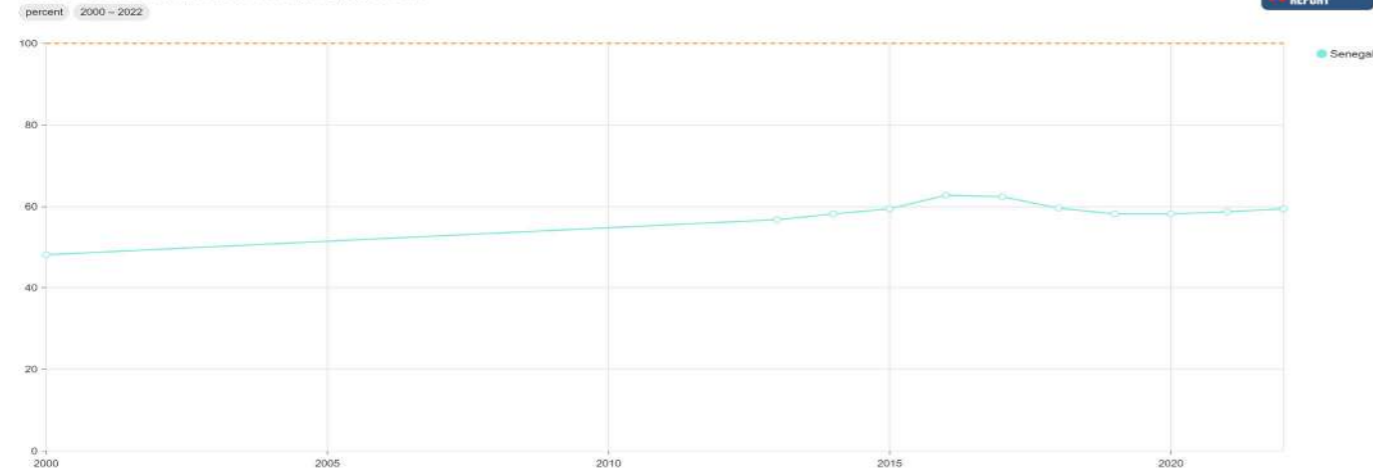
Ratio of female-to-male mean years of education received
percent 2000 - 2021



Source: UNDP

5 GENDER EQUALITY

Ratio of female-to-male labor force participation rate



Source: ILO

Seats held by women in national parliament



Source: IPU

6 CLEAN WATER AND SANITATION

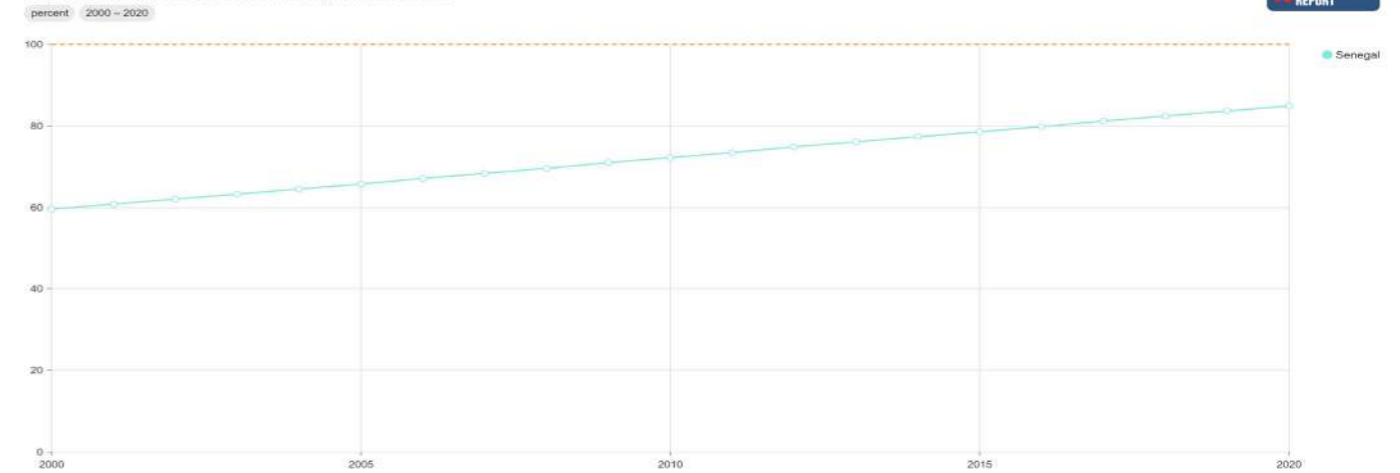
SDG6 – Clean Water and Sanitation

Indicator	Value	Year	Rating	Trend
Population using at least basic drinking water services (%)	84.9	2020	On track or maintaining SDG achievement	↑
Population using at least basic sanitation services (%)	56.8	2020	Major challenges	→
Freshwater withdrawal (% of available freshwater resources)	11.8	2019	SDG achieved	●
Anthropogenic wastewater that receives treatment (%)	0.5	2020	Major challenges	●
Scarce water consumption embodied in imports (m ³ H ₂ O eq/capita)	418.3	2018	SDG achieved	●

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

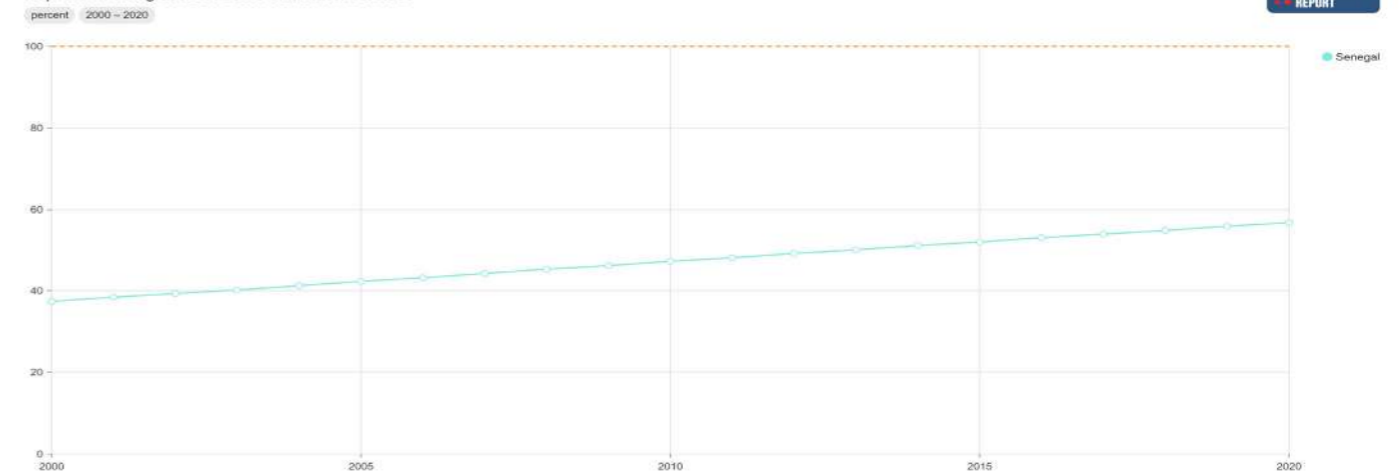
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Population using at least basic drinking water services



Source: JMP

Population using at least basic sanitation services

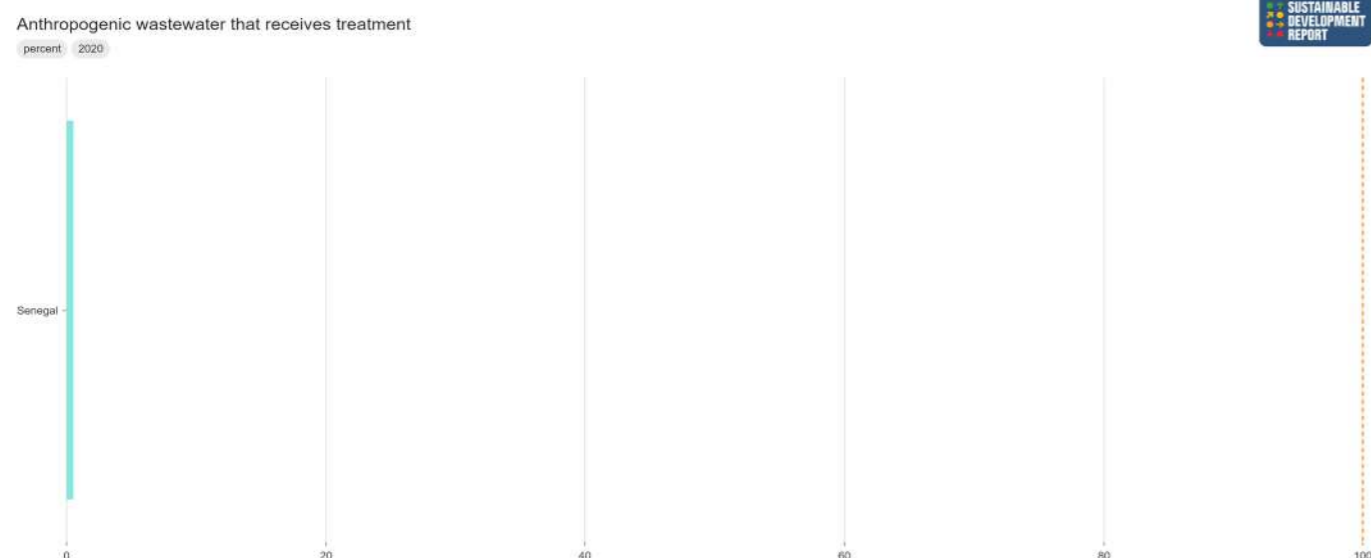


Source: JMP

6 CLEAN WATER AND SANITATION



Source: FAO



Source: EPI

Results of implementing SDG 6

- The proportion of safely treated domestic wastewater flows was 14.6 % in 2018.
- The degree of integrated water resources management implementation was 53.0 % in 2018.
- In 2017, The proportion of transboundary basins (river and lake basins and aquifers) with an operational arrangement for water cooperation stood at 34.0 % .
- In 2017, The proportion of transboundary aquifers with an operational arrangement for water cooperation stood at 0.0 % .
- In 2017, The proportion of transboundary river and lake basins with an operational arrangement for water cooperation stood at 100.0 % .
- The level of participation by users/communities in planning programs in water resources planning and management, by level of participation (where 3 = High; 2 = Moderate; 1 = Low; and 0 = NA) stood at 2.0 points in 2019 .
- The level of definition of legal or policy procedures for participation by service users/communities in planning program in water resources planning and management (where 10 = Clearly defined; 5 = Not clearly defined ; 0 = NA) stood at 5.0 points in 2019 .

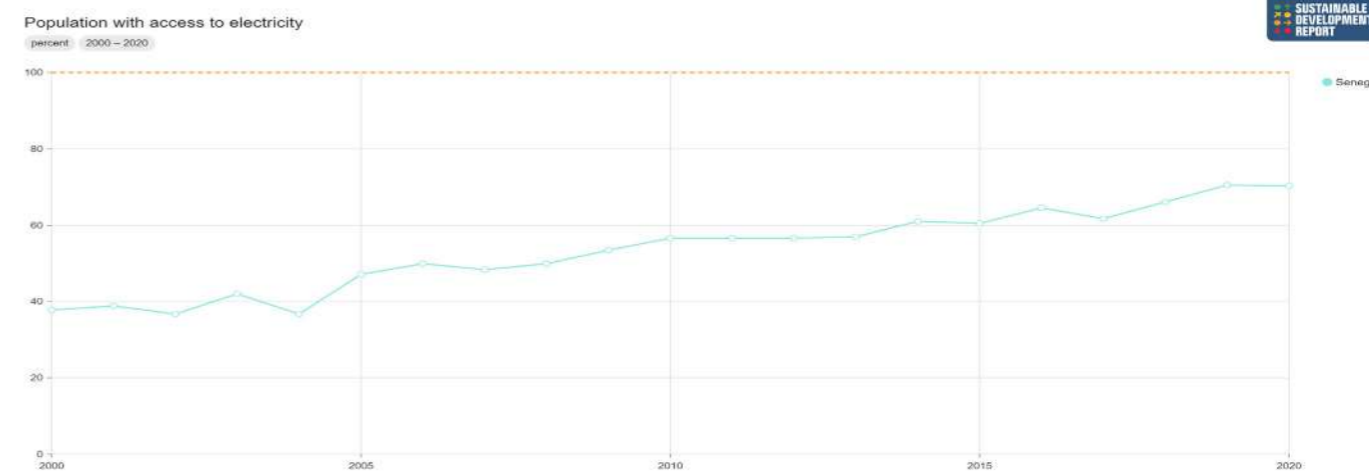
7 AFFORDABLE AND CLEAN ENERGY

SDG8 – Decent Work and Economic Growth

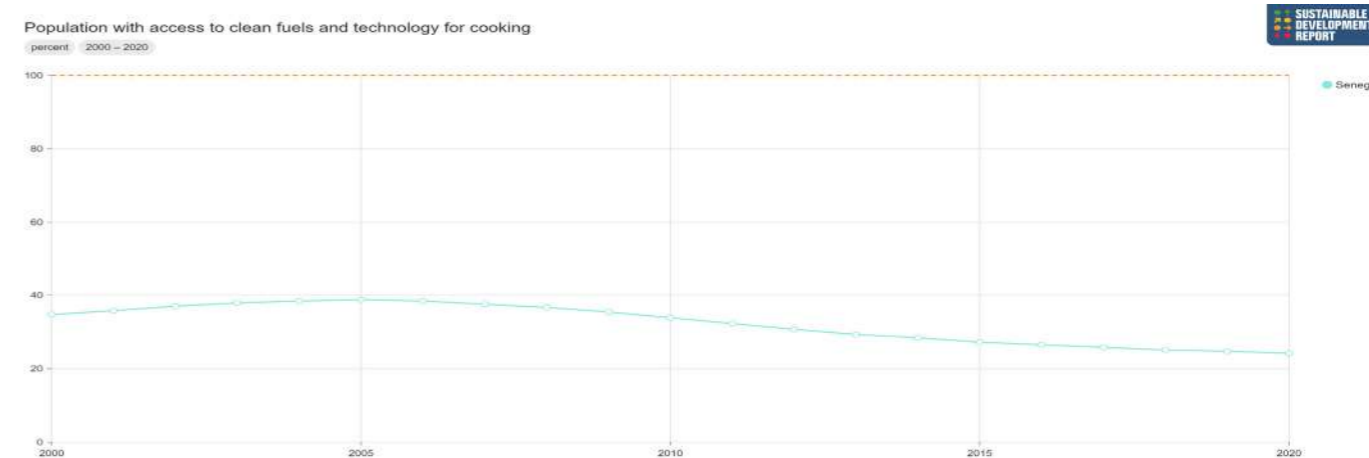
	Value	Year	Rating	Trend
Adjusted GDP growth (%)	-3.2	2021	Major challenges	Decreasing
Victims of modern slavery (per 1,000 population)	2.9	2018	SDG achieved	Information unavailable
Adults with an account at a bank or other financial institution or with a mobile-money-service provider (% of population aged 15 or over)	56.0	2021	Significant challenges	On track or maintaining SDG achievement
Unemployment rate (% of total labor force, ages 15+)	3.4	2023	Challenges remain	On track or maintaining SDG achievement
Fundamental labor rights are effectively guaranteed (worst 0–1 best)	0.7	2021	Challenges remain	On track or maintaining SDG achievement

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 Information unavailable

Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>



Source: IEA, IRENA, UNSD, WB, WHO



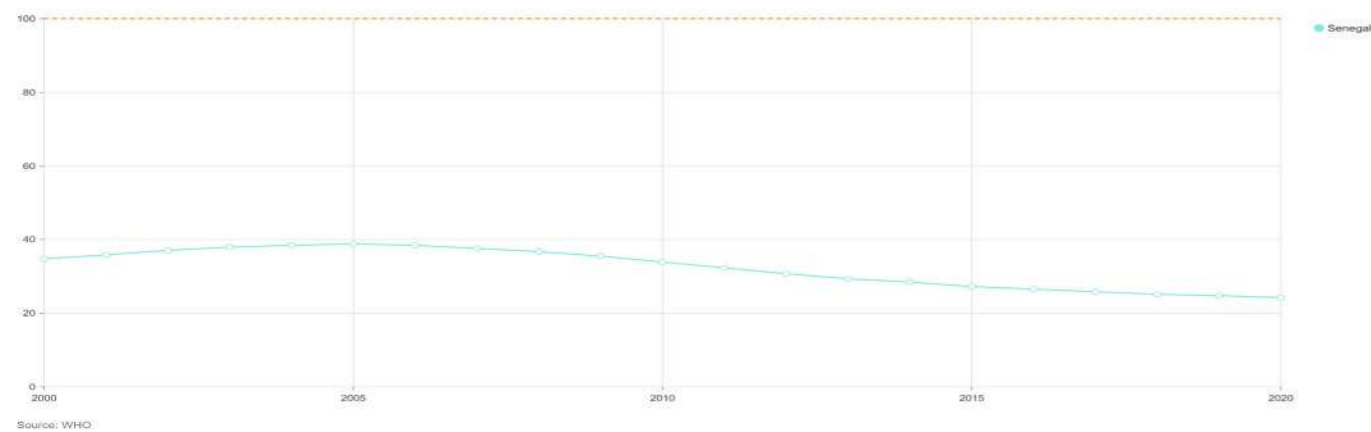
Source: WHO

7 AFFORDABLE AND CLEAN ENERGY

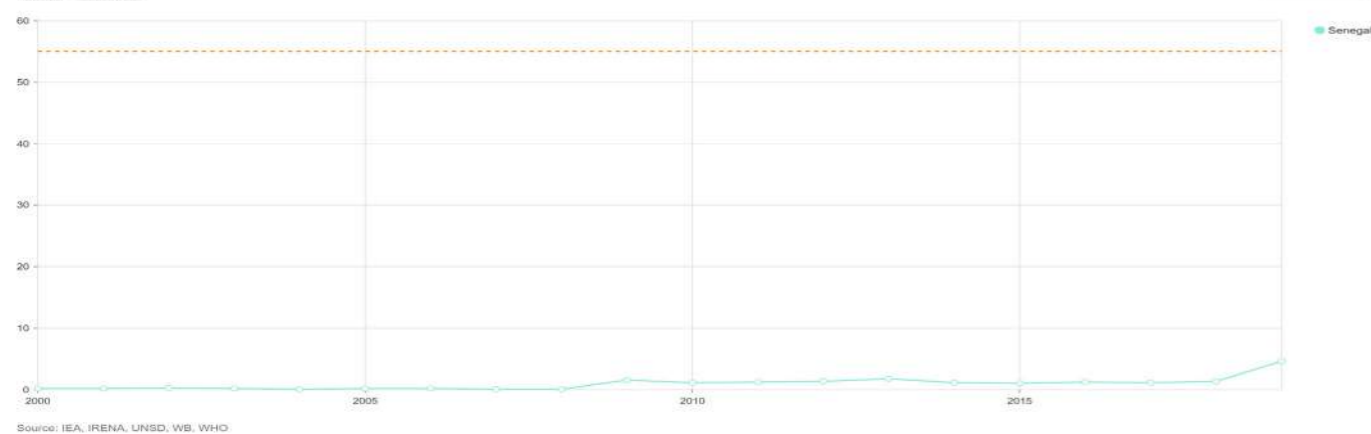
CO₂ emissions from fuel combustion per total electricity output
MCO₂/TWh 2000–2019



Population with access to clean fuels and technology for cooking
percent 2000–2020



Renewable energy share in total final energy consumption
percent 2000–2019



8 DECENT WORK AND ECONOMIC GROWTH

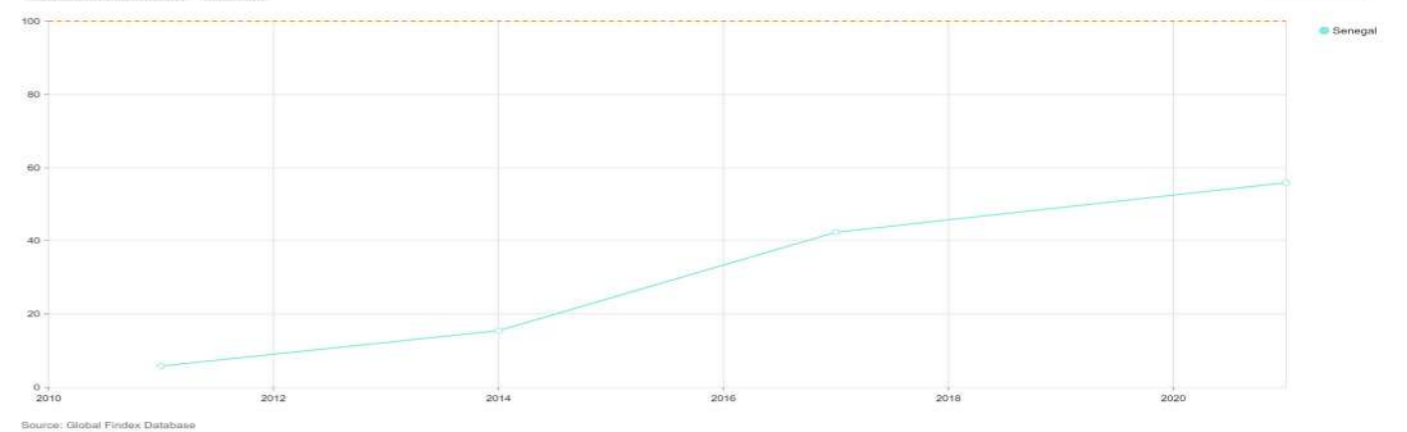
SDG8 – Decent Work and Economic Growth

	Value	Year	Rating	Trend
Adjusted GDP growth (%)	-3.2	2021	Major challenges	Information unavailable
Victims of modern slavery (per 1,000 population)	2.9	2018	SDG achieved	Information unavailable
Adults with an account at a bank or other financial institution or with a mobile-money-service provider (% of population aged 15 or over)	56.0	2021	Challenges remain	On track or maintaining SDG achievement
Unemployment rate (% of total labor force, ages 15+)	3.4	2023	SDG achieved	On track or maintaining SDG achievement
Fundamental labor rights are effectively guaranteed (worst 0–1 best)	0.7	2021	Challenges remain	On track or maintaining SDG achievement
Fatal work-related accidents embodied in imports (per 100,000 population)	0.0	2018	SDG achieved	Stagnating
Victims of modern slavery embodied in imports (per 100,000 population)	9.0	2018	SDG achieved	Information unavailable

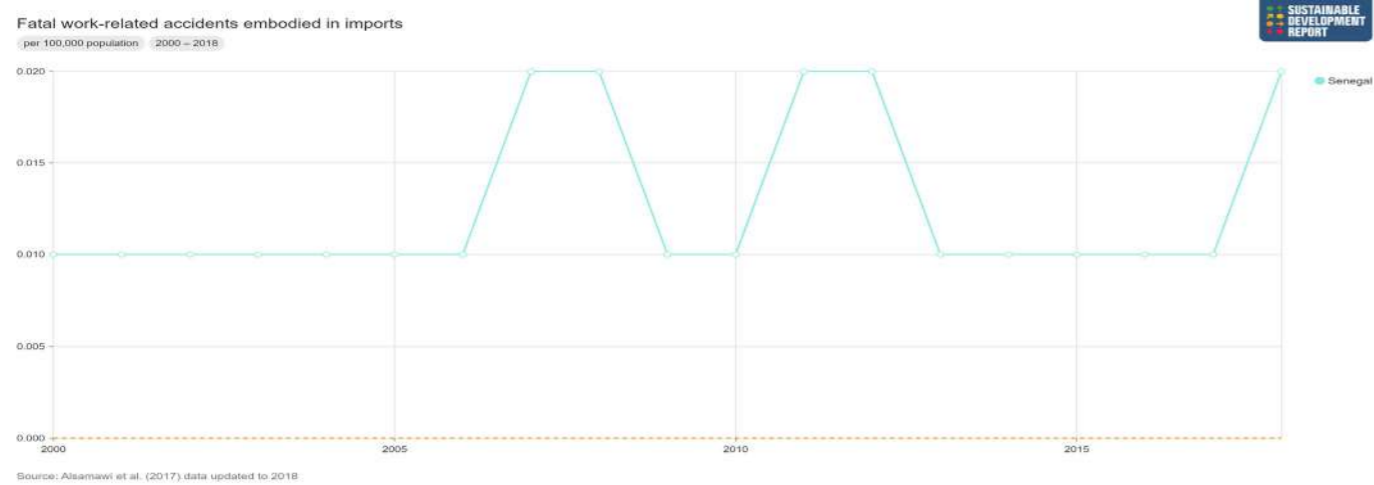
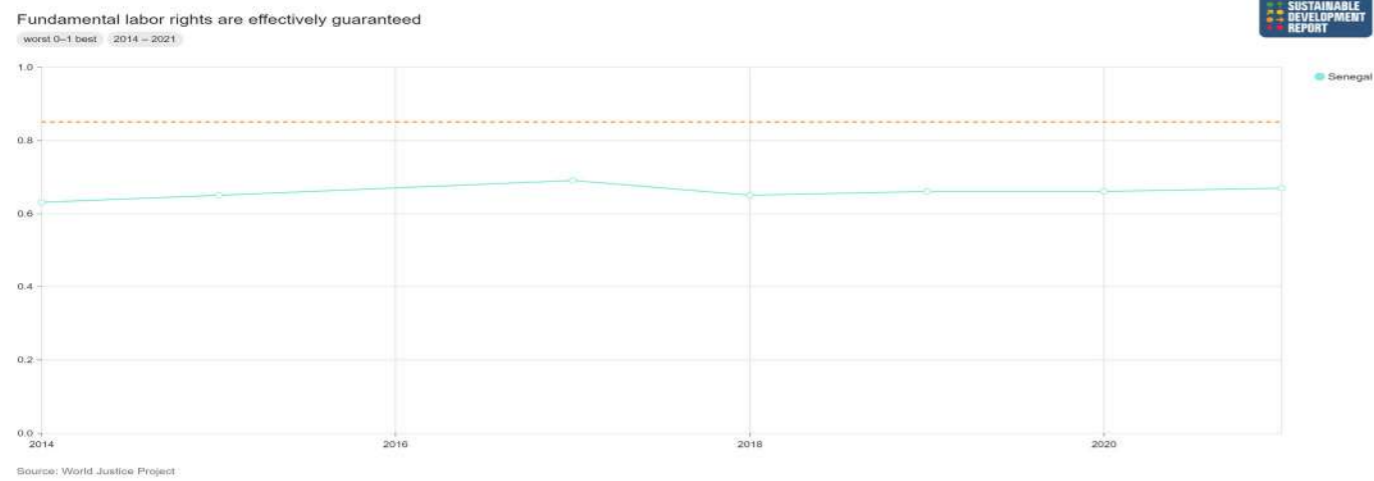
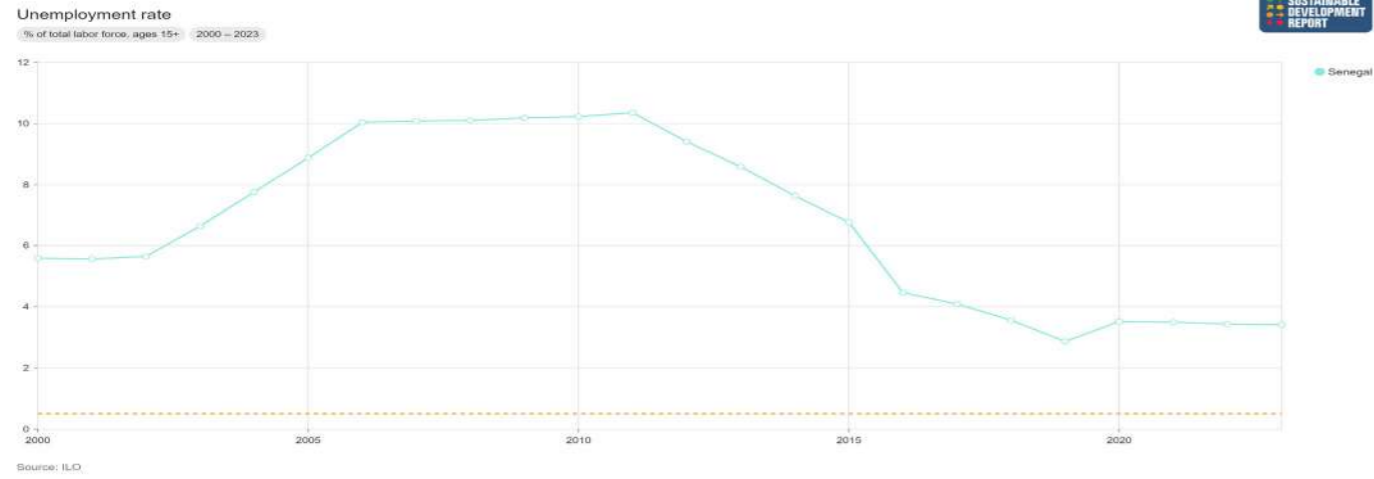
■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

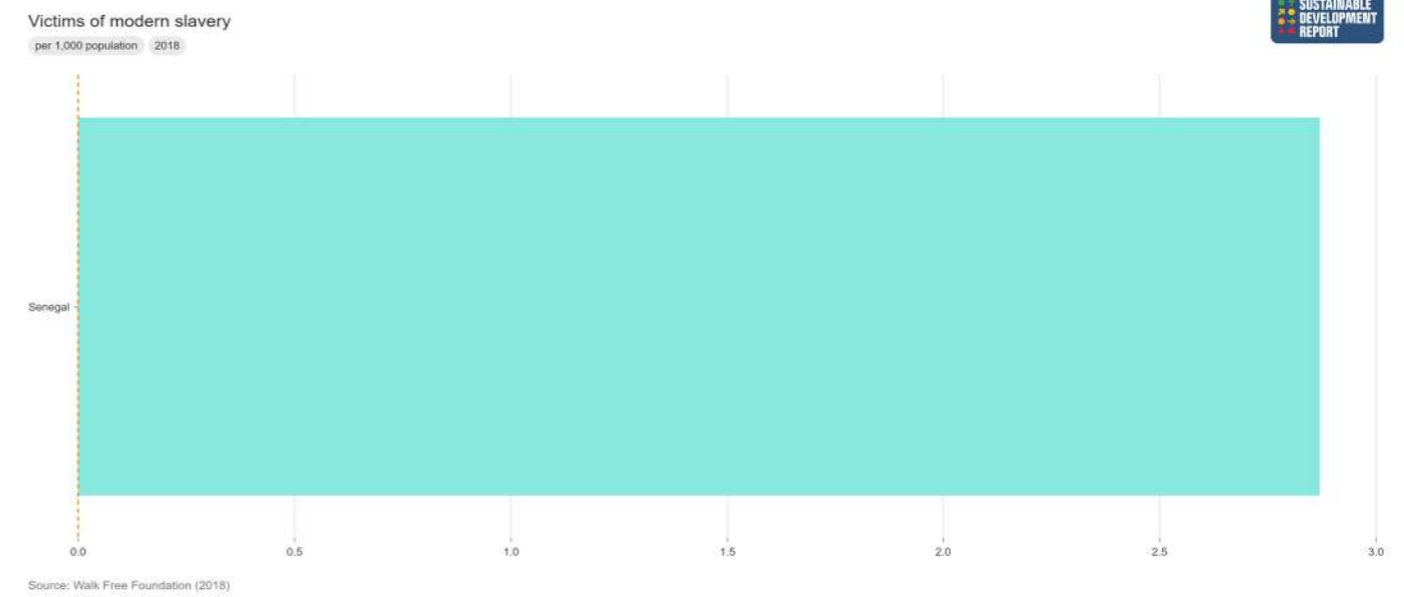
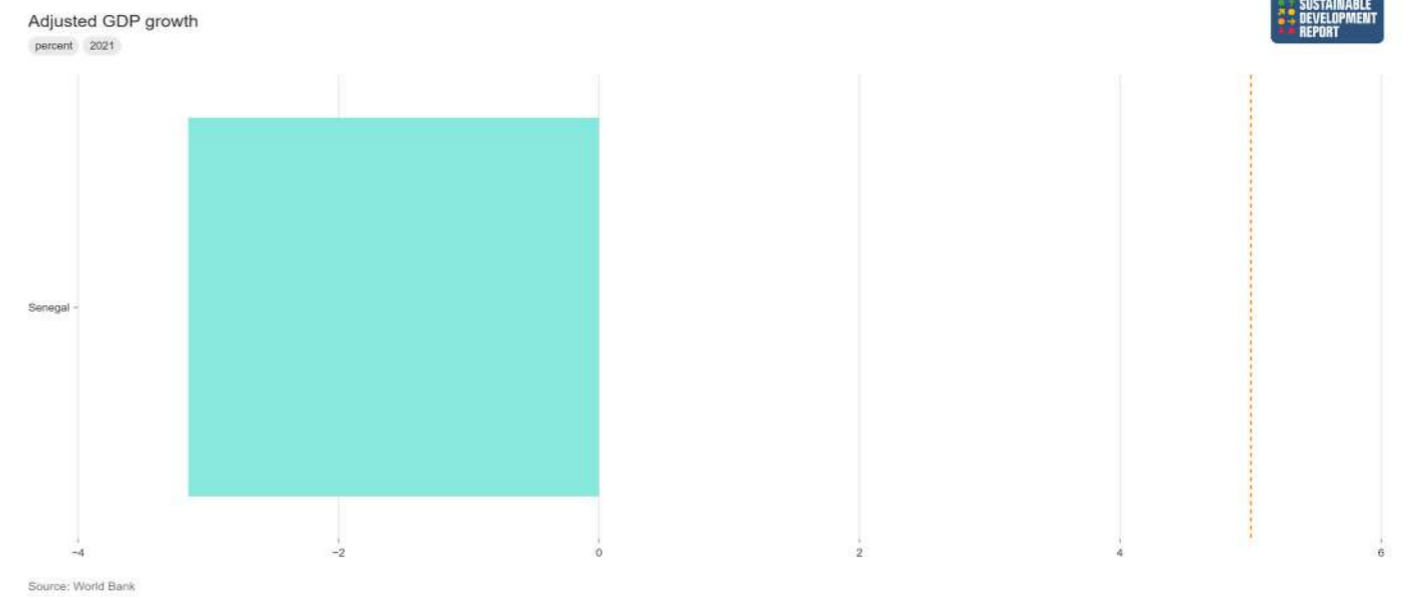
Adults with an account at a bank or other financial institution or with a mobile-money-service provider
% of population aged 15 or over 2011–2021



8 DECENT WORK AND ECONOMIC GROWTH



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

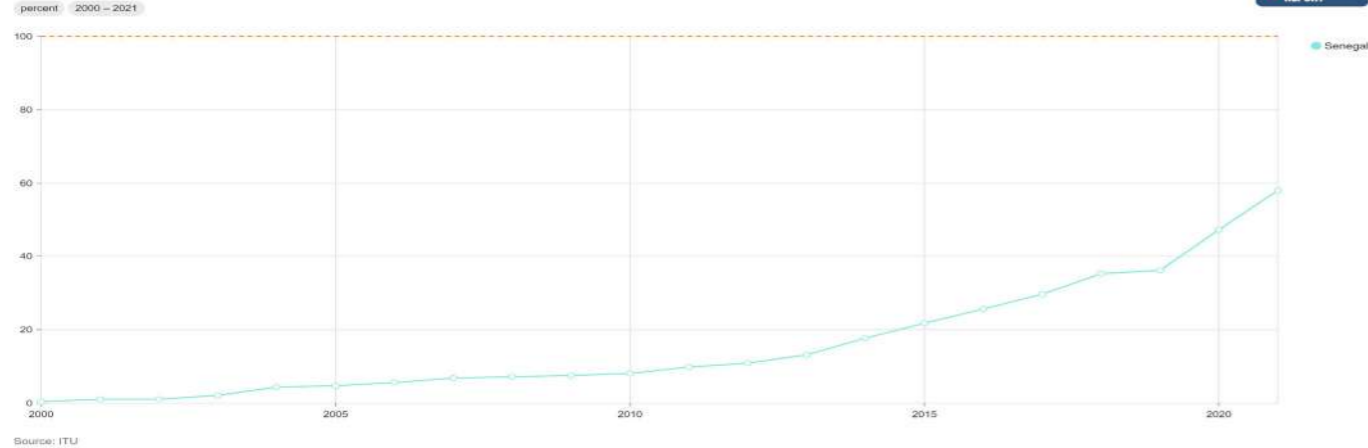
SDG9 – Industry, Innovation and Infrastructure

	Value	Year	Rating	Trend
Rural population with access to all-season roads (%)	72.8	2022	●	●
Population using the internet (%)	58.1	2021	●	↑
Mobile broadband subscriptions (per 100 population)	94.1	2021	●	↑
Logistics Performance Index: Quality of trade and transport-related infrastructure (worst 1–5 best)	2.2	2018	●	↓
The Times Higher Education Universities Ranking: Average score of top 3 universities (worst 0–100 best)	* 0.0	2022	●	●
Articles published in academic journals (per 1,000 population)	0.1	2021	●	→
Expenditure on research and development (% of GDP)	0.6	2015	●	●

- Major challenges (Red square)
- Significant challenges (Orange square)
- Challenges remain (Yellow square)
- SDG achieved (Green square)
- Information unavailable (Grey square)
- Decreasing (Red arrow down)
- Stagnating (Orange arrow right)
- Moderately improving (Yellow arrow up-right)
- On track or maintaining SDG achievement (Green arrow up)
- Information unavailable (Grey circle)

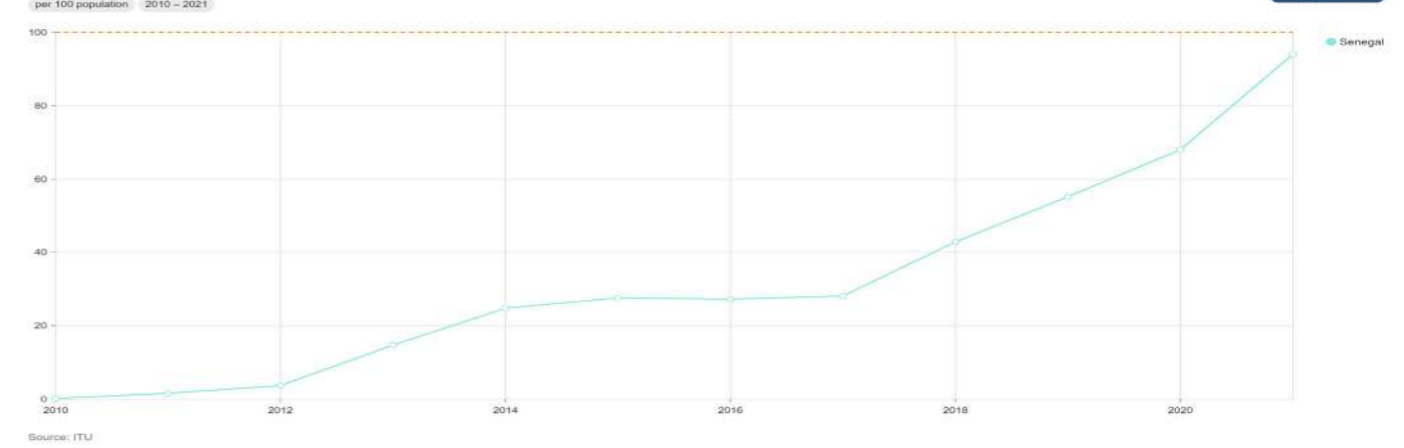
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Population using the internet

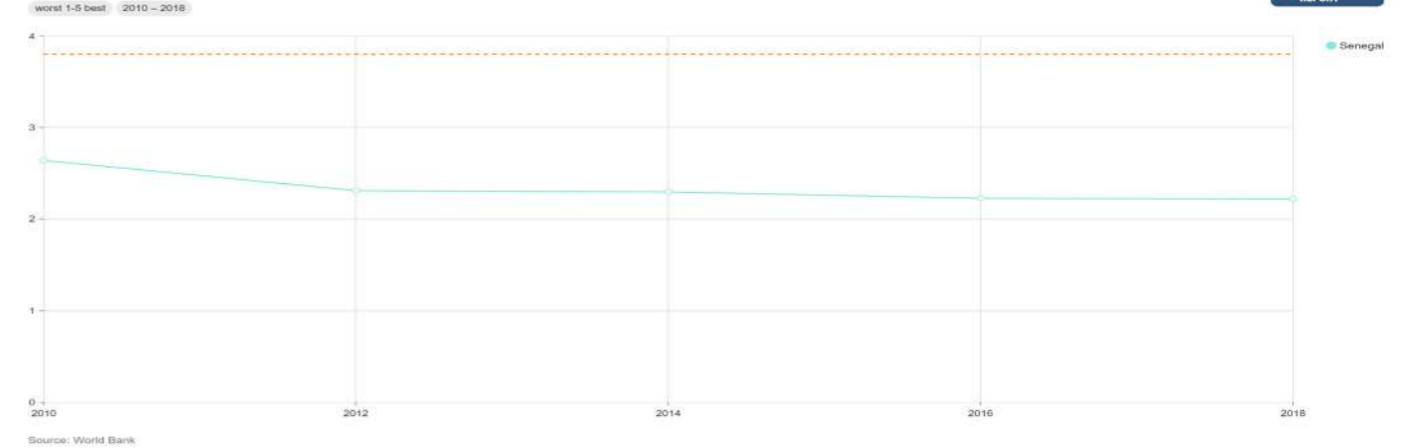


9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

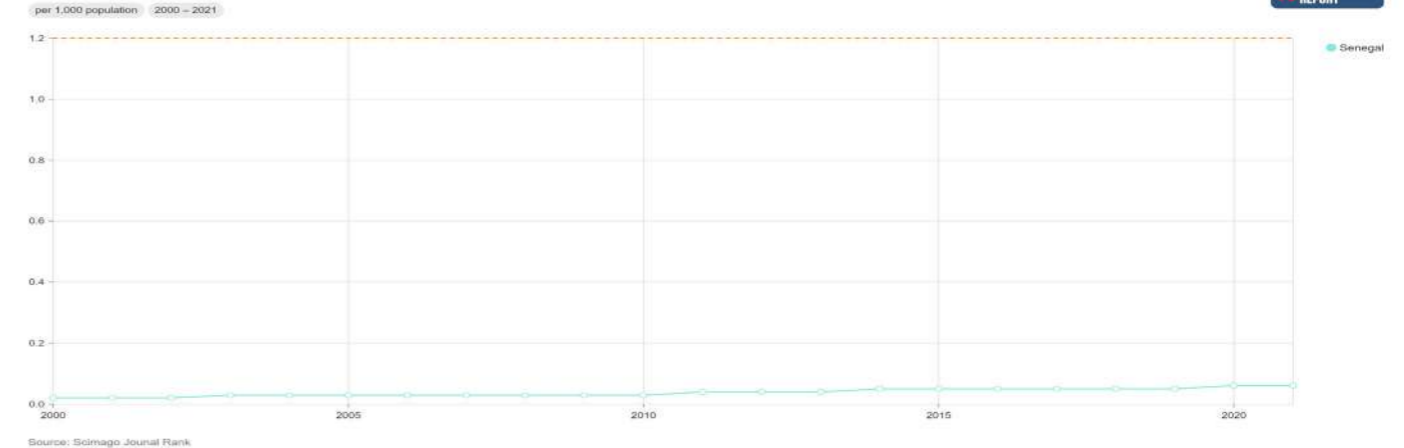
Mobile broadband subscriptions



Logistics Performance Index: Quality of trade and transport-related infrastructure

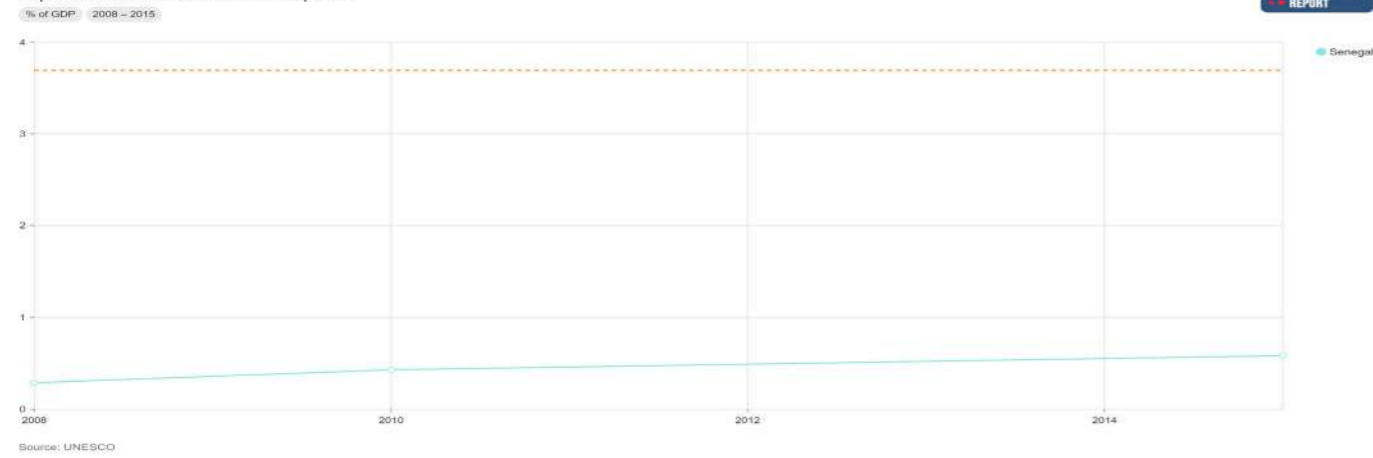


Articles published in academic journals

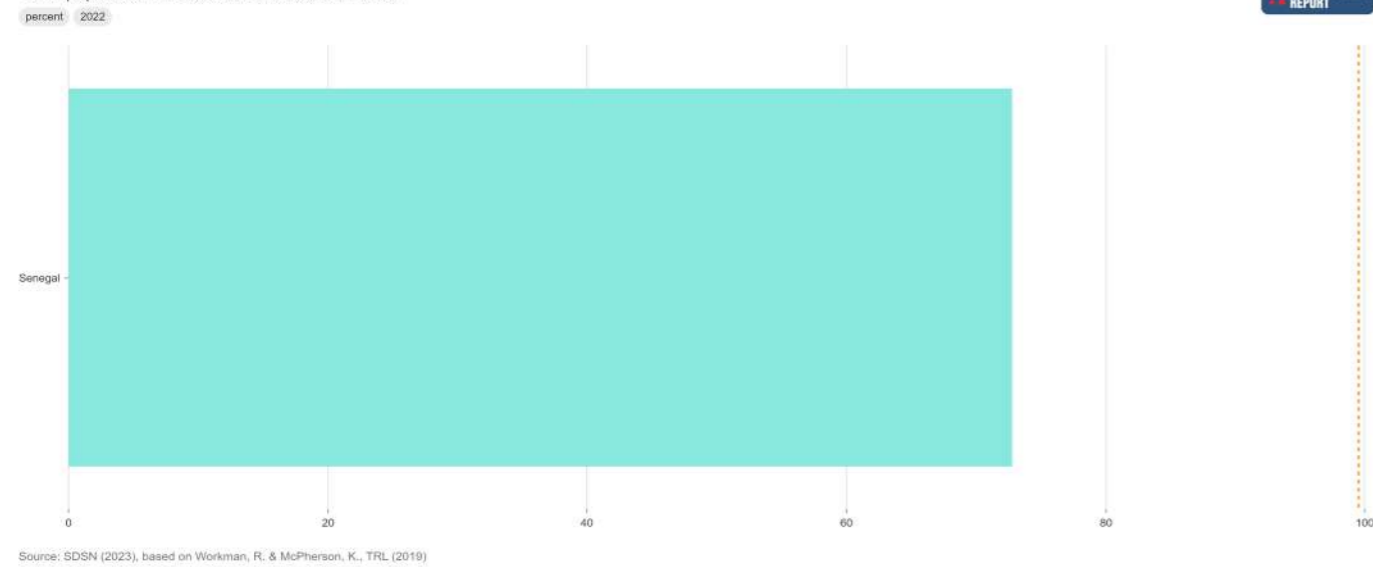


9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Expenditure on research and development



Rural population with access to all-season roads



10 REDUCED INEQUALITIES

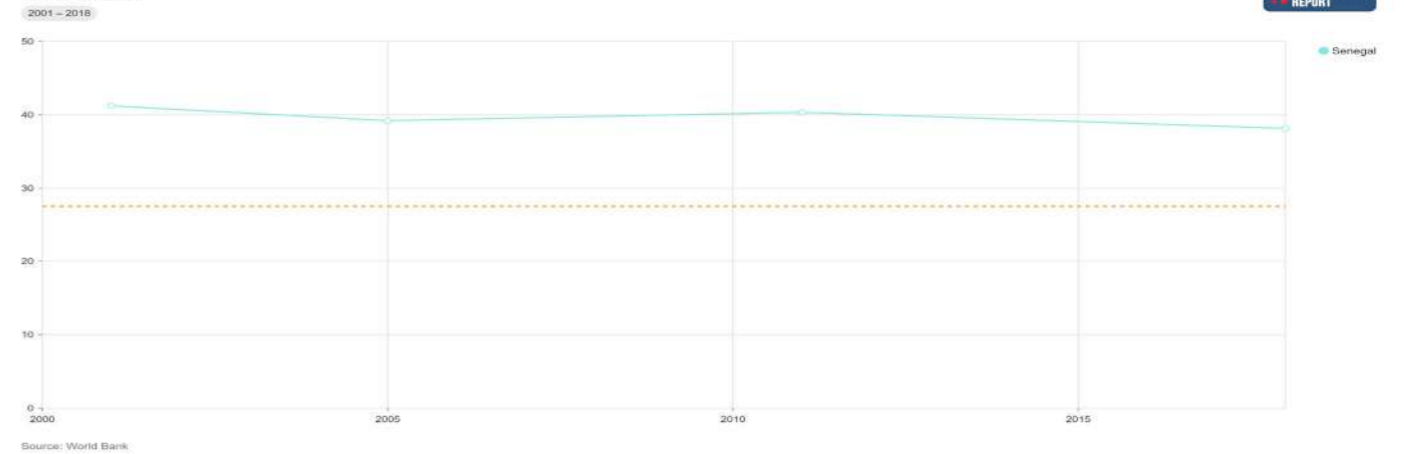
SDG10 – Reduced Inequalities

	Value	Year	Rating	Trend
Gini coefficient	38.1	2018	Orange circle	Grey circle
Palma ratio	1.7	2018	Red circle	Grey circle

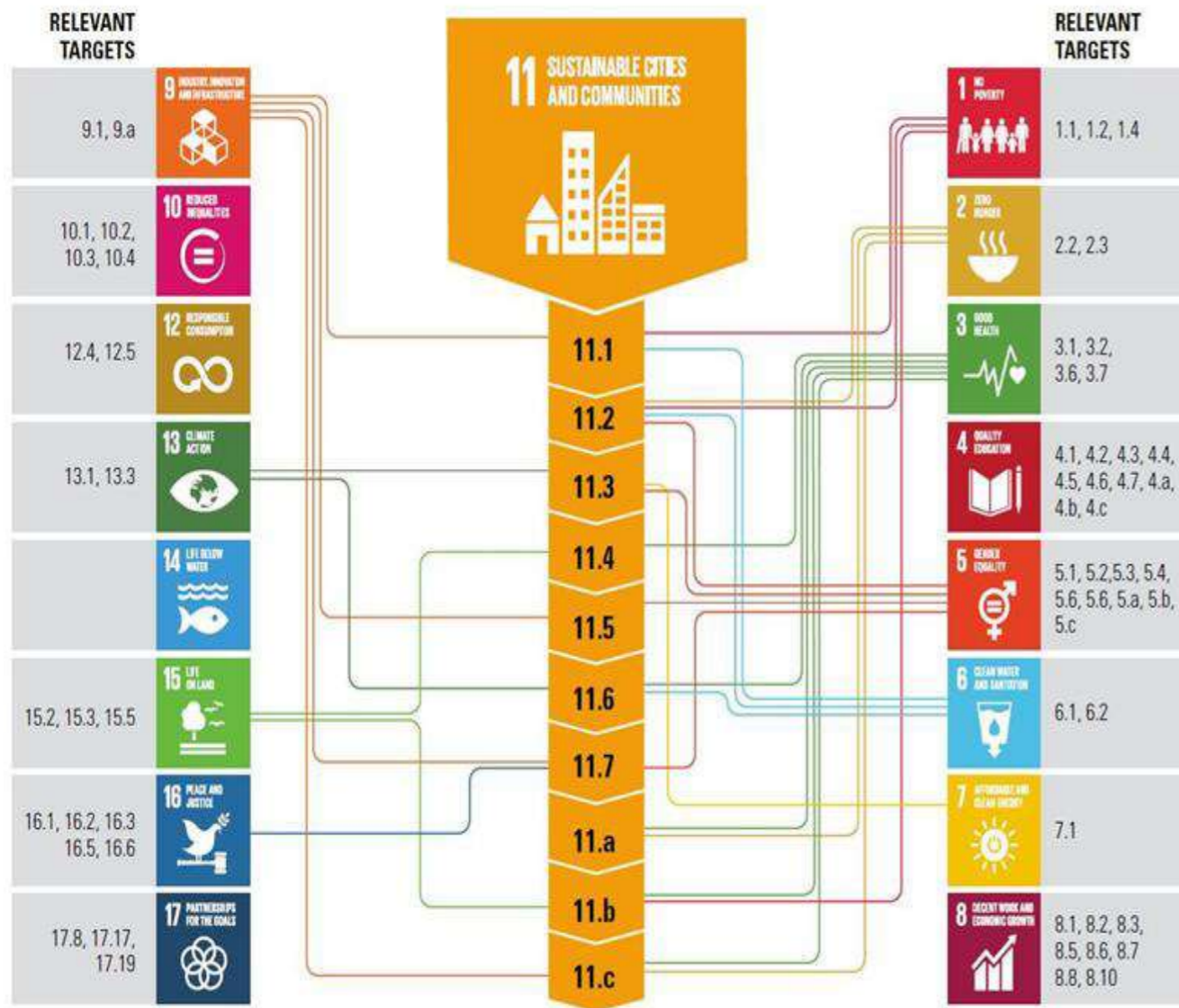
- Major challenges (Red square)
- Significant challenges (Orange square)
- Challenges remain (Yellow square)
- SDG achieved (Green square)
- Information unavailable (Grey square)
- Decreasing (Red arrow down)
- Stagnating (Orange arrow right)
- Moderately improving (Yellow arrow up-right)
- On track or maintaining SDG achievement (Green arrow up)
- Information unavailable (Grey circle)

Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Gini coefficient



11 SUSTAINABLE CITIES AND COMMUNITIES



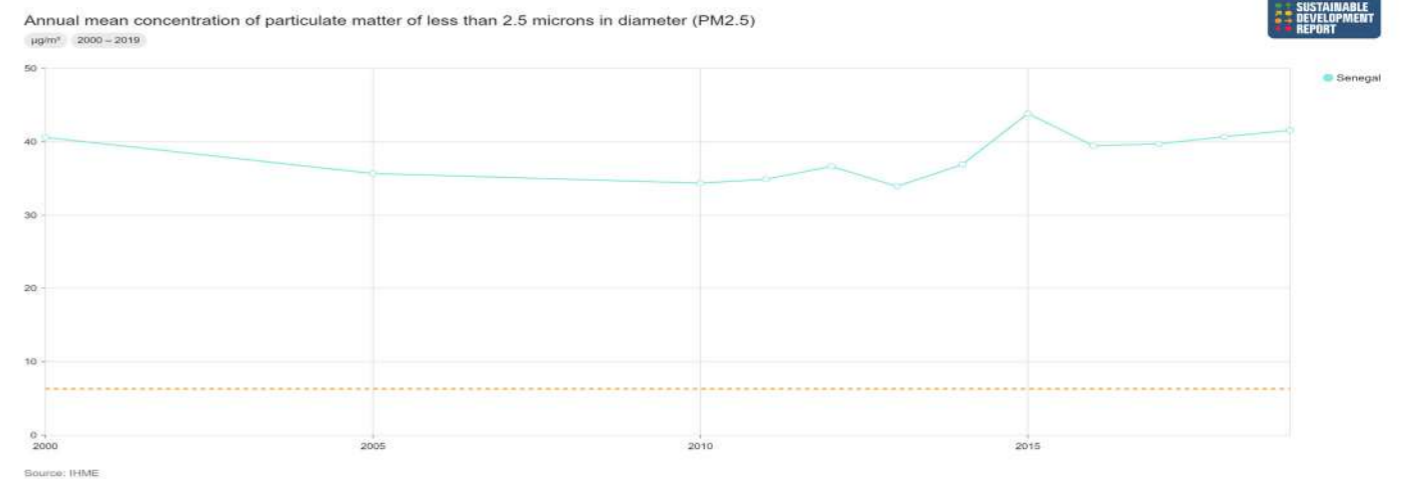
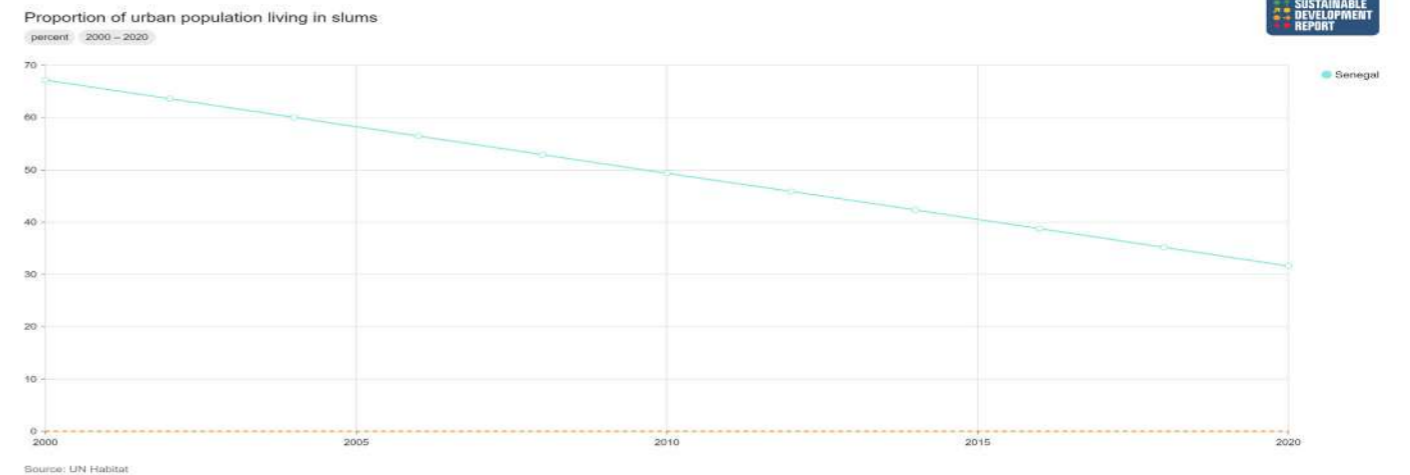
11 SUSTAINABLE CITIES AND COMMUNITIES

SDG11 – Sustainable Cities and Communities

	Value	Year	Rating	Trend
Proportion of urban population living in slums (%)	31.6	2020	●	↗
Annual mean concentration of particulate matter of less than 2.5 microns in diameter (PM2.5) (µg/m³)	41.6	2019	●	→
Access to improved water source, piped (% of urban population)	85.4	2020	●	→
Satisfaction with public transport (%)	51.0	2022	●	↗

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>



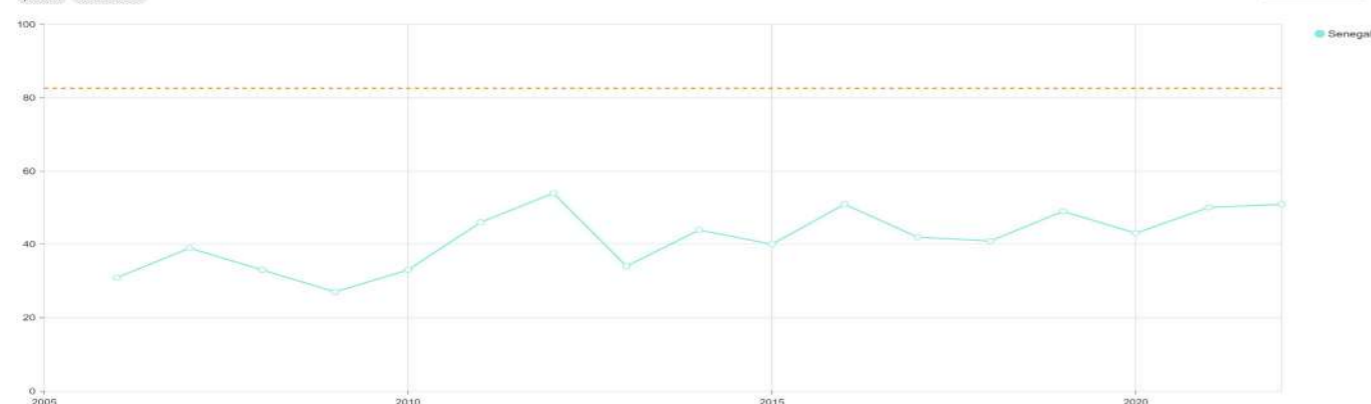
11 SUSTAINABLE CITIES AND COMMUNITIES

Access to improved water source, piped
% of urban population 2000 - 2020



Source: WHO and UNICEF

Satisfaction with public transport
percent 2006 - 2022



Source: Gallup

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

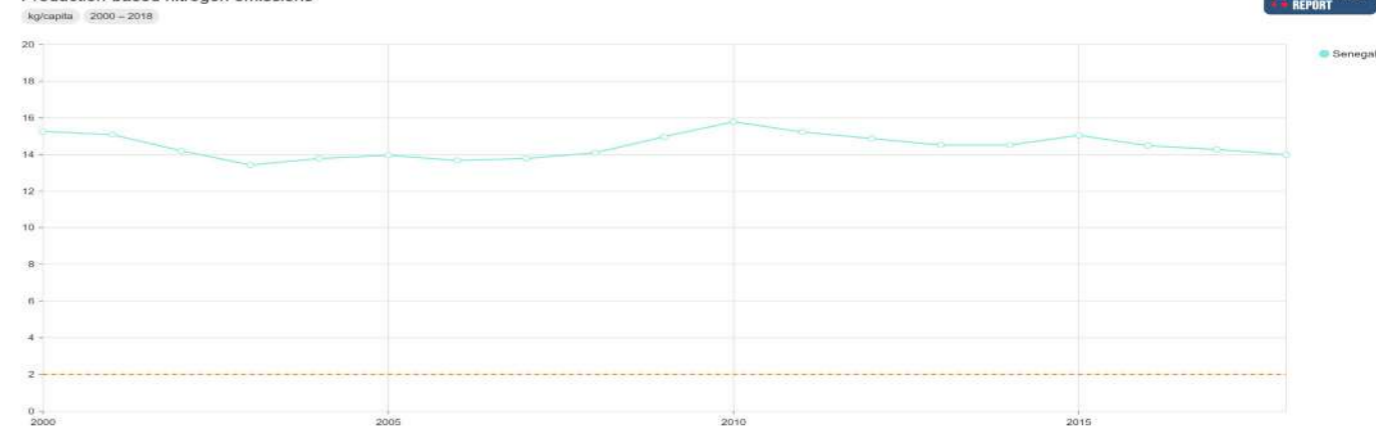
SDG12 – Responsible Consumption and Production

	Value	Year	Rating	Trend
Municipal solid waste (kg/capita/day)	0.4	2016	●	●
Electronic waste (kg/capita)	1.2	2019	●	●
Production-based SO ₂ emissions (kg/capita)	3.7	2018	●	●
SO ₂ emissions embodied in imports (kg/capita)	0.5	2018	●	●
Production-based nitrogen emissions (kg/capita)	14.0	2018	●	↑
Nitrogen emissions embodied in imports (kg/capita)	3.4	2018	●	↑
Exports of plastic waste (kg/capita)	0.2	2021	●	→

- Major challenges (Red square)
- Significant challenges (Orange square)
- Challenges remain (Yellow square)
- SDG achieved (Green square)
- Information unavailable (Grey square)
- Decreasing (Red arrow down)
- Stagnating (Orange arrow right)
- Moderately improving (Yellow arrow up-right)
- On track or maintaining SDG achievement (Green arrow up)
- Information unavailable (Grey circle)

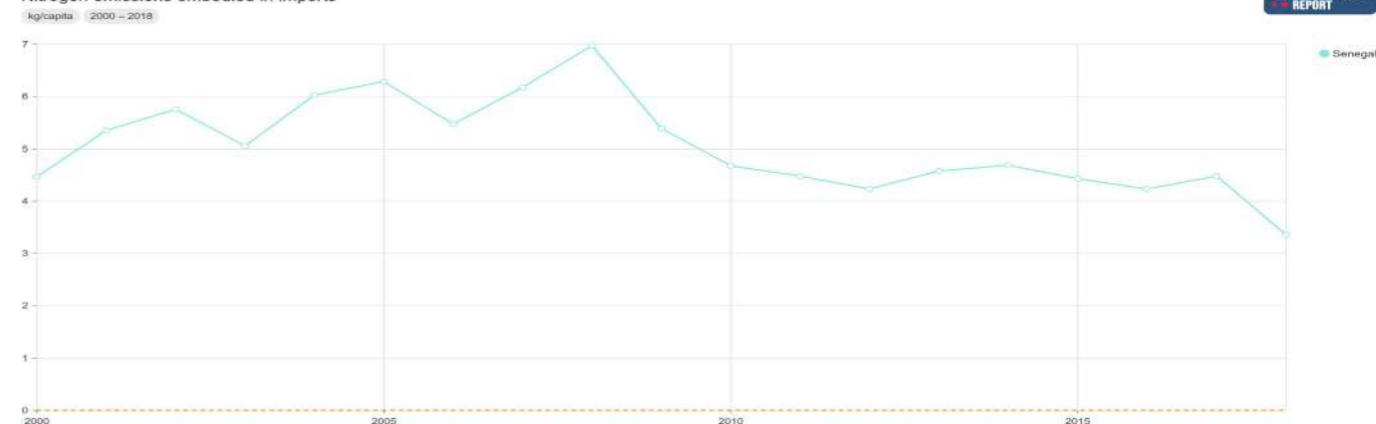
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Production-based nitrogen emissions



Source: UNEP

Nitrogen emissions embodied in imports

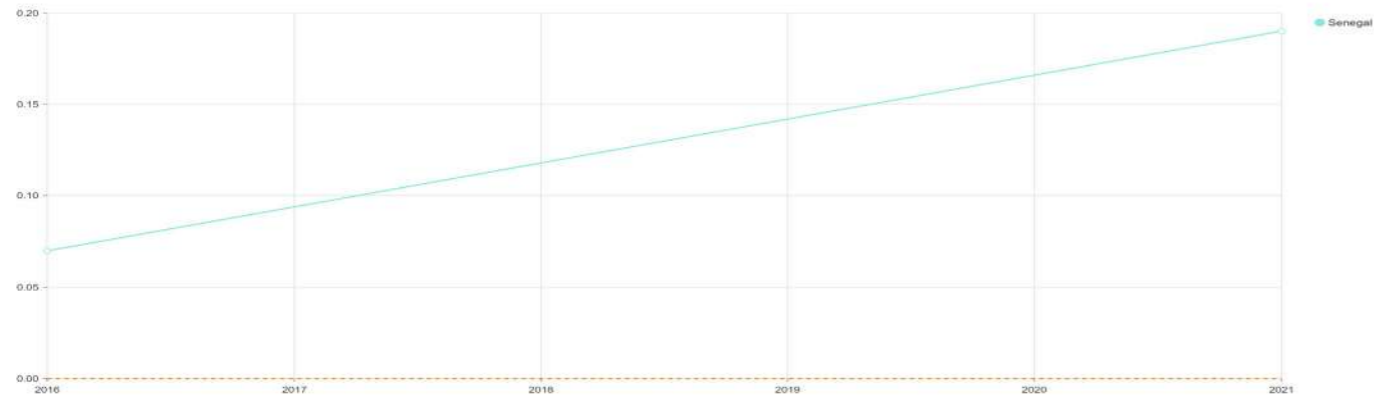


Source: UNEP

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Exports of plastic waste

kg/capita | 2016 - 2021



Source: UN Comtrade



12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Production-based SO₂ emissions

kg/capita | 2018

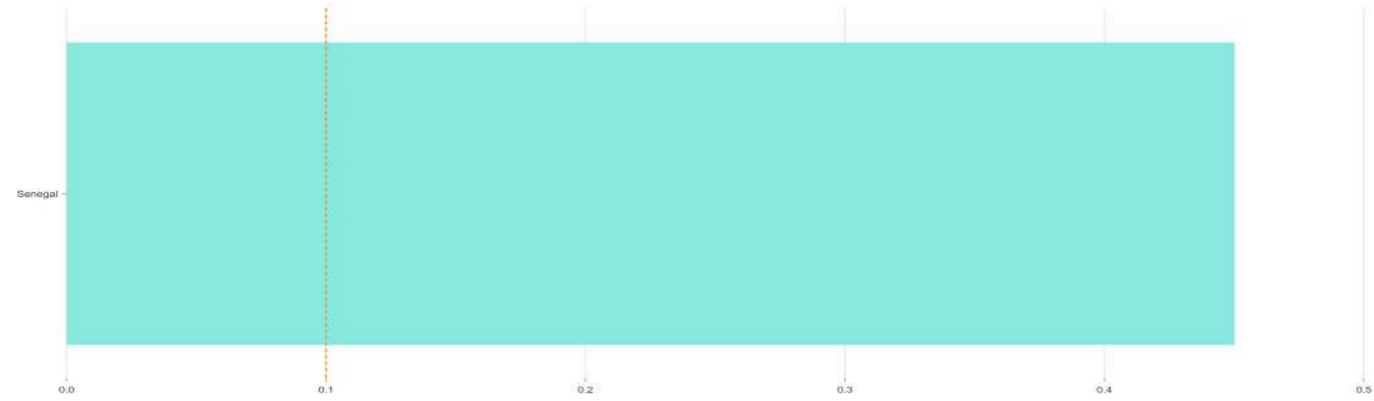


Source: Lenzen et al. (2022)



Municipal solid waste

kg/capita/day | 2019

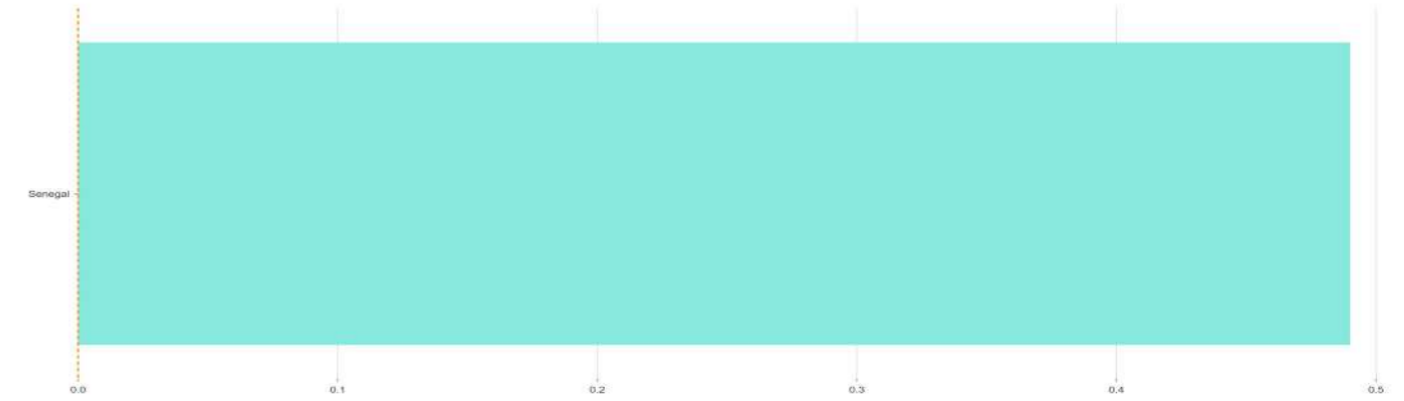


Source: World Bank



SO₂ emissions embodied in imports

kg/capita | 2018

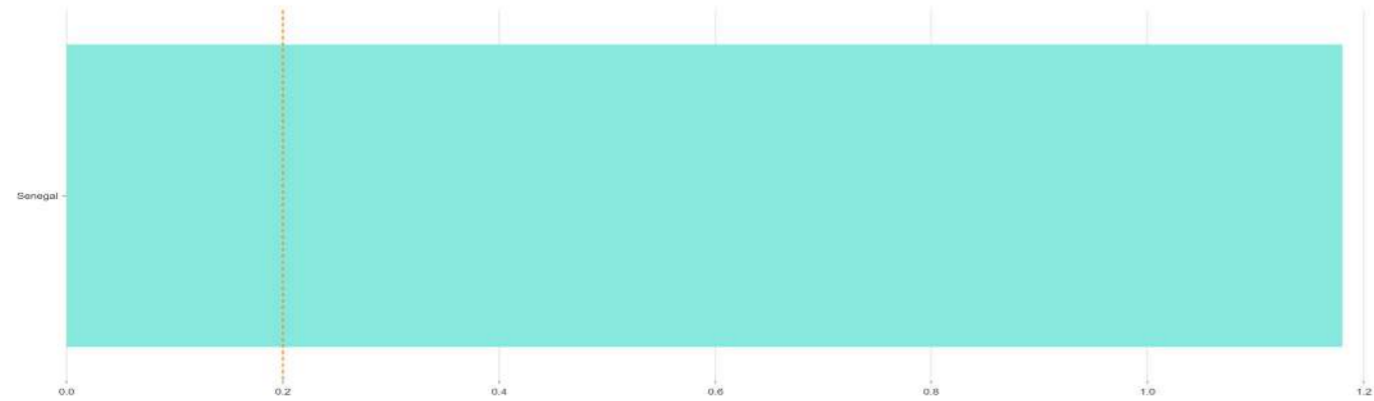


Source: Lenzen et al. (2022)



Electronic waste

kg/capita | 2019



Source: UNU-IAS



13 CLIMATE ACTION

SDG13 – Climate Action

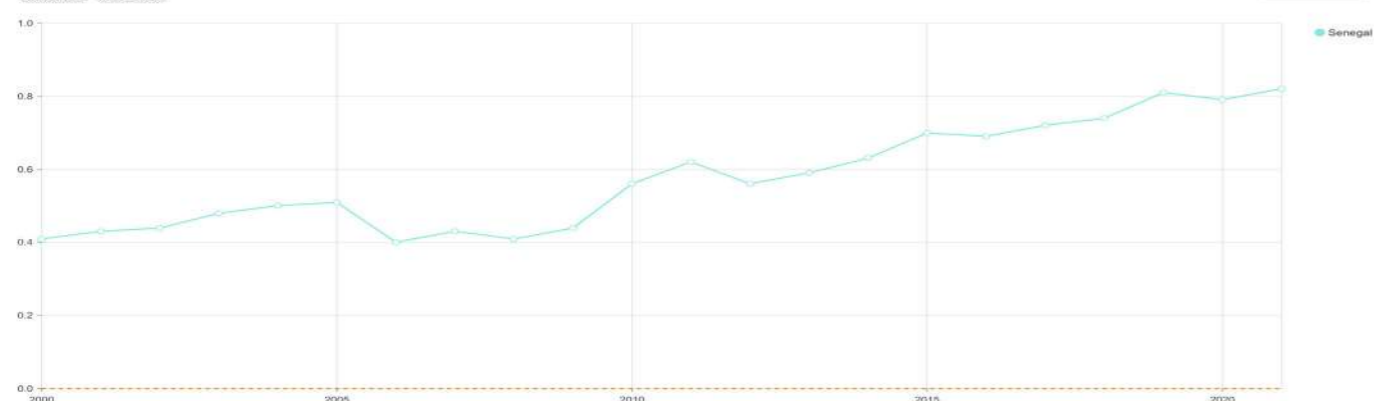
Value Year Rating Trend

CO ₂ emissions from fossil fuel combustion and cement production (tCO ₂ /capita)	0.8	2021	●	➔
CO ₂ emissions embodied in imports (tCO ₂ /capita)	0.1	2018	●	➔
CO ₂ emissions embodied in fossil fuel exports (kg/capita)	0.0	2021	●	●

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 ➔ Stagnating
 ➔ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

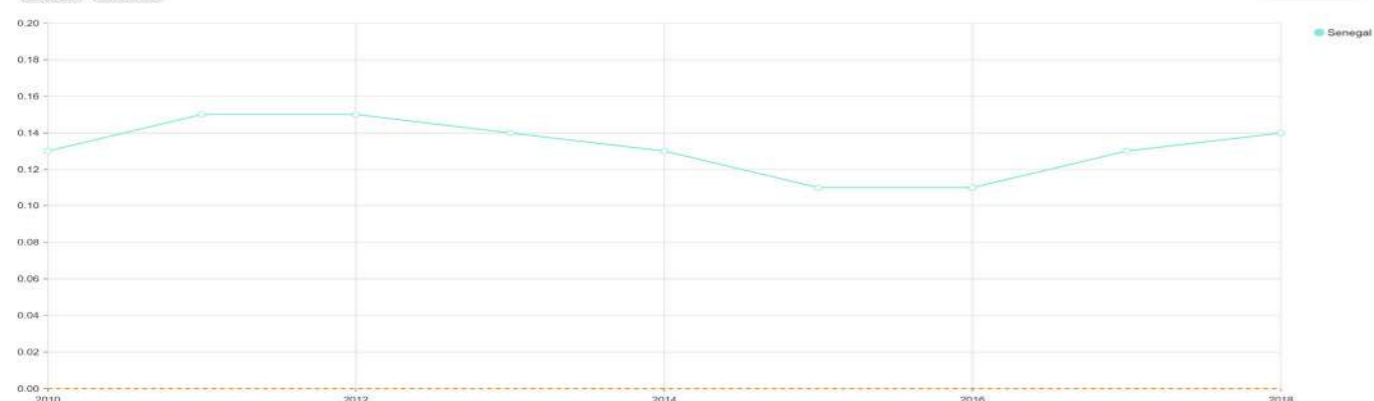
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

CO₂ emissions from fossil fuel combustion and cement production (tCO₂/capita) 2000 – 2021



Source: Global Carbon Project

CO₂ emissions embodied in imports (tCO₂/capita) 2010 – 2018



Source: Lenzen et al. (2022)

14 LIFE BELOW WATER

SDG14 – Life Below Water

Value Year Rating Trend

Mean area that is protected in marine sites important to biodiversity (%)	36.7	2022	●	➔
Ocean Health Index: Clean Waters score (worst 0–100 best)	43.8	2022	●	↓
Fish caught from overexploited or collapsed stocks (% of total catch)	14.4	2018	●	↑
Fish caught by trawling or dredging (%)	6.0	2019	●	↑
Fish caught that are then discarded (%)	5.0	2019	●	↑
Marine biodiversity threats embodied in imports (per million population)	0.0	2018	●	●

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 ➔ Stagnating
 ➔ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

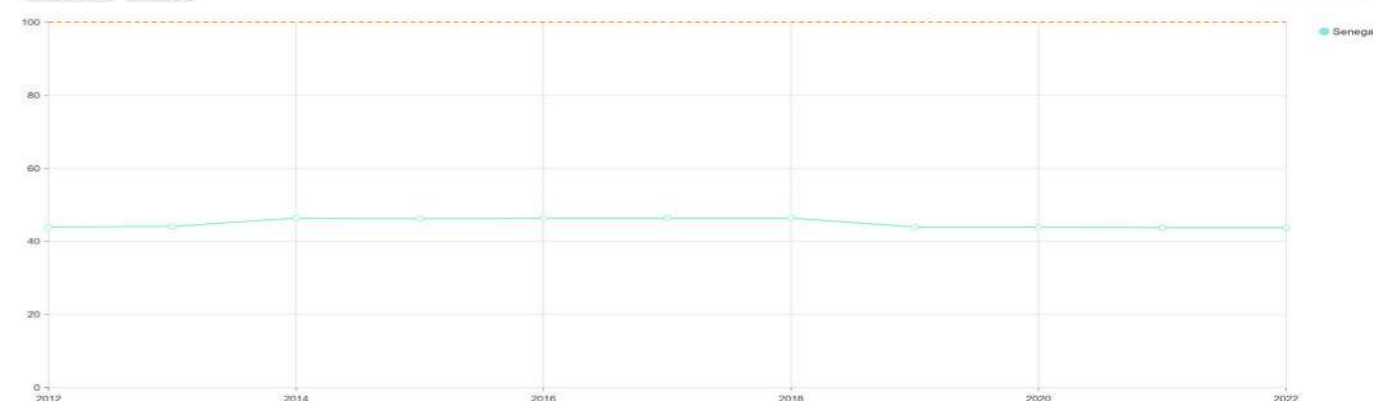
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Mean area that is protected in marine sites important to biodiversity (percent) 2000 – 2022



Source: Birdlife International et al.

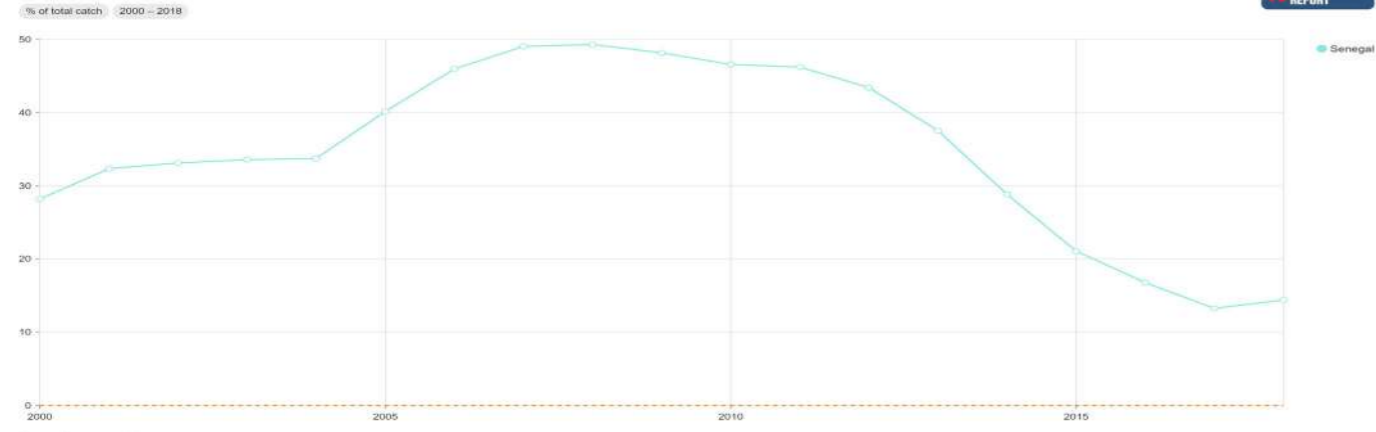
Ocean Health Index: Clean Waters score (worst 0–100 best) 2012 – 2022



Source: Ocean Health Index

14 LIFE BELOW WATER

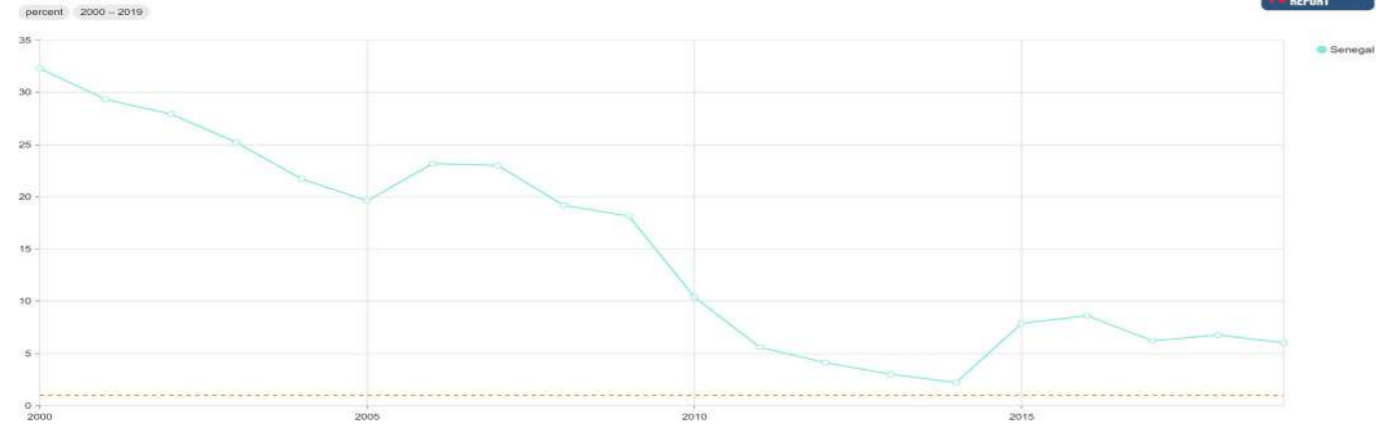
Fish caught from overexploited or collapsed stocks



Source: Sea around Us



Fish caught by trawling or dredging



Source: Sea Around Us



Fish caught that are then discarded

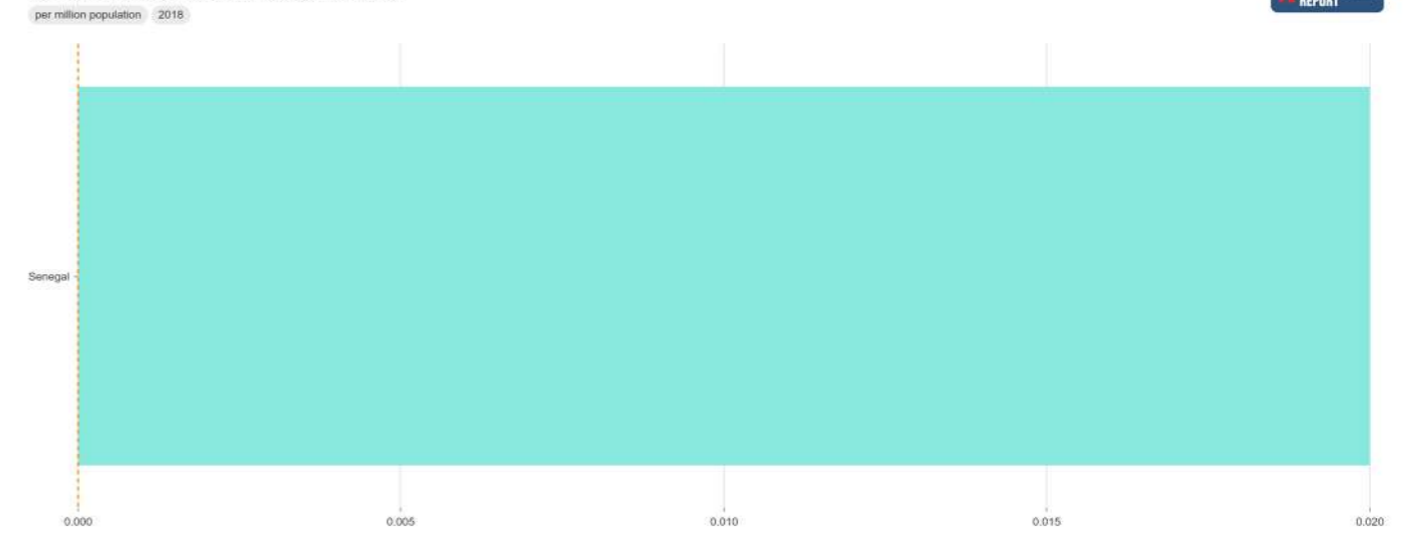


Source: Sea around Us



14 LIFE BELOW WATER

Marine biodiversity threats embodied in imports



Source: Lenzen et al. (2012) data updated to 2018



15 LIFE ON LAND

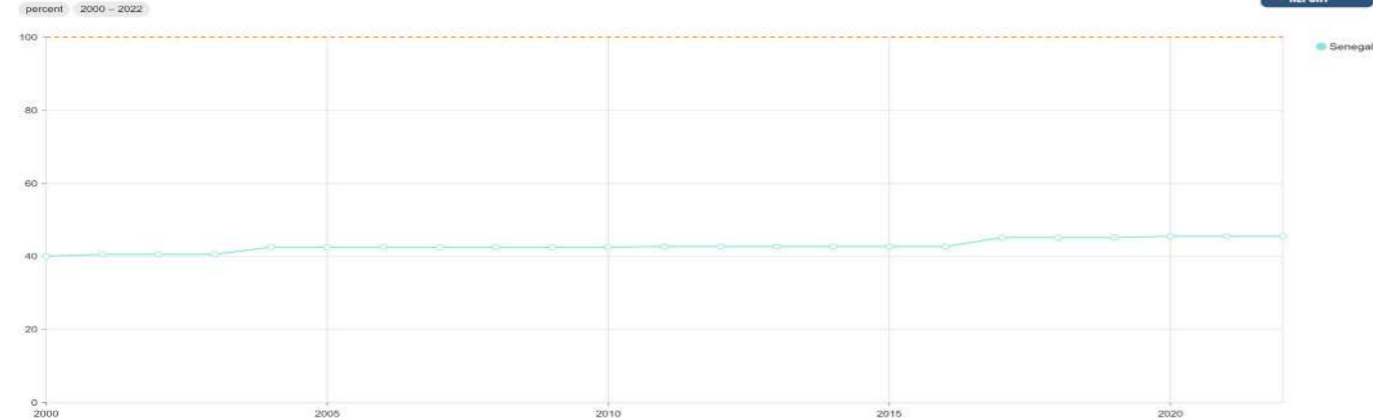
SDG15 – Life on Land

	Value	Year	Rating	Trend
Mean area that is protected in terrestrial sites important to biodiversity (%)	45.4	2022	●	→
Mean area that is protected in freshwater sites important to biodiversity (%)	23.9	2022	●	→
Red List Index of species survival (worst 0–1 best)	0.94	2023	●	→
Permanent deforestation (% of forest area, 3-year average)	0.3	2021	●	→
Terrestrial and freshwater biodiversity threats embodied in imports (per million population)	0.1	2018	●	●

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

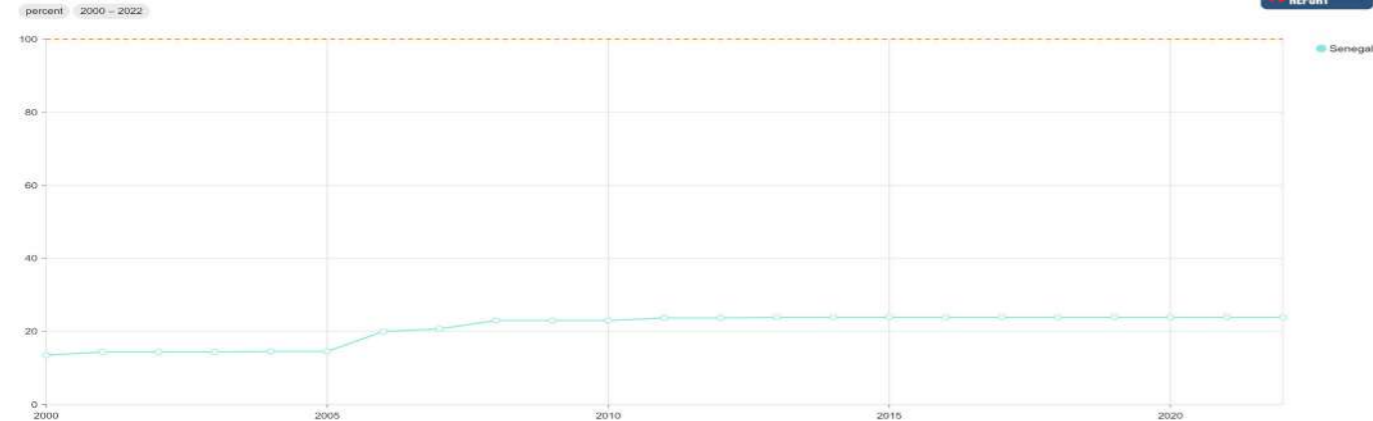
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Mean area that is protected in terrestrial sites important to biodiversity



Source: Birdlife International et al.

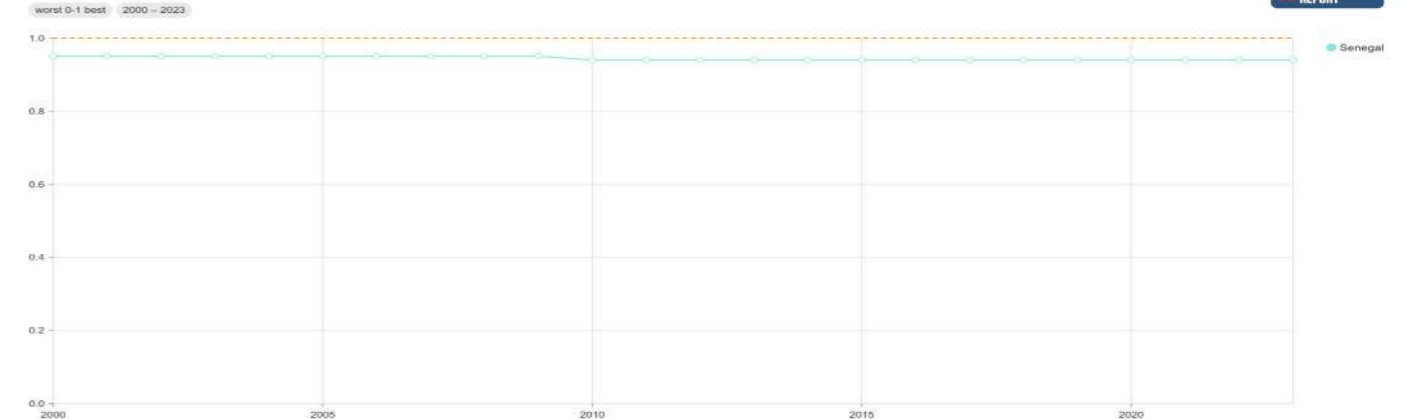
Mean area that is protected in freshwater sites important to biodiversity



Source: Birdlife International et al.

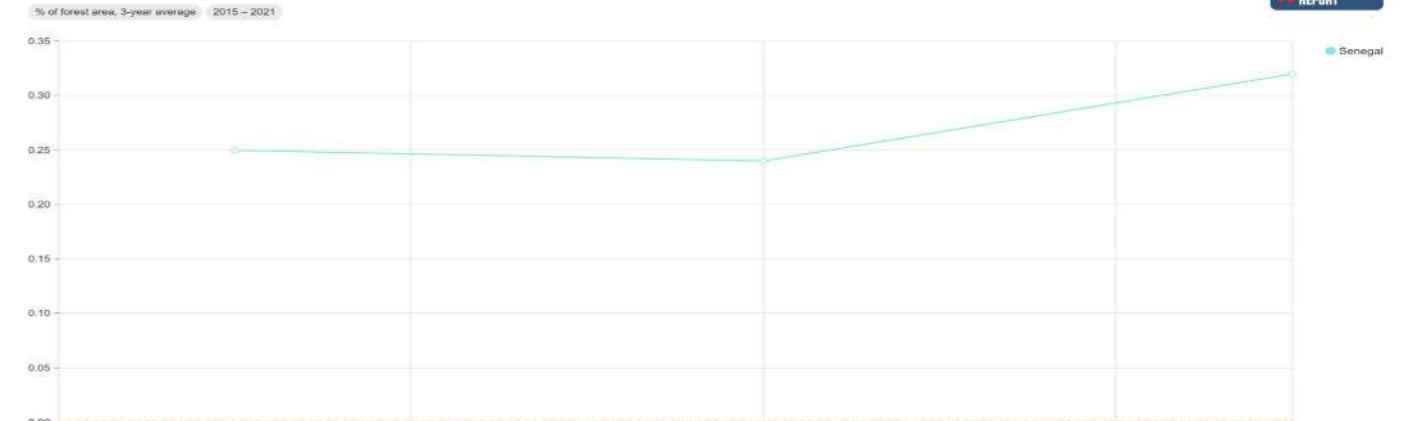
15 LIFE ON LAND

Red List Index of species survival



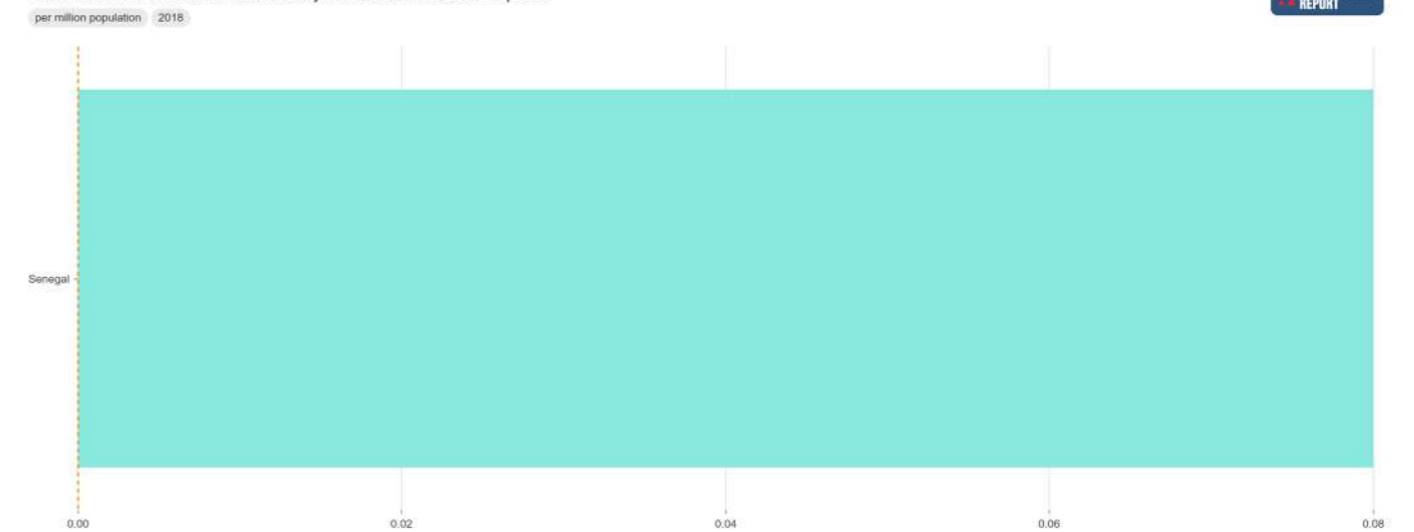
Source: IUCN and Birdlife International

Permanent deforestation



Source: Curtis et al. (2018) data updated to 2021

Terrestrial and freshwater biodiversity threats embodied in imports



Source: Lenzen et al. (2012) data updated to 2018

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

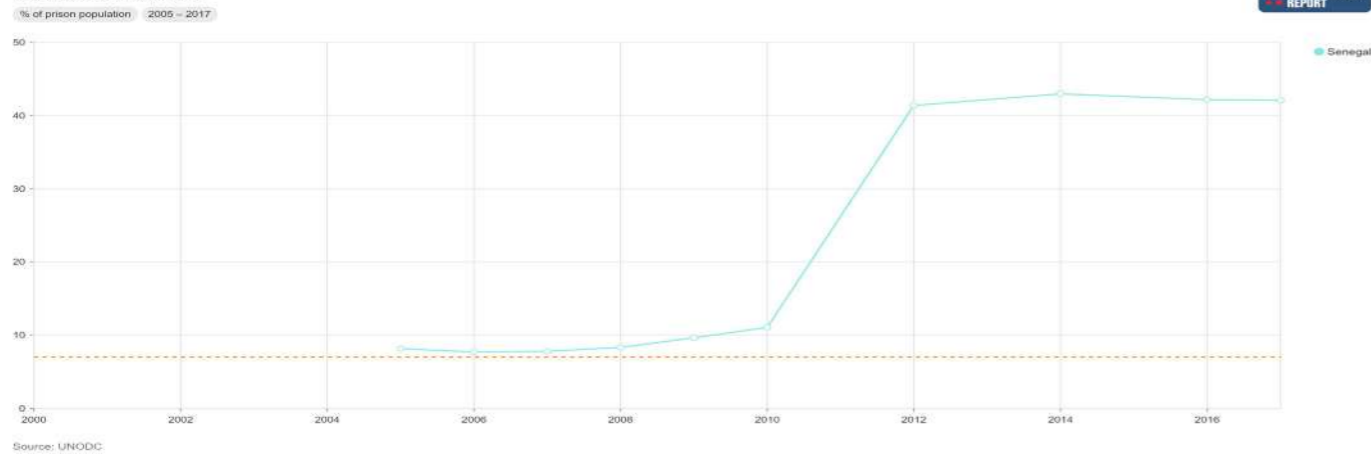
SDG16 – Peace, Justice and Strong Institutions

	Value	Year	Rating	Trend
Homicides (per 100,000 population)	NA	NA	●	●
Unsentenced detainees (% of prison population)	42.1	2017	●	●
Population who feel safe walking alone at night in the city/area where they live (%)	57	2022	●	↗
Birth registrations with civil authority (% of children under age 5)	78.7	2019	●	●
Corruption Perceptions Index (worst 0–100 best)	43	2022	●	↓
Children involved in child labor (% of population aged 5 to 14)	22.8	2016	●	●
Exports of major conventional weapons (TIV constant million USD per 100,000 population)	0.0	2021	●	●
Press Freedom Index (worst 0–100 best)	55.8	2023	●	↓
Access to and affordability of justice (worst 0–1 best)	0.5	2021	●	↗
Timeliness of administrative proceedings (worst 0–1 best)	0.5	2021	●	→
Expropriations are lawful and adequately compensated (worst 0–1 best)	0.6	2021	●	↓

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

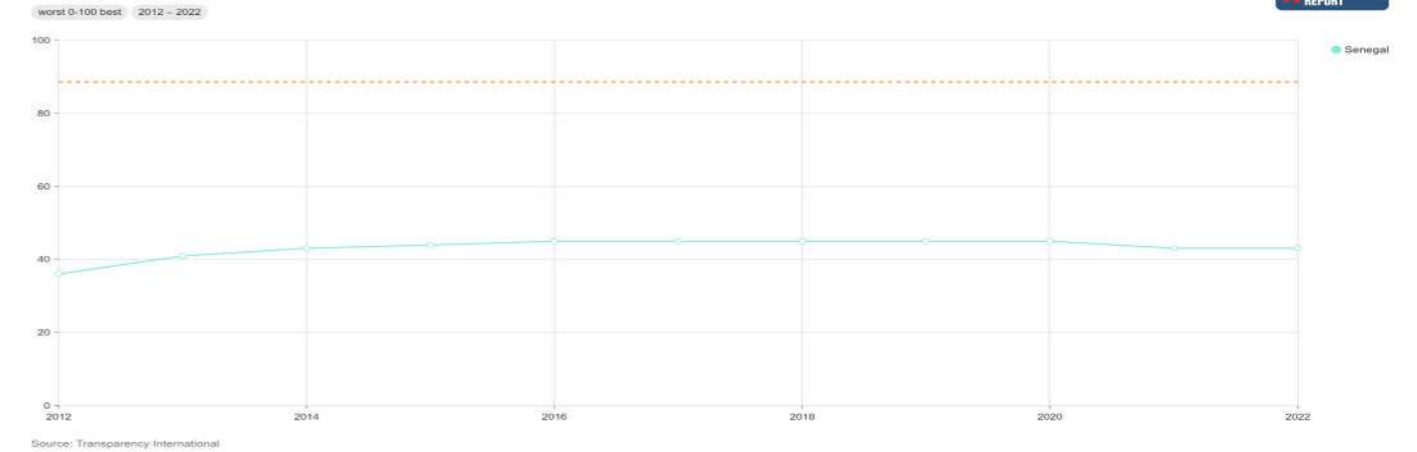
Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Unsentenced detainees

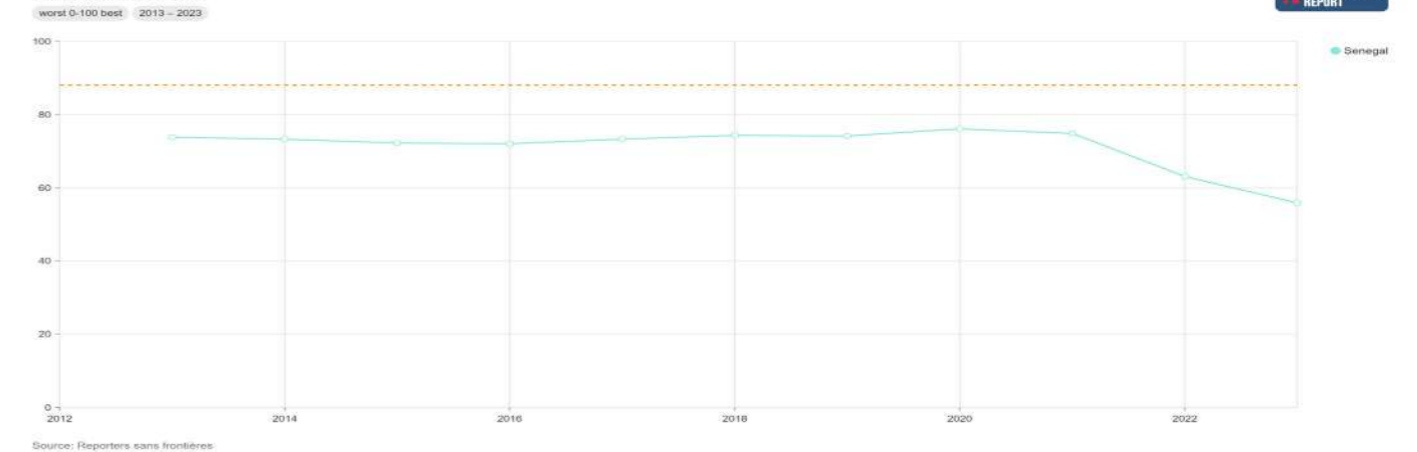


16 PEACE, JUSTICE AND STRONG INSTITUTIONS

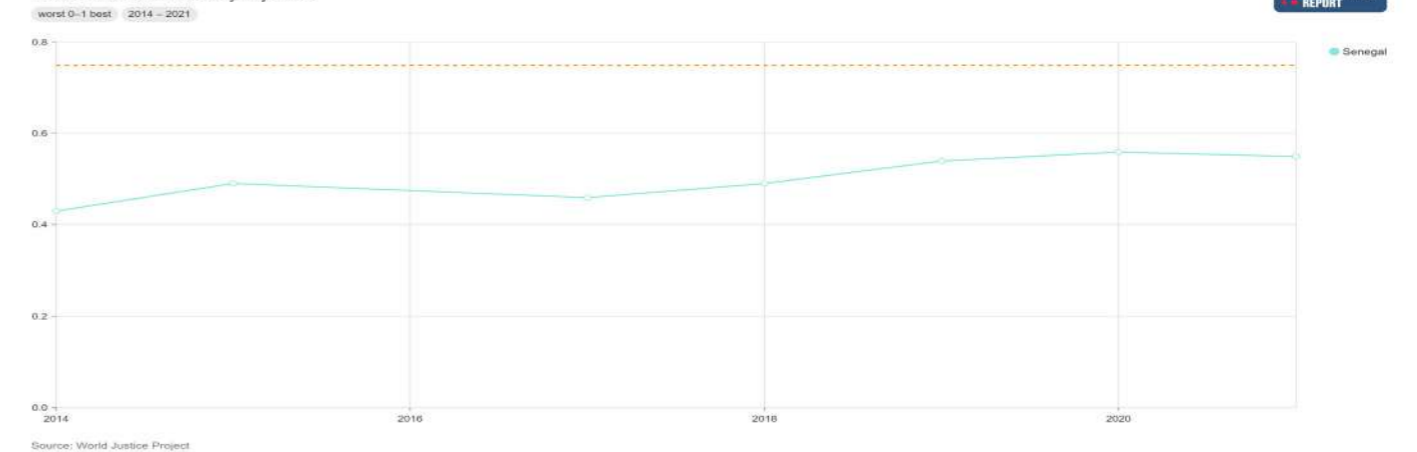
Corruption Perceptions Index



Press Freedom Index



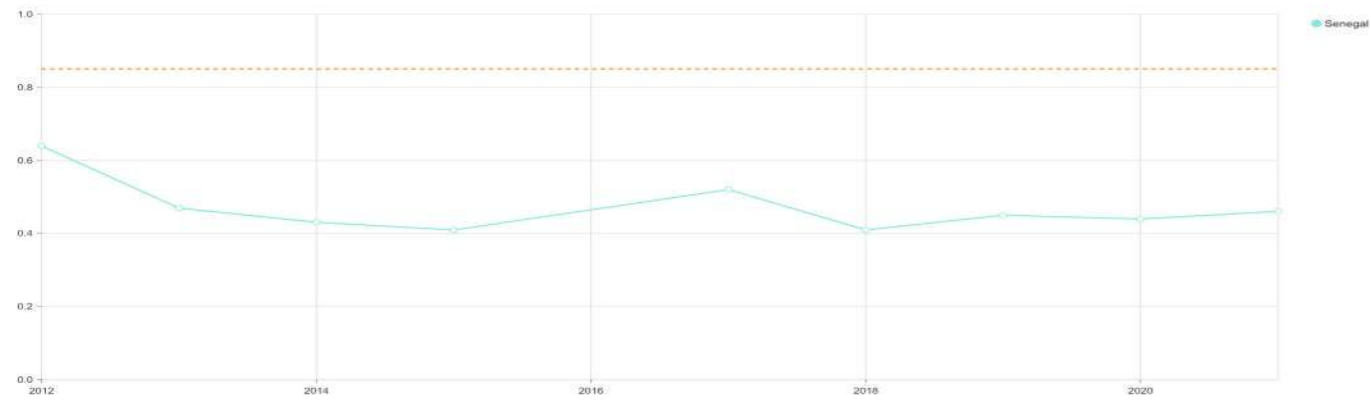
Access to and affordability of justice



16 PEACE, JUSTICE AND STRONG INSTITUTIONS

Timeliness of administrative proceedings

worst 0 - 1 best | 2012 - 2021



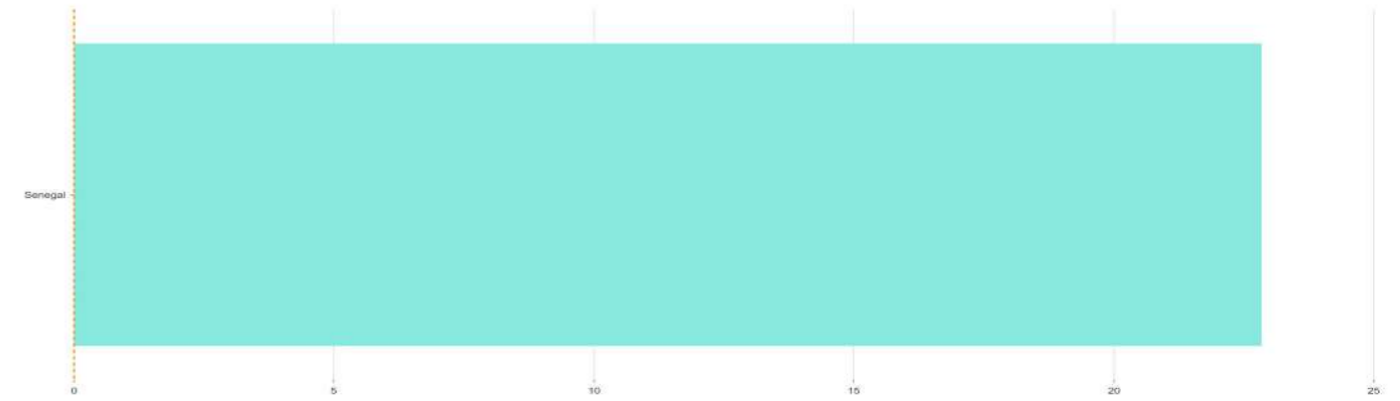
Source: World Justice Project



16 PEACE, JUSTICE AND STRONG INSTITUTIONS

Children involved in child labor

% of population aged 5 to 14 | 2021

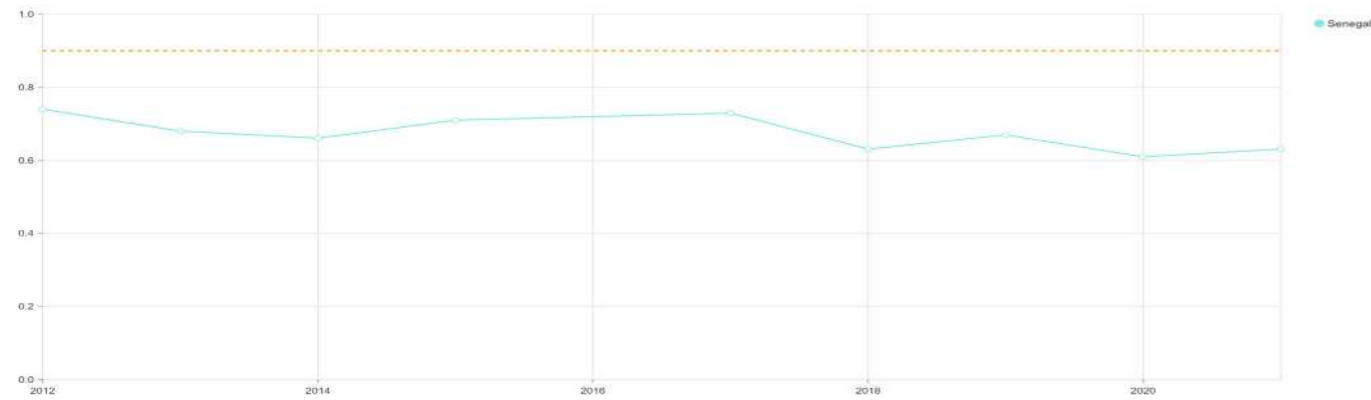


Source: UNICEF



Expropriations are lawful and adequately compensated

worst 0 - 1 best | 2012 - 2021

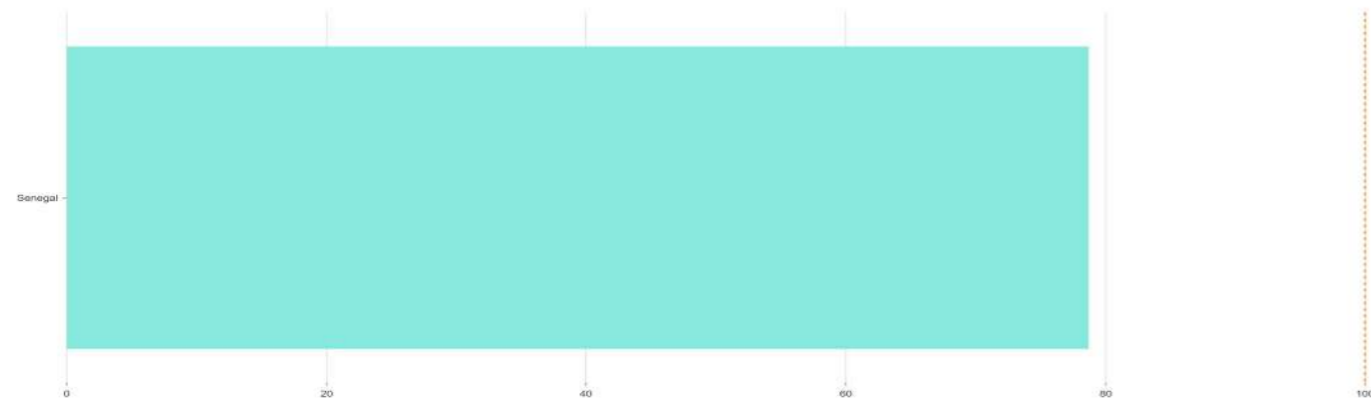


Source: World Justice Project



Birth registrations with civil authority

% of children under age 5 | 2022



Source: UNICEF



17 PARTNERSHIPS FOR THE GOALS

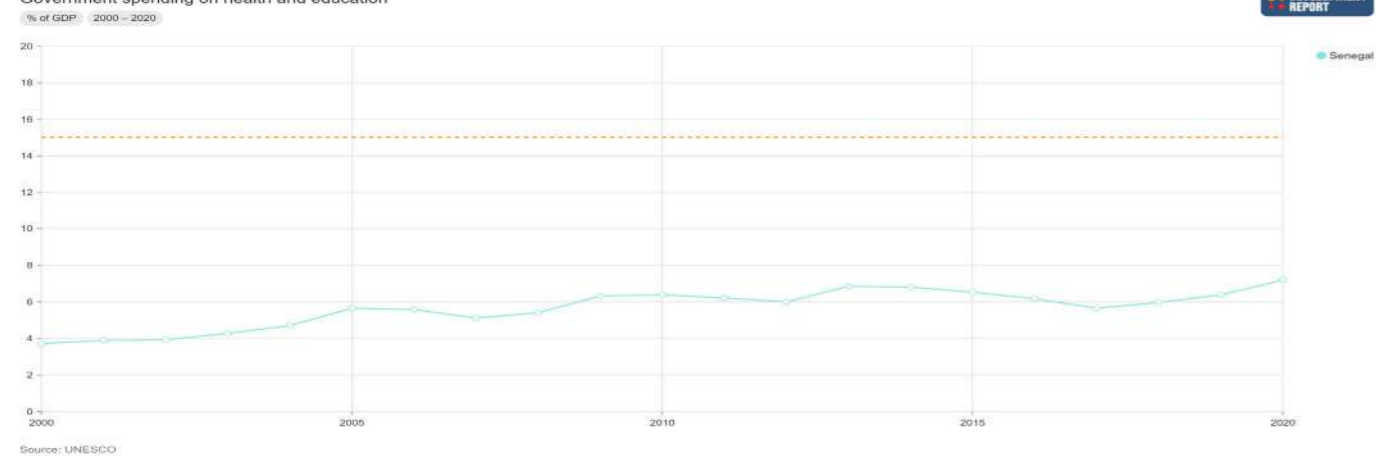
SDG17 – Partnerships for the Goals

	Value	Year	Rating	Trend
Government spending on health and education (% of GDP)	7.2	2020	●	↗
For high-income and all OECD DAC countries: International concessional public finance, including official development assistance (% of GNI)	NA	NA	●	●
Other countries: Government revenue excluding grants (% of GDP)	19.8	2018	●	●
Corporate Tax Haven Score (best 0–100 worst)	*	0	●	●
Statistical Performance Index (worst 0–100 best)	72.2	2022	●	↗

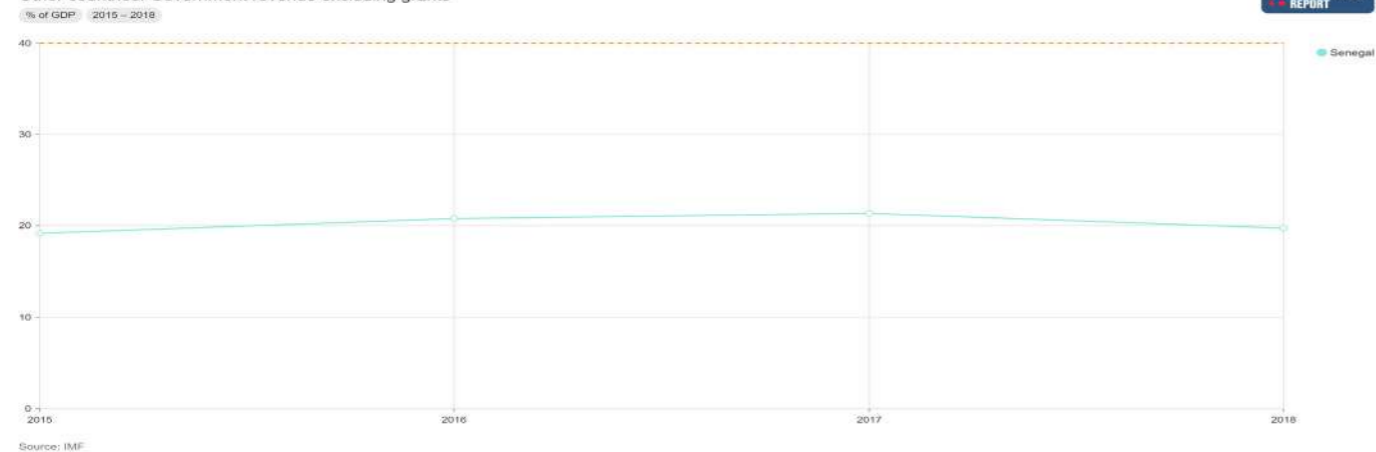
- Major challenges
- Significant challenges
- Challenges remain
- SDG achieved
- Information unavailable
- ↓ Decreasing
- Stagnating
- ↗ Moderately improving
- ↑ On track or maintaining SDG achievement
- Information unavailable

Note: The full title of each SDG is available here: <https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>

Government spending on health and education

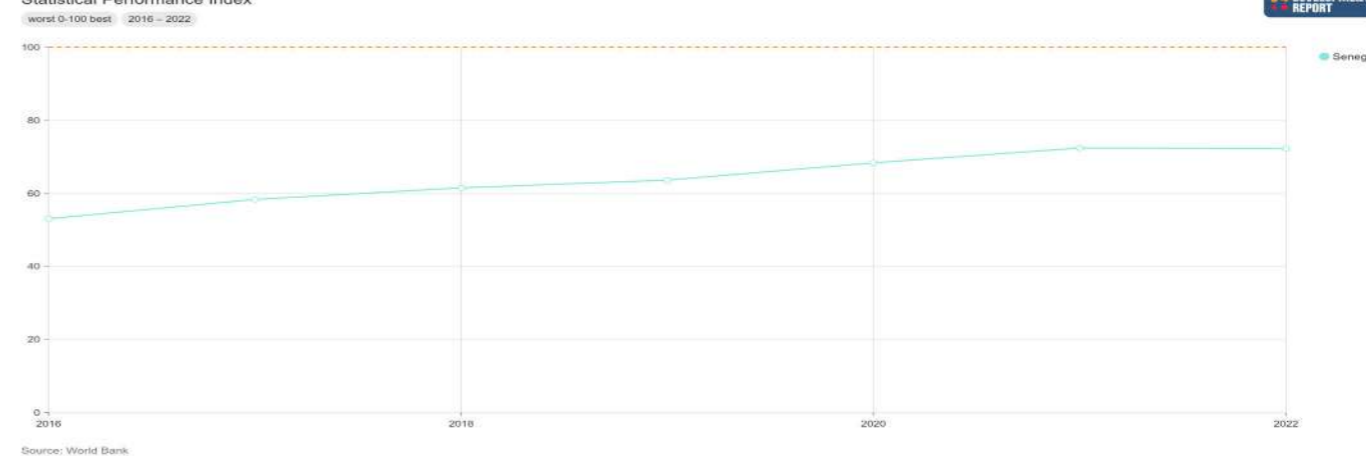


Other countries: Government revenue excluding grants



17 PARTNERSHIPS FOR THE GOALS

Statistical Performance Index



3.3. Phase I Investigation: Analysis and synthesis

STUDY SCALES

Global scale_1:55000
 Intermediate scale_1:20000
 Local scale_1:6000

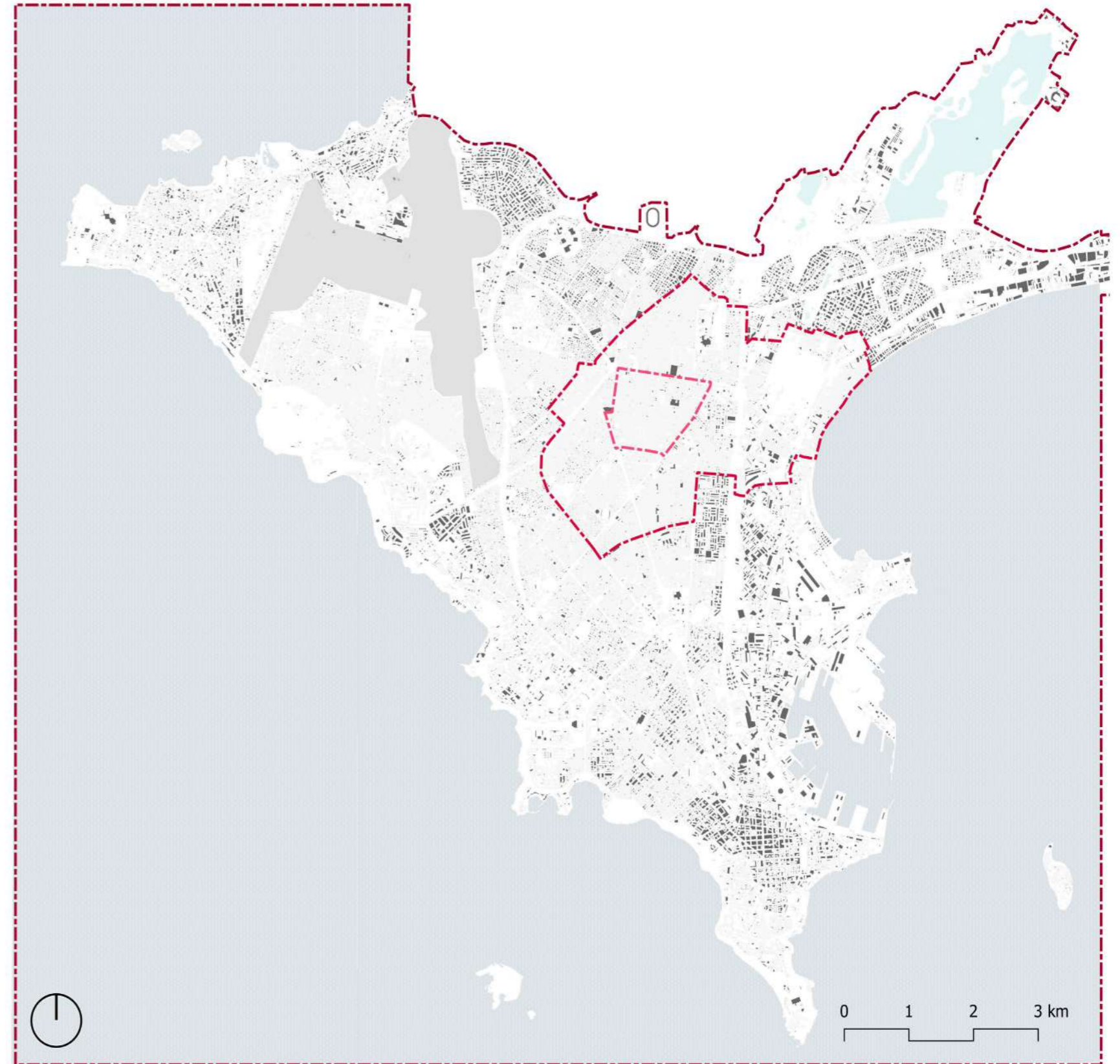
Horizontal Investigation

- 1. Volumes
- 2. Voids
- 3. Types of uses
- 4. Links

LEGEND

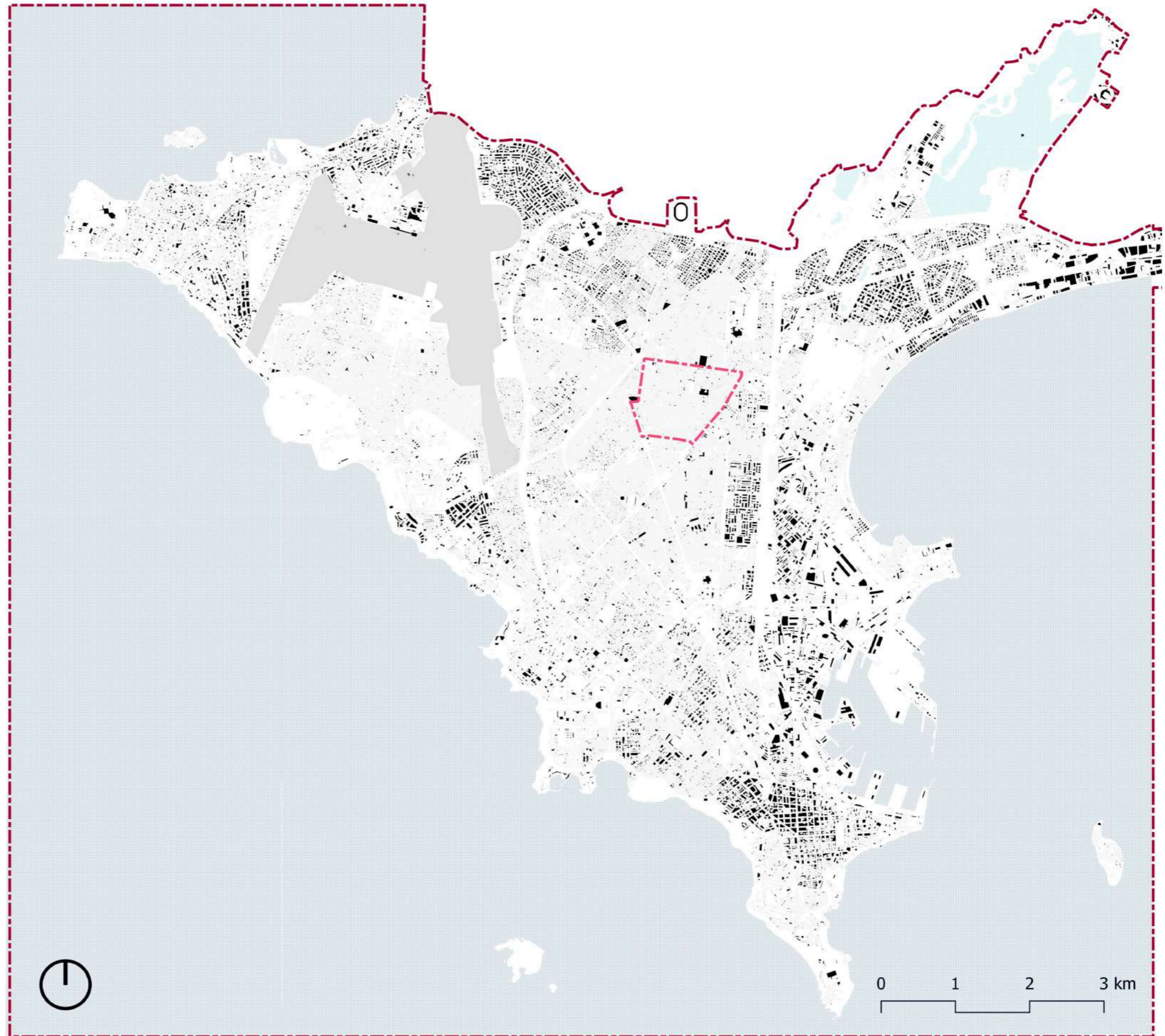
Boundaries

-  Global boundary
-  Intermediate boundary
-  Local boundary



Volumes

Global scale_1:55000



LEGEND


Boundaries

 Global boundary

 Local boundary

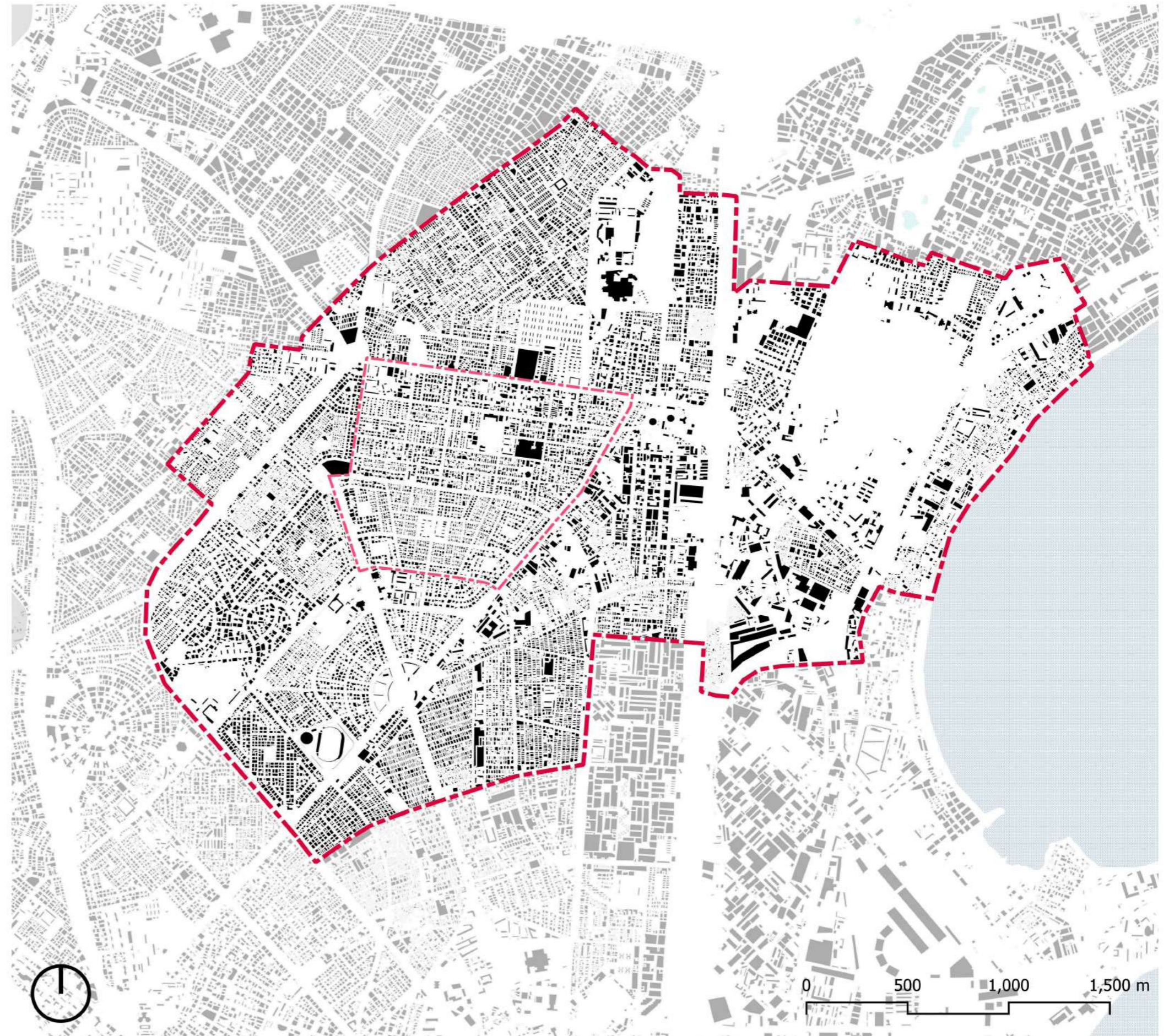
Horizontal investigation

Volumes

 Global boundary volumes

Volumes

Intermediate scale_1:20000



LEGEND

Boundaries

- Global boundary
- Intermediate boundary
- Local boundary

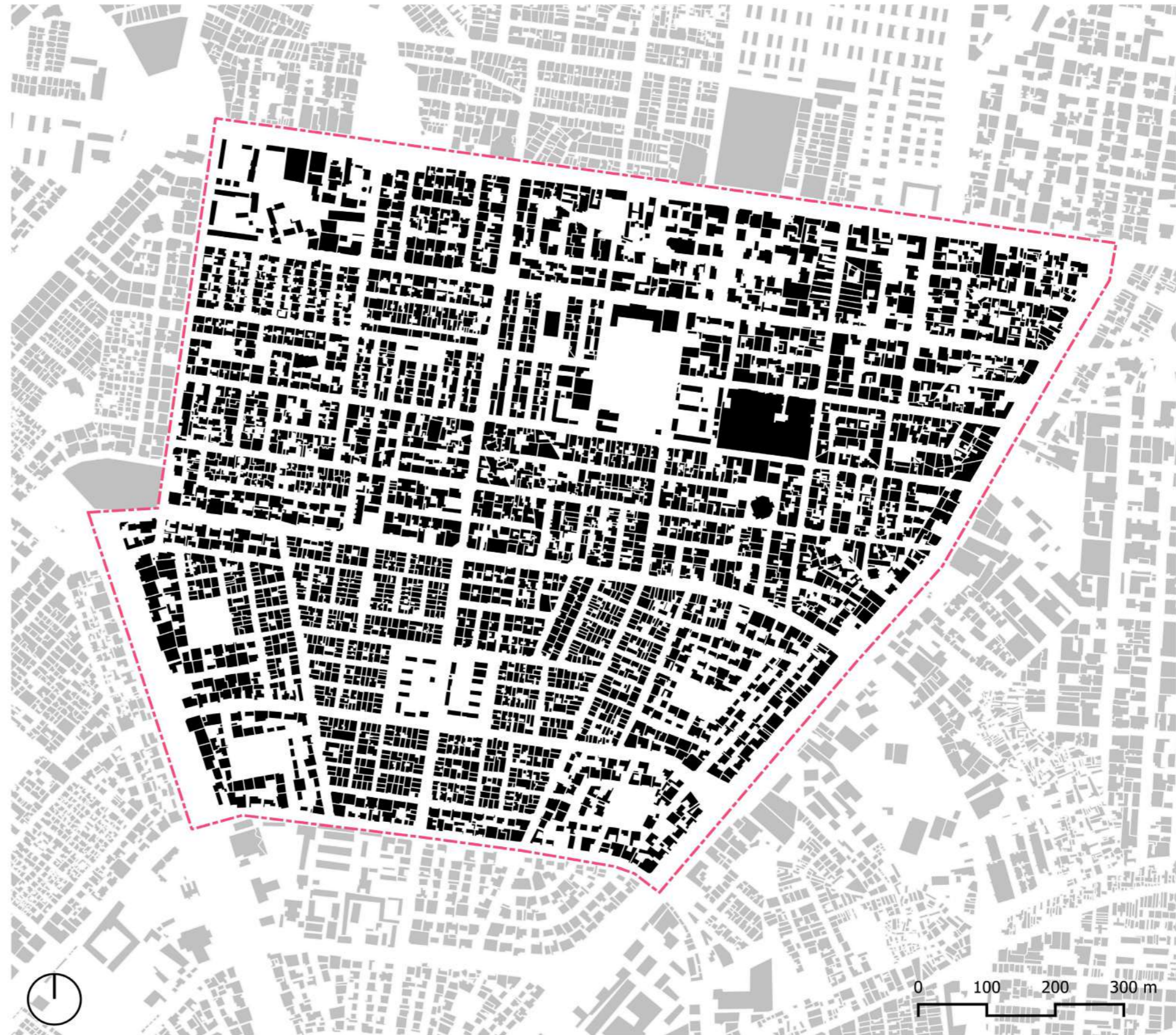
Horizontal investigation

Volumes

- Intermediate boundary volumes

Volumes

Local scale_1:6000




LEGEND

Boundaries

 Local boundary

Horizontal investigation

Volumes

 Local boundary volumes

Voids

Global scale_1:55000

LEGEND

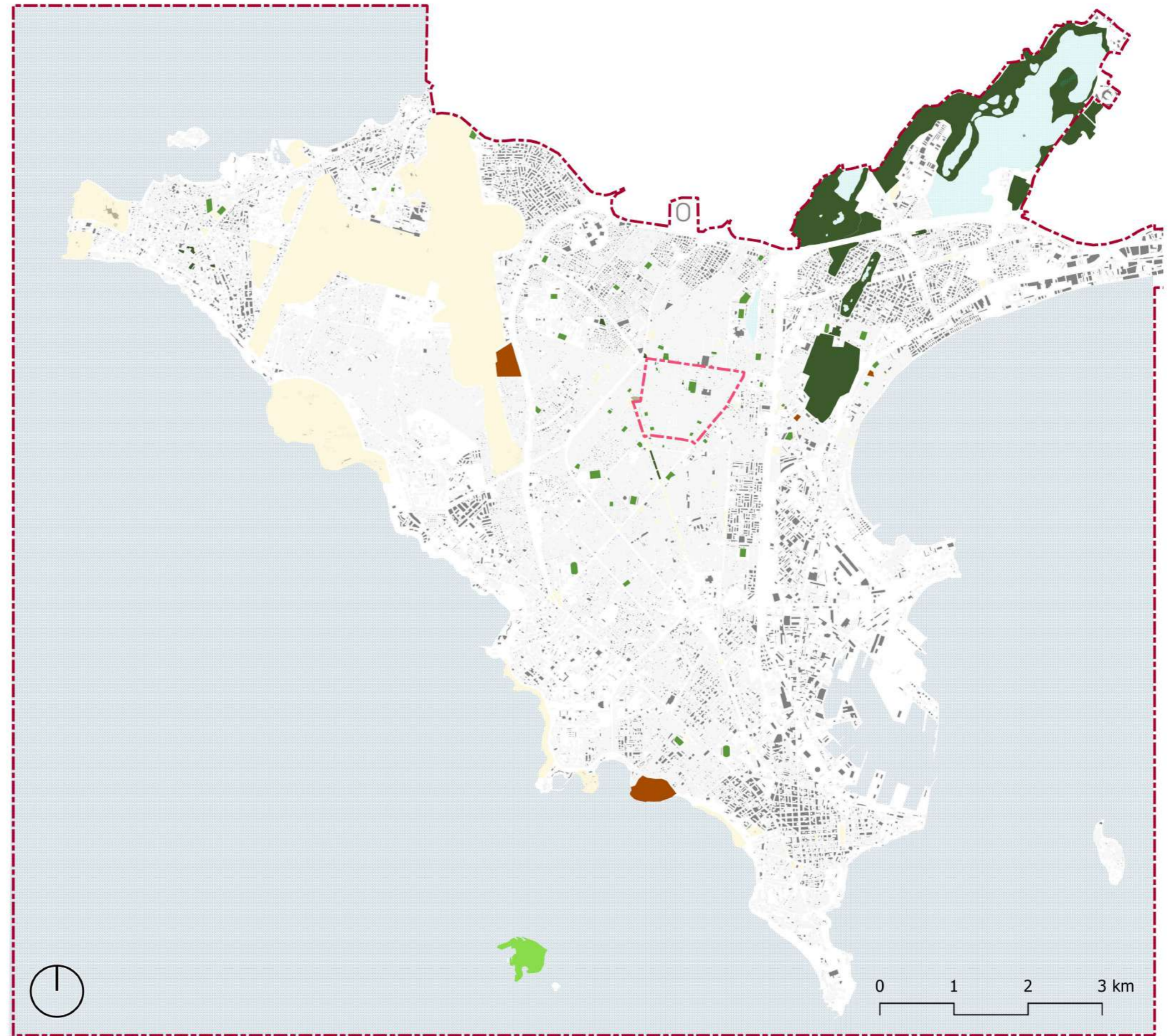
Boundaries

- Global boundary
- Local boundary

Horizontal investigation

Voids

- Global boundary voids
- Open green area,zoo
- Sports activites
- Island
- Ocean
- Wetland, water
- Cemetery
- Others



Voids

Intermediate scale_1:20000








LEGEND

Boundaries

-  Global boundary
-  Intermediate boundary
-  Local boundary

Horizontal investigation

Voids

- Intermediate boundary voids
-  Open green area, zoo
-  Sports activities
-  Island
-  Ocean
-  Wetland, water
-  Cemetery
-  Others



Voids

Local scale_1:6000

LEGEND


Boundaries

 Local boundary

Horizontal investigation

Voids

Local boundary voids


 Open green area, zoo

 Sports activities


 Wetland, water

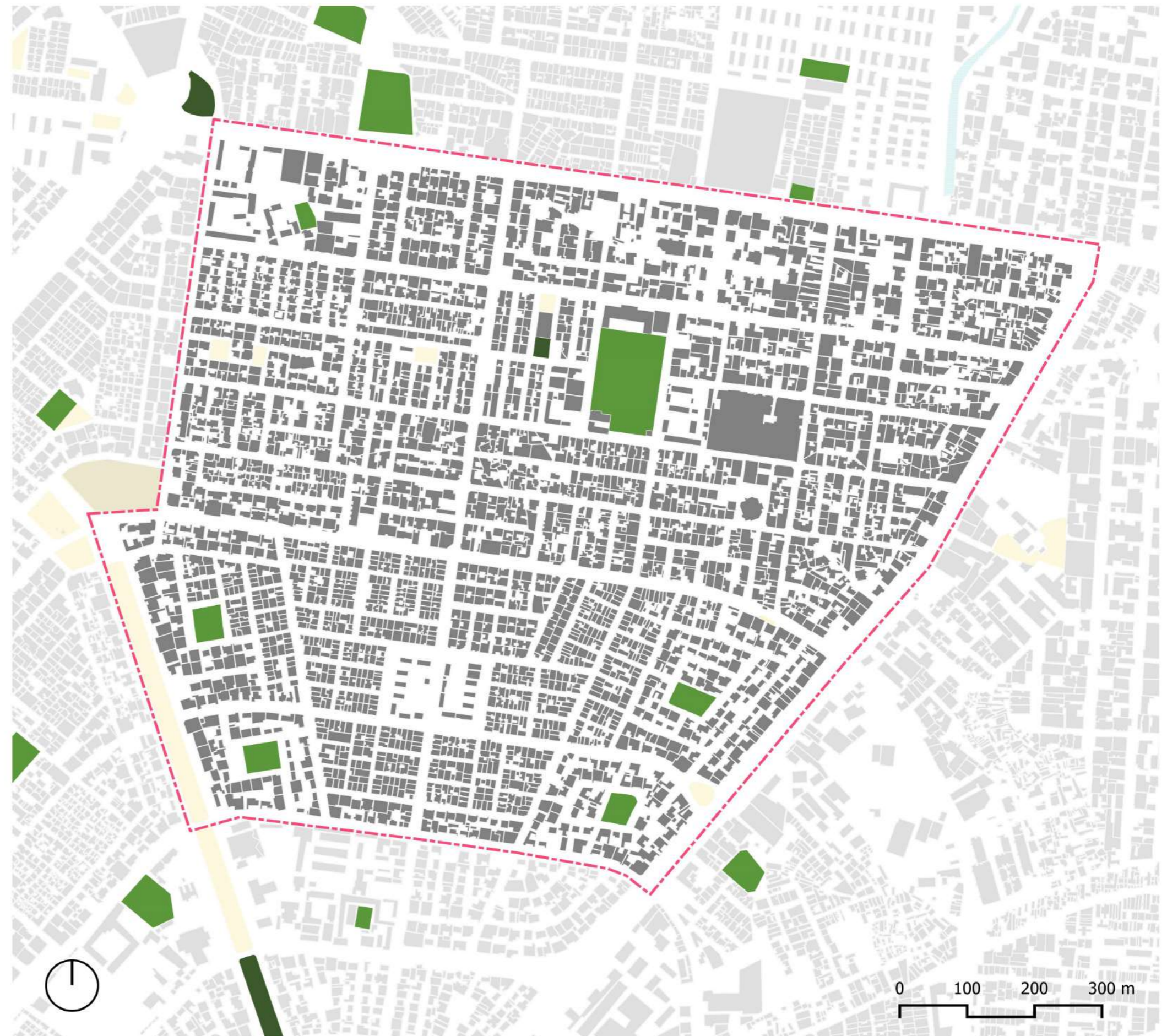
 Cemetery

 Others

 Global boundary volume

 Intermediate boundary volumes

 Local boundary volumes



Types of uses_volumes

Global scale_1:55000

LEGEND

Boundaries

- Global boundary
- Local boundary

Horizontal investigation

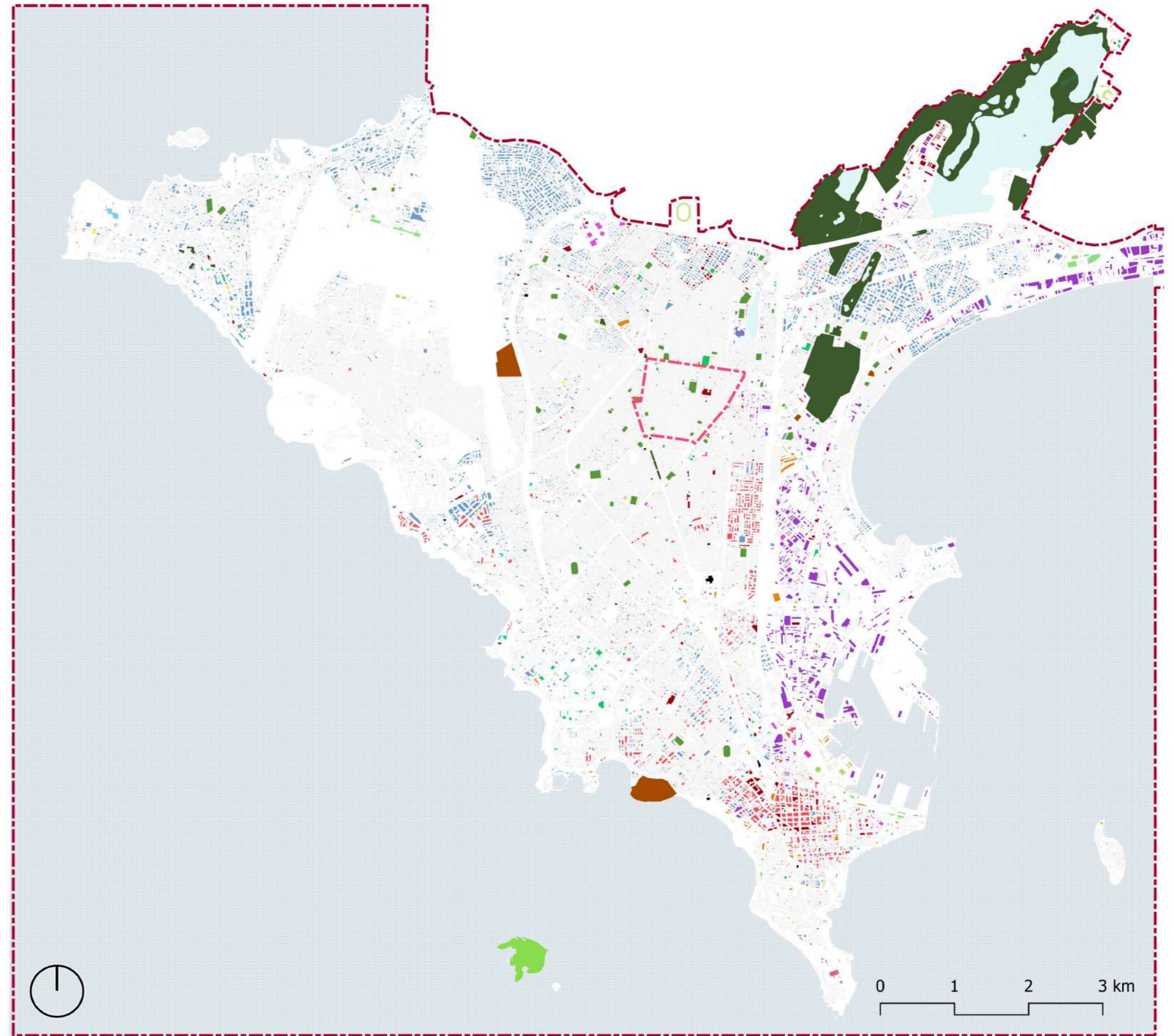
Type of uses

Global boundary volume

- Residential
- Mixed use
- Public buildings
- Education
- Industrial
- Health
- Business
- Military
- Transport
- Place of worship
- Commercial
- Catering
- Money
- Sports
- Accommodation
- Tourism
- Leisure
- Abandoned

Global boundary voids

- Open green area,zoo
- Sports activites
- Island
- Cemetery



Types of uses_volumes

Intermediate scale_1:20000

LEGEND


Boundaries

-  Global boundary
-  Intermediate boundary
-  Local boundary

Horizontal investigation

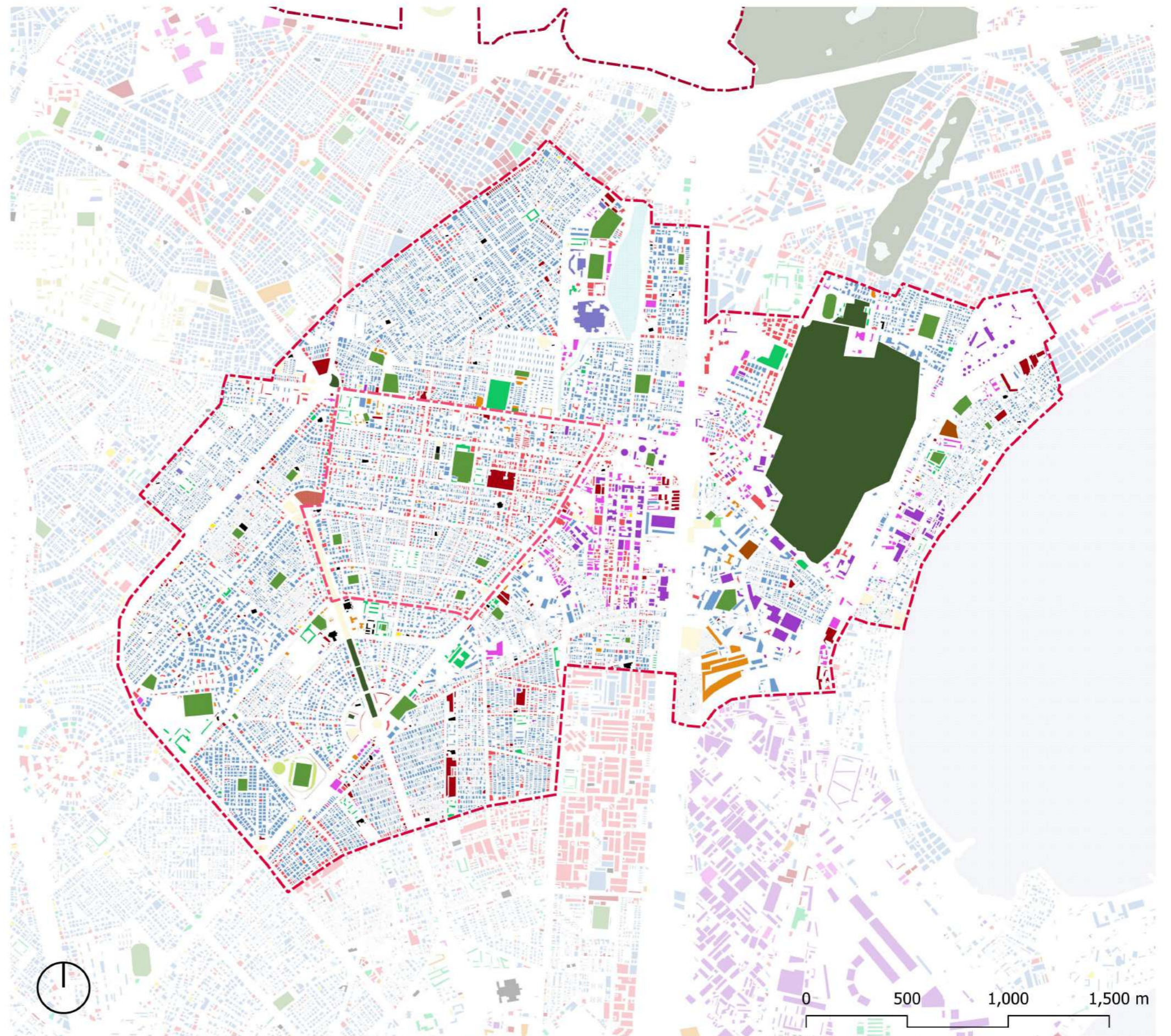
Type of uses

Intermediate boundary volumes

-  Residential
-  Mixed use
-  Public buildings
-  Education
-  Industrial
-  Health
-  Business
-  Transport
-  Place of worship
-  Commercial
-  Catering
-  Money
-  Sports
-  Accommodation
-  Abandoned

Intermediate boundary voids

-  Open green area,zoo
-  Sports activites



Types of uses_volumes

Local scale_1:6000

LEGEND



Boundaries

 Local boundary

Horizontal investigation

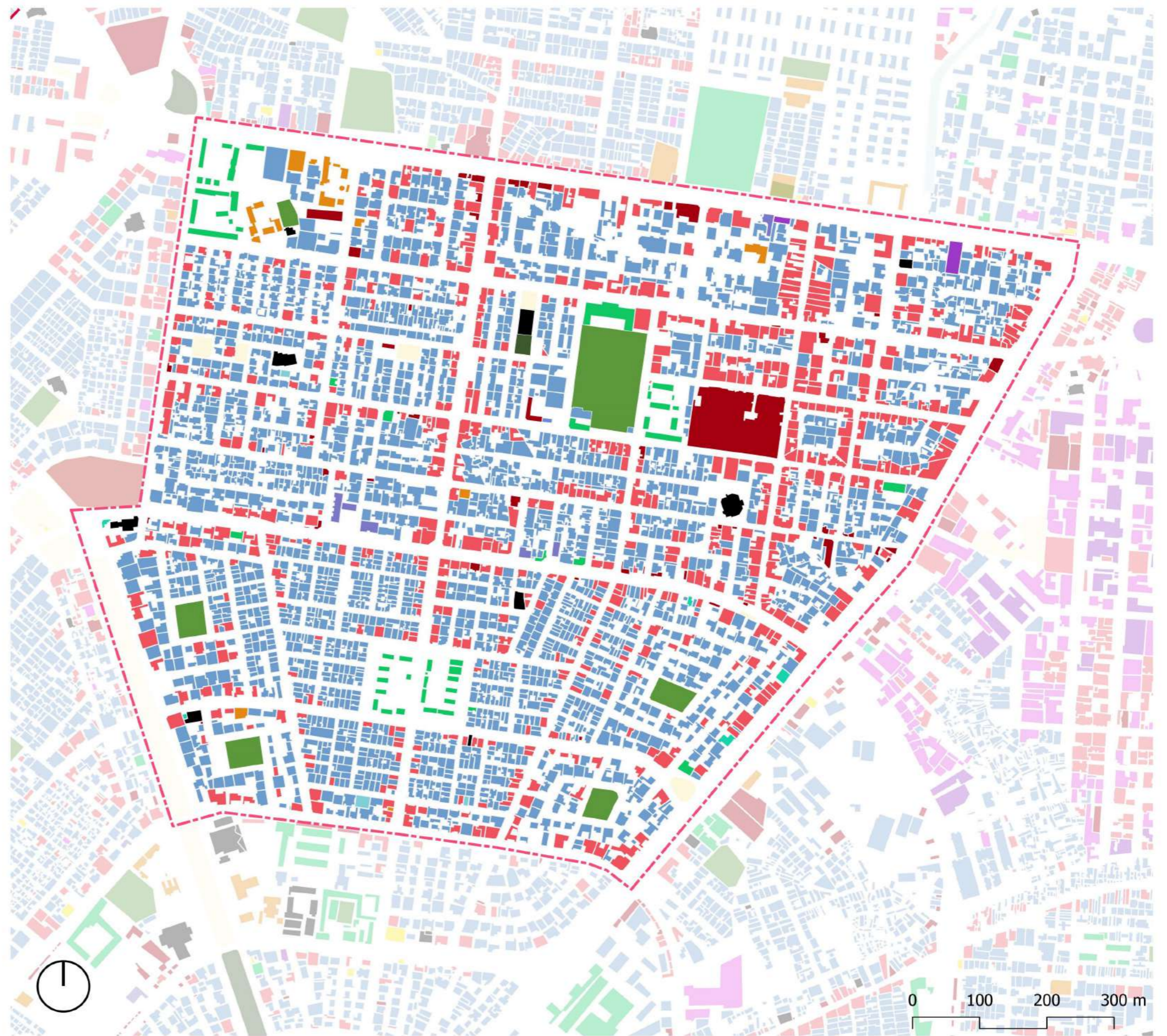
Type of uses

Local boundary volumes

-  Residential
-  Mixed use
-  Public buildings
-  Education
-  Industrial
-  Health
-  Place of worship
-  Commercial
-  Money
-  Accommodation
- 

Local boundary voids

-  Open green area,zoo
-  Sports activities
-  Others



Types of uses_points

Global scale_1:55000

LEGEND

Boundaries

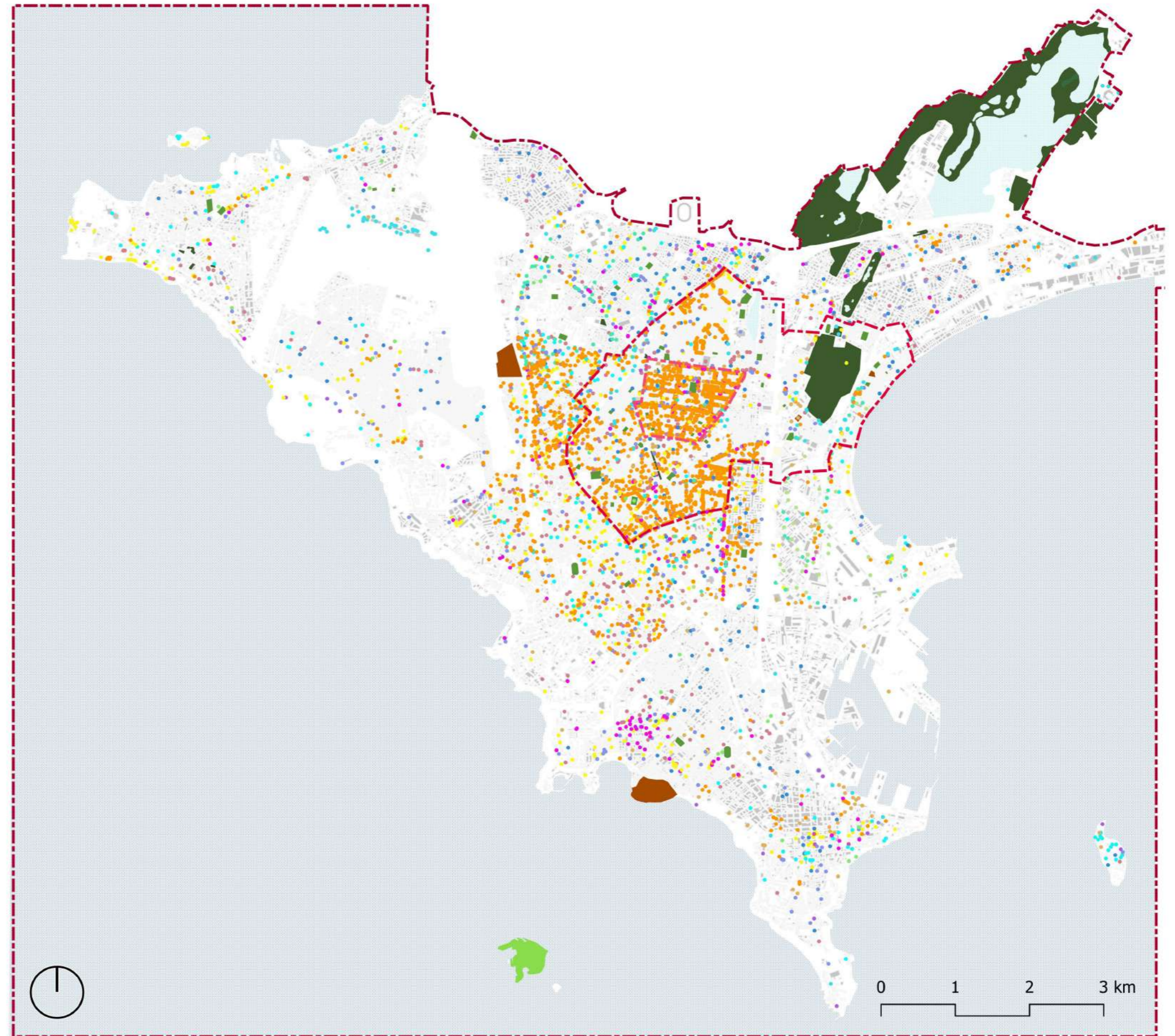
 Global boundary

Horizontal investigation

Types of uses_points

Global boundary types of uses

-  Business
-  Place of worship
-  Catering
-  Education
-  Commercial
-  Health
-  Money
-  Public buildings
-  Transport
-  Sports
-  Accomodation
-  Industrial
-  Tourism
-  Leisure





Types of uses_points

Intermediate scale_1:20000

LEGEND

Boundaries

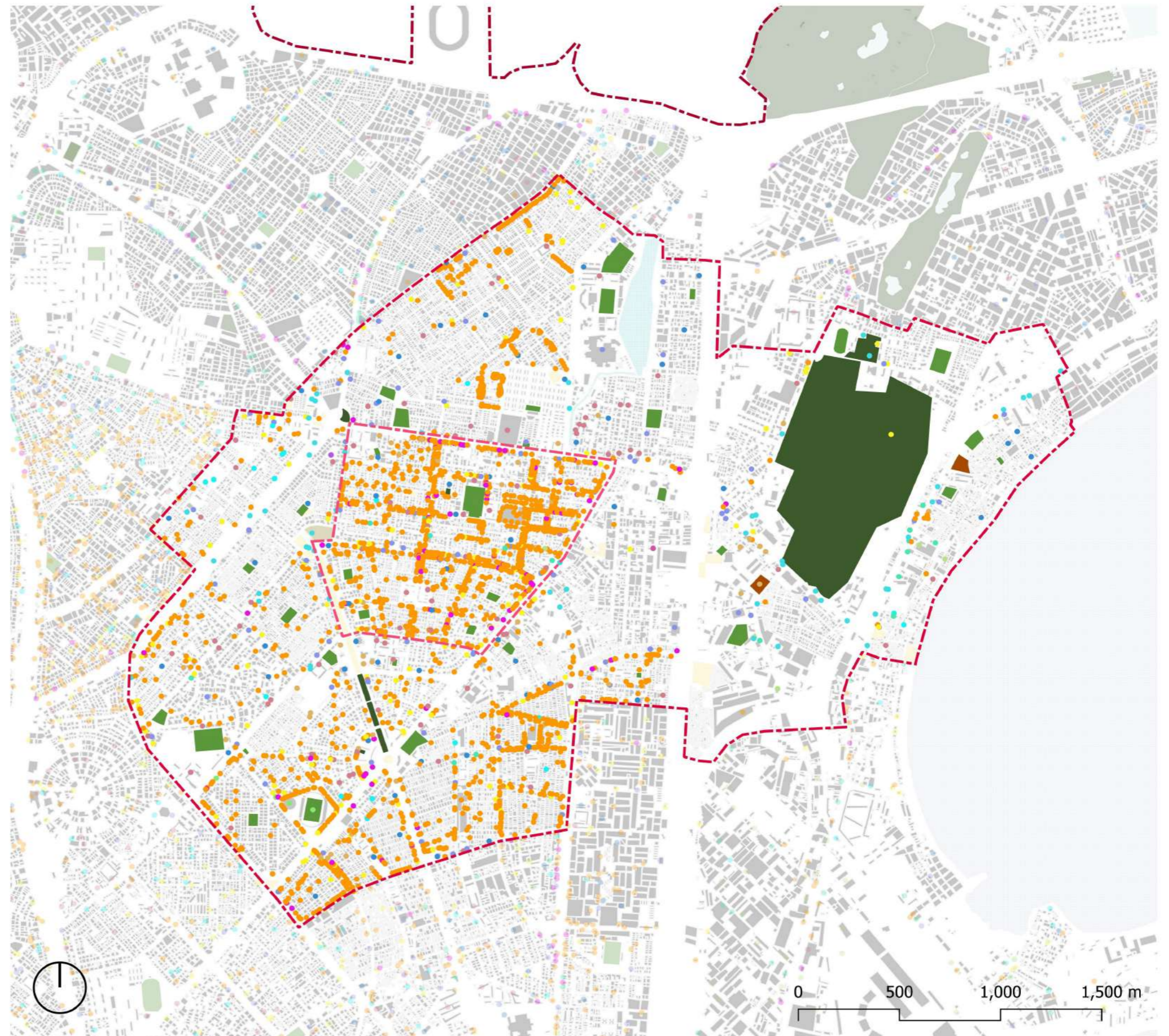
-  Global boundary
-  Intermediate boundary
-  Local boundary

Horizontal investigation

Types of uses_points

Intermediate boundary types of uses

-  Business
-  Place of worship
-  Catering
-  Education
-  Commercial
-  Health
-  Money
-  Public buildings
-  Transport
-  Sports
-  Accomodation
-  Industrial
-  Tourism
-  Leisure






Types of uses_points

Local scale_1:6000

LEGEND

Boundaries

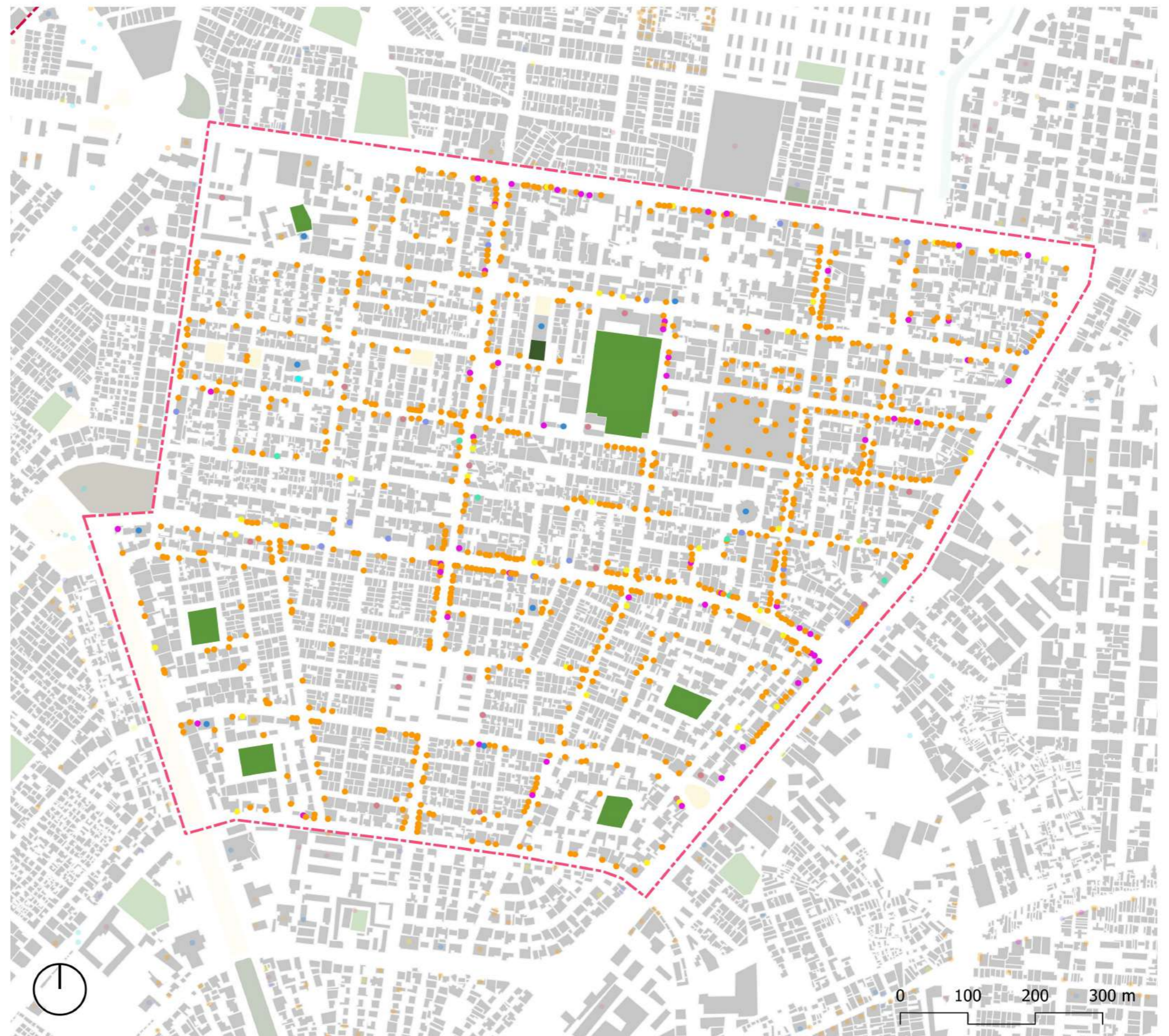
-  Global boundary
-  Intermediate boundary
-  Local boundary

Horizontal investigation

Types of uses_points

Local boundary types of uses

-  Business
-  Place of worship
-  Catering
-  Education
-  Commercial
-  Health
-  Money
-  Public buildings
-  Accomodation
-  Industrial






Links



Global Scale_1:55000

LEGEND



Boundary

-  Intermediate_boundary_1104
-  Local_boundary_1104
-  Global_boundary_1104



Ferry

-  Network_ferry_stops
-  Network_ferry

Railways

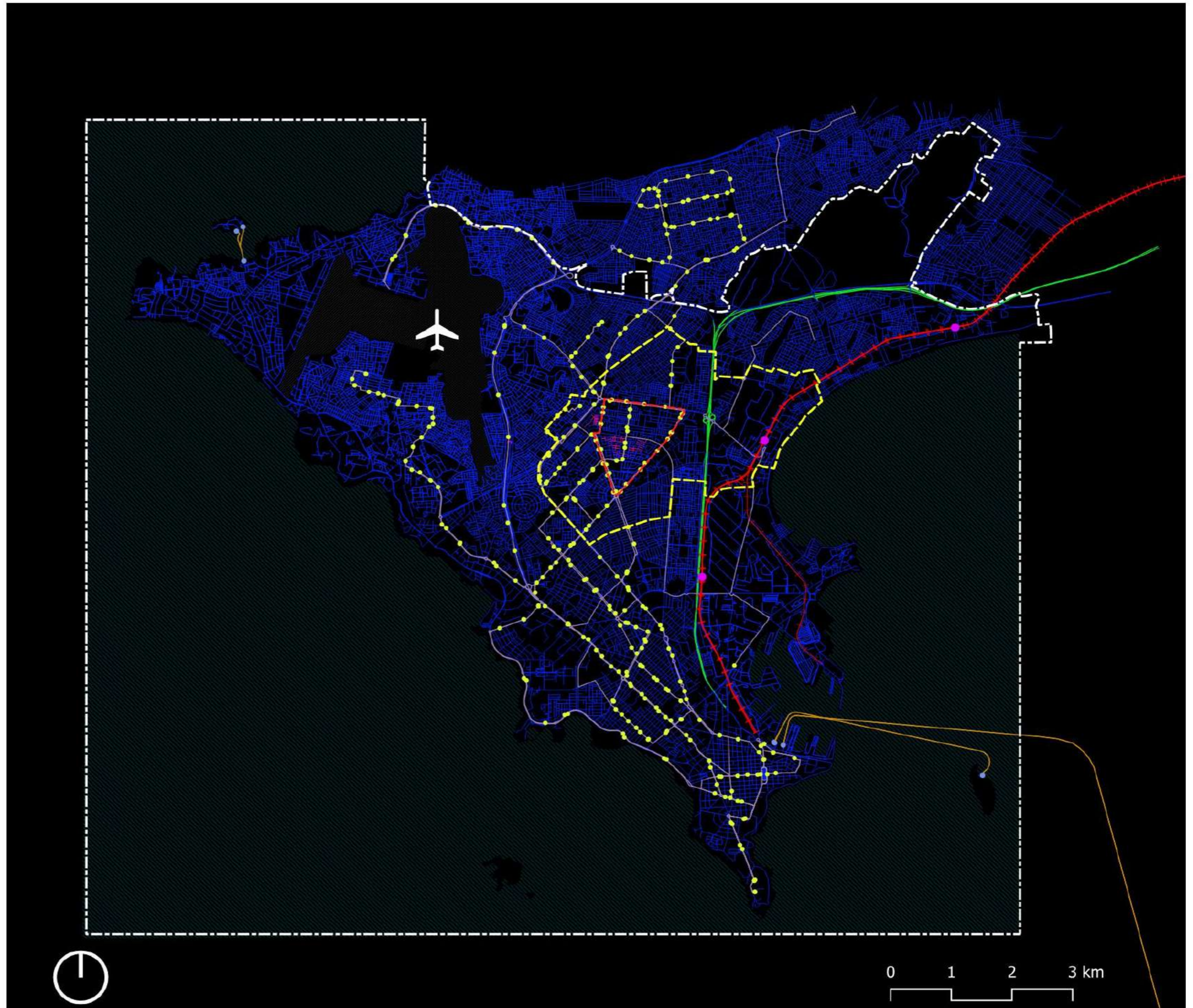
-  Network_railways_stops
-  Network_railways

Bus

-  Network_bus_stops
-  Network_bus

Roads

-  Roads
-  Roads_pedestrian streets
-  Roads_pedestrian bridges
-  Roads_highway



Links

Intermediate Scale_1:20000

LEGEND

Boundary

- ▭ Intermediate_boundary_1104
- ▭ Local_boundary_1104
- ▭ Global_boundary_1104

Ferry

- Network_ferry_stops
- Network_ferry

Railways

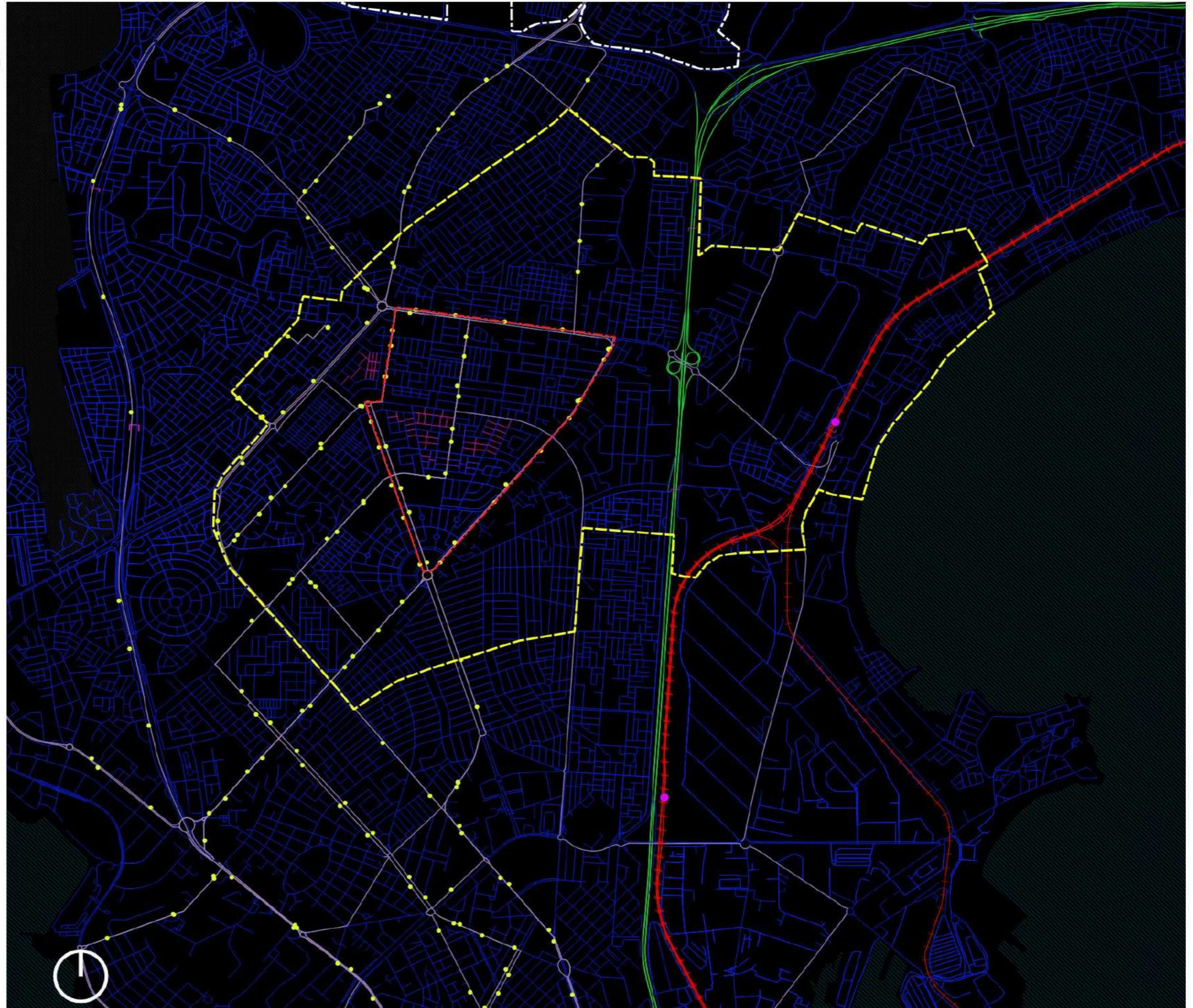
- Network_railways_stops
- Network_railways

Bus

- Network_bus_stops
- Network_bus

Roads

- Roads
- Roads_pedestrian streets
- Roads_pedestrian bridges
- Roads_highway






Links



Local Scale_1:6000

LEGEND

Boundary

-  Intermediate_boundary_1104
-  Local_boundary_1104
-  Global_boundary_1104

Bus

-  Network_bus_stops
-  Network_bus

Roads

-  Roads
-  Roads_pedestrian streets
-  Roads_pedestrian bridges
-  Roads_highway



3.3. IMM Phase I Investigation: Analysis and synthesis

STUDY SCALES

Global scale_1:55000
 Intermediate scale_1:20000
 Local scale_1:6000

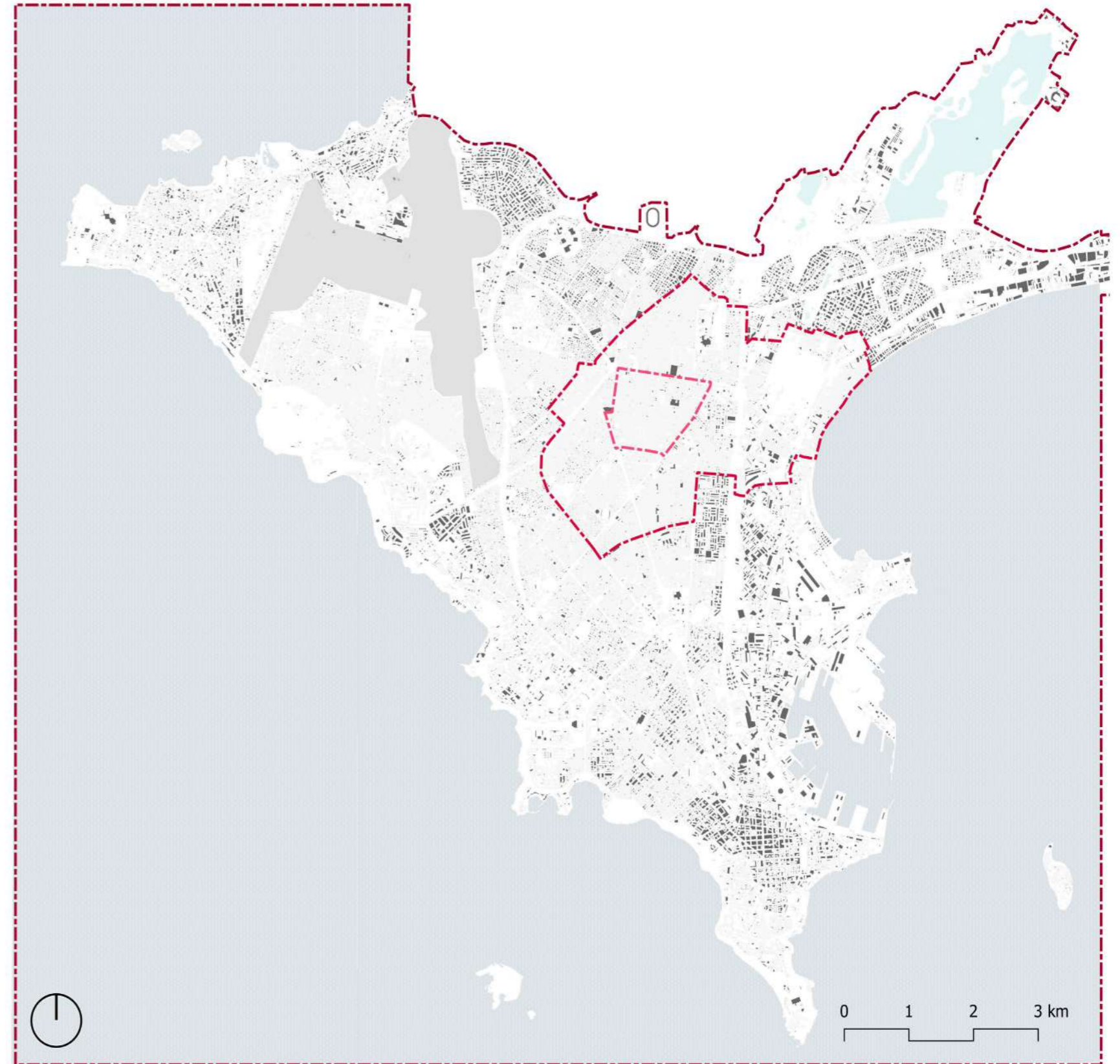
Vertical Investigation

1. Accessibility
2. Diversity
3. Effectiveness
4. Interface
5. Permeability
6. Porosity
7. Proximity

LEGEND

Boundaries

-  Global boundary
-  Intermediate boundary
-  Local boundary






ACCESSIBILITY

Global scale_1:55000

LEGEND

BOUNDARIES

-  Global_boundary
-  Intermediate_boundary
-  Local_boundary

NETWORK

ROADS





-  Roads_primary
-  Roads_secondary
-  Roads_tertiary
-  Roads_highway
-  Roads_industrial

PUBLIC TRANSPORTATION






Global Bus Isochrones

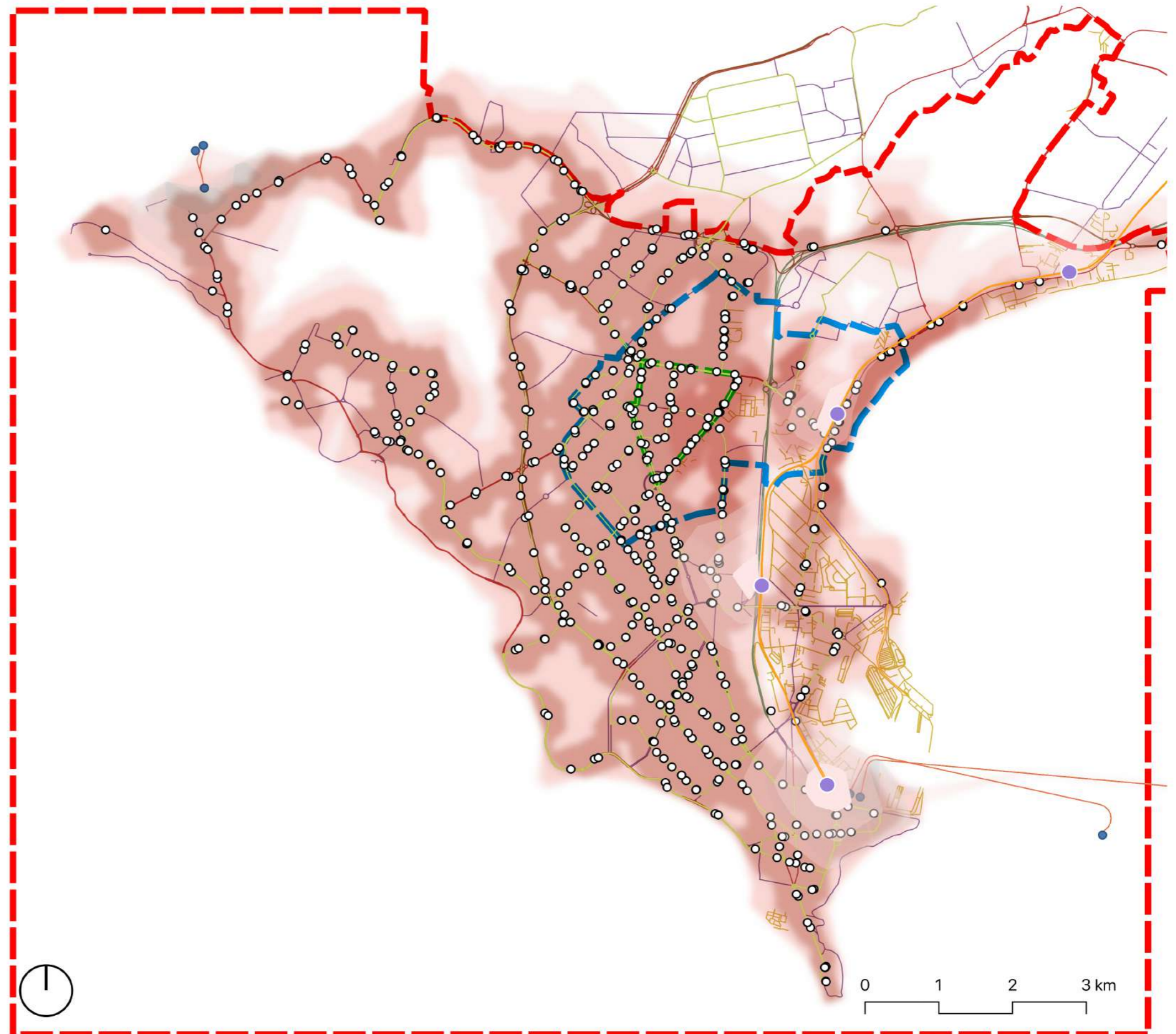
-  Network_Bus
-  Network_Bus_Stops
-  5_MINS
-  10_MINS
-  15_MINS

Global Railway Isochrones

-  Network_Railways
-  Network_Railways_Stops
-  5_MINS
-  10_MINS
-  15_MINS

Global Ferry Isochrones

-  Network_Ferry
-  Network_Ferry_Stops
-  5_MINS
-  10_MINS
-  15_MINS






ACCESSIBILITY

Intermediate scale_1:18000

LEGEND

BOUNDARIES

-  Global_boundary
-  Intermediate_boundary
-  Local_boundary

NETWORK

ROADS

-  Roads_primary
-  Roads_secondary
-  Roads_tertiary
-  Roads_highway
-  Roads_industrial

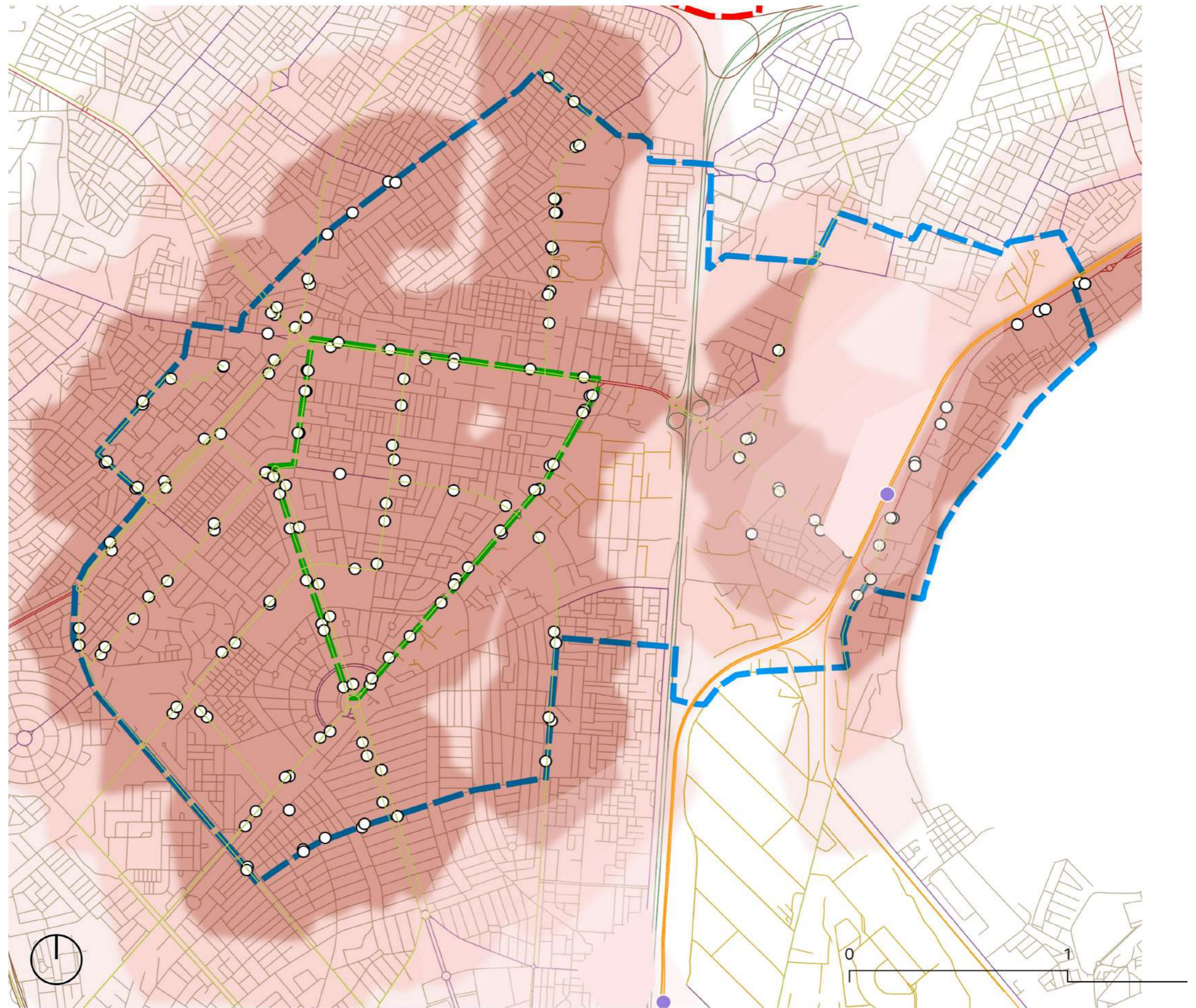
PUBLIC TRANSPORTATION

Global Bus Isochrones

-  Network_Bus
-  Network_Bus_Stops
-  5_MINS
-  10_MINS
-  15_MINS

Global Railway Isochrones

-  Network_Railways
-  Network_Railways_Stops
-  5_MINS
-  10_MINS
-  15_MINS



ACCESSIBILITY

Local scale_1:6000


LEGEND


BOUNDARIES


 Local_boundary

NETWORK

ROADS

 Roads_secondary


 Roads_tertiary


 Roads_industrial


PUBLIC TRANSPORTATION

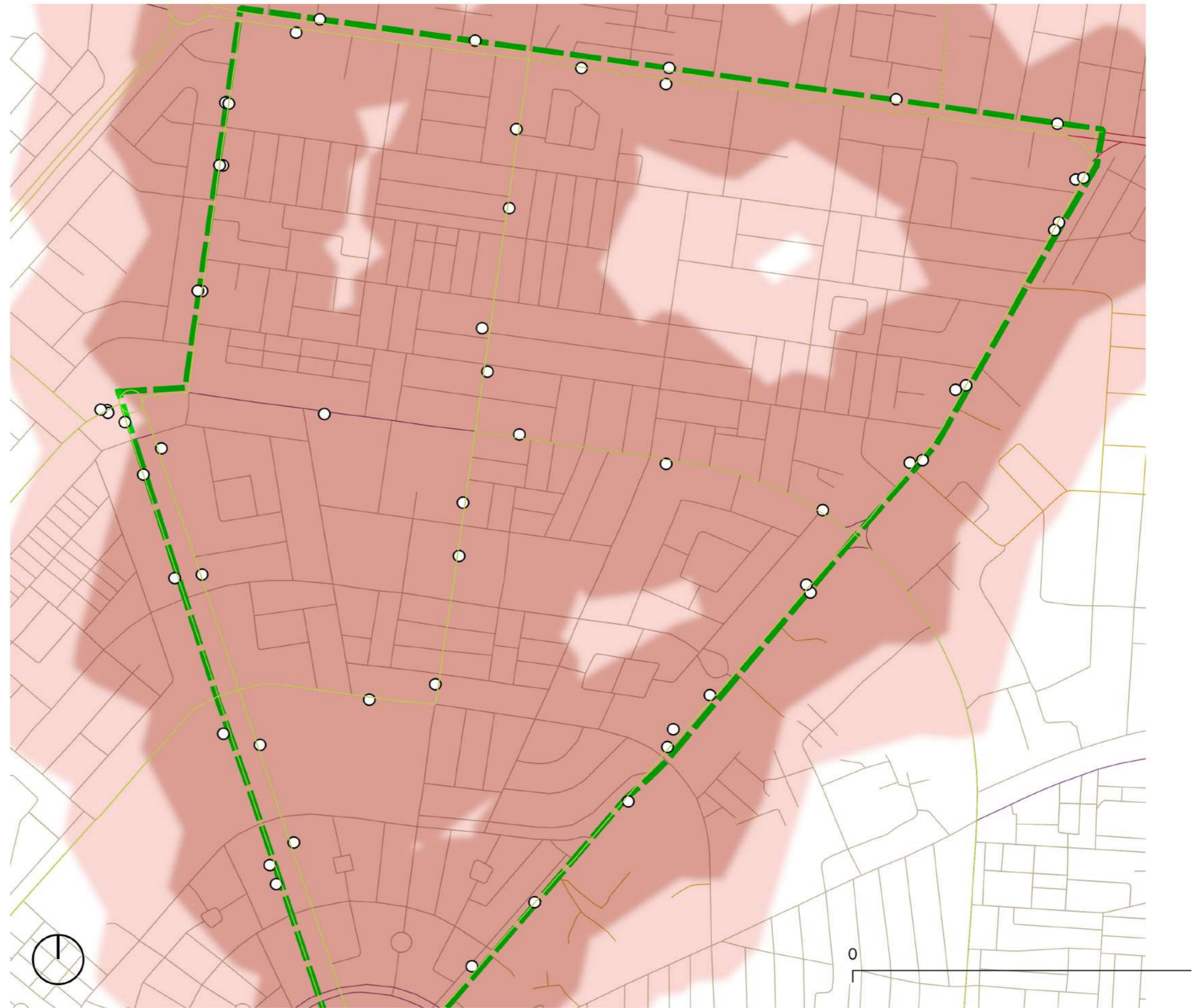
Global Bus Isochrones

 Network_Bus

 Network_Bus_Stops

 3_MINS

 5_MINS



Diversity

Global scale_1:55000

Necessary Regular Functions:

- School
- University
- Supermarket

Necessary Occasional Functions:

- Bank
- Poste Office
- Administration
- Pharmacy
- Hospital

Optional Activities

- Department store
- Mall
- Theatre
- Museum
- Cinema
- Sports
- Hotel

LEGEND

Type of uses

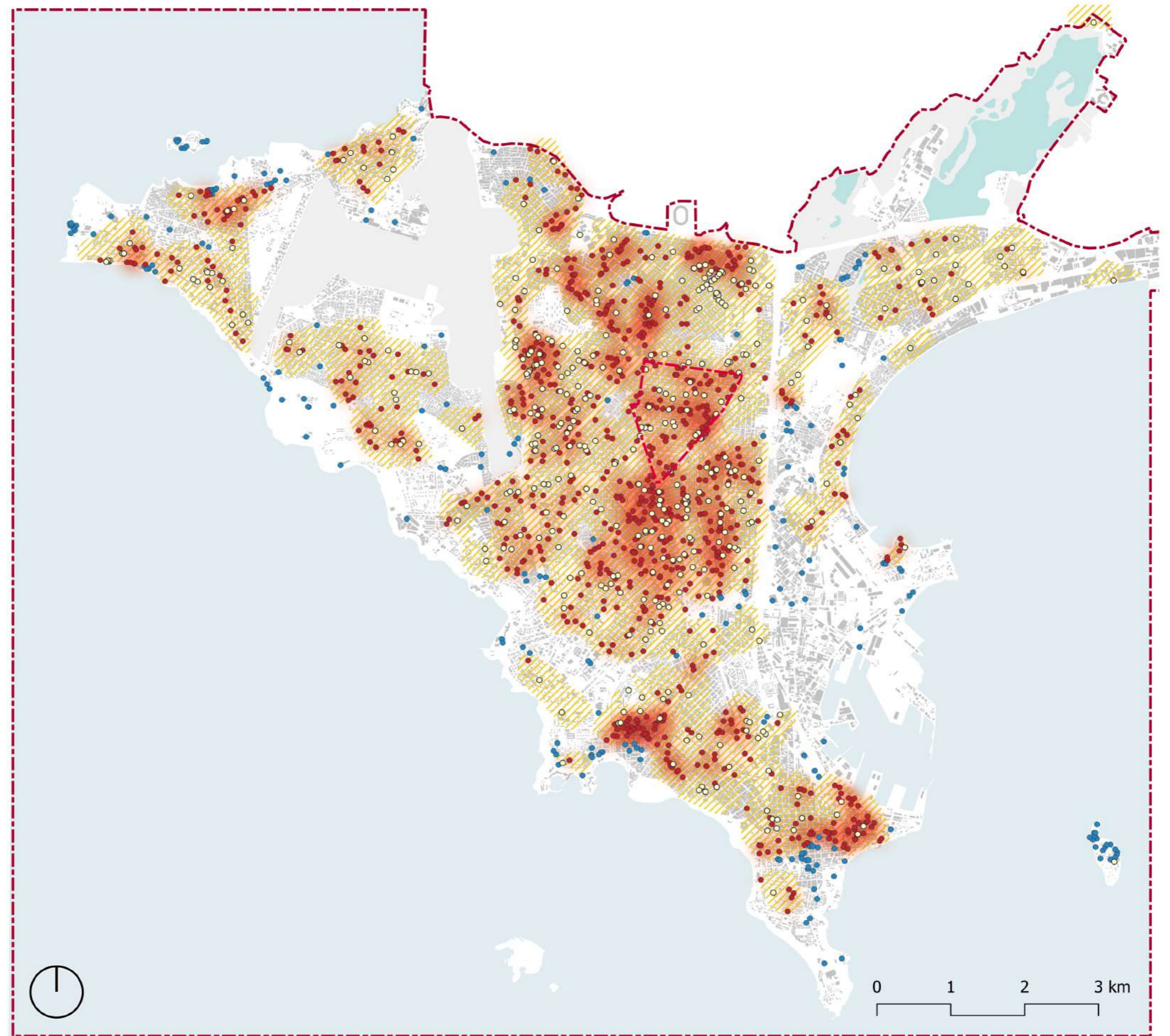
- Necessary Regular
- NO and OP within 5mins
- NO and OP out of 5 mins

Isochrones

- /// NR_ISO_5mins

Boundaries

- Global Boundary
- Local Boundary



Diversity

Intermediate
Scale_1:18000

Necessary Regular Functions:

- School
- University
- Supermarket

Necessary Occasional Functions:

- Bank
- Poste Office
- Administration
- Pharmacy
- Hospital

Optional Activities

- Department store
- Mall
- Theatre
- Museum
- Cinema
- Sports
- Hotel

LEGEND

Type of uses

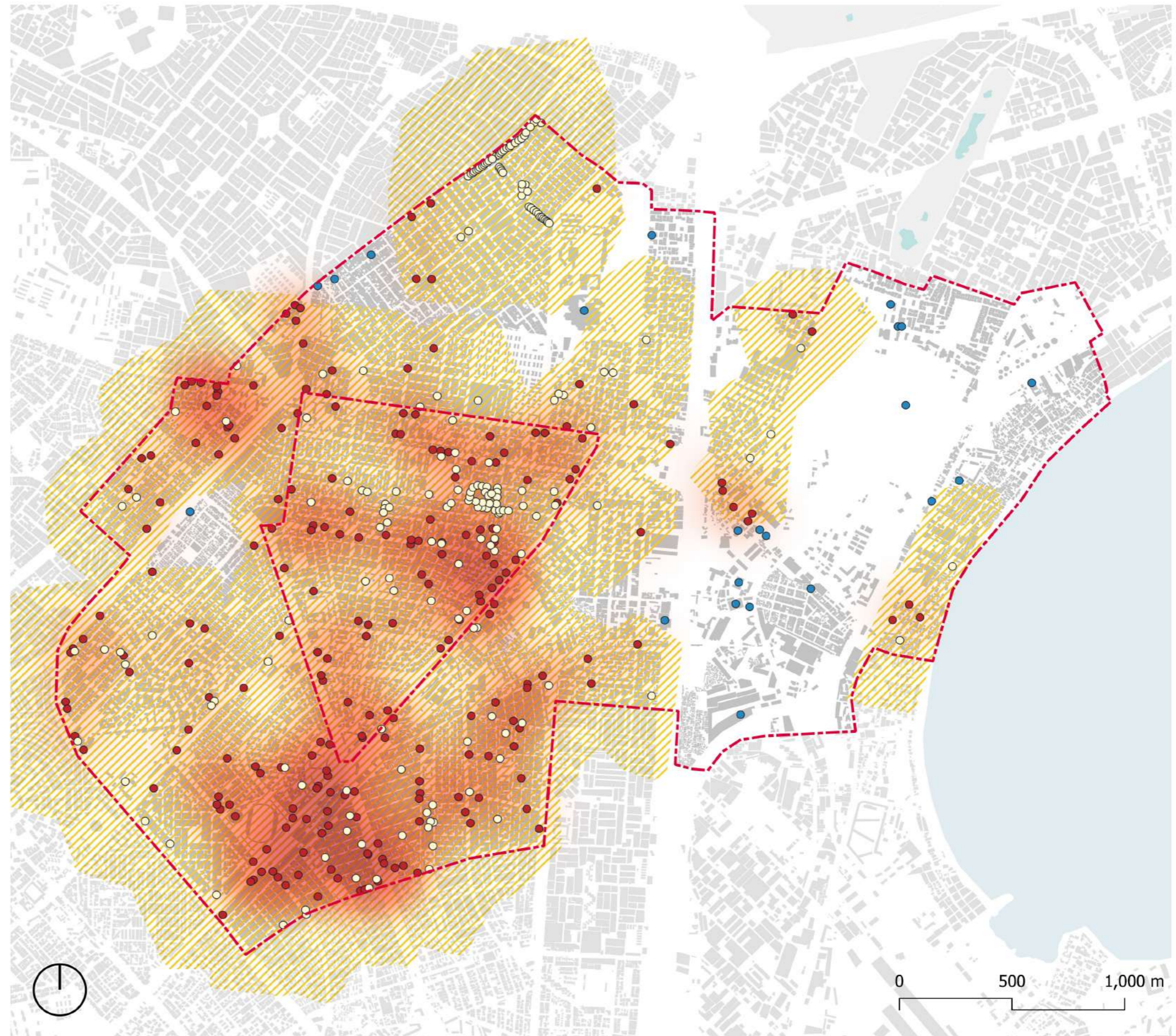
- Necessary Regular
- NO and OP within 5mins
- NO and OP out of 5 mins

Isochrones

- ▨ NR_ISO_5mins

Boundaries

- ▭ Local Boundary
- ▭ Intermediate Boundary



Diversity

Local scale_1:7000

Necessary Regular Functions:

- School
- University
- Market
- General (store)
- Bakery
- Convenience (store)
- Supermarket
- Butcher

Necessary Occasional Functions:

- Bank
- ATM
- Poste Office
- Place of worship
- Administration
- Bar
- cafe
- Pharmacy
- Hospital
- Doctor
- Dentist
- Laboratory
- Currency services
- Community Centre

Optional Activities

- Department store
- Mall
- Theatre
- Museum
- Cinema
- Sports
- Hotel
- Hostel
- Retails (clothes, hairdresser, stationery, laundry)

LEGEND

Type of uses

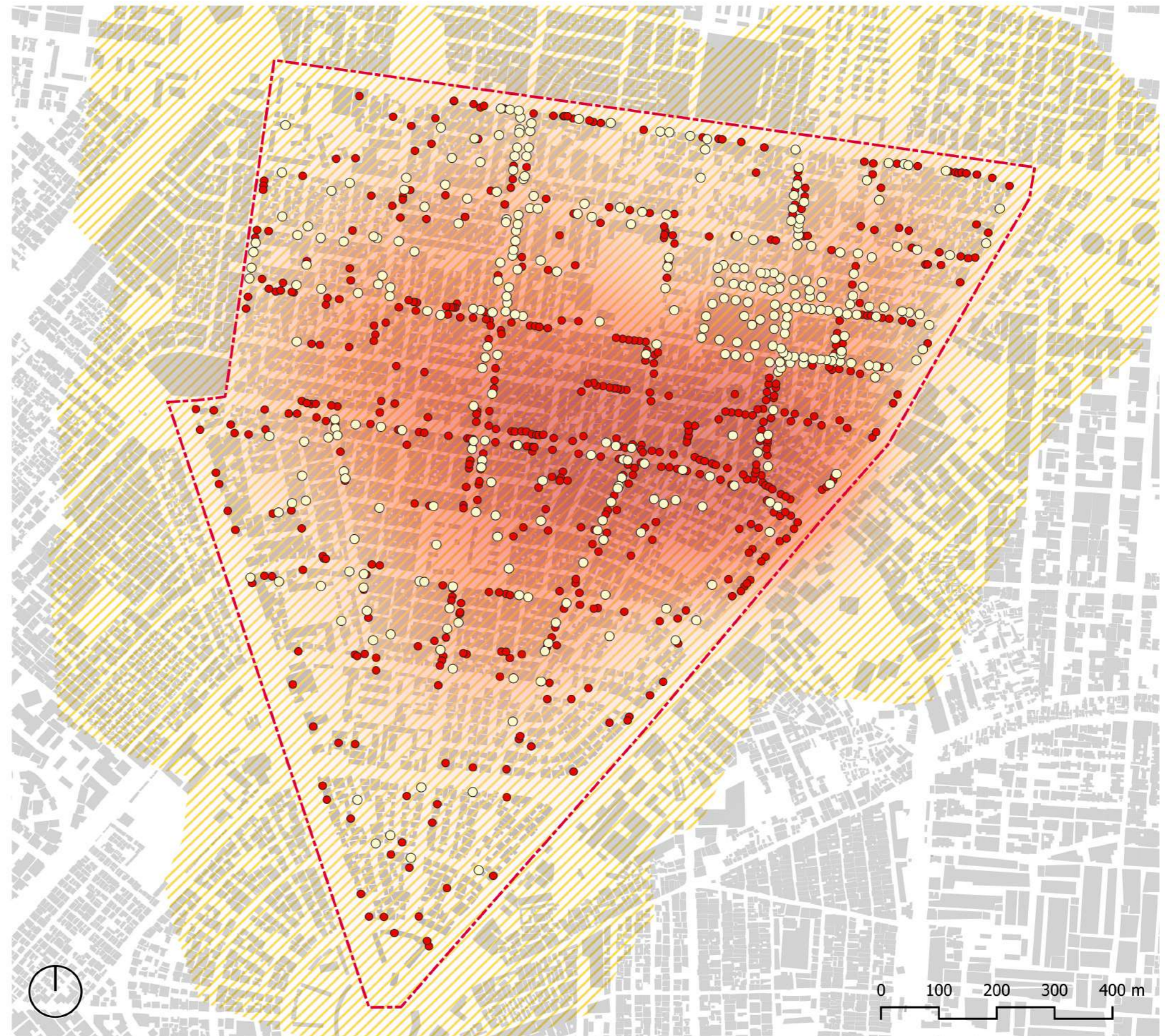
- Necessary Regular
- NO and OP within 5mins

Isochrones

- ▨ NR_ISO_5mins

Boundaries

- ▭ Local boundary






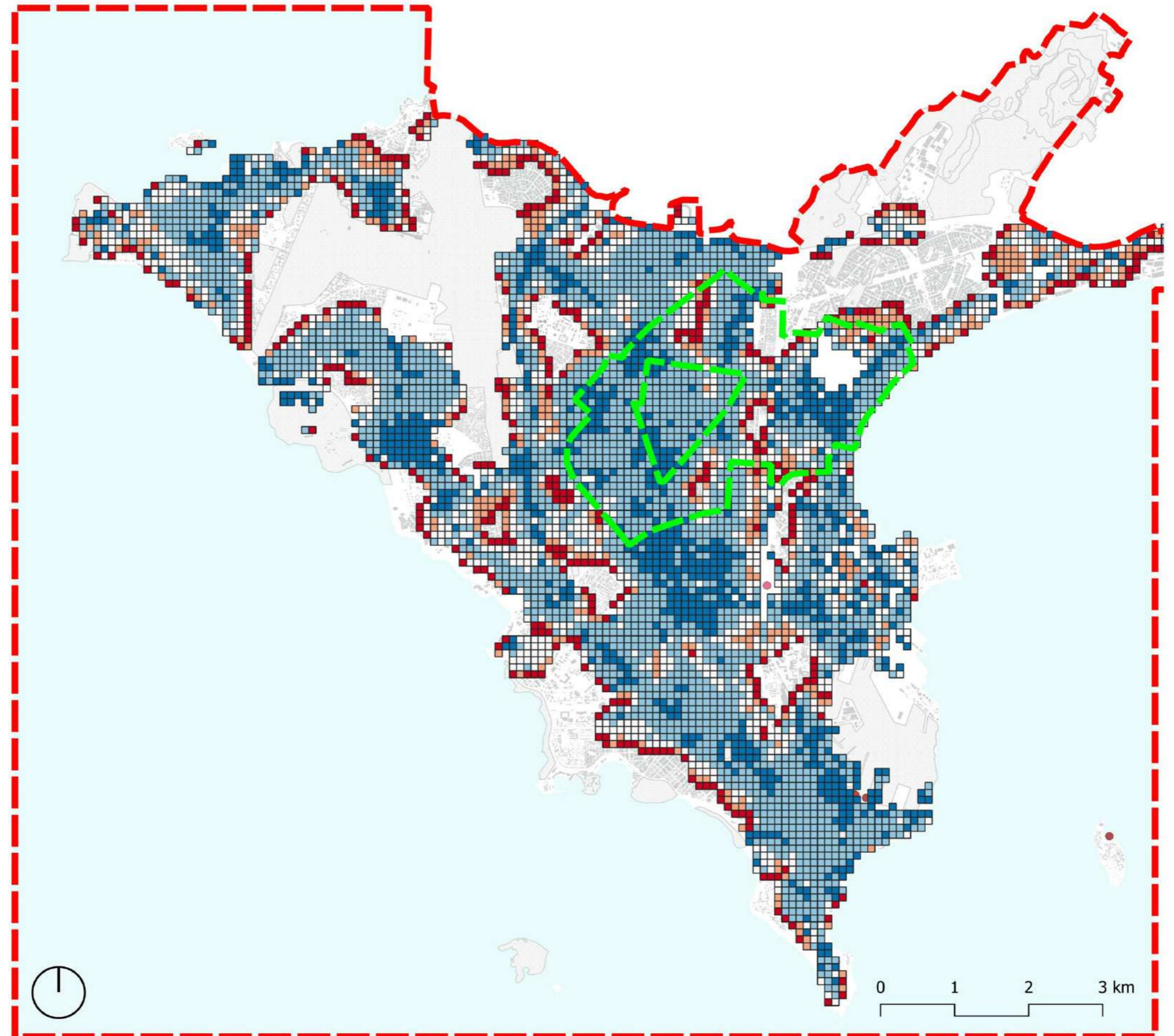
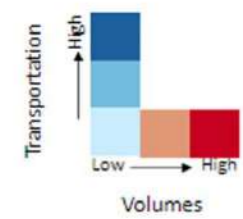
EFFECTIVENESS

Global scale_1:55000

LEGEND

Boundaries

-  Global_boundary_1104
-  Intermediate_boundary_1104
-  Local_boundary_1104






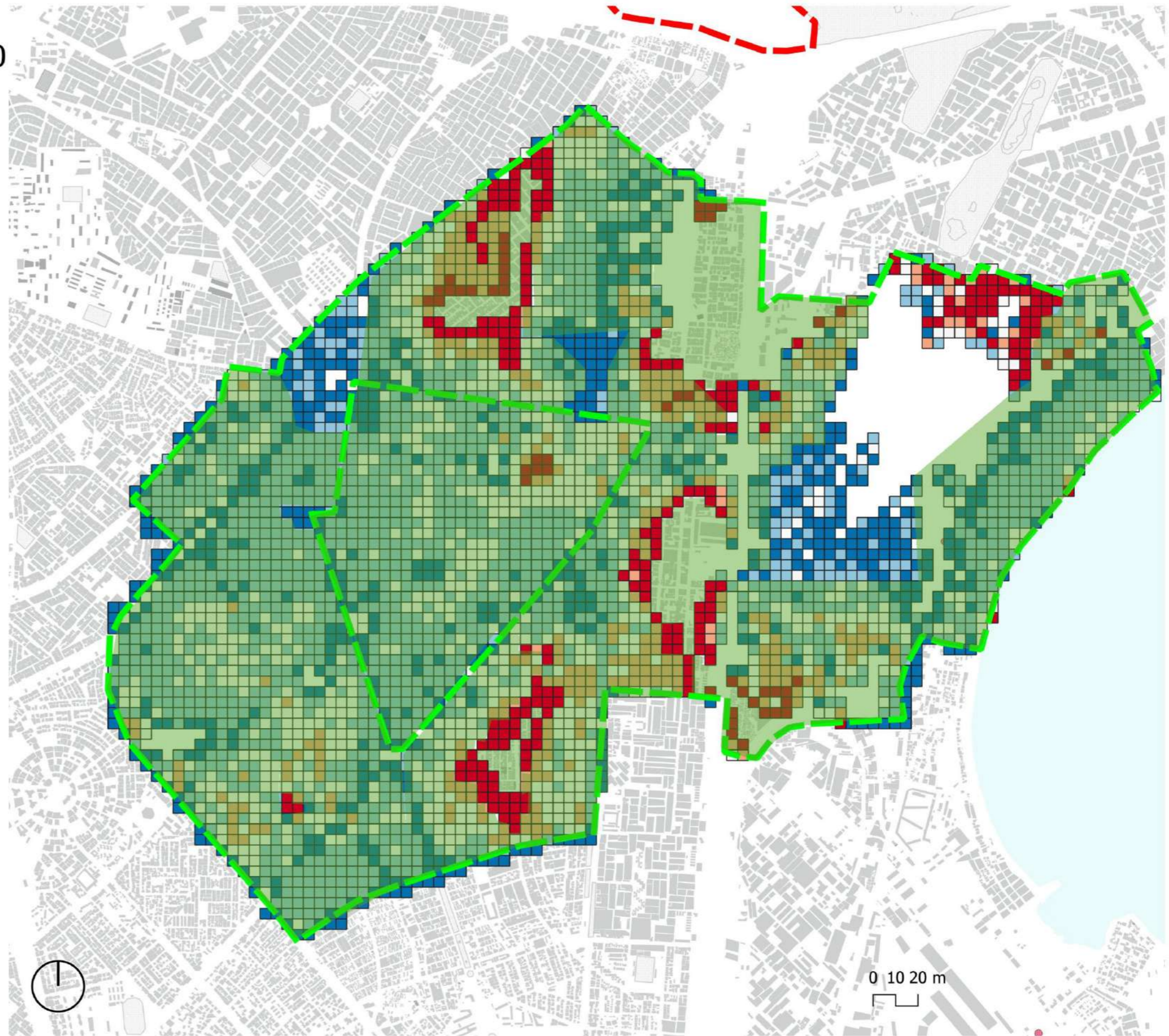
EFFECTIVENESS

Intermediate scale_1:18000

LEGEND

Boundries

-  Global_boundary_1104
-  Intermediate_boundary_1104
-  Local_boundary_1104



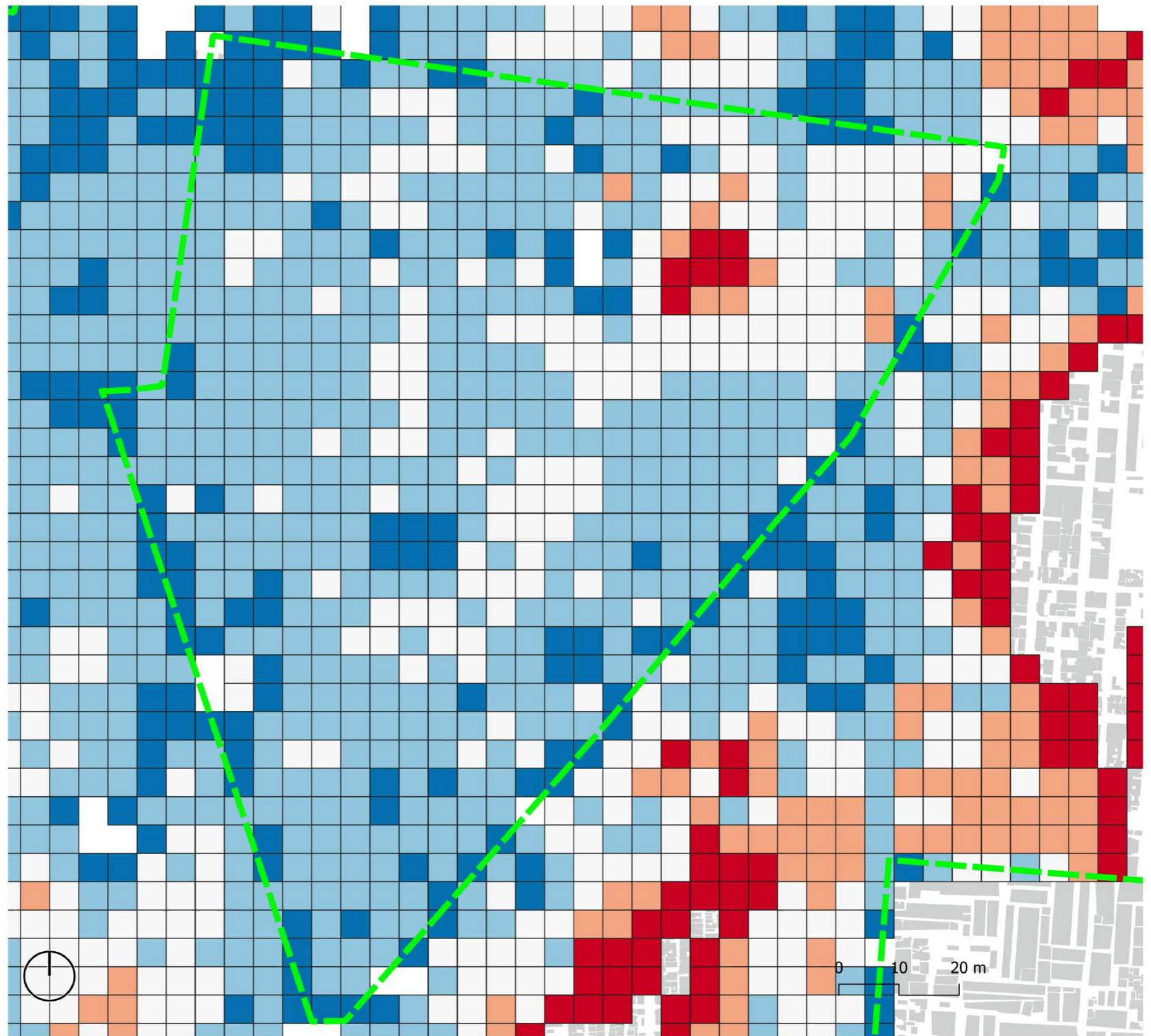
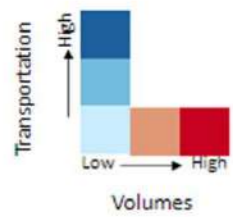
EFFECTIVENESS

Local scale_1:6000

LEGEND

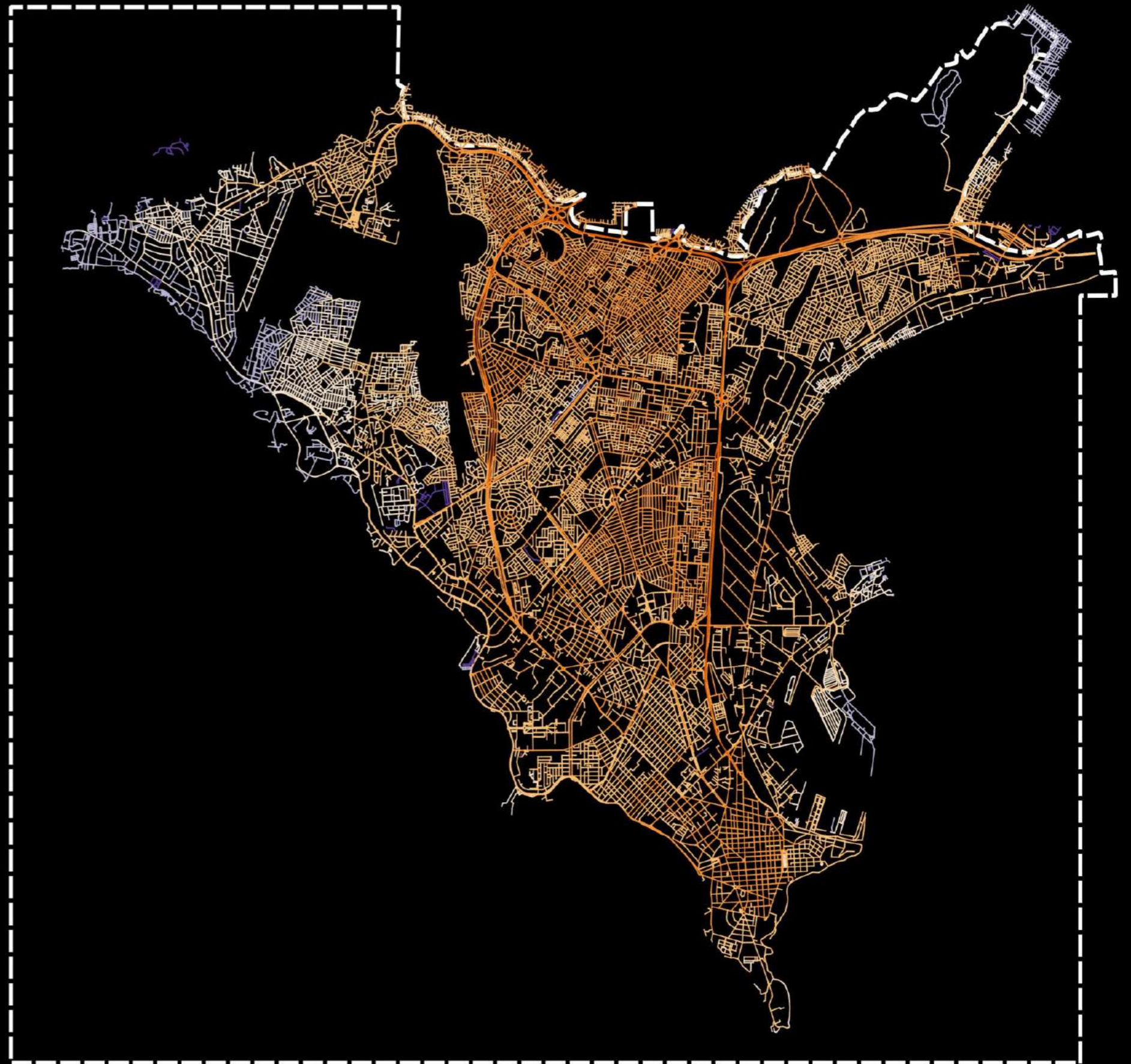
Boundries

- Global_boundary_1104
- Intermediate_boundary_1104
- Local_boundary_1104



Interface

Global Scale 1:55000



Global Interface

— 3 - 100

— 1000 - 2500

— 2500 - 3000

— 3000 - 4200

— 4200 - 5500

— 5500 - 6033

▭ Global_boundary_1104


Interface

Local Scale 1:18000



Intermediate Interface

- 3 - 150
- 150 - 350
- 350 - 500
- 500 - 650
- 650 - 900
- 900 - 1100
- 1100 - 1423

 Intermediate_boundary_1104

Interface

Intermediate Scale 1:6000



- Local Interface
- 220 - 270
 - 270 - 320
 - 320 - 370
 - 370 - 430
 - 430 - 490
 - 490 - 550
 - 550 - 600
 - 600 - 639
- Local_boundary_1104



Permeability Global Scale 1:55000



Permeability
Global Scale



0 1000m 2000m

high ●●● low

Permeability

Local Scale 1:18000



Permeability
Intermediate Scale



high ●●●● low

Permeability Intermediate Scale 1:6000



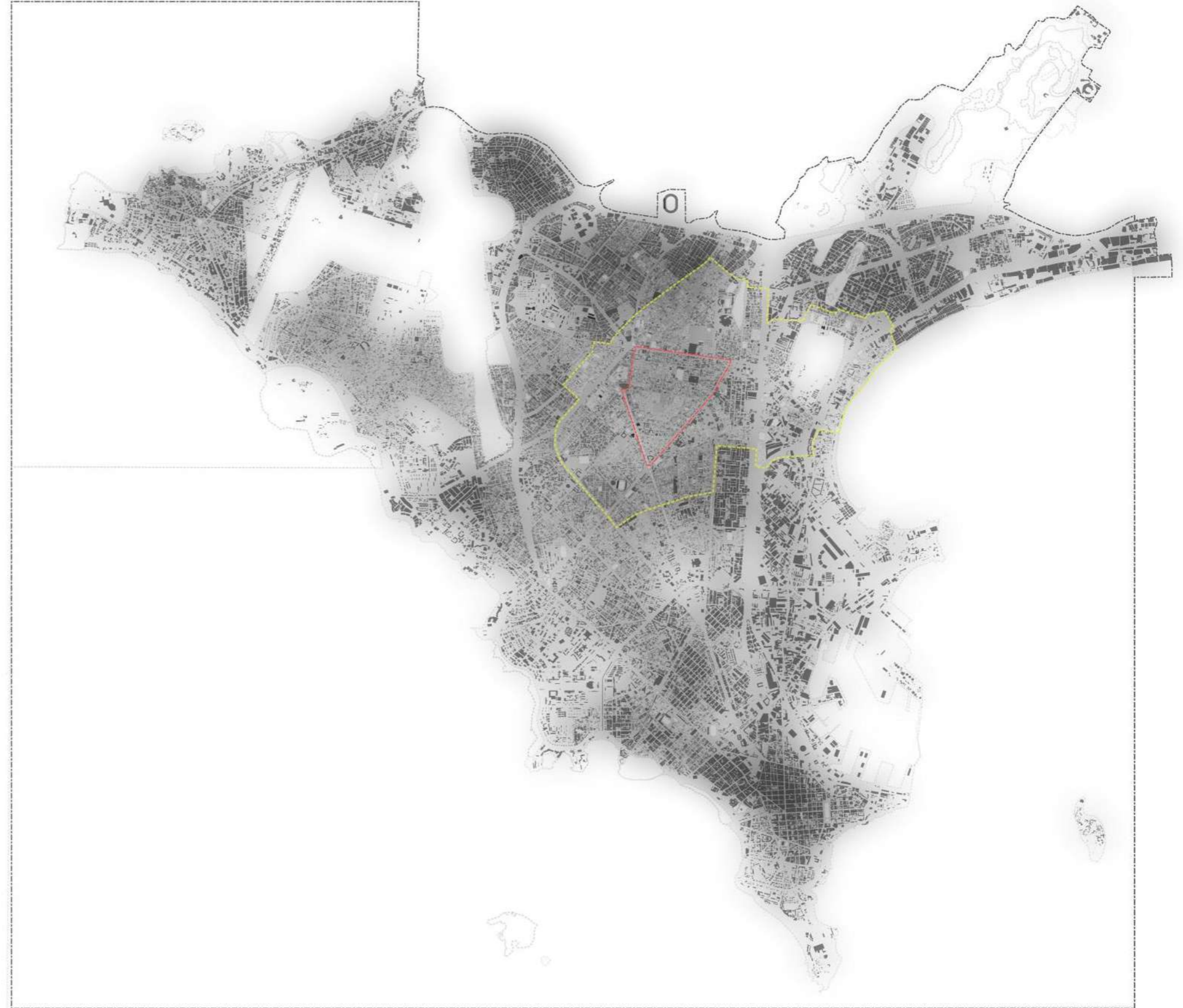
Permeability
Local Scale



high ● ● ● ● low

Porosity

Global scale_55000



Global_porosity

Global_boundary_1104

Local_boundary_1104




Intermediate_boundary_1104

Global voids

POROSITY

Intermediate Scale_1:20000

LEGEND

-  Local_boundary_1104
-  Intermediate_boundary_1104
-  Intermediate voids

Intermediate_volumes
No of floors

-  1
-  2
-  3
-  4
-  5
-  6
-  7
-  8
-  9



POROSITY

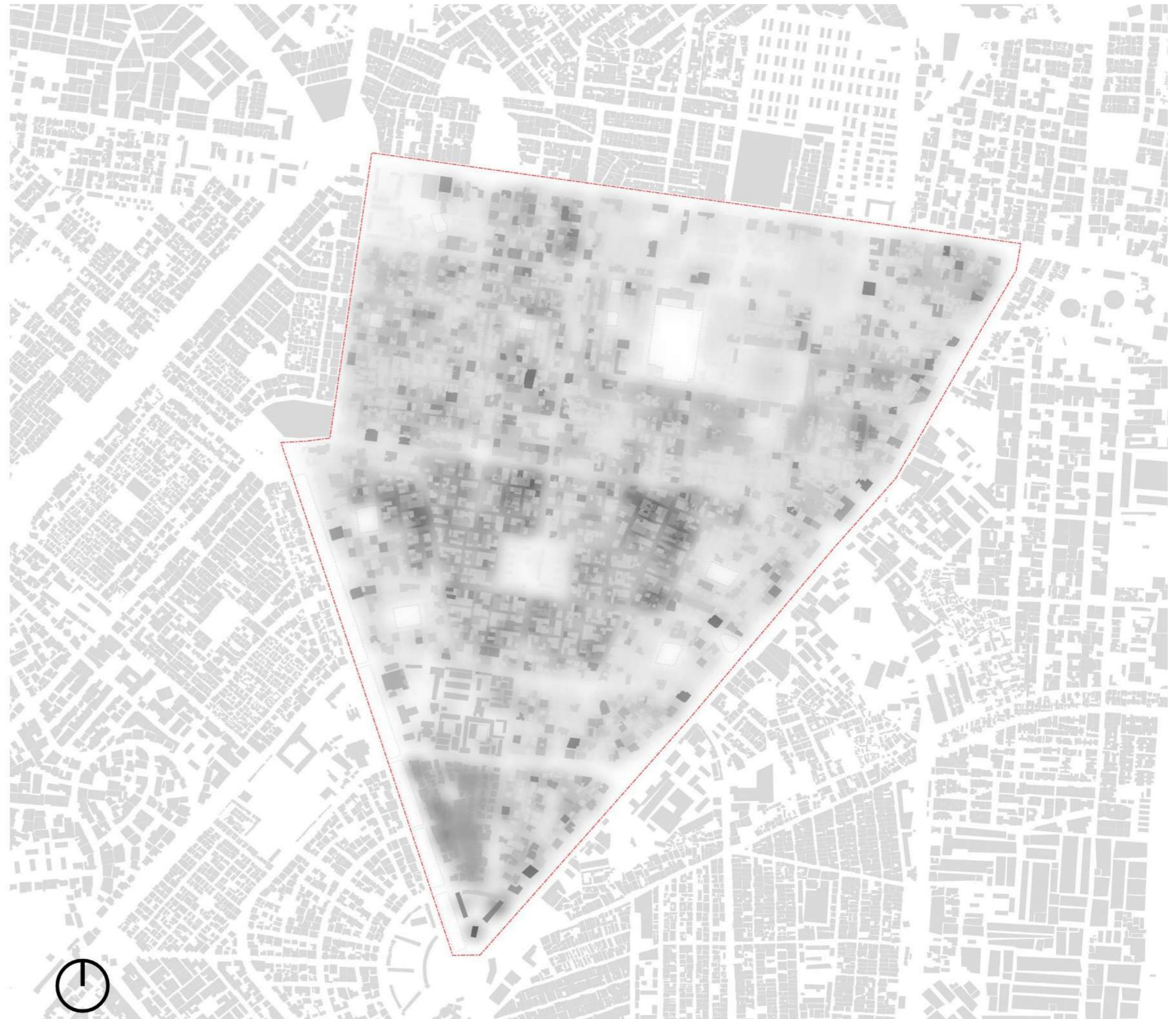
Local Scale_1:6000

LEGEND

- Local_boundary_1104
- Local_boundary_voids_1104

Local volumes
No of floors

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9






Proximity

Global scale_1:55000

LEGEND







Boundries

-  Global_boundary_1104
-  Intermediate_boundary_1104
-  Local_boundary_1104

Network







Public transortation

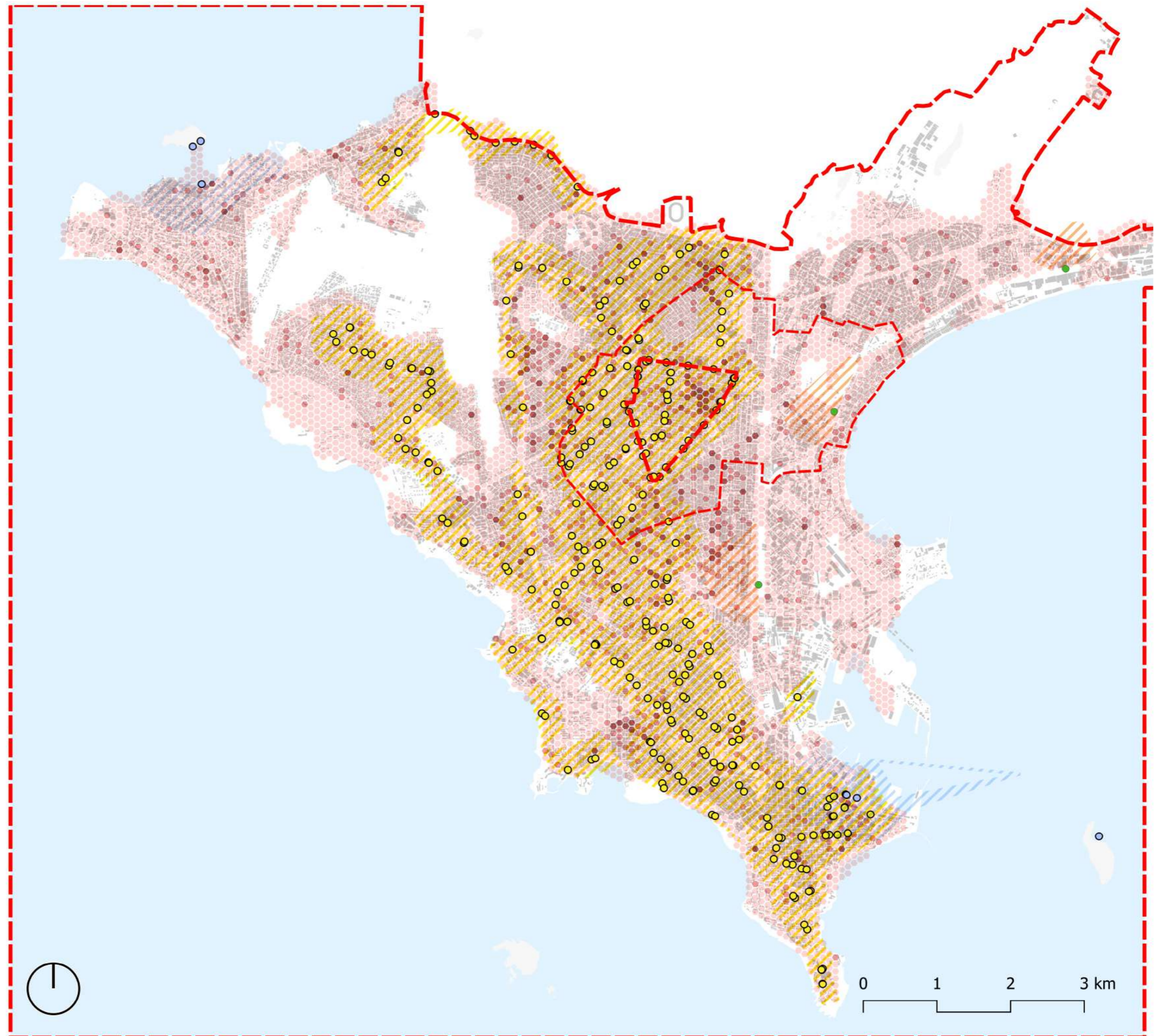
Global

-  Network_railway_stop_Global
-  10 min from train stop
-  Network_ferry_stop_Global
-  10 min from ferry stop
-  Network_bus_stop_Global
-  5 min from bus stop

PROXIMITY

Proximity_FILTERED

-  0 - 0
-  0 - 1
-  1 - 20
-  Island
-  Volume
-  ocean






Proximity

intermediate

scale_1:18000

LEGEND





Boundries

-  Global_boundary_1104
-  Intermediate_boundary_1104
-  Local_boundary_1104








Network

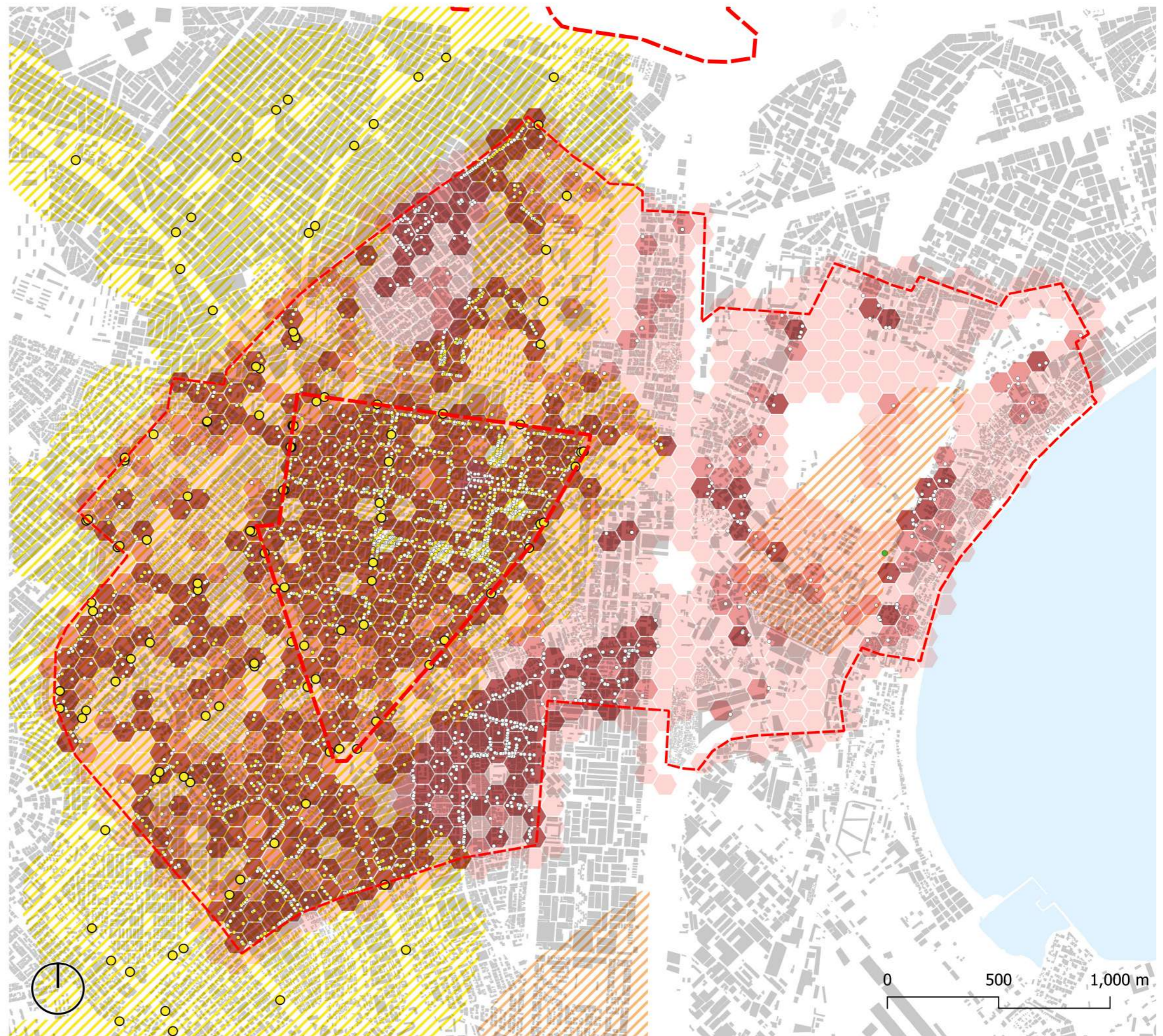
Public transortation

Global

-  Network_railway_stop_Global
-  10 min from train stop
-  Network_bus_stop_Global
-  5 min from bus stop

PROXIMITY

-  key functions
- Proximity_inter_without
-  0 - 0
 -  0 - 1
 -  1 - 20
 -  Island
 -  Volume
 -  ocean



Proximity

Local
scale_1:7000

LEGEND

Boundries

- Global_boundary_1104
- Intermediate_boundary_1104
- Local_boundary_1104

Network

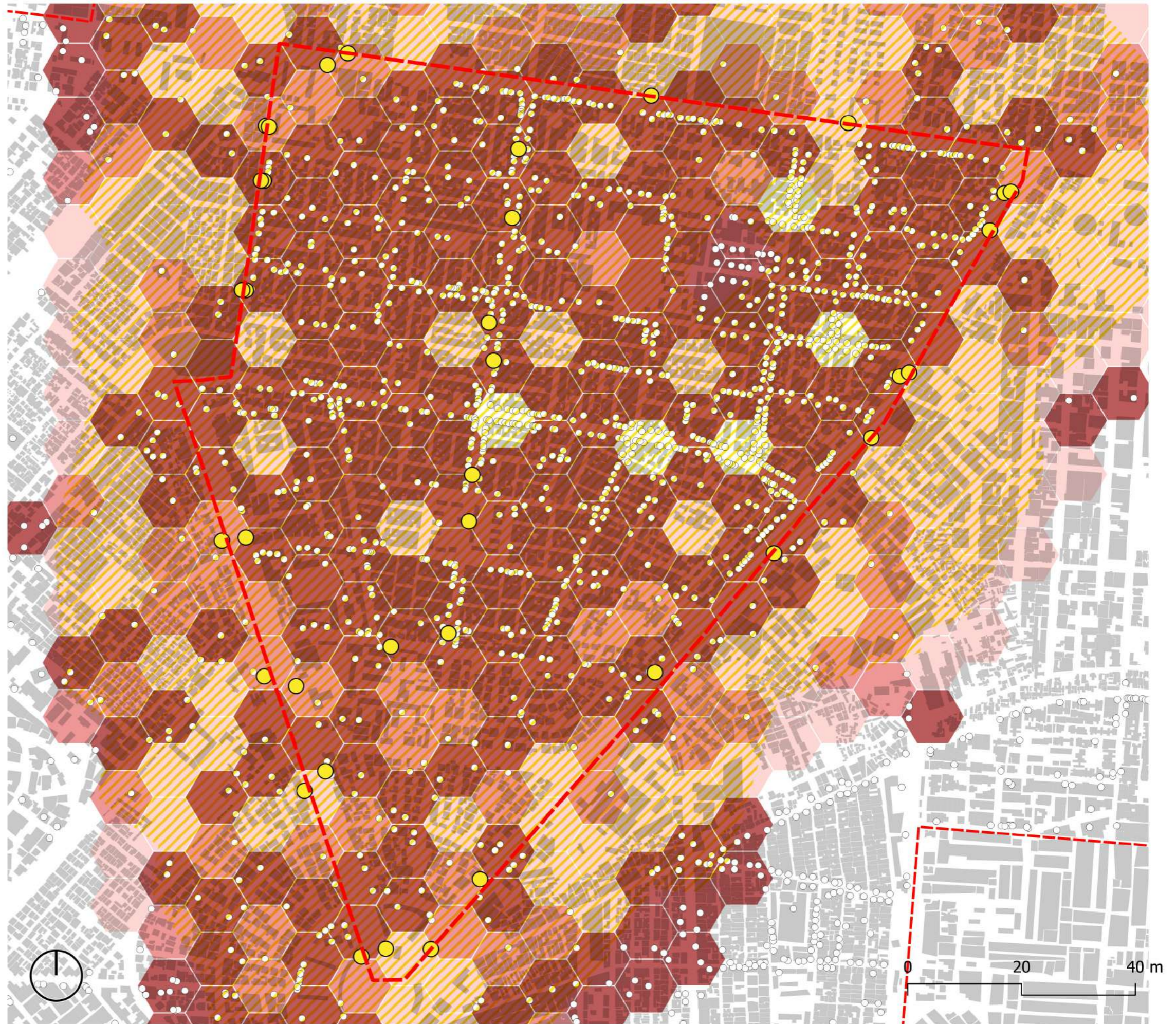
Public transortation

Local

- Network_bus_stop_local
- 5 min from bus stop local

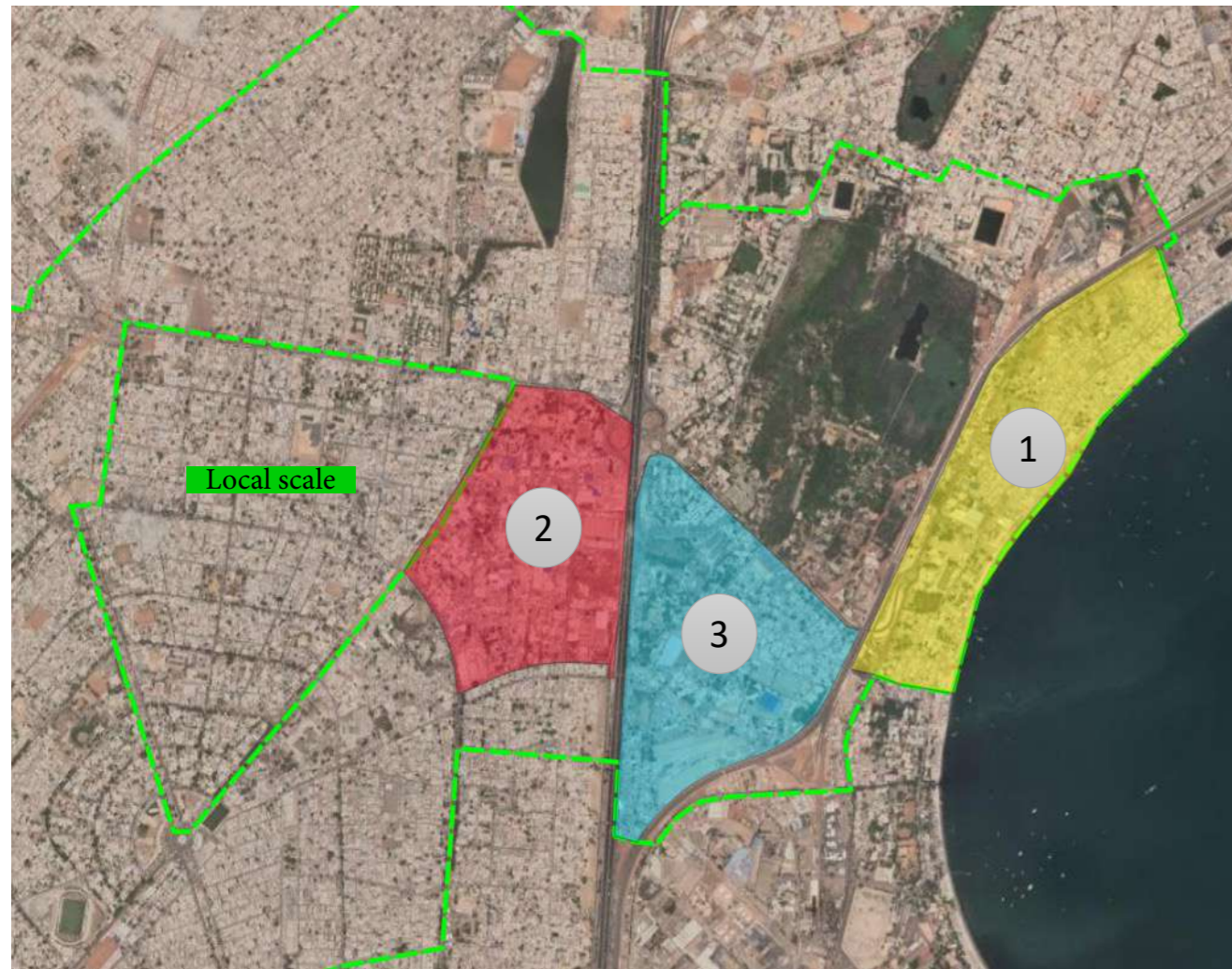
PROXIMITY

- key functions
- Proximity_local_without
 - 0 - 0
 - 0 - 1
 - 1 - 20
- Volume



3.4. Identified weak areas.

After the thorough analysis of Horizontal and Vertical catalysers 3 weak areas in the as been identified. For the better understanding and defining the problems of the identified areas the Vertical and Horizontal catalysers are ranked based on the performance in comparison to the local scale.



IDENTIFIED WEAK AREAS

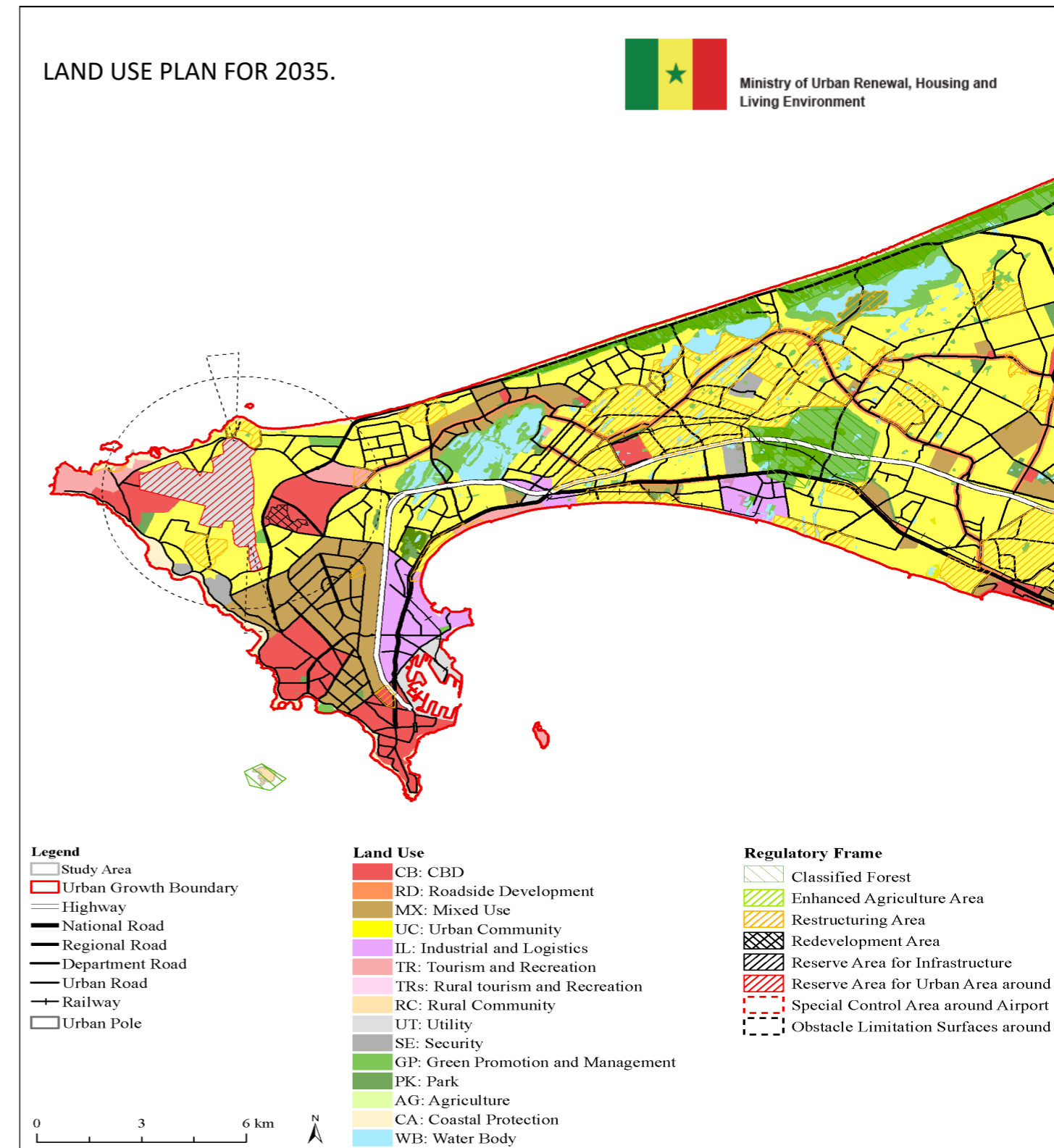
Vertical Catalyser

RANK	AREA_1	AREA_2	AREA_3
1	INTERFACE	DIVERSITY	INTERFACE
2	DIVERSITY	PROXIMITY	DIVERSITY
3	ACCESSIBILITY	EFFECTIVENES S	POROSITY
4	PROXIMITY	ACCESSIBILITY	PROXIMITY
5	PERMEABILITY	INTERFACE	PERMEABILITY
6	POROSITY	POROSITY	ACCESSIBILITY
7	EFFECTIVENES S	PERMEABILITY	EFFECTIVENESS

Horizontal Catalyser

RANK	AREA_1	AREA_2	AREA_3
1	TYPES OF USES	VOIDS	TYPES OF USES
2	LINKS	TYPES OF USES	VOIDS
3	VOIDS	LINKS	POROSITY
4	VOLUMES	VOLUMES	PROXIMITY

3.5. Selection of area for the retrofitting.



Legend

- Study Area
- Urban Growth Boundary
- Highway
- National Road
- Regional Road
- Department Road
- Urban Road
- Railway
- Urban Pole

Land Use

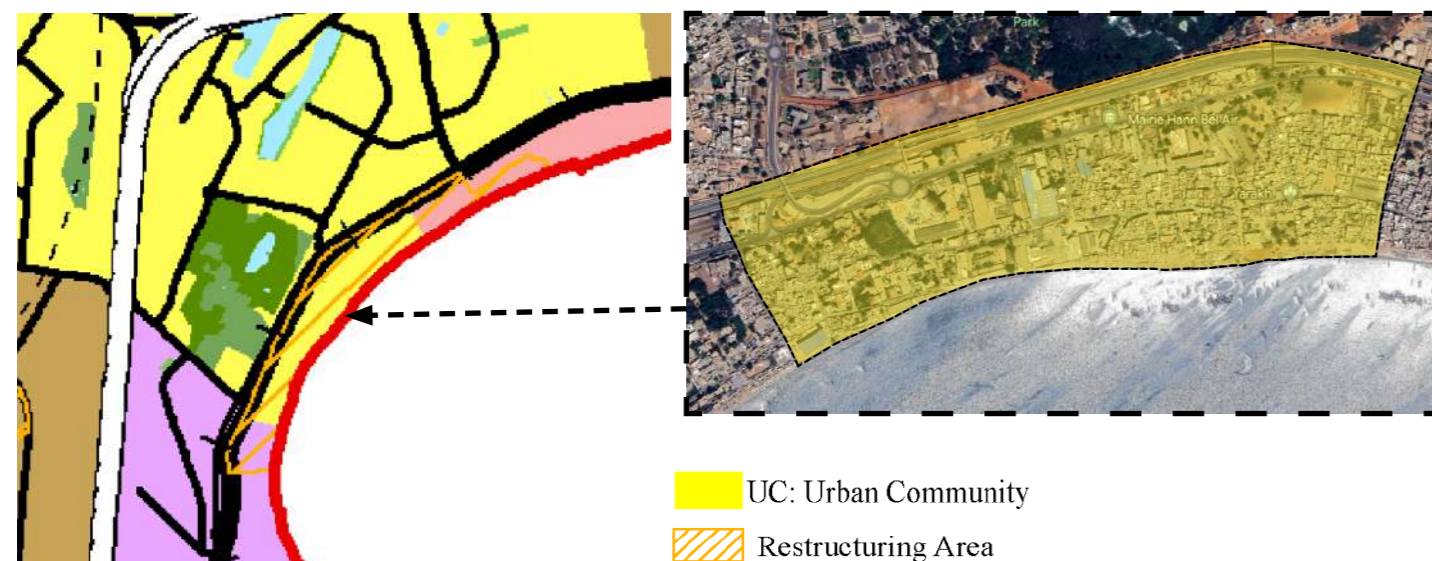
- CB: CBD
- RD: Roadside Development
- MX: Mixed Use
- UC: Urban Community
- IL: Industrial and Logistics
- TR: Tourism and Recreation
- TRs: Rural tourism and Recreation
- RC: Rural Community
- UT: Utility
- SE: Security
- GP: Green Promotion and Management
- PK: Park
- AG: Agriculture
- CA: Coastal Protection
- WB: Water Body

Regulatory Frame

- Classified Forest
- Enhanced Agriculture Area
- Restructuring Area
- Redevelopment Area
- Reserve Area for Infrastructure
- Reserve Area for Urban Area around
- Special Control Area around Airport
- Obstacle Limitation Surfaces around

INFORMAL IS THE NEW FORMAL

The area for the intervention is selected in consideration of the future development plans according to the “Ministry of Urban Renewal, Housing and Living Environment” for 2035. According to the Land use for plan 2035 of Ministry of Urban Renewal, Housing and Living Environment, in relation to the above 3 weak identified areas. Area 1 is been reconized as the Urban commu- nity and also it is considered for the restructuring this particular area.



Land use plan of slected area for 2035.

3.5.1 Ranking of Design ordering principle’s (DOP’s)

VERTICAL CATALYSER RANKING	DOP FAMILY	KPI(INDICATOR)	LOCAL_SCALE	AREA_1	
INTERFACE	1. Ground Use:	a) Urban Built density. Building Volume Density	2.55	1.23	
	6b. Walkability:	b) Car free or minimal car traffic streets	3922.31	2775.082	
		c) Percentage of daily trips on foot	70.00%	70.00%	
		d) Pedestrian street paths (%)	7.20%	20.95%	
DIVERSITY	4. Urban biodiversity:	a) Percentage of Areas designated for nature protection and biodiversity under international, national schemes	2.17%	3.9%	
		i) Proportion of the resident living 300m of a park (%)	67.58%	75.8%	
		n) Indication of vegetation cover in overall area (%)	16.00%	7.98%	
		b) Car free or minimal car traffic streets	3922.31	2775.082	
ACCESSIBILITY	6b. Walkability:	c) Percentage of daily trips on foot	70.00%	70.00%	
		d) Pedestrian street paths (%)	7.20%	20.95%	
		7a. Urban flow (people)	t) Length of road per urban hectare	0.36	0.244
		PROXIMITY	6b. Walkability:	b) Car free or minimal car traffic streets	3922.31
c) Percentage of daily trips on foot	70.00%			70.00%	
d) Pedestrian street paths (%)	7.20%			20.95%	
10. Food management	e) Nb of food deserts			0	1
PERMEABILITY	6b. Walkability:	i) Number of supermarkets within a local/community	51	0	
		1. Ground Use:	e) Street Cover Ratio (SCR) (%)	50.00%	62.00%
		b) Car free or minimal car traffic streets	3922.31	2775.082	
		c) Percentage of daily trips on foot	70.00%	70.00%	
POROSITY	1. Ground Use:	d) Pedestrian street paths (%)	7.20%	20.95%	
		t) Length of road per urban hectare	0.36	0.244	
		a) Urban Built density. Building Volume Density	2.55	1.23	
		c) Number of buildings per hectare (n°)	25.79	28.86	
EFFECTIVENESS	1. Ground Use:	e) Street Cover Ratio (SCR) (%)	50.00%	62.00%	
		m) Land cover in a given area (%)	53.92%	65.90%	
		a) Urban Built density. Building Volume Density	2.55	1.23	
		c) Number of buildings per hectare (n°)	25.79	28.86	
7a. Urban flow (people)	t) Length of road per urban hectare		0.36	0.244	

In order to improve the performance of the Catalysers for the above selected area (i.e, Area 1). It is essention to understance the performance of the Design Ordering Principle’s (DOP’s) which in direct relation with the effective performance of the catalysers. To understand the and rank the required DOP’s to be improved we use the Key performance index (KPI) as indicators. The data of the important KPI indicators which pose the direct effect on the DOP’s are collected from the diffrent sources and are synthesised to understand the effective actions. These values are then compared to the Local scale KPI indicator values to under- stand the areas to be improved. After the analysis of KPI indicators in comparson to local scale.

Considering both weak and strong performing areas the DOP’s are ranked accordingly to priorities the implementation of respect- ed design ordering principle in our retrofitting. The each individual KPI plays a significant role in sustainable urban development.

DOP RANKINGS OF SELECTED AREA IN COMPARISON WITH LOCAL SCALE KPI INDICATORS

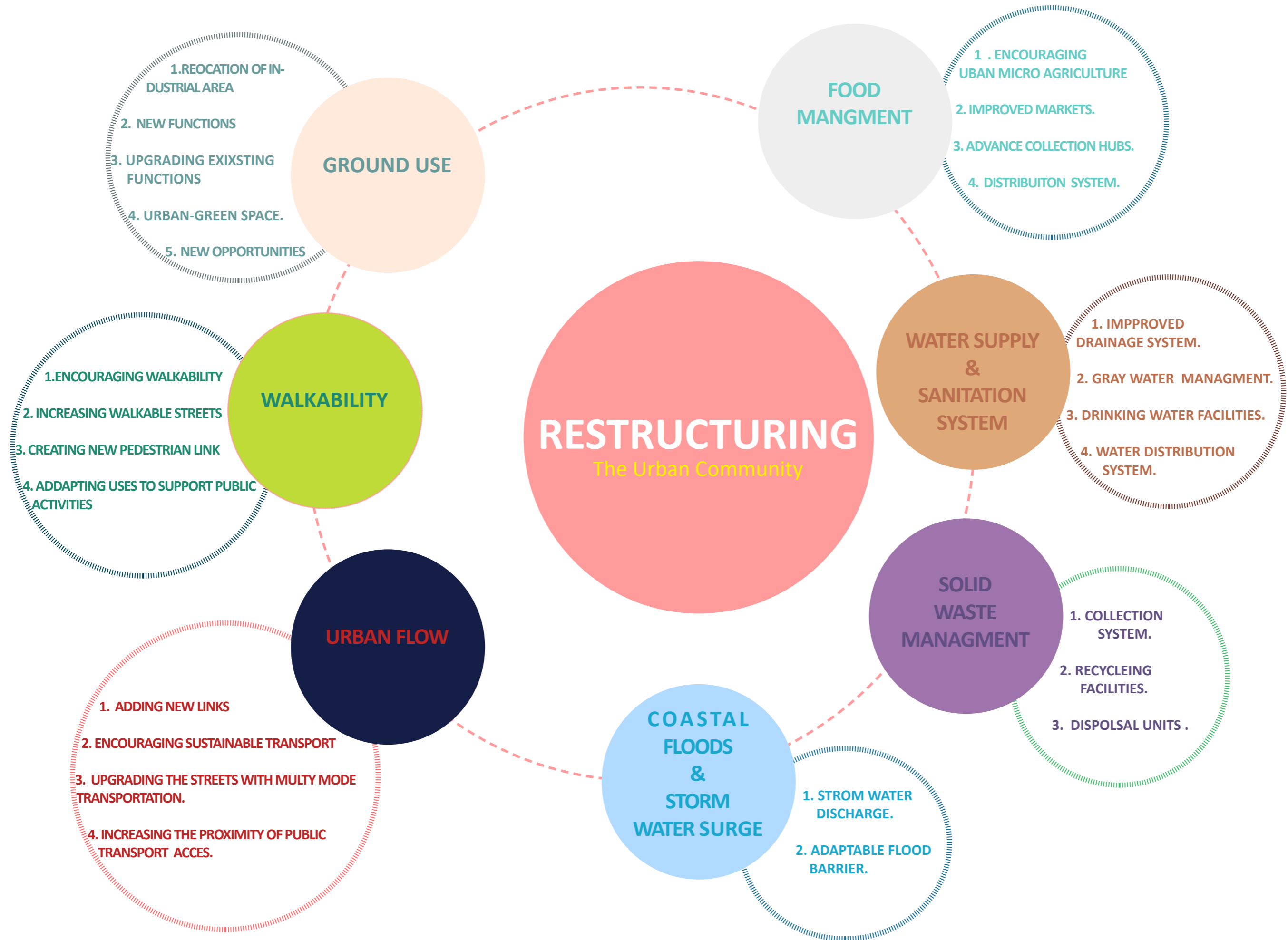
DOP FAMILY	NO OF WEAK PERFORMING AREAS KPI(INDICATOR)	NO OF STRONG PERFORMING AREAS KPI(INDICATOR)	RANK	DOP FAMILY
			1	WALKABILITY
GROUND USE	3	7	2	URBAN FLOW
WALKABILITY	4	5	3	GROUND USE
URBAN BIODIVERSITY	1	2	4	FOOD MANAGEMENT
FOOD MANAGEMENT	1	1	5	URBAN BIODIVERSITY
URBAN FLOW (PEOPLE)	3	0		

DOP RANKINGS OF SELECTED AREA IN RELATION TO CATALYSER

VERTICAL CATALYSER	DOP’S RANKING BASED ON KPI INDICATOR
INTERFACE	1. GROUND USE 2. WALKABILITY
DIVERSITY	1. URBAN FLOW 2. WALKABILITY
ACCESSIBILITY	1. GROUND USE
PROXIMITY	1. FOOD MANAGEMENT 2. WALKABILITY
PERMEABILITY	1. URBAN FLOW 2. WALKABILITY 3. GROUND USE
POROSITY	1. GROUND USE
EFFECTIVENESS	1. URBAN FLOW 2. GROUND USE

4. RESTRUCTURING

The Urban Community



RESTRUCTURING

GROUND USE

4.1.1 RELOCATION OF INDUSTRIAL AREA

WALKABILITY

URBAN FLOW

FOOD MANAGMENT

COSTAL FLOODS & STORM SURGE

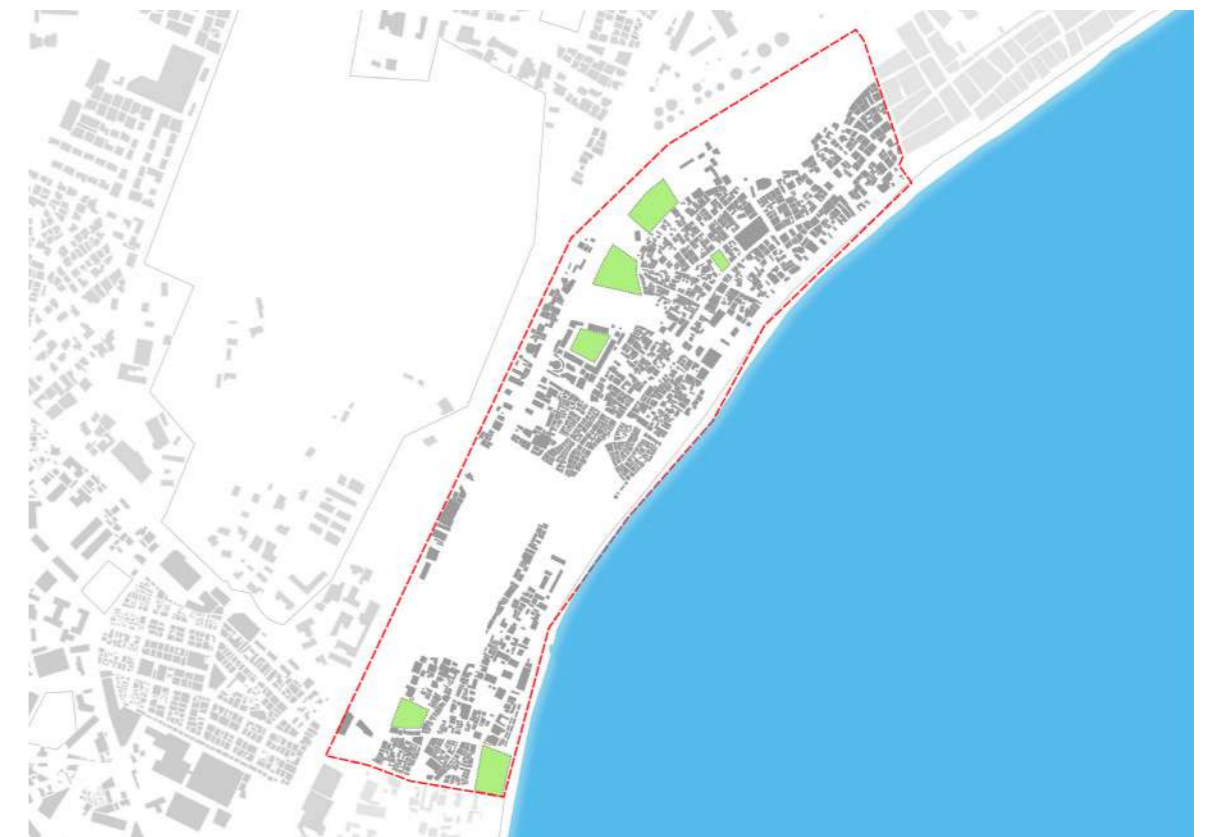
WATER SUPPLY & SANITATION SYSTEM

SOLID WASTE MANAGMENT



Under the restructuring act the land used for the industrial use are relocated to the new hubs allocated for the industrial area at Daga Kholpa. The relocation of industrial blocks create an unique opportunity for the intervention, the available land can be used for the addition of new land use function. The already existing informal settlements can have a huge advantage by the addition of new essential function which could be challenging with already occupied area.

The new area can also be used to add the volumes in organized manner in contrary with present settlements. Along with the retrofitting act the design of new area also play a crucial part in the urban structure. This also adds an advantage in converting the land into an urban community which is the goal set for 2035 by the municipal dakar.



RESTRUCTURING

GROUND USE

4.1.2 NEW FUNCTIONS

WALKABILITY

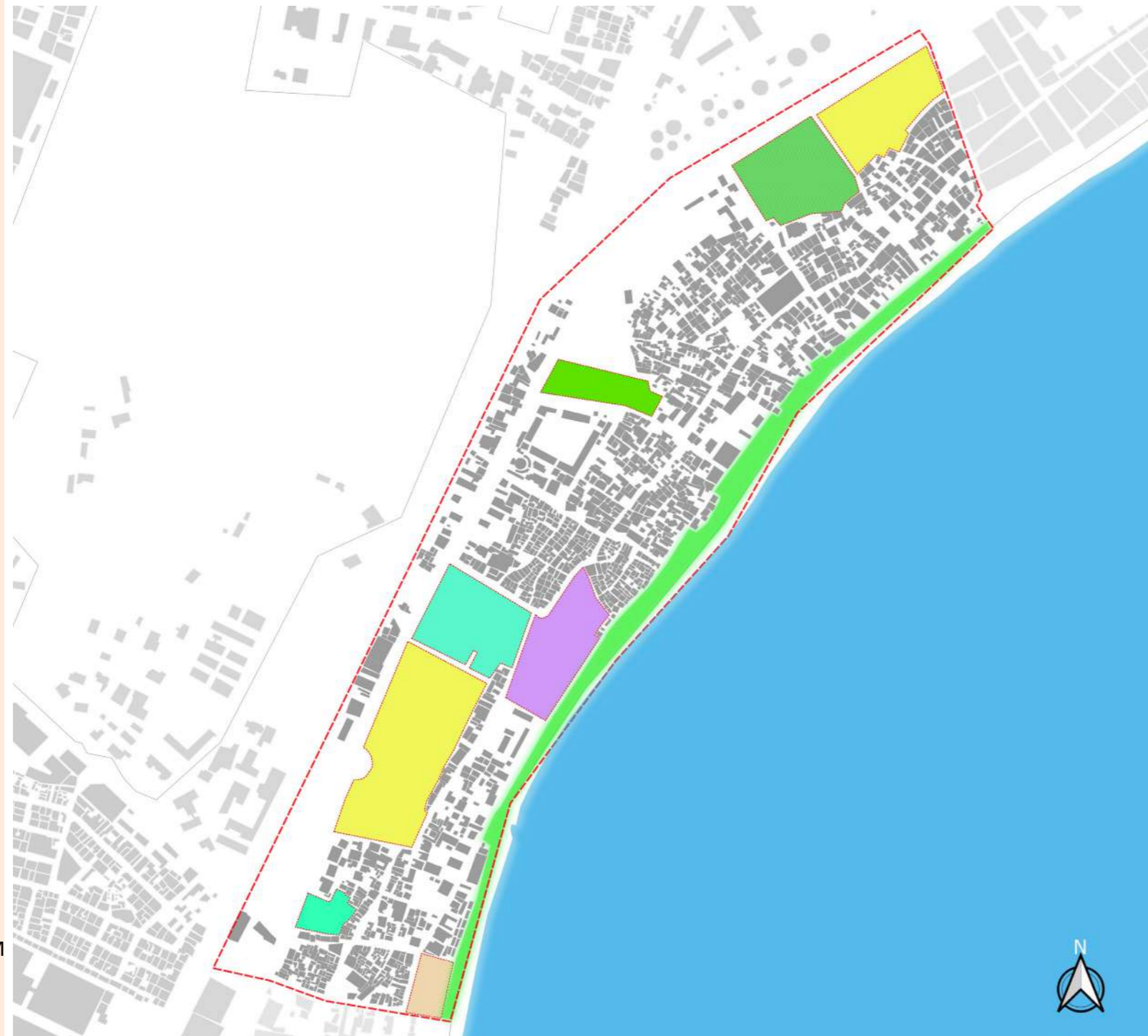
URBAN FLOW

FOOD
MANAGEMENT

COSTAL FLOODS
& STORM SURGE

WATER SUPPLY &
SANITATION SYSTEM

SOLID WASTE
MANAGEMENT



INTRODUCING NEW FUNCTIONS

Functions

- Recreational area
- Economic zone
- Residential urban community
- Fish Market
- Micro Agriculture hub
- Urban Agriculture training
- Cultural Garden
- Adaptive sea wall
- Volumes

The area that are available after the relocation of the industrial area has created the opportunity to add the new required functions and features for the area. The functions are decided by considering the present lack of uses and also considering the future requirements.

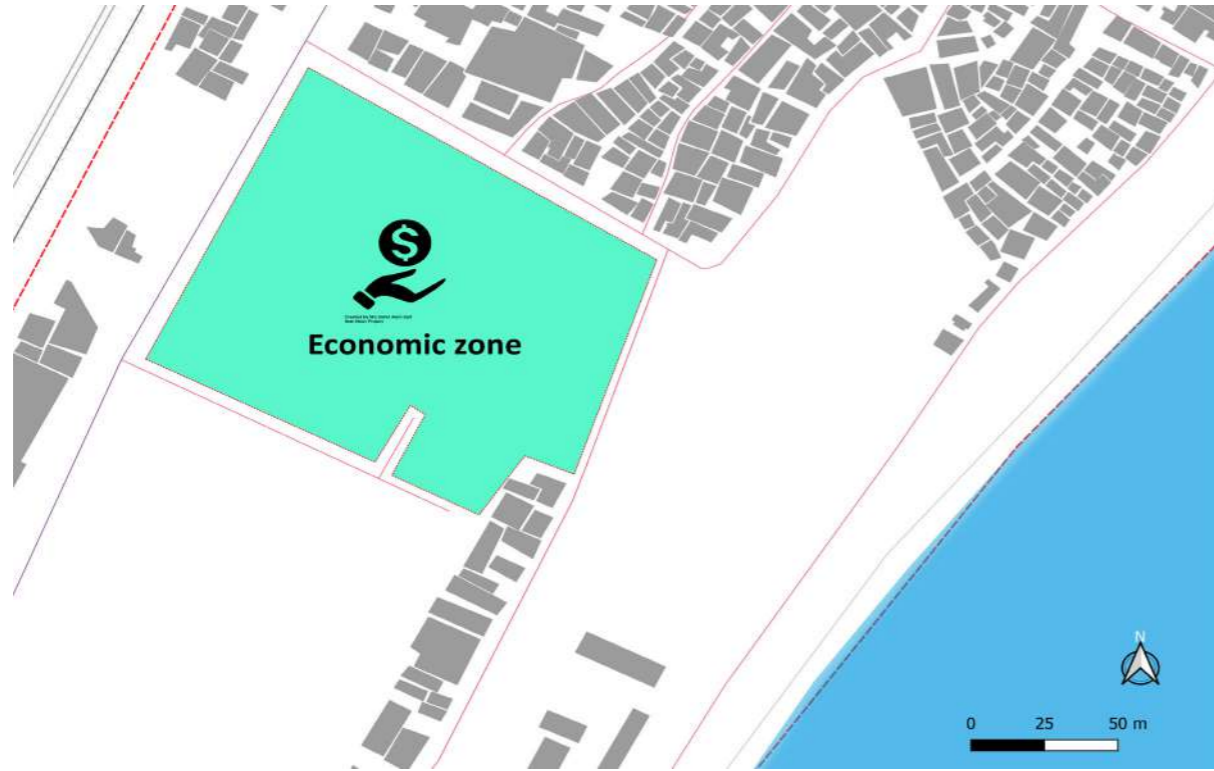
This addition of strategic functions will play a vital role in combining the already existing informal settlements and the upcoming future settlements.

Functions that are selected is the part of sustainable development goals (SDG 11). Hence the addition of these functions can lead the path for the formation of the new sustainable community for the future.

RESTRUCTURING

GROUND USE

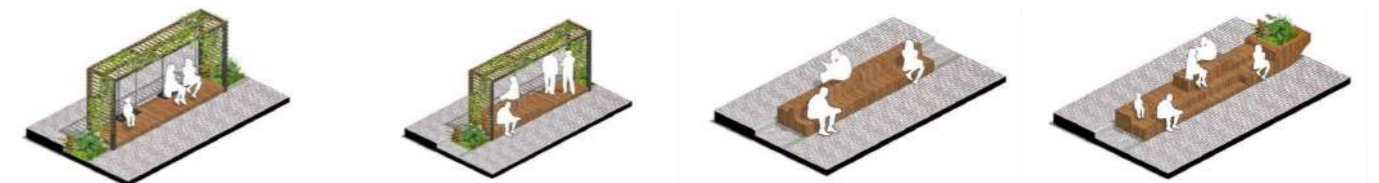
4.1.2.1 Economic zone



The Economic Zone is an opportunity for the development of the territory. The territorial system around the Special Economic Zone must be planned by the strategic urban plan. Only the urban plan determines the integrated quality system between infrastructures, urbanization, territory and landscape. The strategic urban plan for territories with Special Economic Zones converts urban spaces into places of development, maximizes the offer of services and technological innovation and increases the quality of life and well-being of citizens.



4.1.2.2 Recreational area



The recreational area creates an opportunity to bringing people together and celebrate their culture in much more effective way. This space can also be used as multi utility area like as season or weekly markets which adds to the job and bussiness opportunities were it also contribute to the economical aspect.

WALKABILITY

URBAN FLOW

FOOD MANAGMENT

COSTAL FLOODS & STORM SURGE

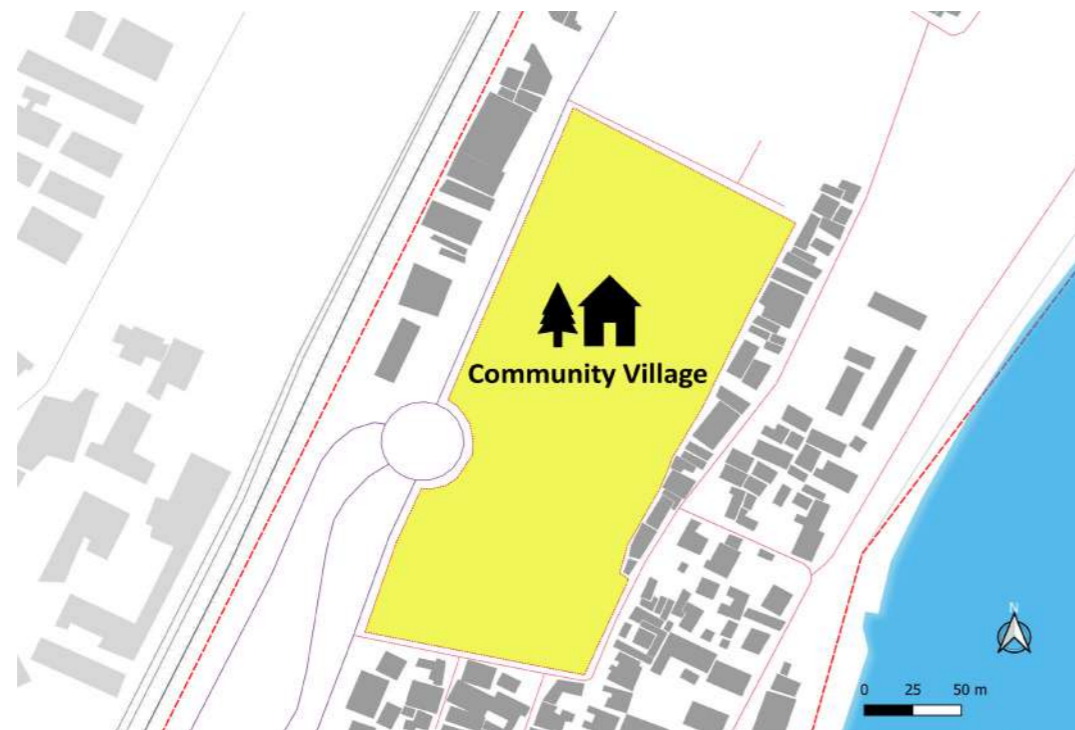
WATER SUPPLY & SANITATION SYSTEM

SOLID WASTE MANAGMENT

RESTRUCTURING

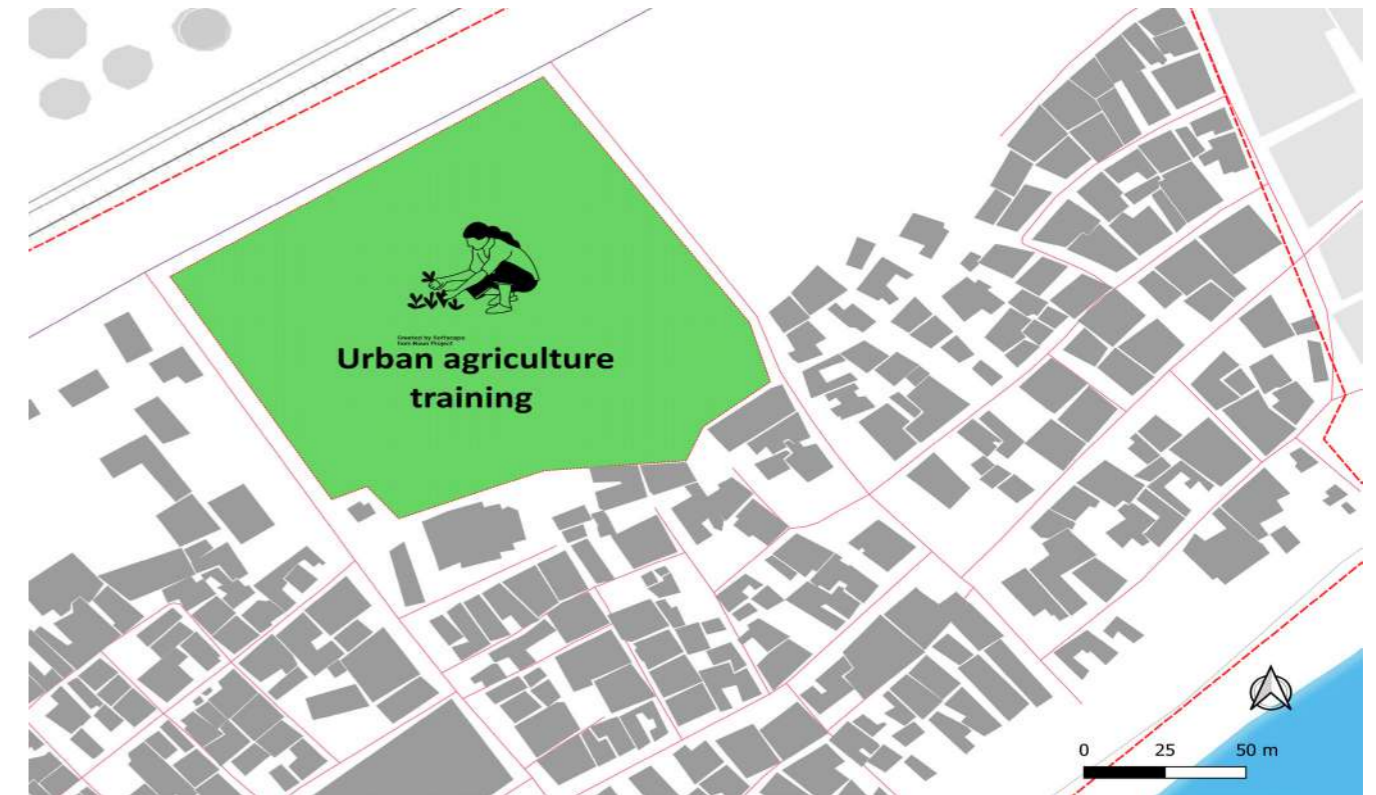
GROUND USE

4.1.2.4 Community village



Community village provides affordable, permanent housing and a supportive community for men and women coming out of chronic homelessness. A development of Mobile Loaves & Fishes, this transformative residential program exists to love and serve our neighbors who have been living on the streets, while also empowering the surrounding community into a lifestyle of service with the homeless.

4.1.2.5 Urban agriculture training



Urban agriculture refers to various practices of cultivating, processing, and distributing food in urban areas. The term also applies to the area activities of animal husbandry, aquaculture, beekeeping, and horticulture in an urban context. Urban agriculture is distinguished from peri-urban agriculture, which takes place in rural areas at the edge of suburbs.

Urban agriculture can appear at varying levels of economic and social development. It can involve a movement of organic growers, “foodies” and “locavores,” who seek to form social networks founded on a shared ethos of nature and community holism. These networks can develop by way of formal institutional support, becoming integrated into local town planning as a “transition town” movement for sustainable urban development. For others, food security, nutrition, and income generation are key motivations for the practice. In either case, the more direct access to fresh vegetable, fruit, and meat products that may be realised through urban agriculture can improve food security and food safety.



WALKABILITY

URBAN FLOW

FOOD MANAGMENT

COSTAL FLOODS & STORM SURGE

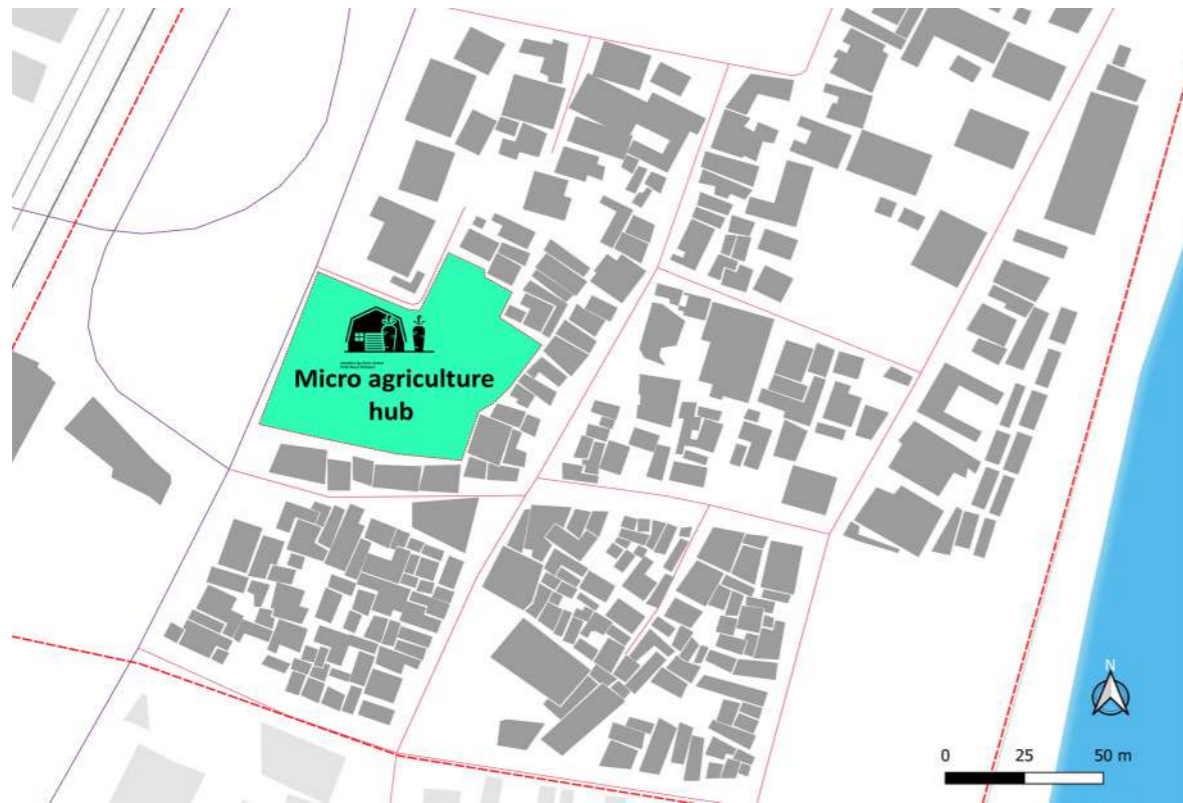
WATER SUPPLY & SANITATION SYSTEM

SOLID WASTE MANAGMENT

RESTRUCTURING

GROUND USE

4.1.2.6 Micro agriculture hub



Micro farms are small-scale agricultural operations that use far less land than the average commercial or family farm — typically under five acres — and are often located in urban or suburban areas. Size limits and zoning restrictions force micro farmers to be creative about the crops they grow and the ways in which they seek to make a profit, and they tend to focus on sustainability, seasonal crops and niche markets for their products.



This micro agriculture hubs helps in teaching the neighbourhood house holds to cultivate uunder their roof with available space. By providing the eduction of micro agriculture we can achive urban agriculture at miniature scale in each and every house hold which directly address the food security and food scarcity. Hub also provides storage facilities for the produced food in order to adapt better managment and distribution system.

4.1.2.5 Fish market



Fishing is the main practice in this area, but the area lack in facilites where they can sell and store for the long term. The fishermens at present are not provided with permanent infrastructre to facilitate them. Hence the addition of the fish market with the advance facilities for storage could help in the betterment of the fisheries and also would help in the economic growth.



WALKABILITY

URBAN FLOW

FOOD MANAGMENT

COSTAL FLOODS & STORM SURGE

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RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FOOD
MANAGEMENT

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4.2. Walkability.

walkability focus on the means or conditions by which walking is enabled, including areas being traversable, compact, physically-enticing, or safe. Others propose that walkability is about the outcomes or performance of such walkable environments, such as making places lively and sociable, enhancing transportation options, or inducing exercise. A final set of discussions uses the term walkability as a proxy for better urban places—with some paying attention to walkability being multidimensional and measurable and others proposing that enhancing walkability provides a holistic solution to a variety of urban problems.

4.2.1 Basic features of walkability.

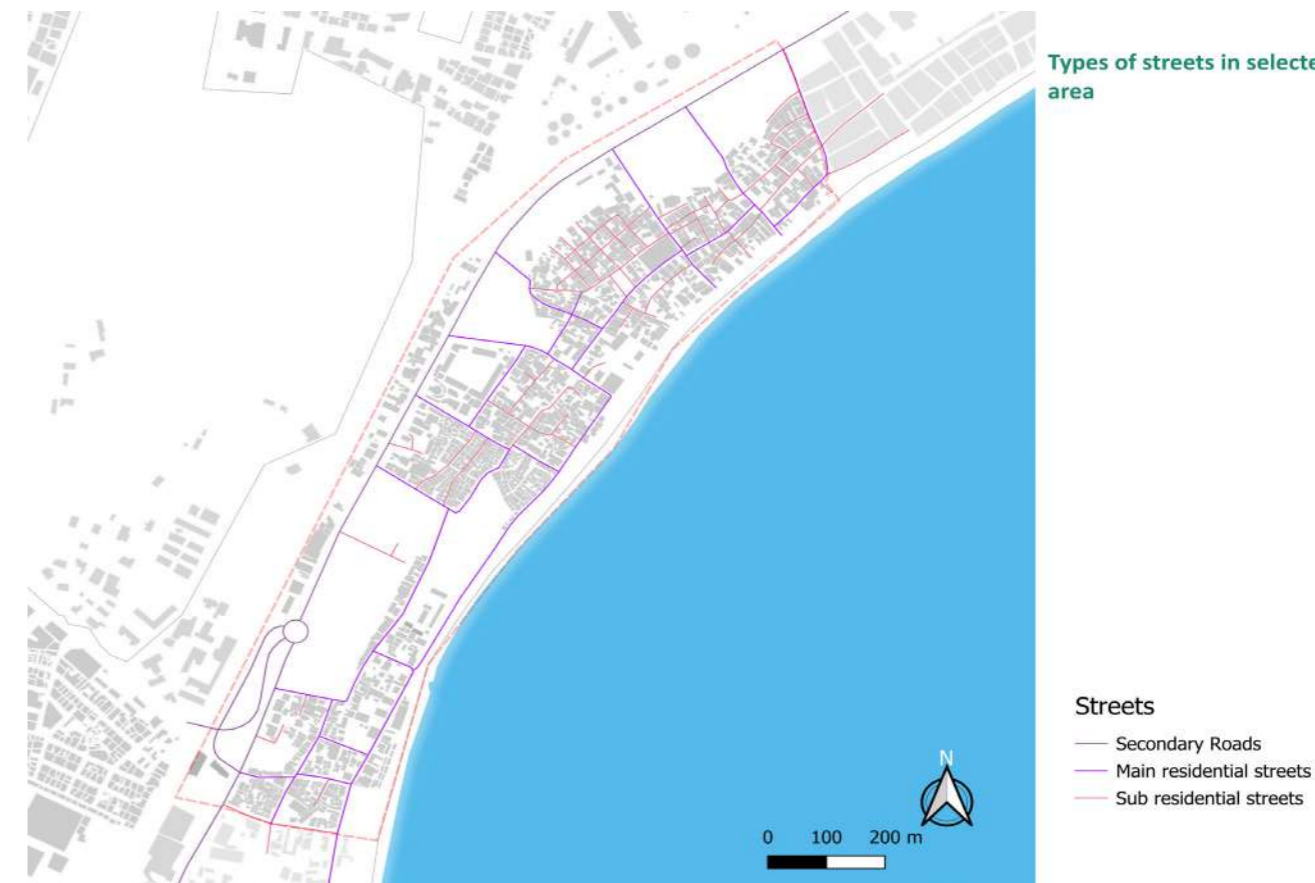
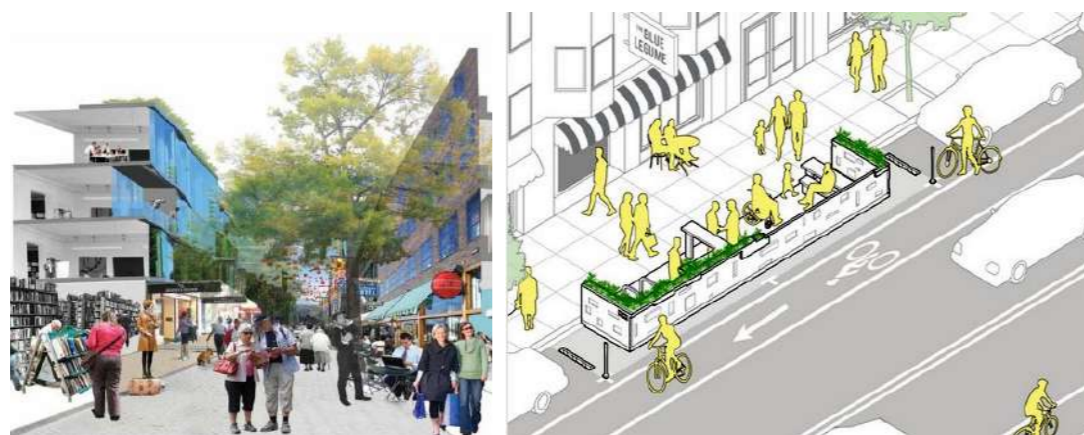
While there are many options in street design, we find there are a few must-have features always present in people-first streets. These features dependably draw people—and these are features your elected officials can demand in your town. That demand usually has to come from both the grassroots and from the top. As former longtime Charleston mayor Joseph Riley has said, “The mayor is the chief urban designer of the city.”

First, good streets are **shaped**. The street space is given a designed form, like an outdoor public room, with the roadway and sidewalk its floor, the buildings its walls, and, sometimes, its ceiling formed by the tree canopy.

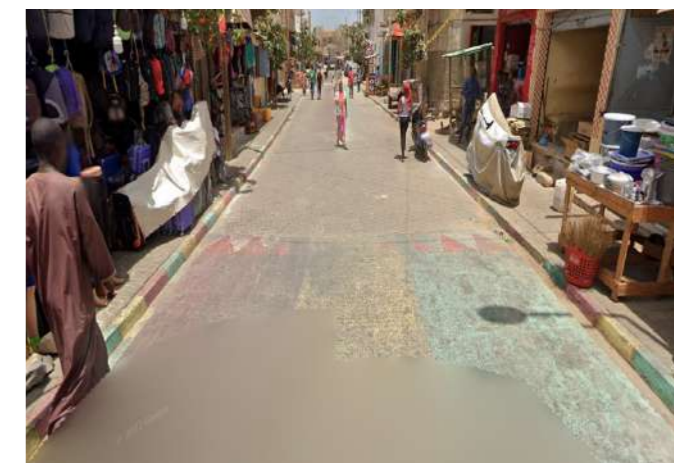


Second, they’re **comfortable**. In most climates that means shaded in the summer. Street trees, and architectural elements like porches, arcades and awnings, moderate the elements.

Next, they’re **safe**. That means you aren’t stressed out about getting run over by a vehicle, because motoring speed is slower by design. You’re also safer if you have what Jane Jacobs called “eyes on the street.” The safe street isn’t faced by blank walls, but by doors and windows and porches and balconies and storefronts.



Main streets of selected area



Through the investigation it was seen that these streets are lacking with parking facilities. Hence the pedestrian streets are mainly parked with the vehicles. Hence the streets needs to re-design in order to achive the streets with dedicated parking space and allow of the pedestrian movement.

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

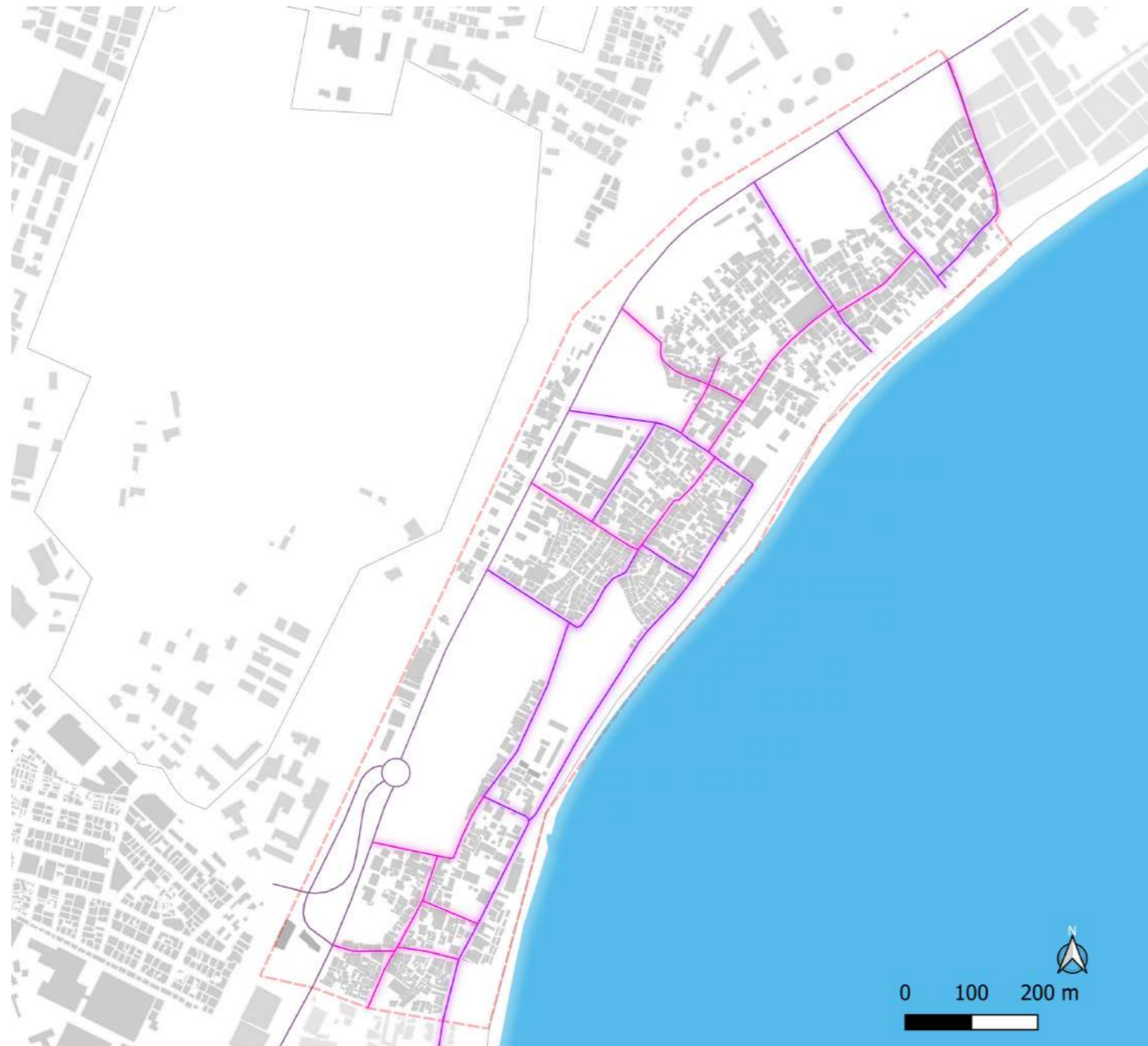
FOOD MANAGMENT

COSTAL FLOODS & STORM SURGE

WATER SUPPLY & SANITATION SYSTEM

SOLID WASTE MANAGMENT

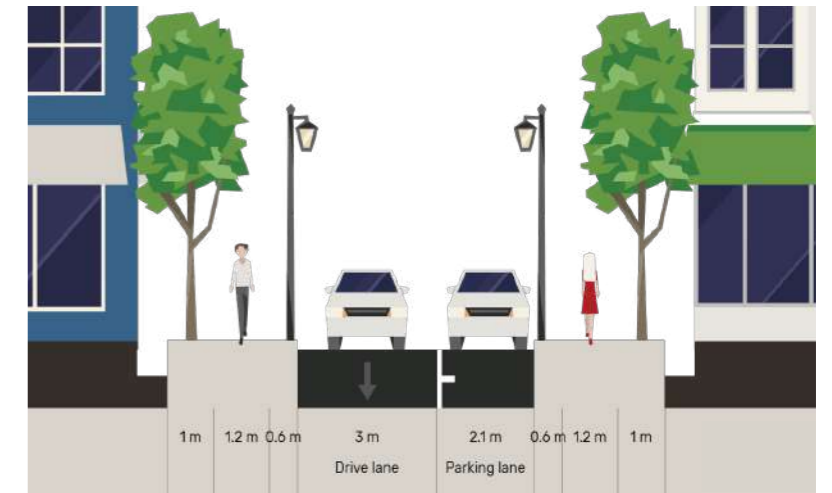
Upgrading streets to promote walkability



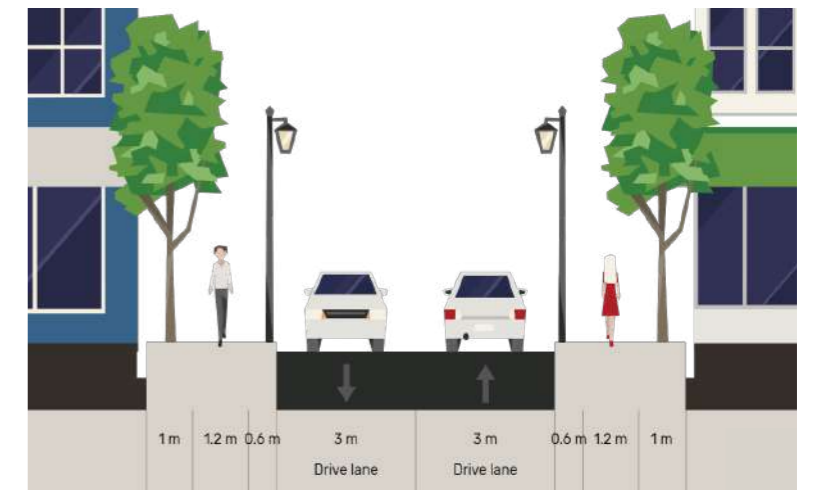
Upgrading streets

New streets

- Driving lane with parking
- 2 way driving lanes



1 driving lane with parking



2 driving lanes without parking

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FOOD
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& STORM SURGE

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SOLID WASTE
MANAGMENT

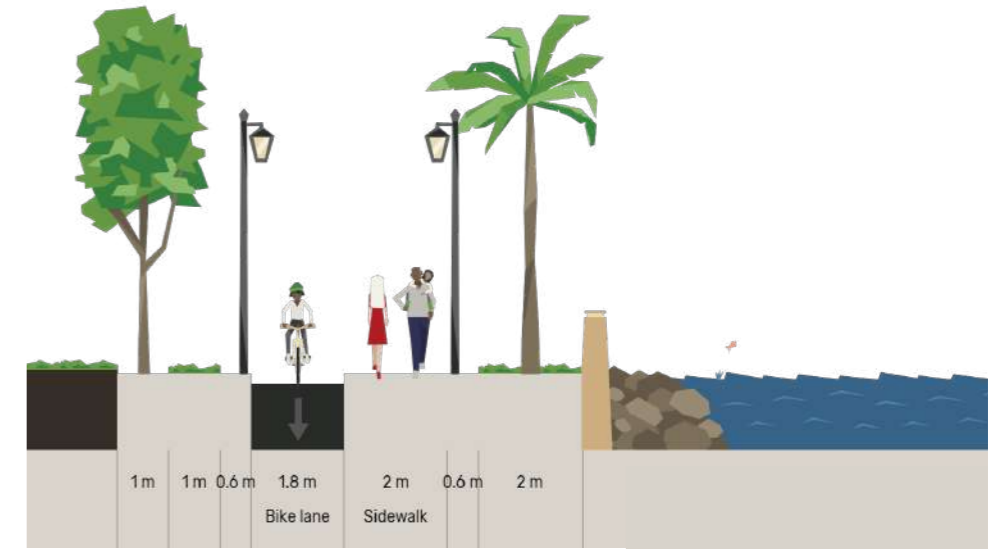
New streets wih pedestrian concentrated design



New streets with pedestrian concentrated design

New streets

- Water front
- New pedestrian path



Water front



New pedestrian path

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FOOD
MANAGEMENT

COSTAL FLOODS
& STORM SURGE

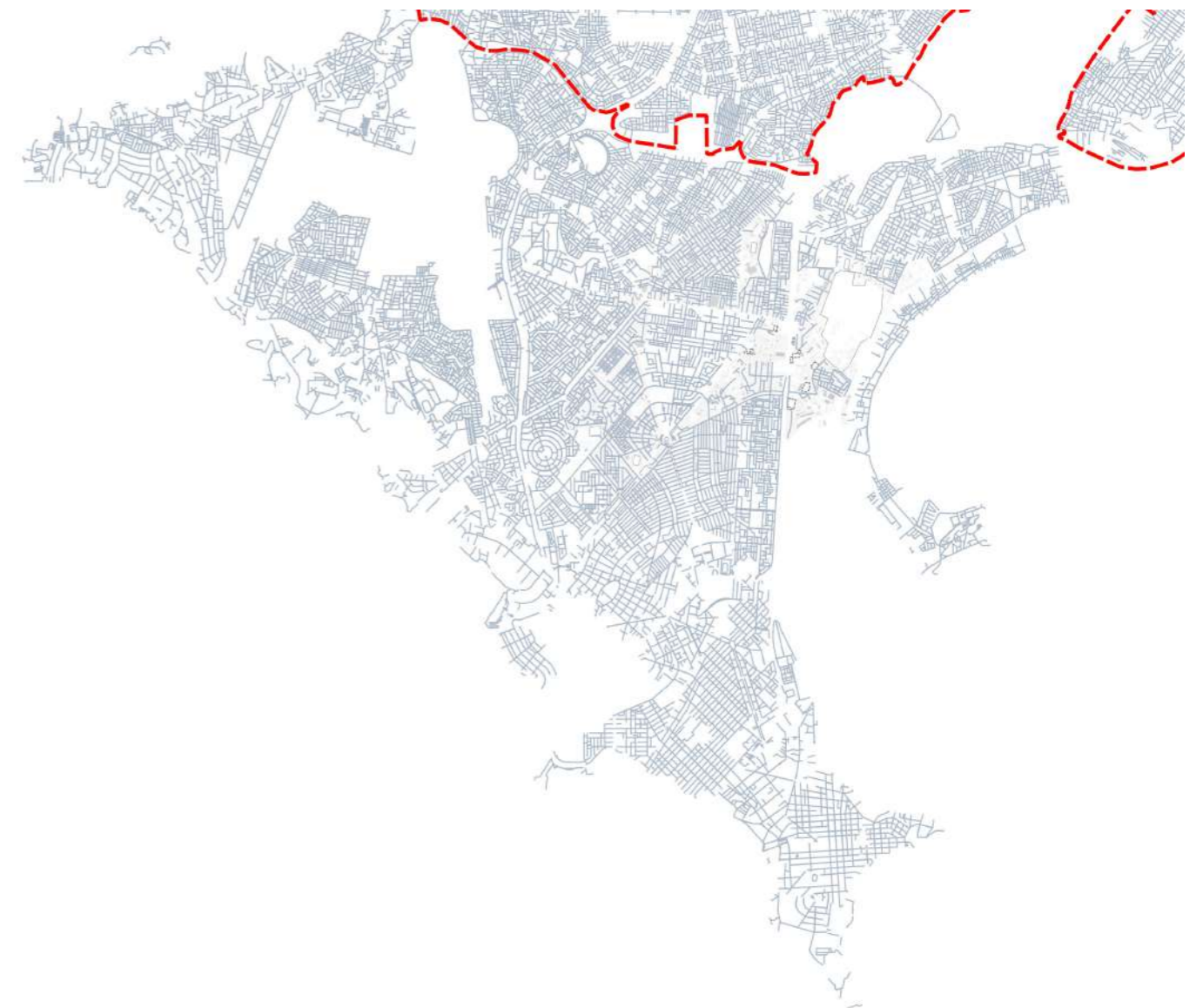
WATER SUPPLY &
SANITATION SYSTEM

SOLID WASTE
MANAGEMENT

Design principles to improve walkability



The streets around the dakar have the similar issue in walkability, were the streets with built with pedestrian paths are usually occupied with parking vehicles. Hence the streets of the residential use must be redesigned in order to over come this issue. The streets around the dakar must be restructured using design principles in order to promote the walkability across the city and encuroage people to use more often sustainable modes of transportation in order to move around the blocks.



RESTRUCTURING

GROUND USE

4.3. Urban flow.

The urban flow defines how well the city is connected, proper designing of the roads plays a vitale role in urban flow. Adapting the multi mode transporrtion design can drastically improve the urban flow and also encoraging people to use more sustainable methods of transportation. Within the city it is more important to combine the different modes of transports like Bus, Trains and bicycle lanes to encourage the use of sustainable tranportation.

WALKABILITY

URBAN FLOW



In Dakar, urban transportation system was not designed for Non Motorized Transportation; most of walking side has developed spontaneously and were never upgraded. The existing walking sides remain outside from the normal processes of transportation planning. The preeminence of walking makes sense in the poor country where population is young. It makes sense where the lack of resource is so high. In Dakar, there is no effort to encourage non motorized transportation as bicycle and most of people do not have money to buy a bike. Despite this bike-less culture, there is no bike infrastructure in the city, any kind of bike lane for the urban planning system. Consequently, the preeminence of walking is justified.

Also there are some stigmatizations of bike use; in Senegal, a woman bike rider is badly seen so does a rich people. It is not also common to see more than 40 years old men using bike. Hence, bike is exclusively reserve to young people and is not defined as a mean of transportation in

Dakar. This situation is noticeable in many countries in Africa while developed countries create bicycle friendly cities. Culture of cycling changed the ways of seeing in some developed countries; lifestyle and gender perception have much more evolved, new economic conditions and western culture removed the difference between male and female. Also, rights are the same for men and women and society is not anymore based on feminine stereotype with women supposed to be only housewife. There is also no categorization of transportation means for rich, or for poor and young.

4.3.1 Domination of informal transport system.

As in much of the rest of Africa, public transport in Dakar is dominated by the informal operations of minibuses locally known as 'Cars Rapides' and 'Ndiaga Ndiaye'. The exact number operating is unknown and their ageing fleet is usually in poor condition and, despite relatively low fares, services are erratic and quality poor. They are old, artisanal, highly polluting vehicles (average age of over 15 years) and a lack of road safety. These types of transportation carry the heaviest load of passengers. Unregulated competition between them and traffic congestion bring them to "stop in unregulated locations, sometimes consuming two full lanes of traffic. Furthermore, the competition for passengers along the roadway means that they run down pedestrians" (ITDP, 2004).

The motorized people in its majority, use the "car rapide", "Ndiaga Ndiaye" and the minibuses to ensure their displacements. They are confronted with very large congestion, but the urban congestion in Dakar is not the prerogative of the poor people, those who are able to take the buses and taxis also are victims, just as those who have their own cars.



Ndiaga Ndiaye with apprentis on the back



Car rapide with apprentis on the back

Car rapide and Ndiaga Ndiaye tend to be older and pollute heavily; the pass-receiver called "apprentis" "stand outside on the back of the bus right above the tailpipe emitting black clouds of exhaust, breathing emissions all day long". Each trip is quite cheap but with cutting road system (car rapide and/or Ndiaga Ndiaye divide one trip into two or three rides to get to their destination), trips have become more expensive than expected.

Owners of Car rapide and Ndiaga Ndiaye are not always the real managers. They used to hire a driver and a pass-receiver who is also the controller. They should pay every day to the owner a fixed amount of money. That amount depends on the state of the vehicle, it is usually between 15 000 Fcfa and 18 000 Fcfa, or 28 to 34 USD (Lombard, 2005). All administrative services and maintenance should be done by the owner; he has to repair the vehicle if it is broken down. The driver is operating the vehicle with the help of a controller he may sometimes choose, in that case, the driver will pay the daily amount required by the owner and will manage the vehicle.

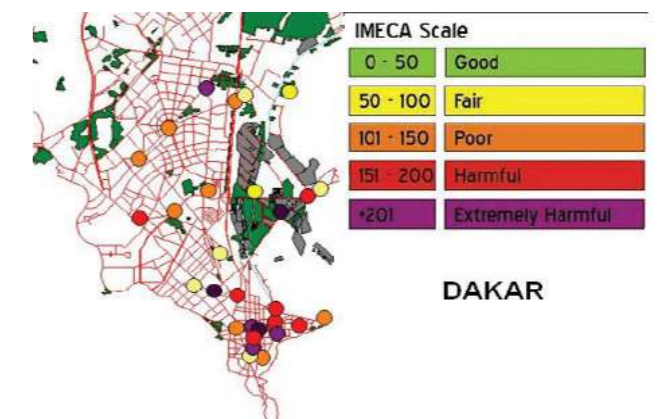
The controller or pass-receiver who is locally called apprentis is directly chosen by owner, thus he has the responsibility to plan and choose the best route where he think demand will be high; this is not a real planning, it depends on the controller feelings. So the real manager is neither a driver nor an owner, but he is essentially the controller.

4.3.2 Urban and environmental risks

Congestion and other transportation problems set off several risk in urban being as noise, pollution and urban deconstruction. Horns of car are first pollutant; sonorous pollutant that disturb circulating people and even population in dwellings. Honk-use is done with zeal in Senegal urban system, therefore, the use of car horn appears as the main communication language between vehicles themselves, between drivers and driver-assistants (apprentis in Senegal), between drivers and customers, between drivers and pedestrians. So any action of car in Dakar is accompanied with vehicle horns noise. The use of horn is a big problem in Dakar urban transport. There is no information about damages directly caused by noise, but compared with European standards, "measurements have shown that the noise level during the morning rush hour in Dakar is always higher than acceptable (65 DBA) on both primary and secondary routes". (World bank, 2001).



Car rapide smoking on traffic jam



Pollution map, sources: AQ Dakar \ B Sivertsen

Pollution. In Dakar, everybody knows that this problem is gaining weight, but so far there are no measures or studies with figures showing the real situation. The polluted gas from old diesel bus is high; car rapide and Ndiaga Ndiaye emit large quantities of blackened smoke in the air that passengers breathe. Air quality is not in a good point according to Dakar local government. "Gasoline sampling results showed that lead was still present in Senegalese gasoline after the ban, but that levels varied across different times and areas. Most importantly, lead content in gasoline in the capital, Dakar, was much lower--and 75% of all cars in Senegal are located here. Overall, lead levels in gasoline decreased between September 2006 and March 2007"(Sivertsen, 2011).

FOOD MANAGMENT

COSTAL FLOODS & STORM SURGE

WATER SUPPLY & SANITATION SYSTEM

SOLID WASTE MANAGMENT

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FOOD
MANAGEMENT

COSTAL FLOODS
& STORM SURGE

WATER SUPPLY &
SANITATION SYSTEM

SOLID WASTE
MANAGEMENT

As it appears in Fig. 5, red signal is shown everywhere in Dakar but is more visible in the area where the international port is located; in this area, there is train station and some factories. Car rapide and Ndiaga Ndiaye stations are also located. So we can understand why the red signal dominates this area. It means the most polluting area in Dakar is this area where Car rapide, Ndiaga Ndiaye, train and factories are concentrated. There is no green signal in Dakar, It means that air quality is not high in the whole city but it appears poor in Ndiaga Ndiaye and Car rapide routes as the signal are brown. It is harmful in Colobane, area where car rapide and Ndiaga Ndiaye are more important and it appears fair (not so low quality) in Corniche, Plateau and wherever Car rapide and Ndiaga Ndiaye are not admitted. This situation shows that Car rapide and Ndiaga Ndiaye cause some dysfunction in the atmosphere. Looking the we find that smoke from vehicles is frequent and accepted in Dakar public transportation. According to the local government, this situation had posed serious environmental and public health problems, especially for the most vulnerable population: children, pregnant women, and people with respiratory diseases such as asthma, pneumonia, and tuberculosis.

Thus, transportation problem in Dakar is not only the lack of organized system and the chronic traffic congestion; it involves also a worrisome pollution for both air and noise. Hence, Dakar needs to consider its urban transportation system; it should identify as well the real needs for a modern and sustainable transport system that meet the international standards. Transportation-needs become a common used concept that observers, researchers try to redefine; it is now more important than the only vision of passengers and users need. It involves effectiveness, efficiency and sustainability.

4.3.3 New transportation systems in Dakar.

1. AFTU minibus to formalize the system.

Car rapide and Ndiaga Ndiaye are supposed to disappear from Dakar's urban design and to be replaced by AFTU minibuses (ITDP, 2004). An important number of minibuses are already introduced in the urban transportation and some specific lines were given to them (Godar, 2005).

Unlike what we used to see with Car Rapide and Ndiaga Ndiaye, AFTU minibuses show a new step of the modernization of the system. They have a ticketing box and specific terminal (stop). AFTU minibuses are quite new and well managed in the beginning. But now about 8 years from their introduction in the urban transportation system, they turn into car rapide and Ndiaga Ndiaye's model. Some of them do not have good maintenance and others are hitting by passengers indiscipline.

The new scheme of GIEs (Grouping of owners in large management units) introduced formally in 2001 does not seem to have introduced really new rules of management; there are neither common structures of management nor accountability between the members: every owner continues his own direct relationship with the driver(s) who are autonomous (Godar 2005).

In this way, the expected result for minibuses and car rapide reform has passed away. What we have in Dakar is renewal of previous system with the same operating methods. That makes people to still use car rapide and Ndiaga Ndiaye and some of them prefer using the old one rather than the new AFTU minibuses. This is because AFTU are not as frequent as Car Rapide and Ndiaga Ndiaye, they are more expensive and it is difficult to get seat in the vehicle.



The Dakar Bus Rapid Transit (BRT) project is part of a comprehensive plan to restructure the capital city's transport network by 2025.

It comprises two components:

1. A hard infrastructure component, procured by the authorities, mainly comprising the construction of lanes, stations, and garages for the exclusive use of the future BRT buses.
2. An operational infrastructure component, tendered as a PPP, encompassing the procurement and maintenance of a 140+ bus fleet together with associated systems and equipment as well as the operation of the network for a duration of 10 years.

Senegal has been experiencing a strong demographic growth over the last decade of almost 3% per year. Combined with the increased migration from rural areas to Dakar, Senegal's economic and political capital is predicted to grow substantially over the next decade. to restructure the public transport network as a whole. The BRT project will contribute to the achievement of a dual objective of ending extreme poverty and promoting shared prosperity by improving access to employment and markets through the establishment of a public transport network efficient with good value for money.



It is the CETUD, the organizing and regulating authority for urban transport in Dakar, which has been designated by the state as the contracting authority for the BRT project. It is the CETUD, the organizing and regulating authority for urban transport in Dakar, which has been designated by the state as the contracting authority for the BRT project.

- It will stop at 23 stations, including 3 interchange hubs at Guédiawaye, Grand Médine and Petersen.
- The BRT project will have 144 articulated buses that can hold 150 passengers each;
- An 18.3km route
- A journey time reduced from 95 min to 45 min on average
- 14 municipalities crossed
- The BRT will operate 7 days a week from 6 a.m. to 10 p.m. and will be commissioned in 2022.

3. DDD (Dakar Dem Dikk)

Dakar Dem Dikk (DDD) is a national public transport operator in Senegal, and is the main public transport operator of its capital, Dakar. The company was formed in 2000 as a successor to the former Société de transport du Cap-Vert (Cape Verde Transport Company; SOTRAC).[2] Its Director General is Me Moussa Diop. In 2015, DDD ordered a fleet of 475 buses from Ashok Leyland of India, at a cost of 47 million CFA Francs (then 71.6 million Euros) As of 2015, it ran seventeen-lines in Dakar, carrying 50 million passengers per year, using 408 buses. The trade union Dakar Dem Dikk Workers Democratic Union represents their workers.



4. PTB Train (Le Petit Train de Banlieue)



Le Petit Train de Banlieue is a rail national transport company created in 1987, it offers a suburban train service between Dakar and Thiès with its own infrastructure and its own rolling stock. The PTB is responsible for all operations related to the transport of passengers by rail.

The commuter train service provides daily service to 15 stations, with 28 round trips between Dakar and Rufisque (thanks to four sets of trains), and one round trip between Dakar and Thiès (thanks to a single train).

In addition to aging infrastructure, the speed of operation (approximately 20 km/h) is very limited, to avoid accidents, because pedestrians, street vendors, animals and even vehicles can take over the railway line. Some stations attract a lot of passengers, and on other part of the network, the railway crosses less populated areas, along the South coast (industrial zone).

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

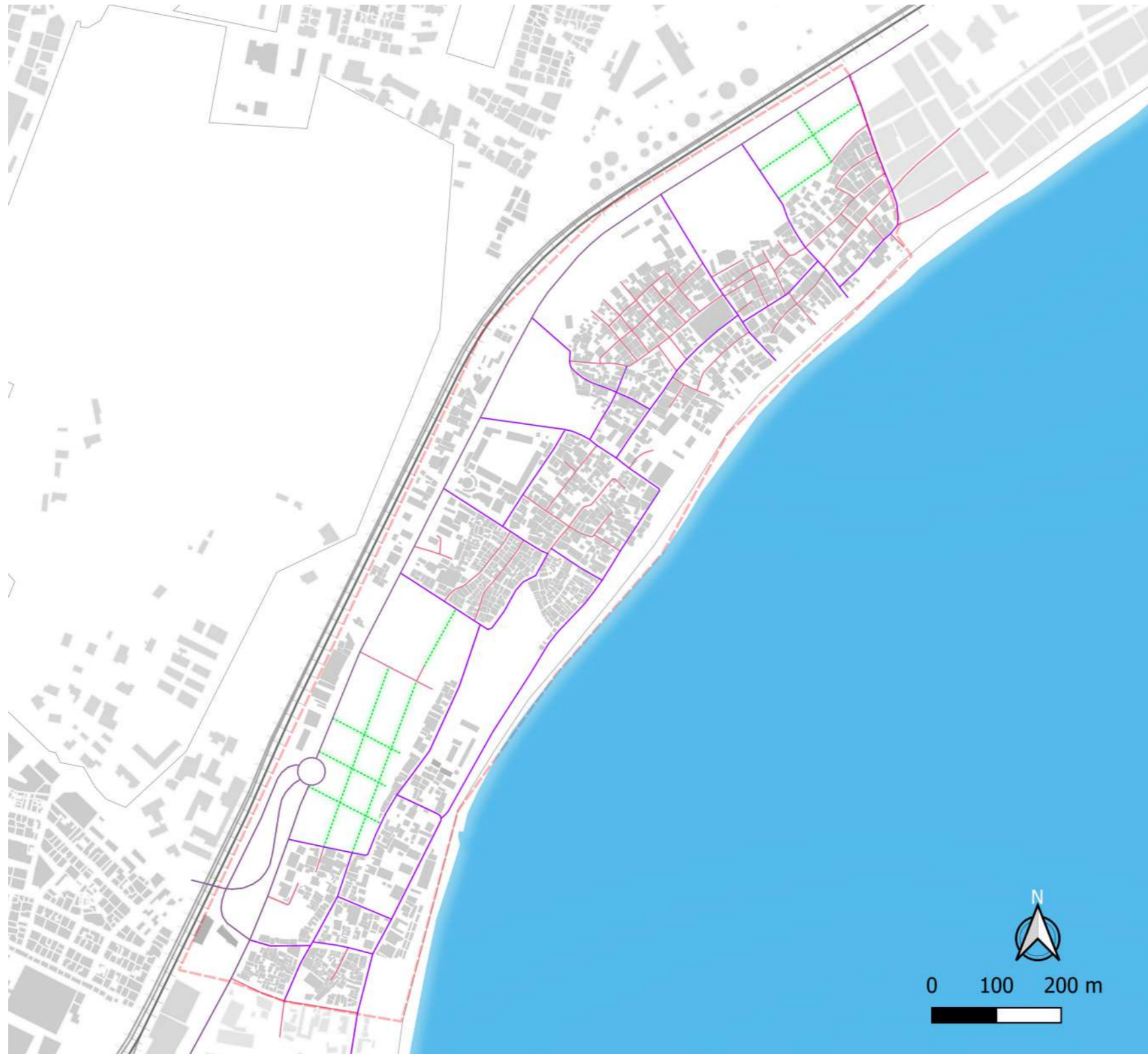
FOOD
MANAGEMENT

COSTAL FLOODS
& STORM SURGE

WATER SUPPLY &
SANITATION SYSTEM

SOLID WASTE
MANAGEMENT

Addition of new streets to improve urban flow



New residential roads

Types of links

- New residential roads
- Main residential streets
- Sub residential streets
- Secondary Roads
- +— Network_railways

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

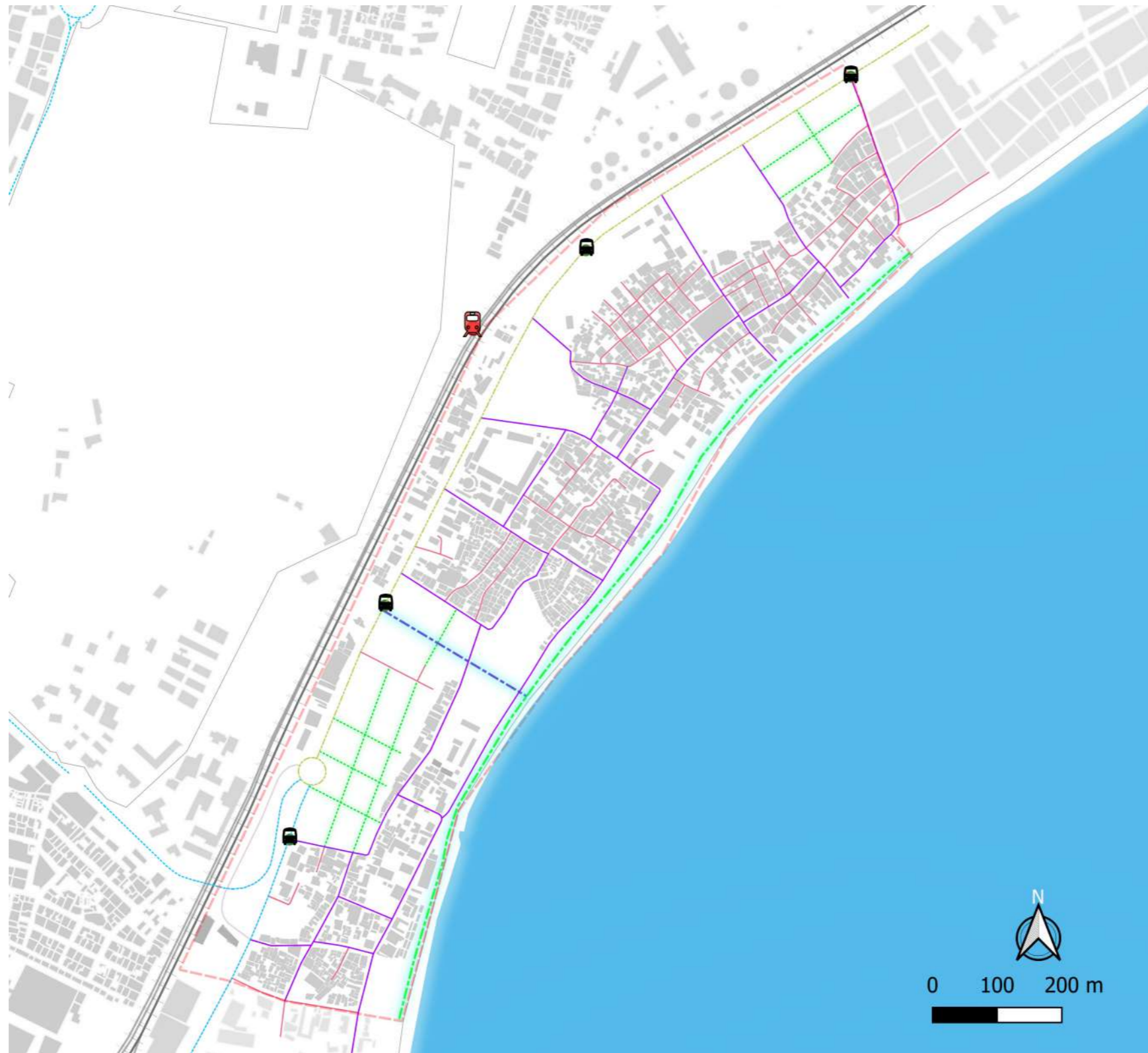
FOOD
MANAGEMENT

COSTAL FLOODS
& STORM SURGE

WATER SUPPLY &
SANITATION SYSTEM

SOLID WASTE
MANAGEMENT

Addition bus lane, bus stops and train station to encourage formal transportation system



New public transport

Types of links

- New residential roads
- Main residential streets
- Sub residential streets
- Secondary Roads
- Network_railways
- New bus lane
- New bus stops
- New railway station
- New pedestrian path
- Water front

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

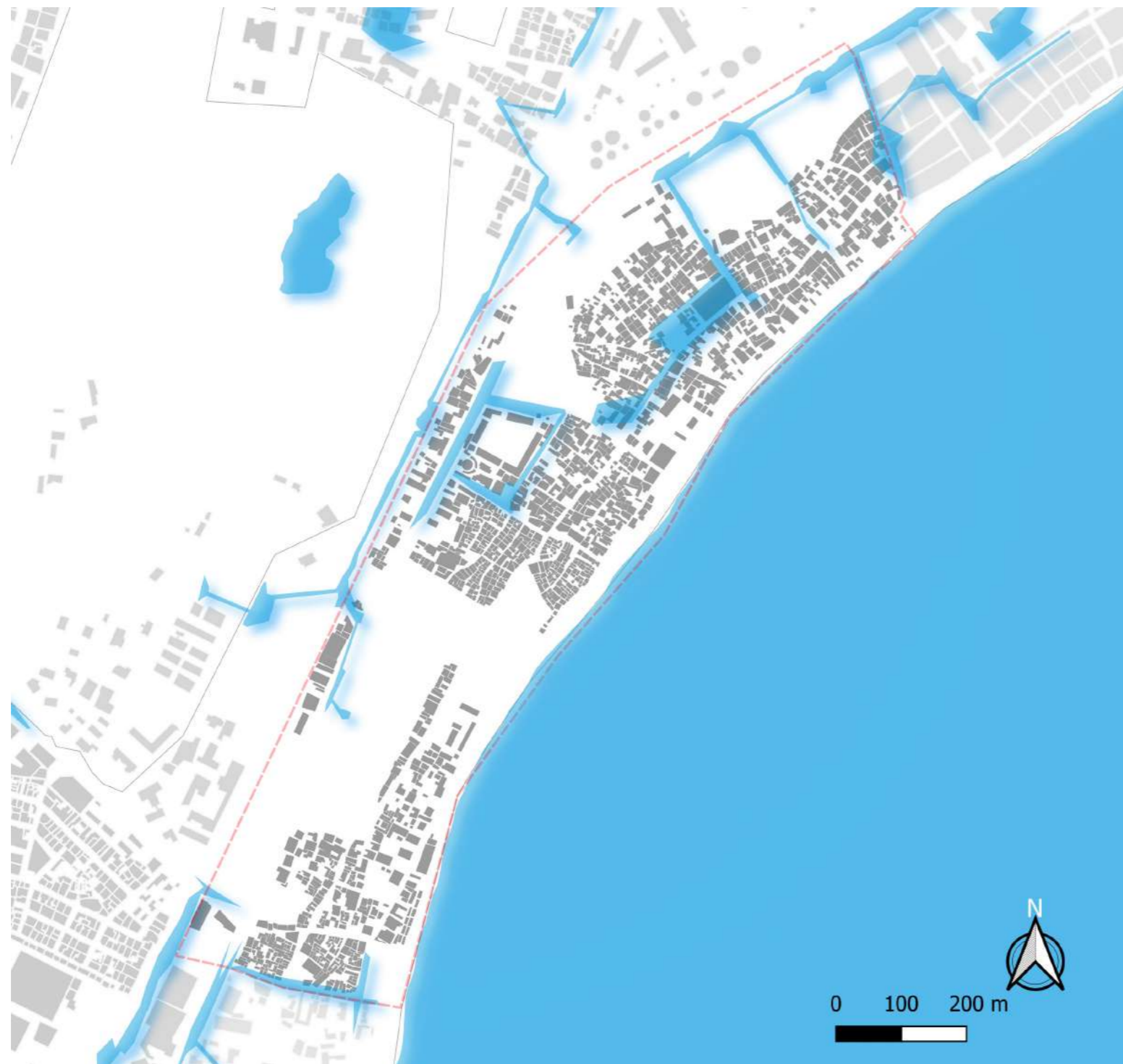
FOOD
MANAGEMENT

COSTAL
FLOODS
& STORM
SURGE

WATER SUPPLY &
SANITATION SYSTEM

SOLID WASTE
MANAGEMENT

4.4. Costal floods and storm water surge



Flood assesment

Senegal's low-lying coasts show signs of increased vulnerability to coastal flooding. Marine submersion is a problem of varying intensity along Senegal's coasts, with the cities of Saint-Louis and Dakar being the most exposed. Coastal flooding often occurs on low-lying coasts , when the total water level (TWL) at the coast is higher than the land elevation. Like St. Louis, Dakar has an increased vulnerability to coastal flooding, which has been recurrent since 2005 . They can be caused there by rainy episodes and meteorological events. Settled in part in wet depressions known as Niayes, and experiencing galloping urbanization, Dakar is indeed highly vulnerable to the risks of coastal and rainfall flooding in a context of climate change marked by a recurrence of extreme events. According to, this vulnerability is attributable to natural hazards, uncontrolled urbanization and the failure of land-use policies. The authors of also judge that beyond climate dynamics the problem of flooding in Dakar is mainly due to the urbanization of non aedificandi areas at risk that should be inconstructible. According to, the people affected by coastal flooding in Dakar would have been between 1500 and 2000 people per year in 2018. This number could reach 20% of the population of Dakar by 2050 and 80% by 2100. This situation shows the importance of studying and understanding coastal flooding on the Senegalese coast, particularly in Dakar. In addition, in the context of ongoing climate change and the prediction of increased climate instability, the delineation of flood-prone areas for a given climate hazard is a scientific issue with strong societal implications. Unfortunately, in Senegal the works on extreme weather-marine events and their modeling are very few in comparison to the issue

- Volumes
- Storm Surge effected area

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FOOD
MANAGEMENT

COSTAL
FLOODS
& STORM
SURGE

WATER SUPPLY &
SANITATION SYSTEM

SOLID WASTE
MANAGEMENT

4.4. Adaptive sea wall



ADAPTIVE SEA WALL

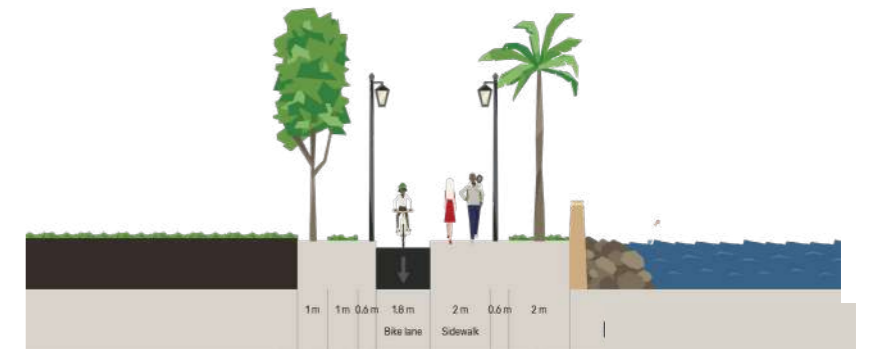
■ Volumes
■ Adaptive sea wall

In order to block the water into the area the wall of 3m height is constructed. The name adaptive sea wall is give due to the fact that this wall as does not only block the water entering into area but also house an diffrent functions longside of it. Since this rise in sea level is seasonal the area longside could host number function taking advantage of the space available which makes it multi functional. This added functions are decide based on the space availability as well as the sar- rounding neighbourhood.

Added functions

Neighbourhood	Function
School	Play ground
Residential area	Park
	Outdoor gym Play ground
Recreational area	Social place
Commercial space	Seasonal market

Along with blocking of water and added functions it can aslo host the walking path and cycling lane on top of it which create a great water front area for more social activities.



Storm Surge pite with flood detention technologies

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FOOD MANAGMENT

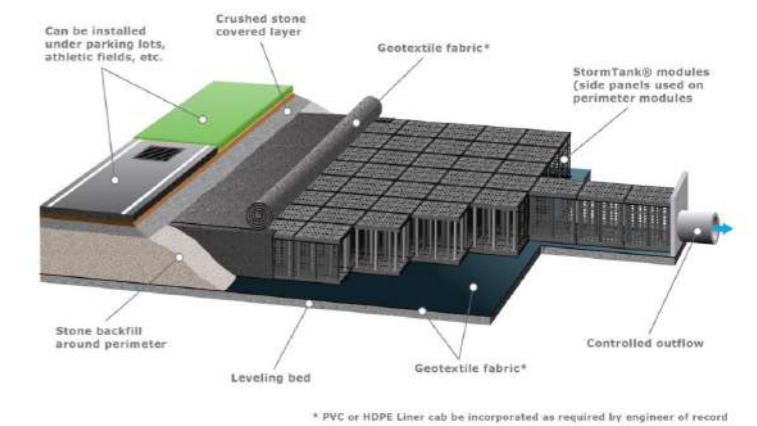
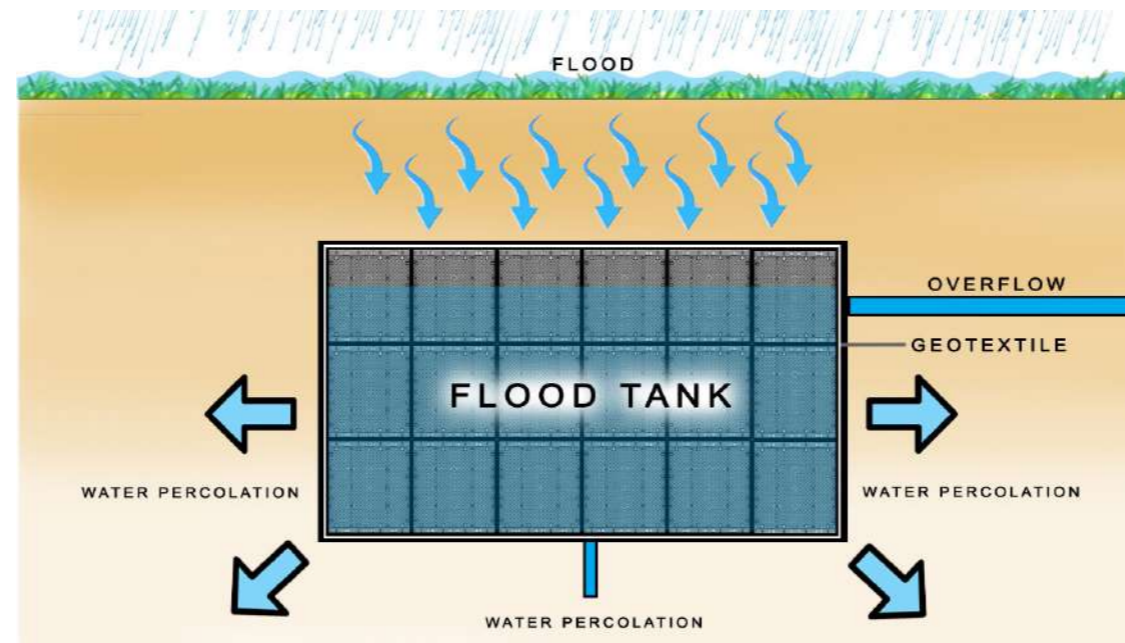
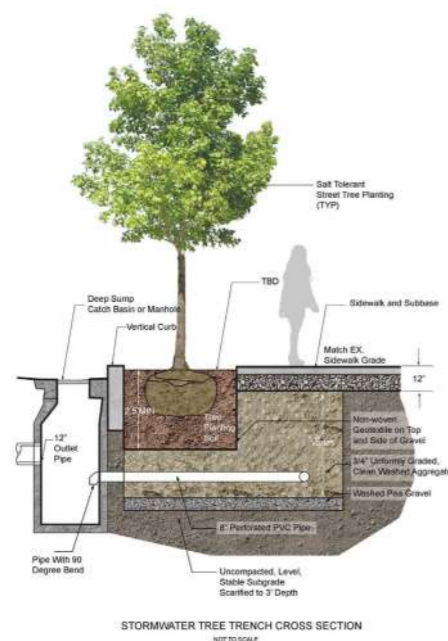


Introducing storm surge pits

- Volumes
- Storm Surge effected area
- ⬡ Storm water pits

COSTAL FLOODS & STORM SURGE

WATER SUPPLY & SANITATION SYSTEM



Flood detention tanks are artificial structures designed to temporarily hold stormwater runoff. Stormwater runoff enters these basins via storm drains. Runoff is collected until peak inflow volumes subside. From there, the detained stormwater is discharged at a controlled rate into nearby waterbodies. This method of stormwater management helps to reduce flooding in our communities and protects coastal areas from erosion.

SOLID WASTE MANAGMENT

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FOOD MANAGEMENT

COSTAL FLOODS & STORM SURGE

WATER SUPPLY & SANITATION SYSTEM

SOLID WASTE MANAGEMENT

4.5 Food Management

Food management is a comprehensive and intricate procedure involving the supervision of food harvesting, selection, presentation, and preservation. The primary purpose of implementing a food management system is to ensure food items are quality and safe before consumer consumption. Most importantly, a food management system helps operators comply with FDA-based regulations.

The top benefits of food management systems include- helps to navigate complex regulations, provides a way to monitor food data to mitigate risk, and streamlines the entire supply chain and management process.

4.5.1 Urban agriculture

Urban agriculture refers to various practices of cultivating, processing, and distributing food in urban areas. The term also applies to the area activities of animal husbandry, aquaculture, beekeeping, and horticulture in an urban context. Urban agriculture is distinguished from peri-urban agriculture, which takes place in rural areas at the edge of suburbs.

Urban agriculture can appear at varying levels of economic and social development. It can involve a movement of organic growers, "foodies" and "locavores," who seek to form social networks founded on a shared ethos of nature and community holism. These networks can develop by way of formal institutional support, becoming integrated into local town planning as a "transition town" movement for sustainable urban development. For others, food security, nutrition, and income generation are key motivations for the practice. In either case, the more direct access to fresh vegetable, fruit, and meat products that may be realised through urban agriculture can improve food security and food safety.



New urban agriculture zones

4.5.1 Urban agriculture hub.

The urban agriculture hub take in charge of providing the necessary agricrops and accessories to facilitate the farmers. The hub also houses an cold storage facility to store the produced food which helps in better preservation. The hub also has plays a part of marketing like collecting the cultivation from diffrenet farmers and distributing it interms of buy andd selling process. This helps in better management and preservation of food instead of allowing the farmers to manage on their own.



New urban agriculture hub

4.5.1 Urban agriculture training center.

The Urban Agriculture training center seeks to expand academic and public knowledge of sustainable farming techniques that improve food and water security. The center also seeks to improve the health and wellness of people in the local community and around the world through research and education on urban and peri-urban agroecology and gardening techniques.



RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FLOOD MANAGEMENT

COSTAL FLOODS & STORM SURGE

WATER SUPPLY & SANITATION SYSTEM

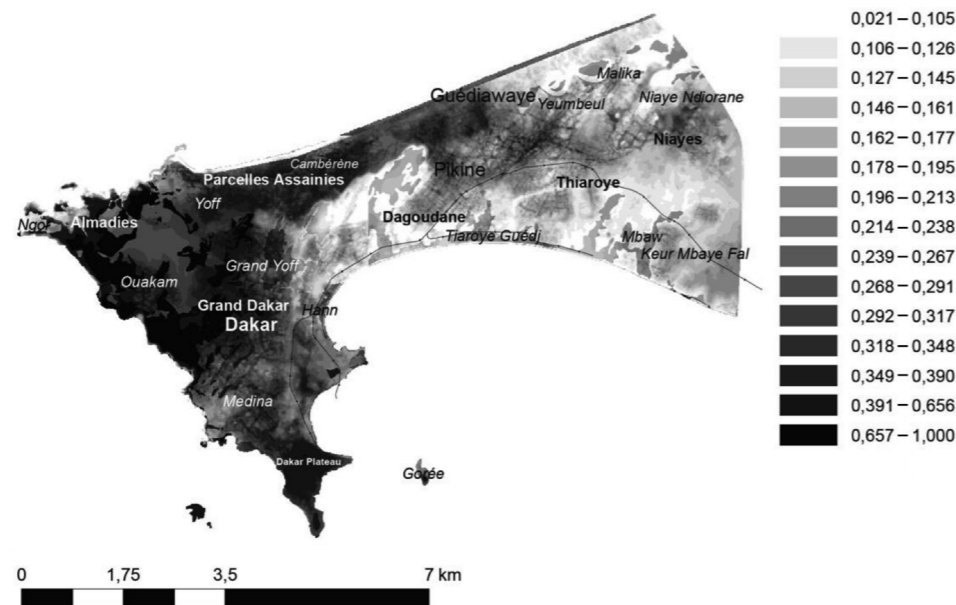
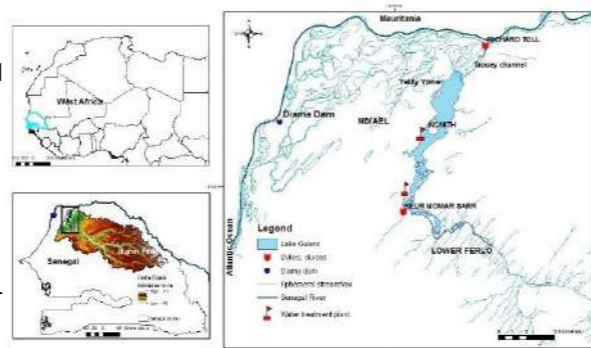
SOLID WASTE MANAGEMENT

4.6. Water supply & sanitation system.

4.6.1 Water source

Lake Guiers, situated 240 km from Dakar, is the country's largest surface water resource. However, underground water forms an essential component of the country's water potential. Thus, 84% of sources for the supply of potable water to urban centres and rural areas as well as for livestock needs come from underground water.

Similarly, all industrial, mining and tourist facilities draw their supply from boreholes or wells using underground water. However, the rainfall deficit observed since the beginning of the 1970s, coupled with the growing demand for water related to population explosion have resulted in a lowering of surface water levels and the early recession of traditional water points, both surface (ponds and streams) and underground (wells and boreholes).

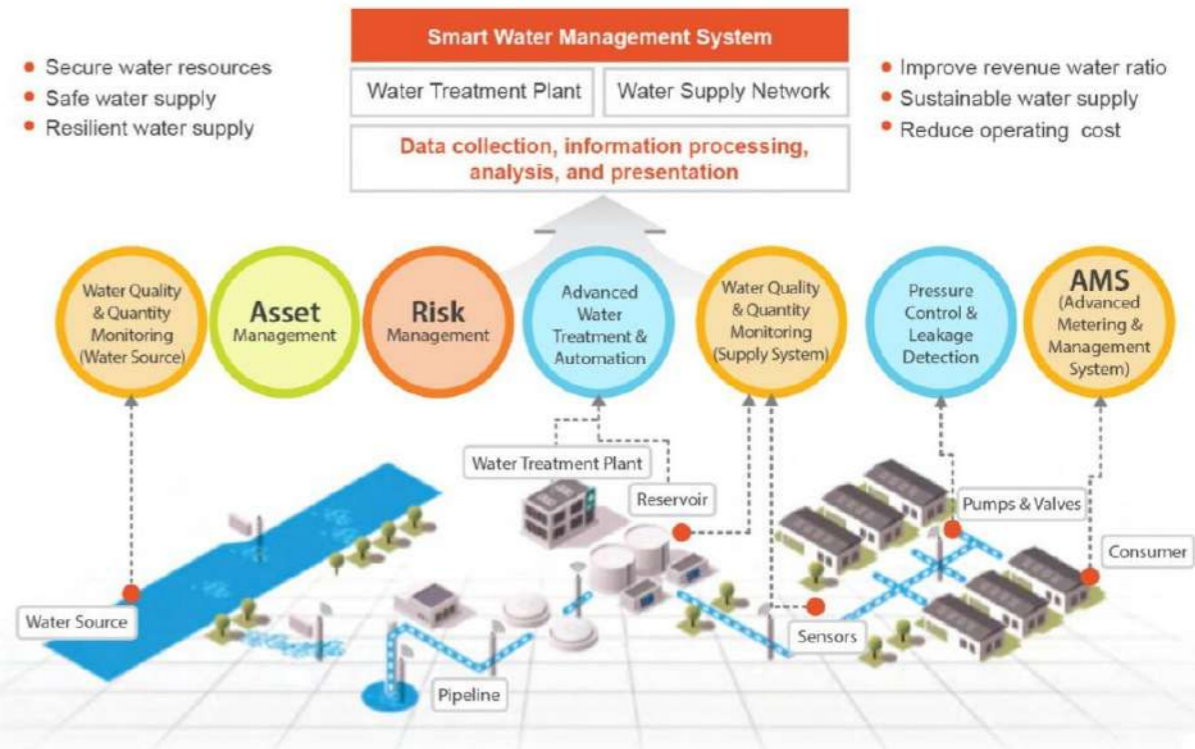


4.6.2. Urban water supply

Water supply is characterized by an average service rate (53%) through connections and an equally average network output of about 70%. Despite the achievements of the WSP, there is a growing deficit of potable water supply in the city of Dakar. On the basis of the study on the long-term demand carried out in November 1997, the deficit will reach 65,000 m³/d in the dry season as from 2003. In the other urban centres upcountry, however, production covers needs.

4.6.3. Sanitation system

wastewater drainage is characterized by a low rate of connection of communities to the sewerage system (about 13%). Only five cities in the country have a community sewerage system. Furthermore, a small portion (20%) of the wastewater collected by the Dakar system is treated by the Camberene station alone, which has not been operating for 6 months. The level of services is low, especially in the Dakar's suburbs; in rural areas, 62% of households have no sanitation system (compared with 33% in urban areas). The development of rainwater drainage infrastructure did not match the growth and often uncontrolled urbanization in various cities. This has led to flooding in areas without sanitation facilities or with inadequate sewerage capacity.

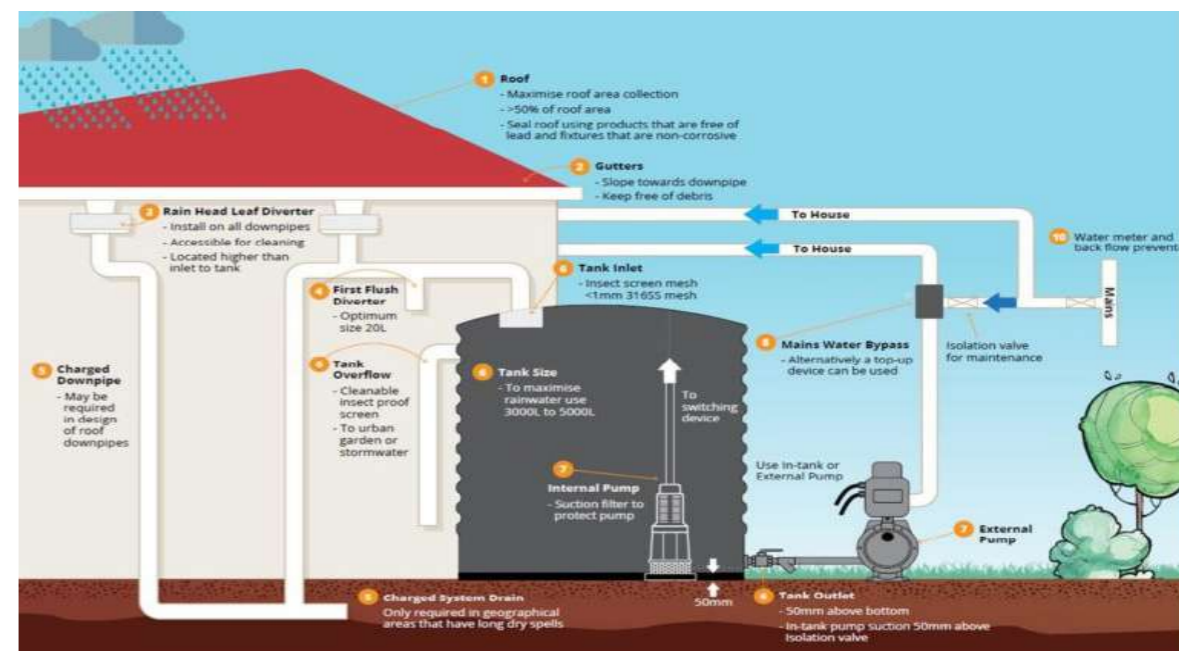


Urban water management

One of the key approaches to sustainable water management is **rainwater harvesting**. This involves collecting rainwater from rooftops, streets, and other surfaces, and storing it for later use. Rainwater harvesting can help to recharge groundwater supplies, reduce the demand for municipal water supplies, and alleviate water scarcity in urban areas. In addition, it can also reduce the risk of flooding and erosion, by diverting excess water away from streets and buildings.

Groundwater recharge is another important strategy for sustainable water management. Groundwater is a valuable resource that can provide a reliable and sustainable source of water for urban communities. However, over-extraction of groundwater can lead to depletion of water tables, which can cause land subsidence, water quality degradation, and other environmental problems. Groundwater recharge involves replenishing depleted aquifers by allowing rainwater to infiltrate the ground and recharge the groundwater table.

Wastewater treatment is also a critical component of sustainable water management. In many Indian cities, wastewater is not treated and is instead discharged directly into rivers and other water bodies, causing pollution and health hazards. By developing wastewater treatment plants, cities can reclaim and reuse this valuable resource, reducing the demand for freshwater supplies and protecting the environment. Treated wastewater can be used for a variety of purposes, including irrigation, industrial processes, and even drinking water.



Residential rain water harvesting schematic

RESTRUCTURING

GROUND USE

WALKABILITY

URBAN FLOW

FLOOD
MANAGEMENT

COSTAL FLOODS
& STORM SURGE

**WATER SUPPLY &
SANITATION SYSTEM**

SOLID WASTE
MANAGEMENT

New water supply system



RESTRUCTURING

GROUND USE

WALKABILITY

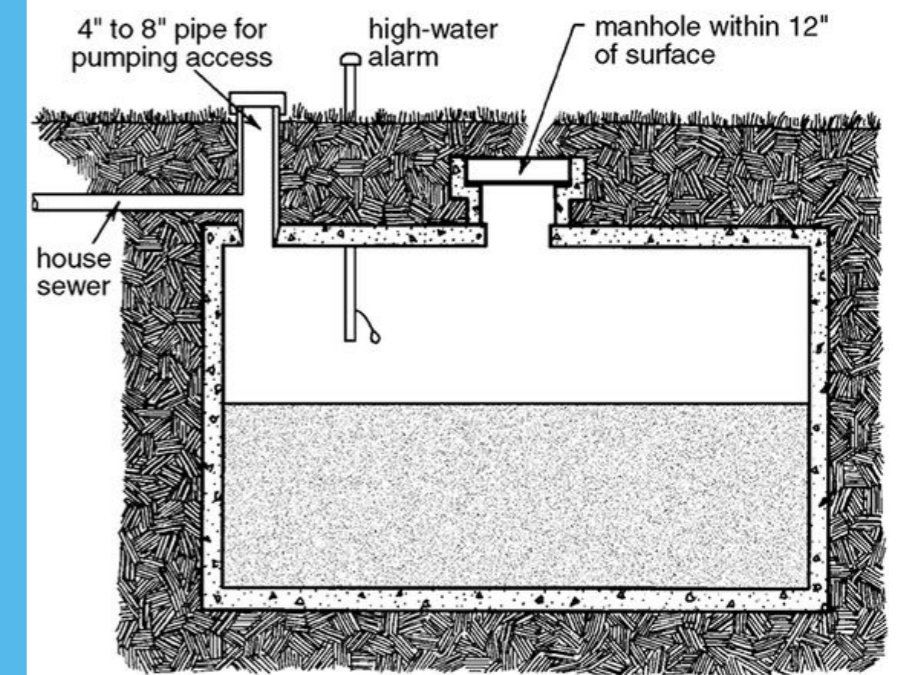
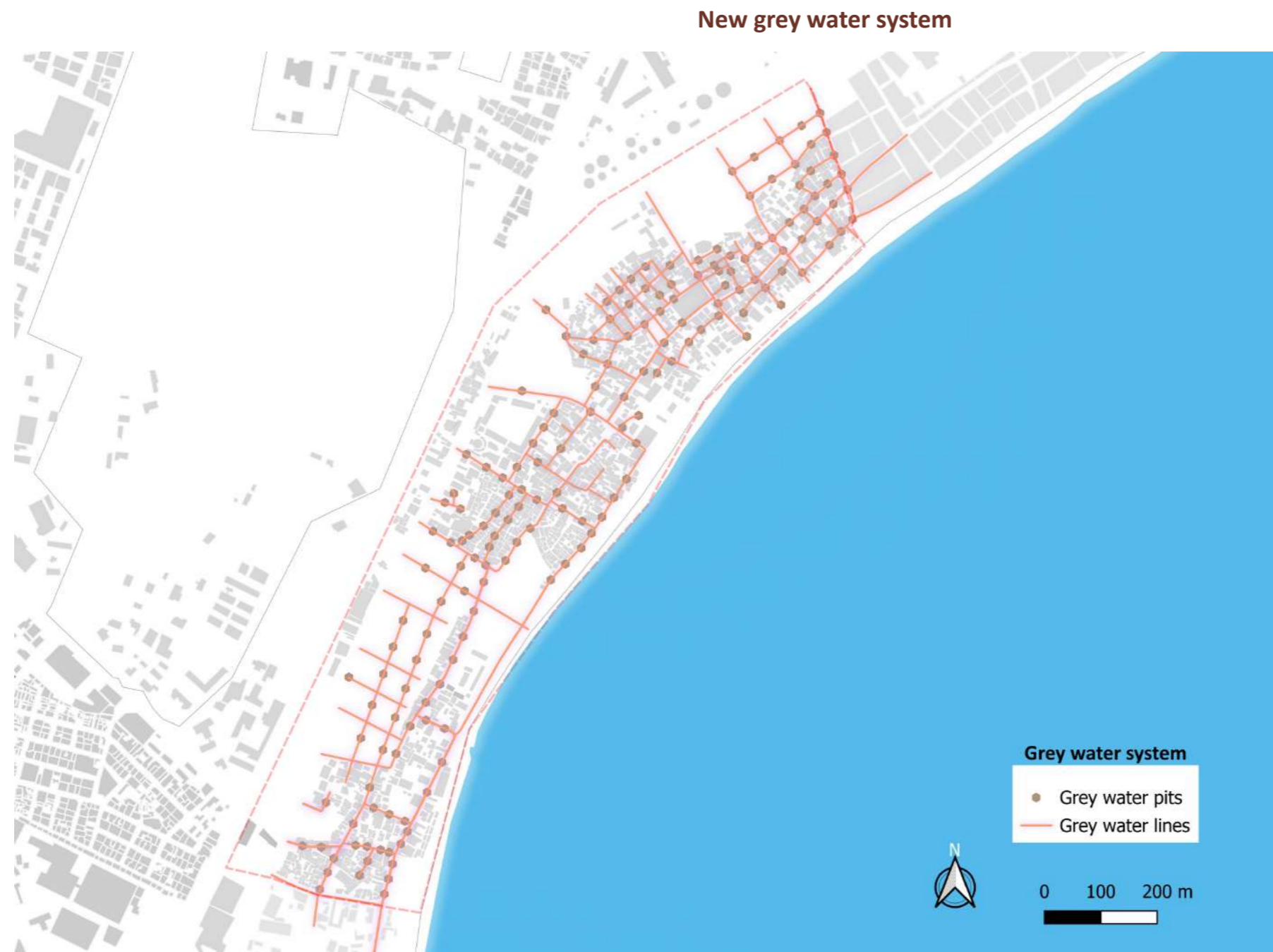
URBAN FLOW

FLOOD
MANAGMENT

COSTAL FLOODS
& STORM SURGE

WATER SUPPLY &
SANITATION SYSTEM

SOLID WASTE
MANAGMENT

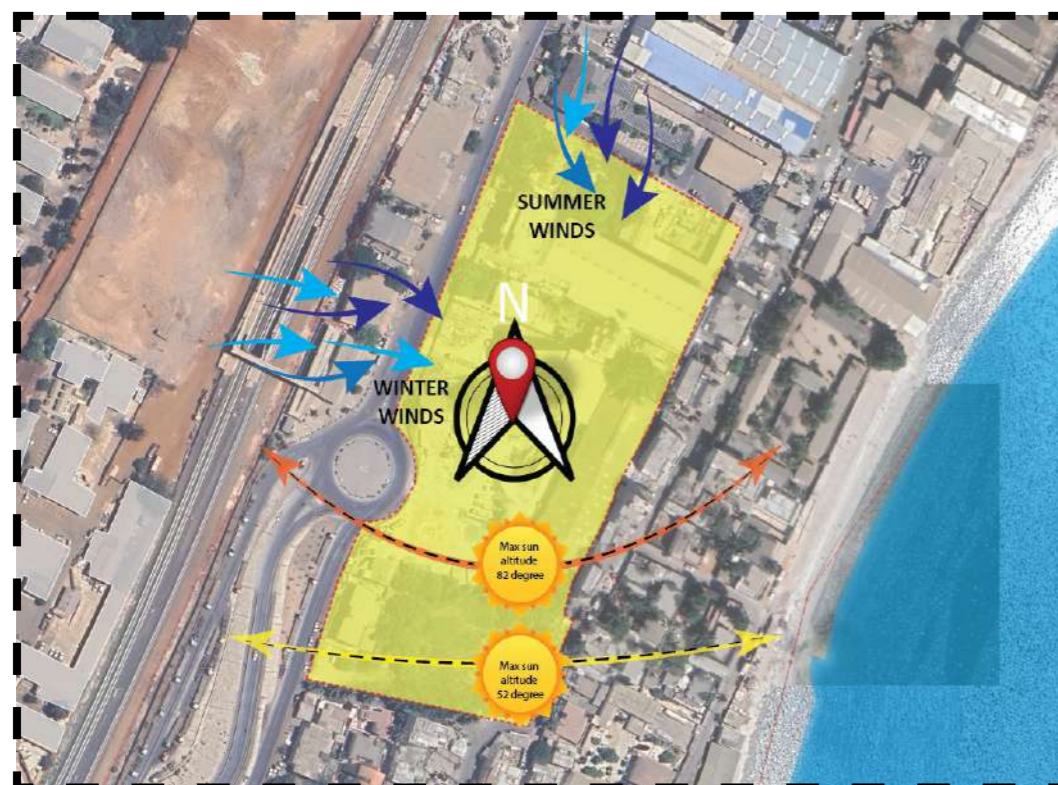


Grey water pits design

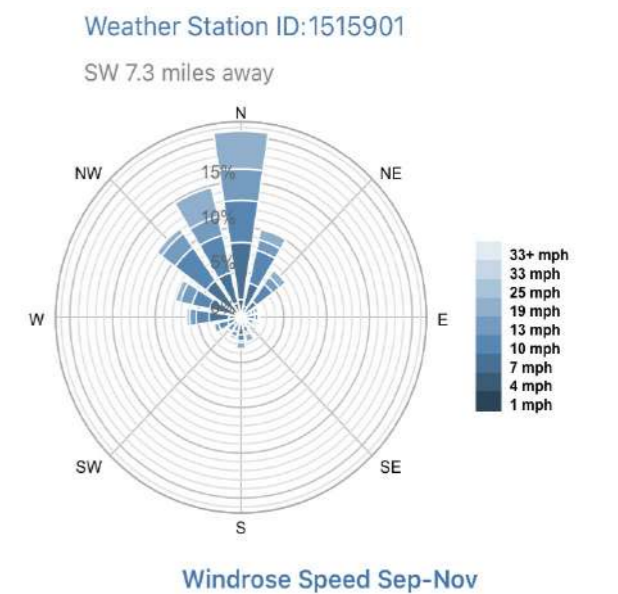
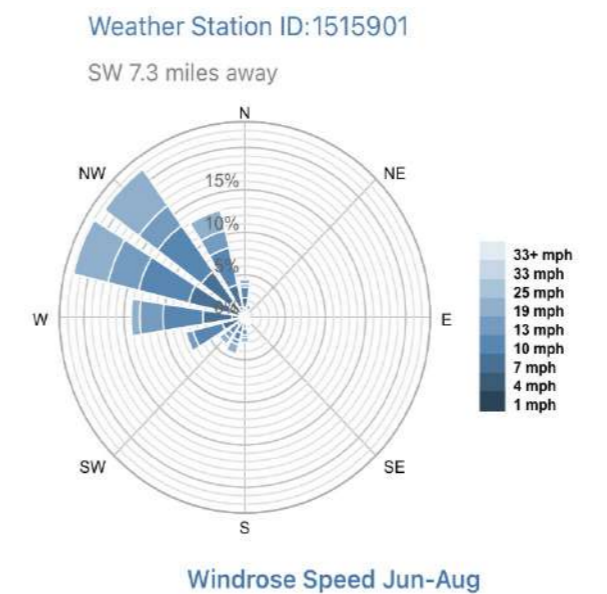
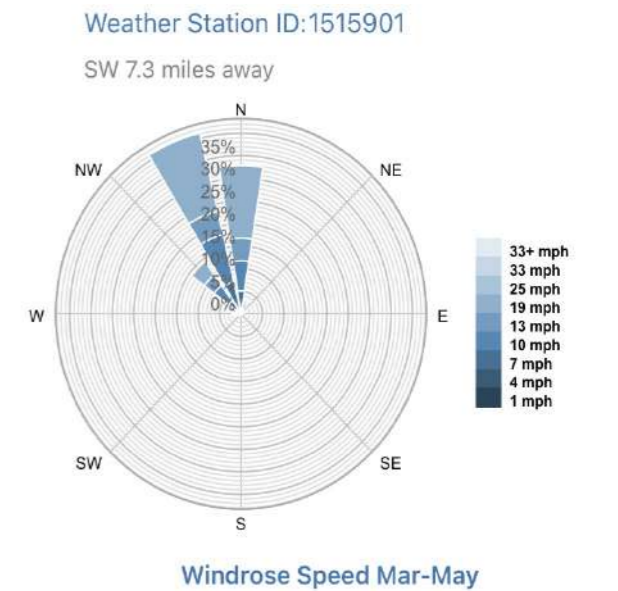
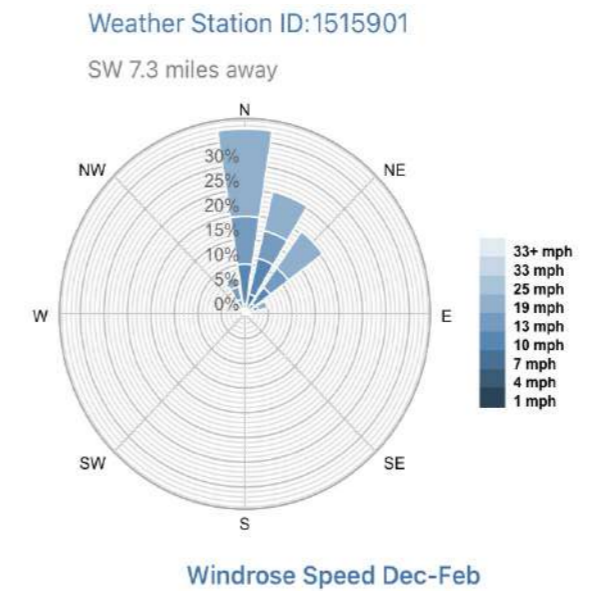
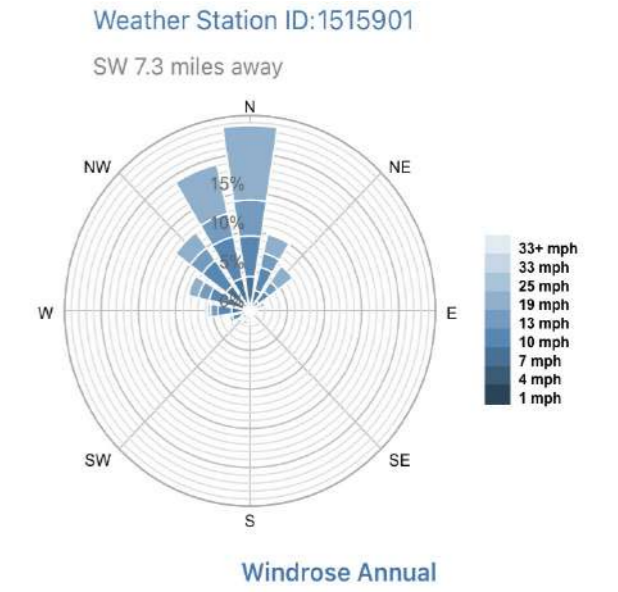
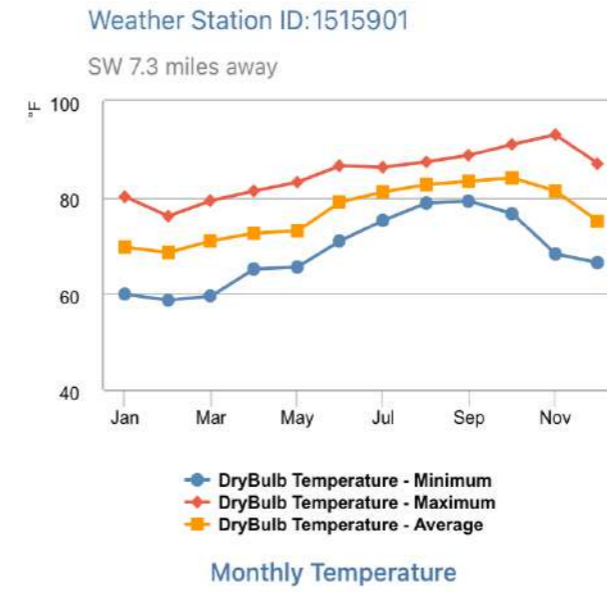


5. Architectural design

5.1 Site analysis



5.1.1 Annual mean temperature and wind rose diagrams

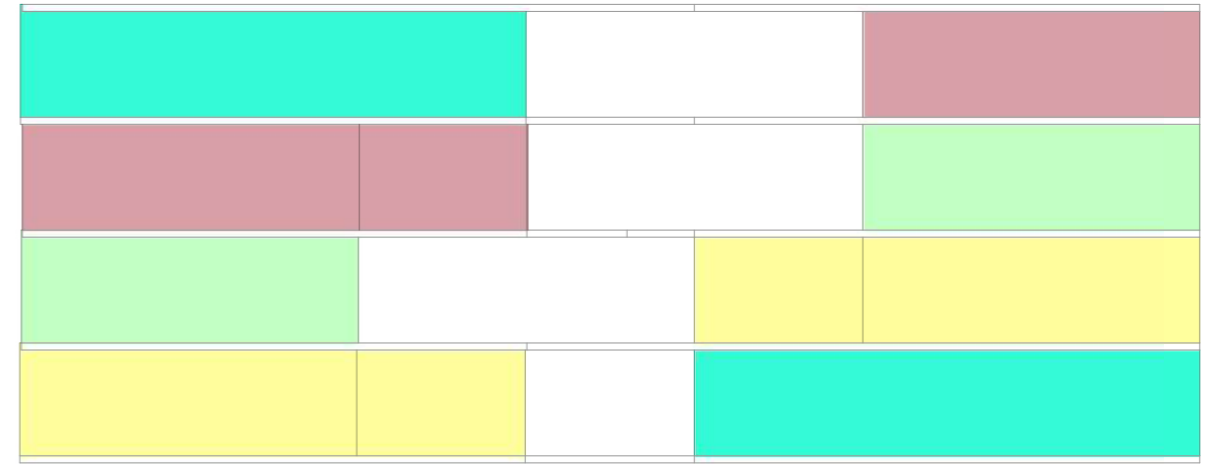


5.2. Spatial distribution of Building

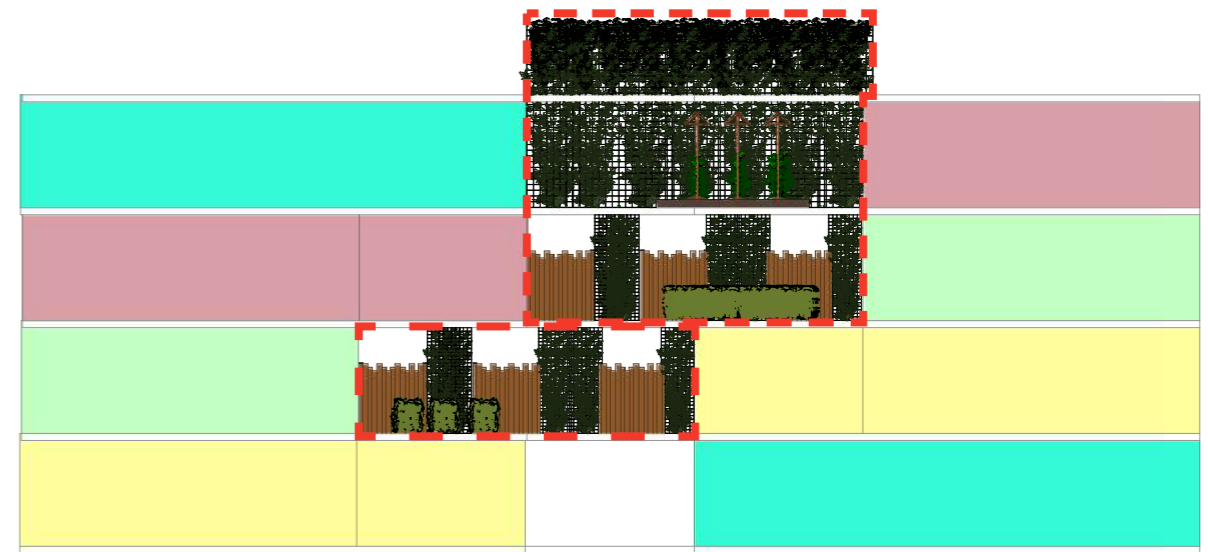
5.2.1. Floor plan of different modules

	FLOOR AREA	FLOOR PLAN
STUDIO	75 sqm	
1-BEDROOM	100 sqm	
2-BEDROOM	125 sqm	
3-BEDROOM	150 sqm	

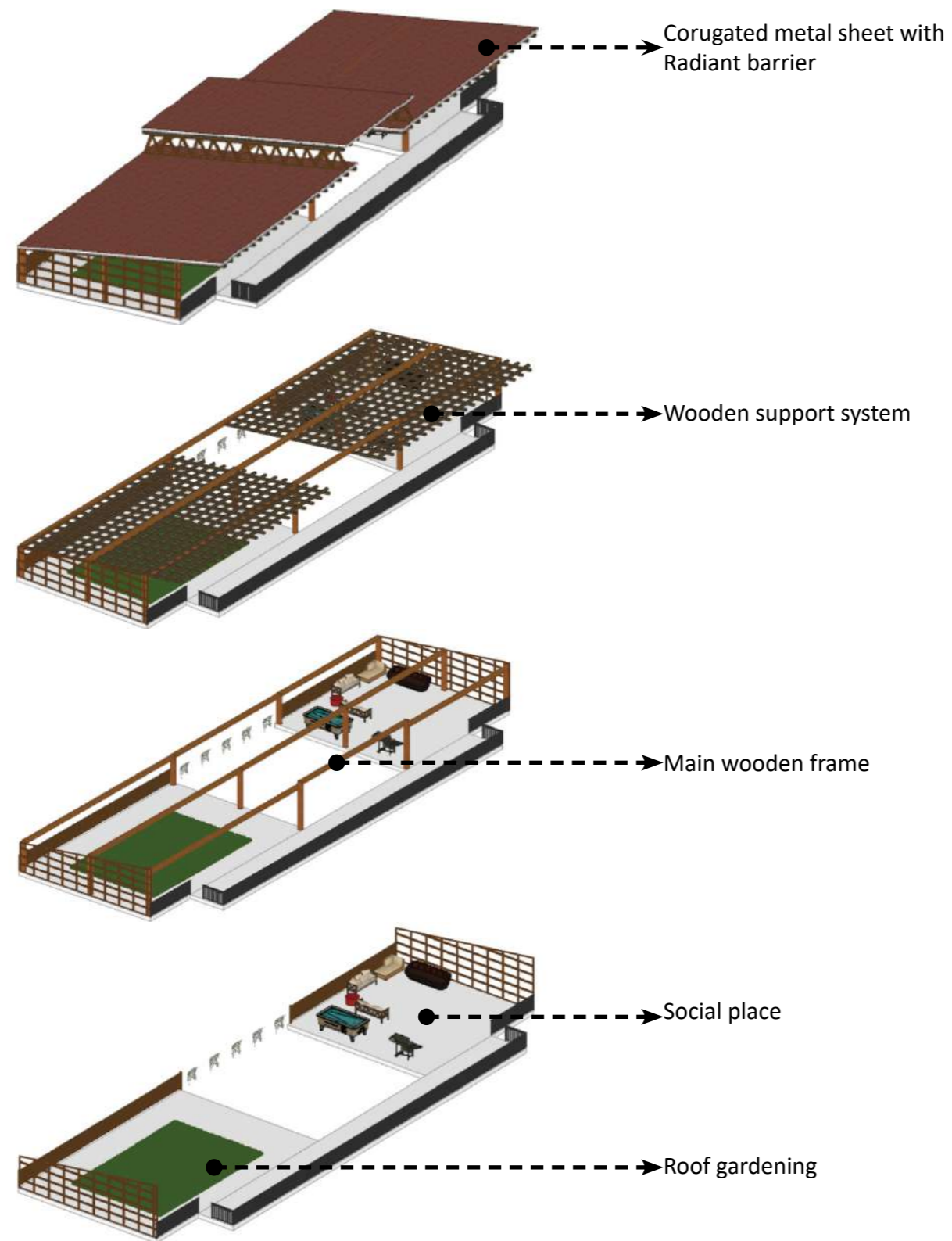
5.2.2. Distribution of modules in each floor



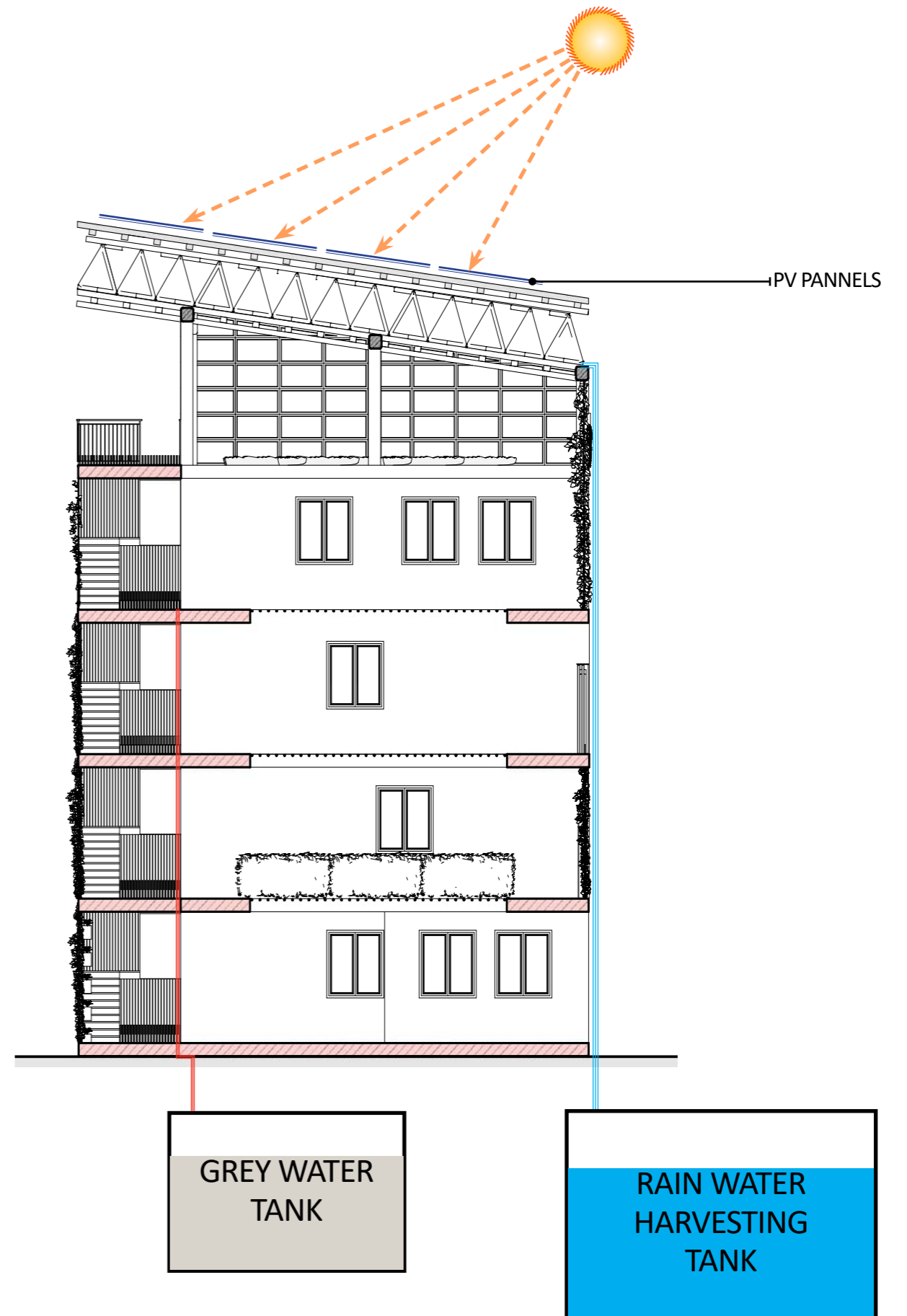
5.2.3. Introducing green space for urban agriculture



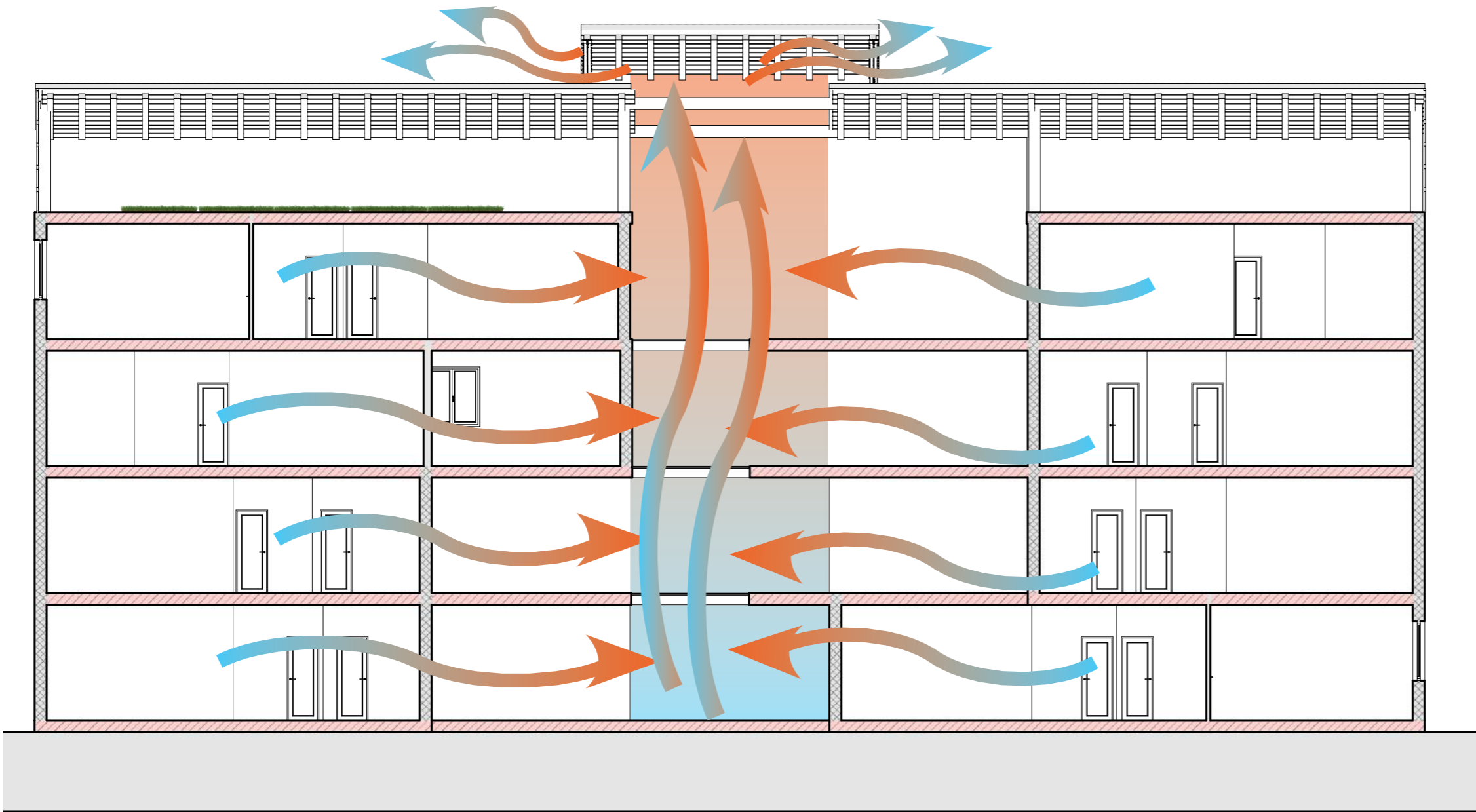
5.2.4. The roof



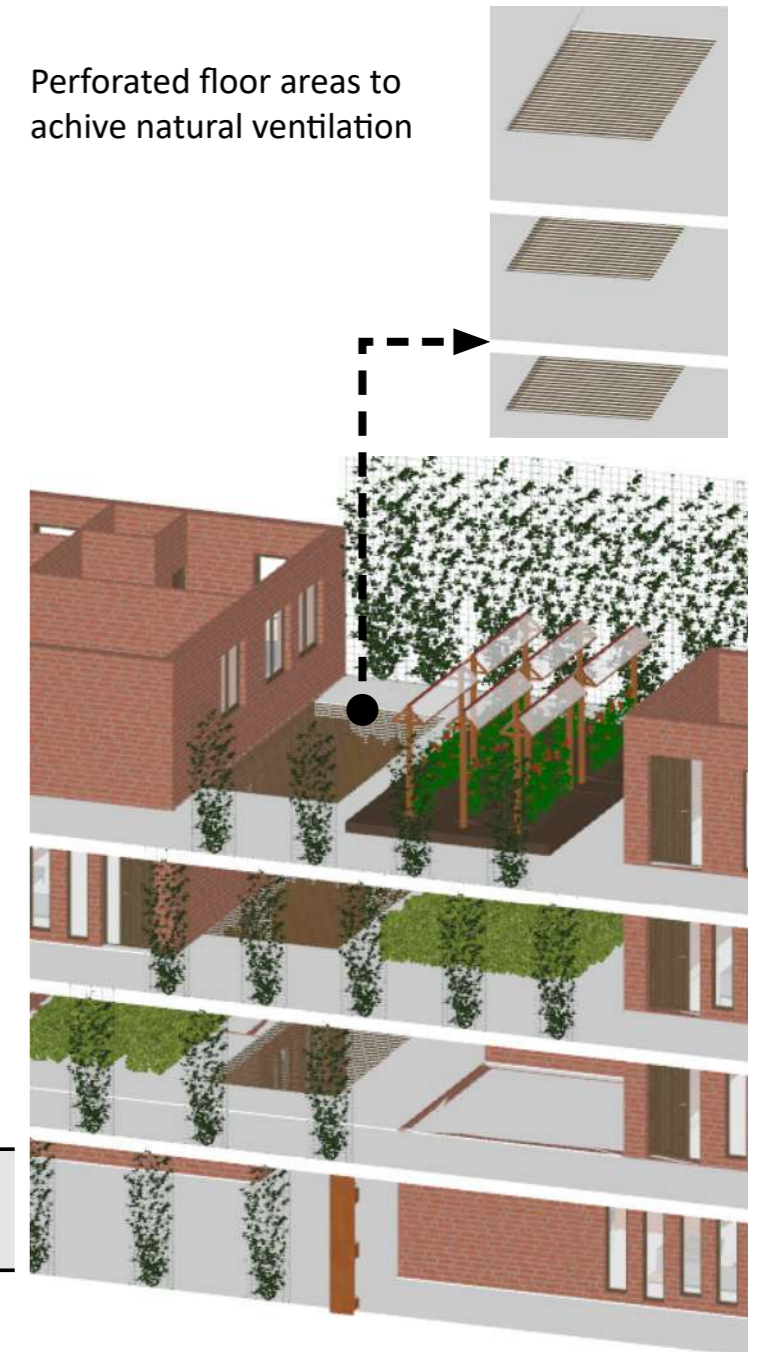
5.3. Passive and active design strategies



5.3.1 NATURAL CROSS VENTILATION



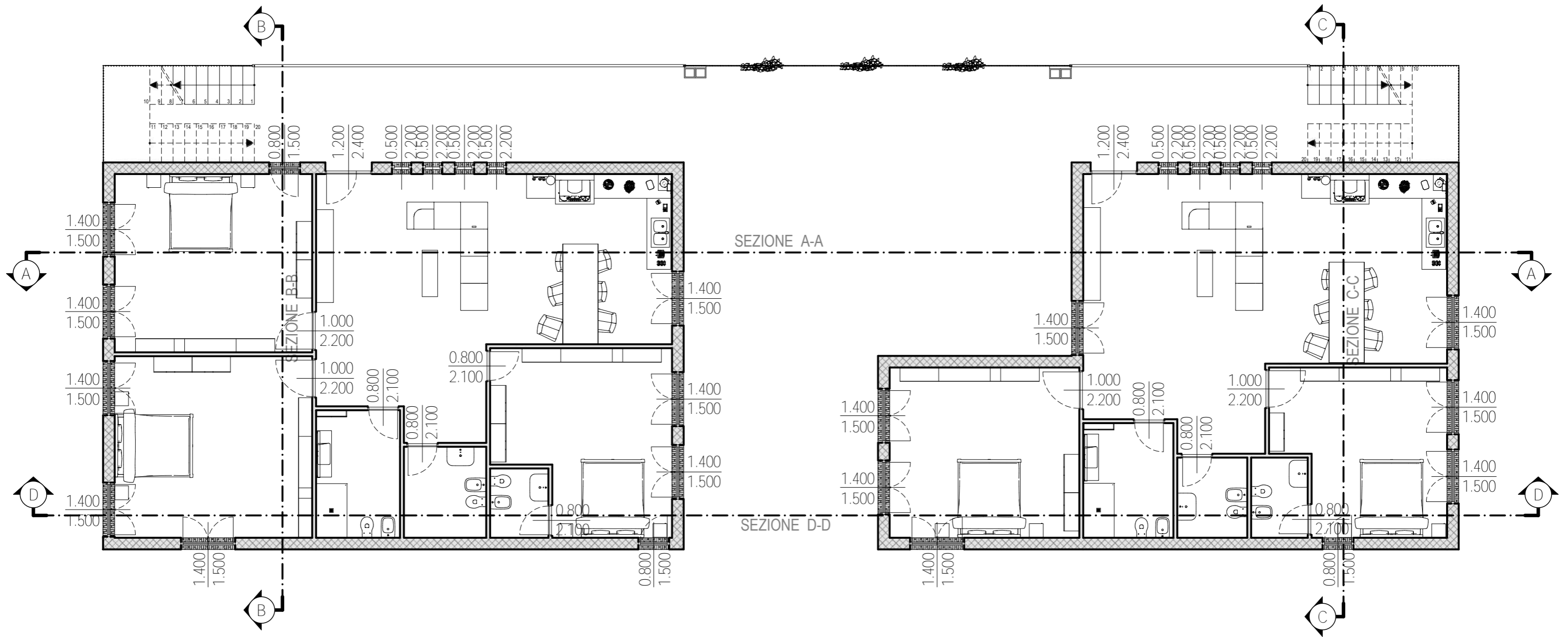
Perforated floor areas to achieve natural ventilation



5.4 FLOOR PLANS

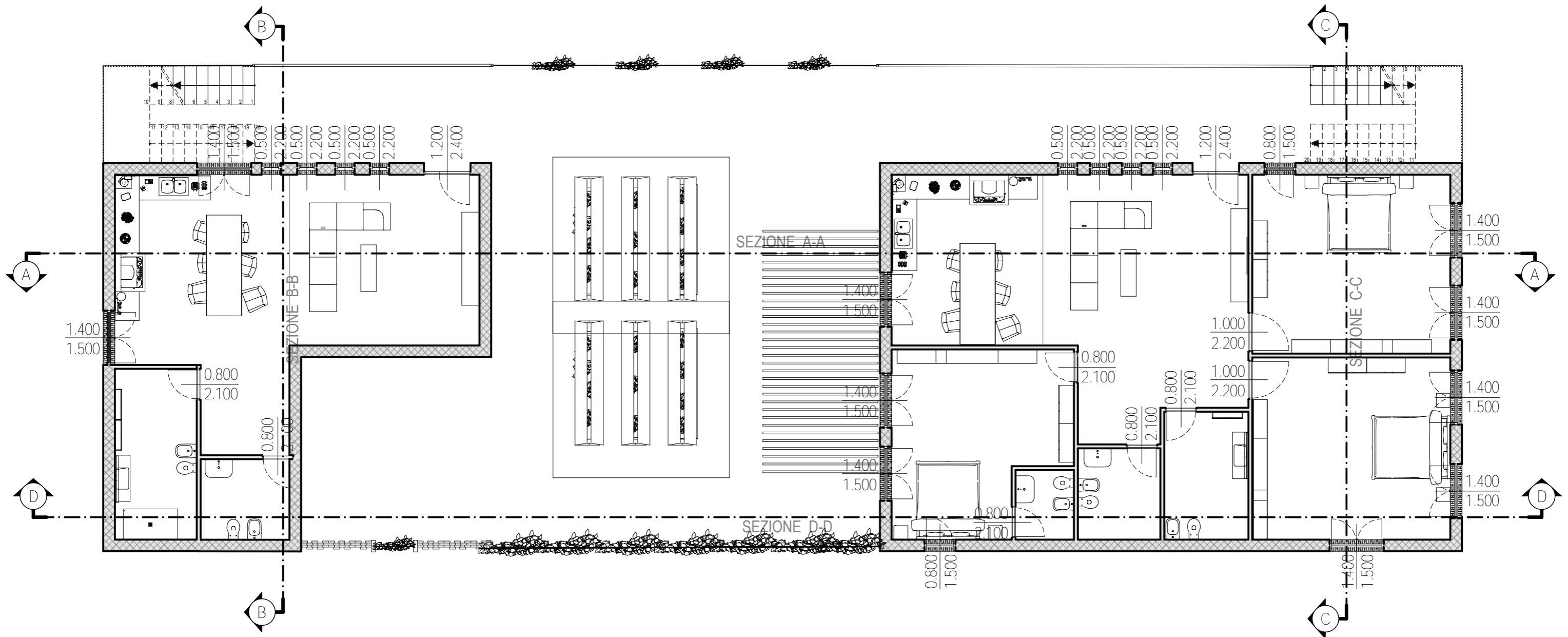
GROUND FLOOR

Scala 1:100



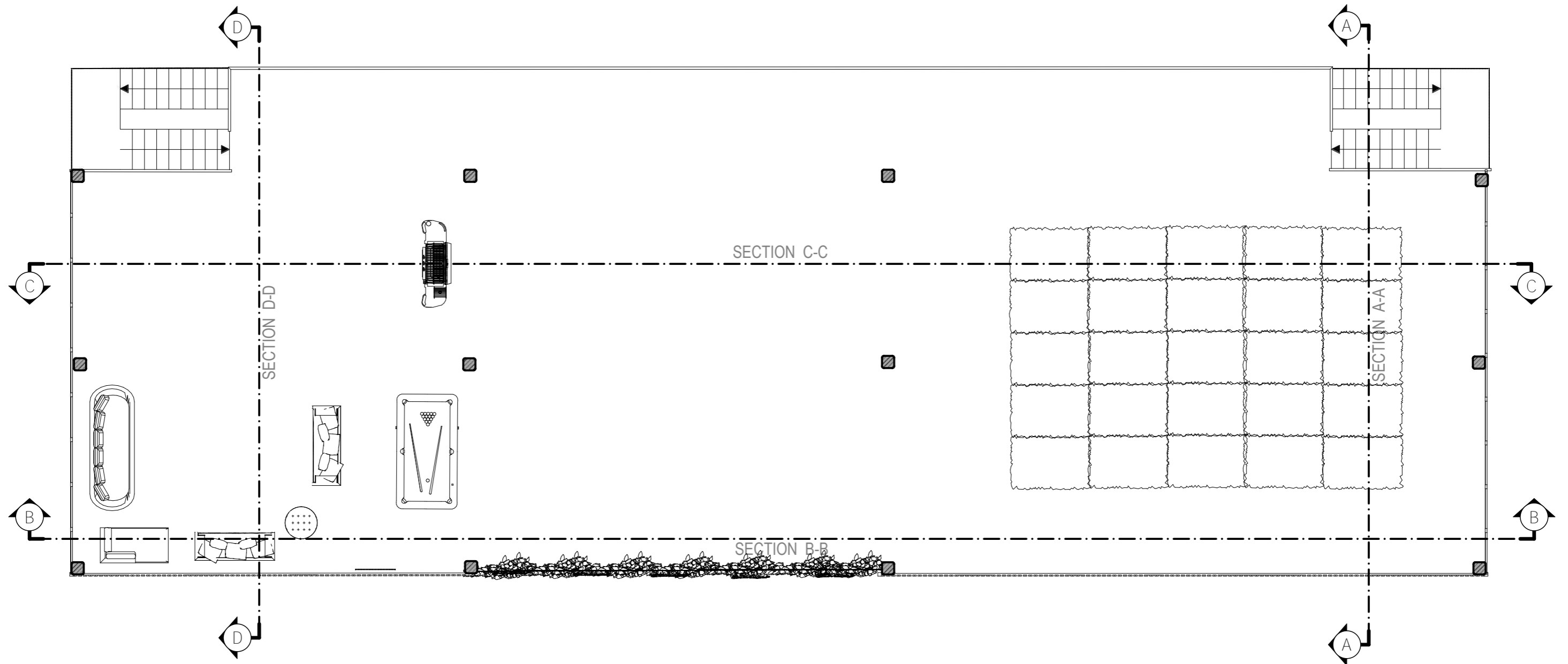
THIRD FLOOR

Scala 1:100



FOURTH FLOOR

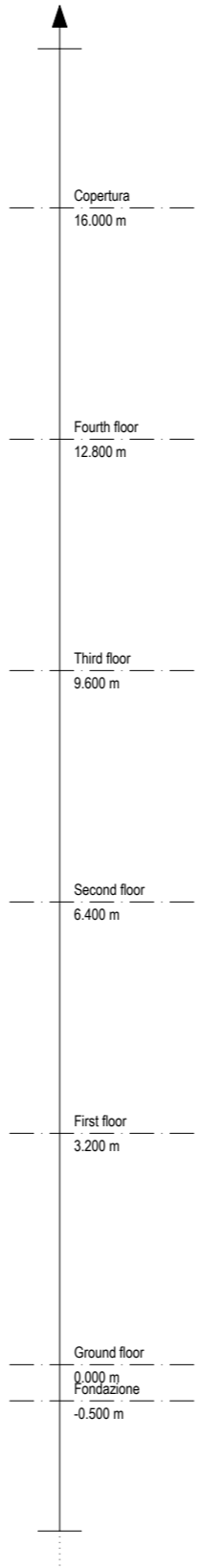
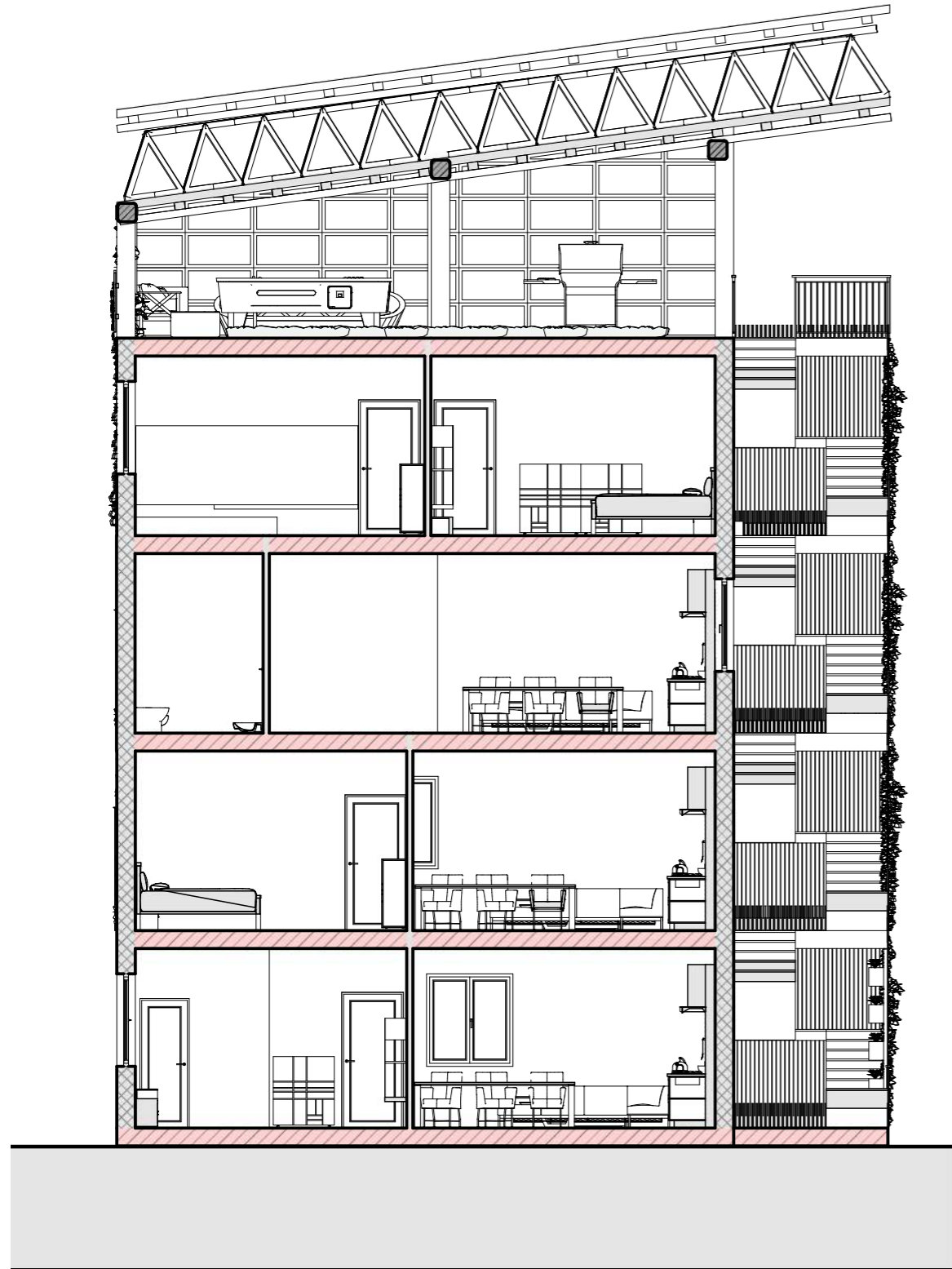
Scala 1:100



5.5. SECTIONS

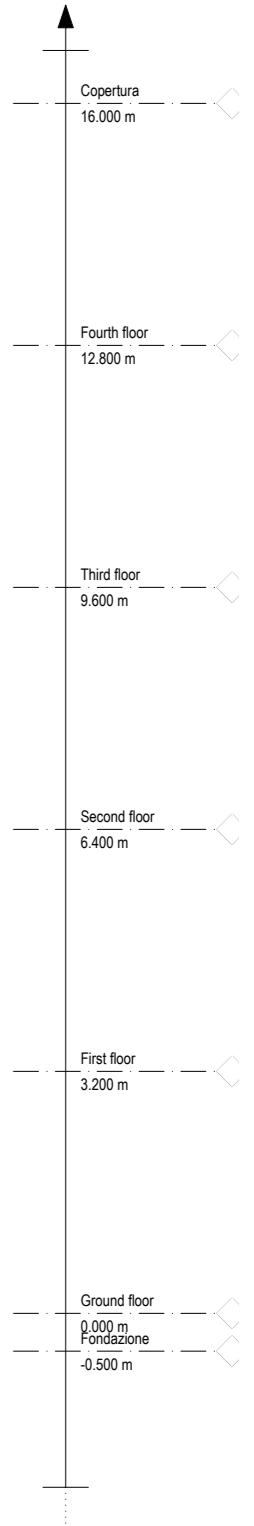
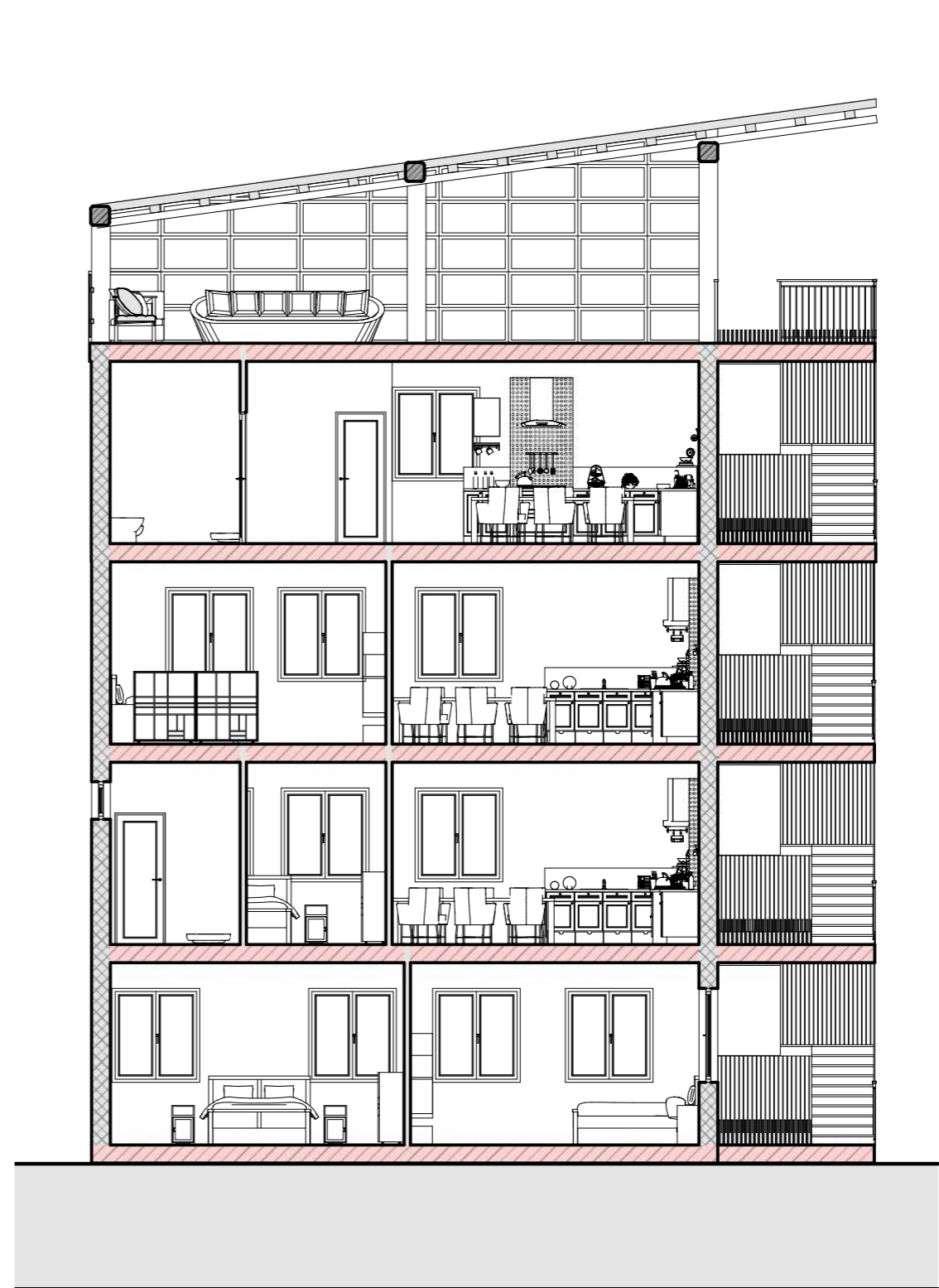
SECTION A-A

Scala 1:100



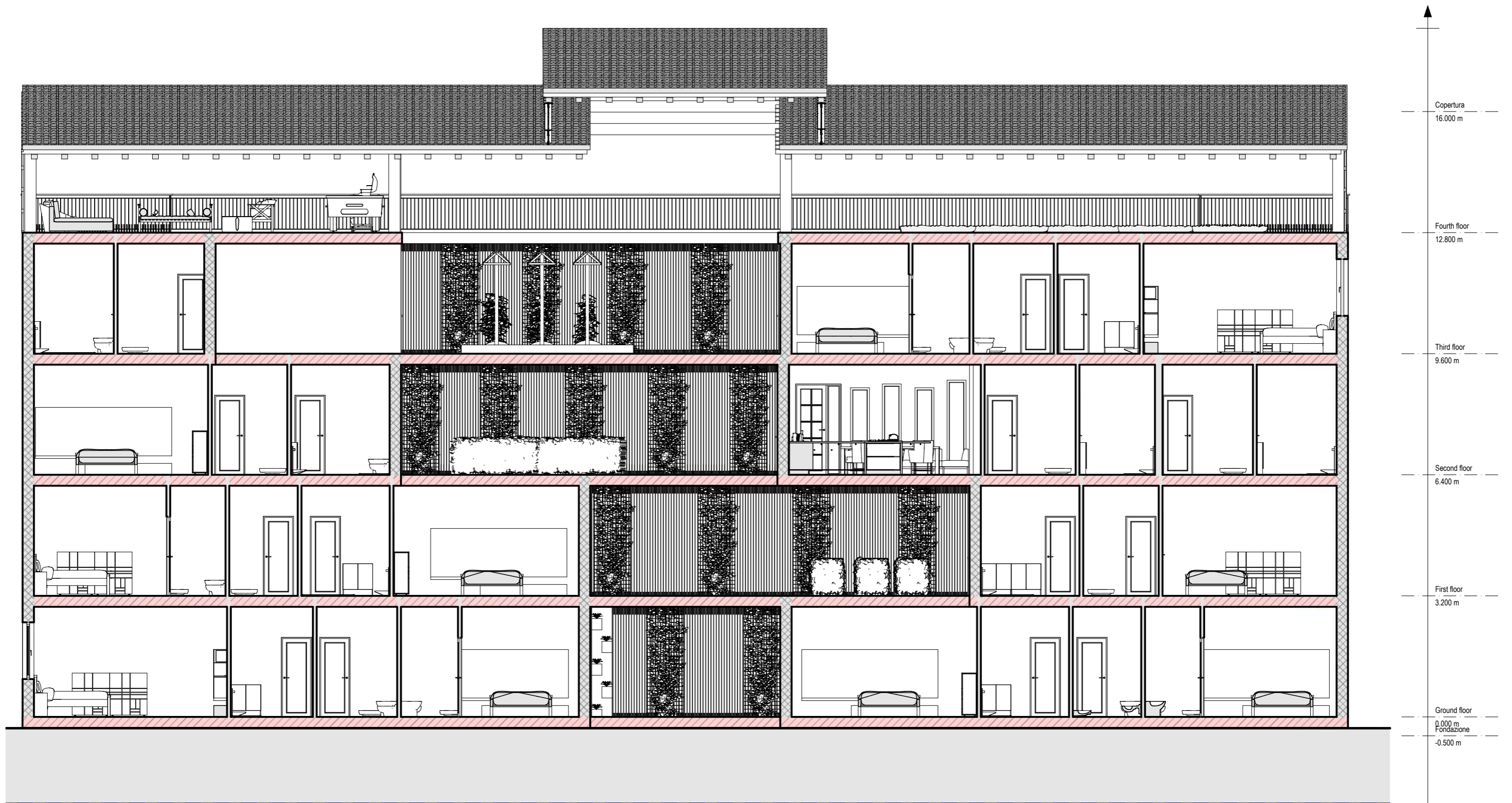
SECTION D-D

Scala 1:100



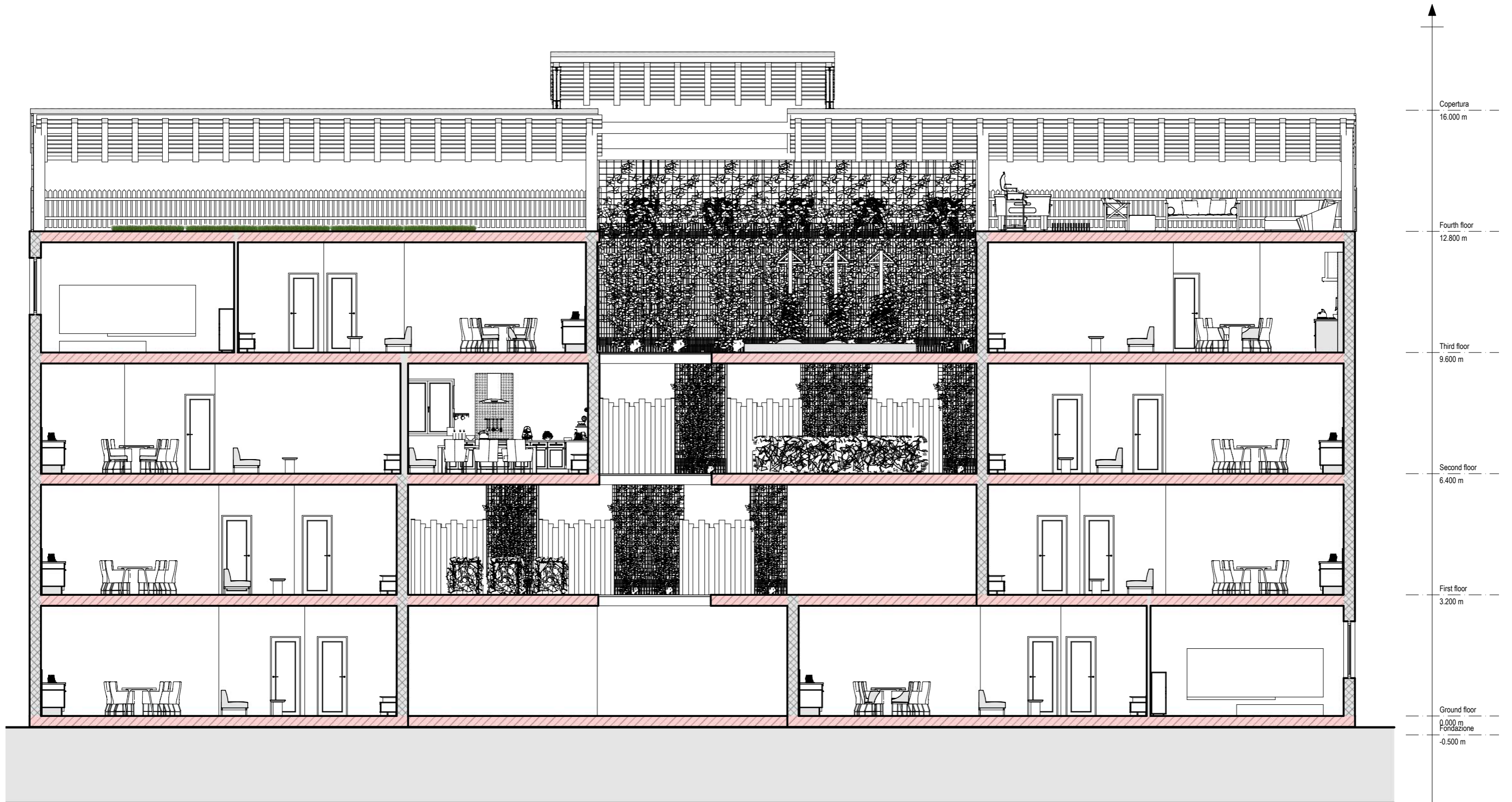
SECTION B-B

Scala 1:100



SECTION C-C

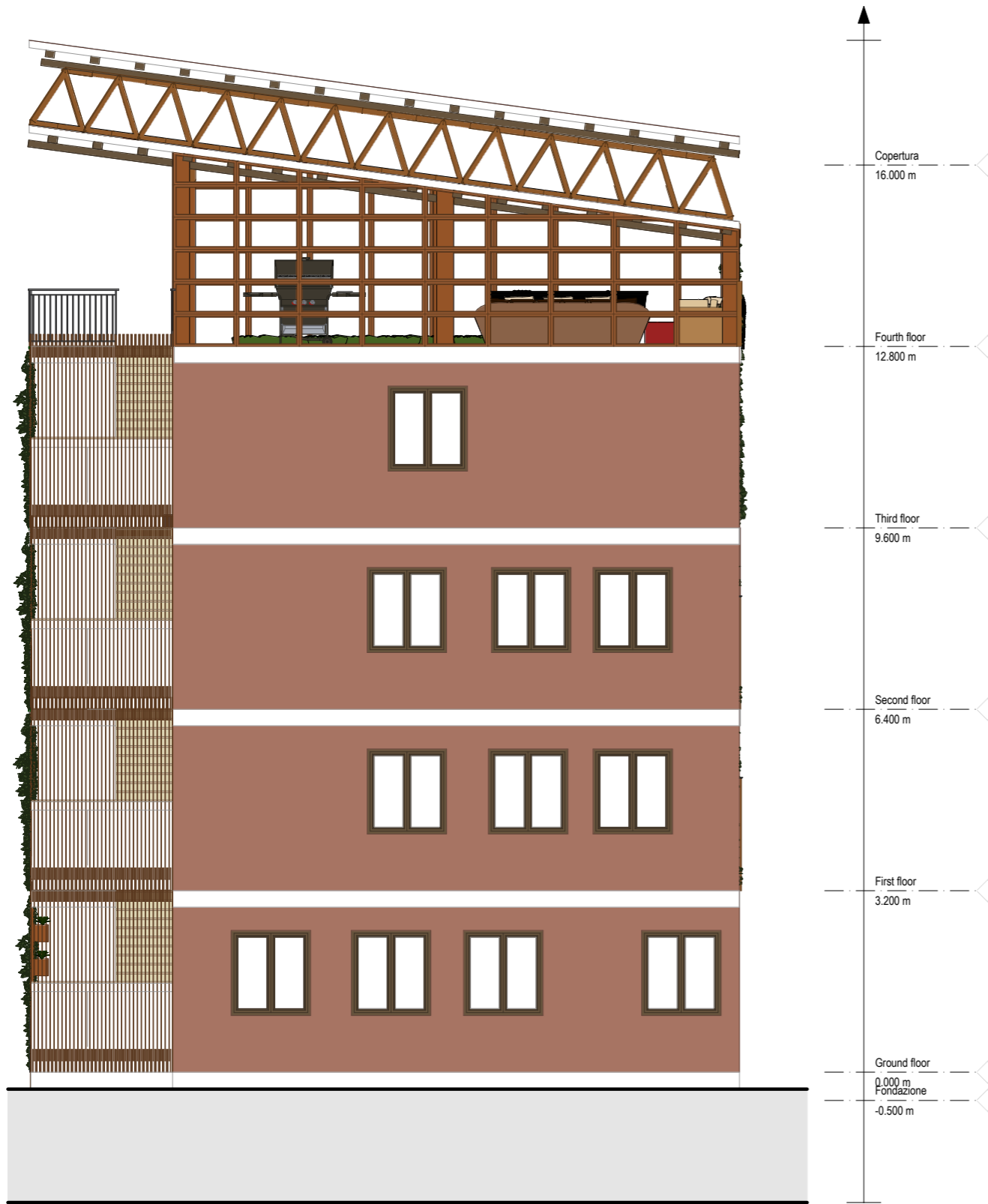
Scala 1:100



5.6. PROSPECTS

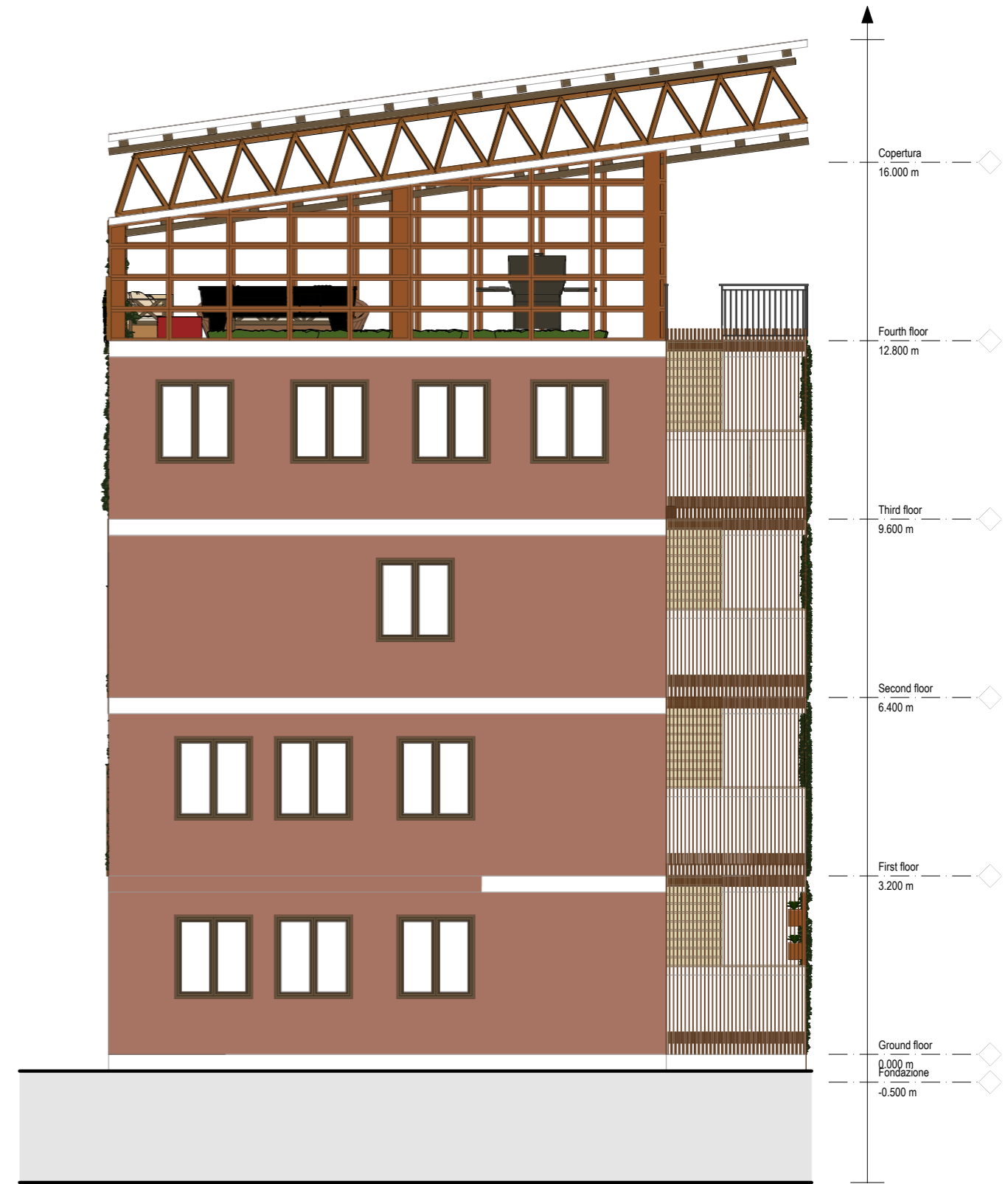
PROSPECT 1

Scala 1:100



PROSPECT 2

Scala 1:100



PROSPECT 3

Scala 1:100



PROSPECT 4

Scala 1:100



5.7. Renders







6. NZEB Energy optimisation

Note:

Due to lack of energy codes for the diagnosis of energy i have used the italian codes for the clacultion and hence thee software used is also the Italian version of TerMus so in this calculation you will find some information and results in the Italian language.

6.1 Materials selection.

The materials identified were selected are based on traditional building methods and materials. The profile and additives in the mixture are considered to enhance the thermal and acoustic performance. The materials maintain mechanical properties, while making them lighter and reducing number of materials needed. Thus, the materials opted are with enhanced insulating properties that are potentially cheaper than the traditionally used materials.

1. Brick

The material is obtained by adding locally sourced biowaste materials to brick mix for compacting to increase thermal and acoustic performance, while ensuring sufficient mechanical performance for low-rise building structures such as the community houses.



Thermal properties of brick

Step 1 - A mix of 8 units of "white soil" (directly from site), 5 units of red soil (delivered to site, but available in the region and fairly cheap) and 10% (volume) of cement and 15% Typha fibers added by volume.

Step 2 - Inserting the mix into a manually operated brick press for Compressed Earth Block (CEB).

Step 3 – upon molding the bricks are transported to the drying area, which is in the shade so as not to expose the bricks to direct sun and cured for 14 days.

Characteristics	SI Units	Value
Thermal conductivity	W/mK	0.2
Mass volume	Kg/m ³	800
Specific heat capacity	J/KgK	760
Vapour rsistance coefficient	μ	5.773

2. Concrete

Thermal properties of brick

Characteristics	SI Units	Value
Thermal conductivity	W/mK	0.85
Mass volume	Kg/m ³	2400
Specific heat capacity	J/KgK	1000
Vapour rsistance coefficient	μ	148.416



3. XPS

Thermal properties of brick

Characteristics	SI Units	Value
Thermal conductivity	W/mK	0.029
Mass volume	Kg/m ³	40
Specific heat capacity	J/KgK	1450
Vapour rsistance coefficient	μ	150



4. EPS

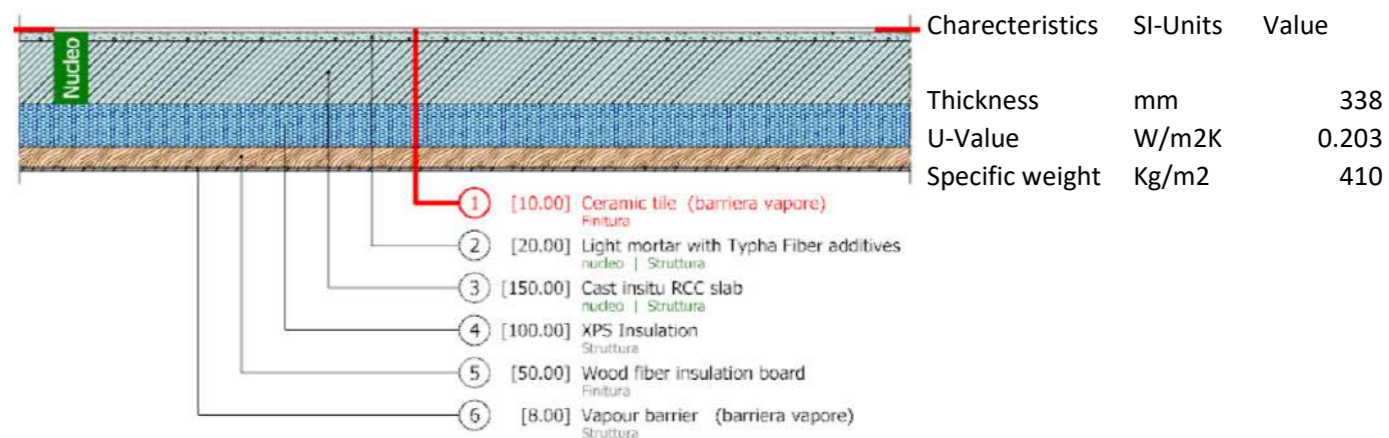
Thermal properties of brick

Characteristics	SI Units	Value
Thermal conductivity	W/mK	0.032
Mass volume	Kg/m ³	40
Specific heat capacity	J/KgK	1450
Vapour rsistance coefficient	μ	60

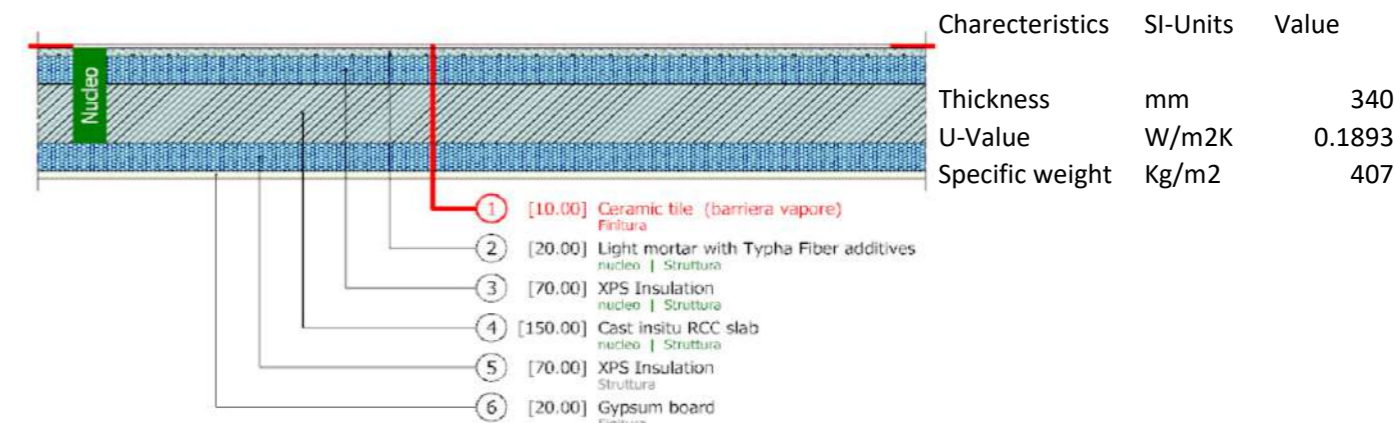


6.1.1 Fixed Stratigraphies

1. Slab in contact with ground.



2. Intermediat slab-Internal.



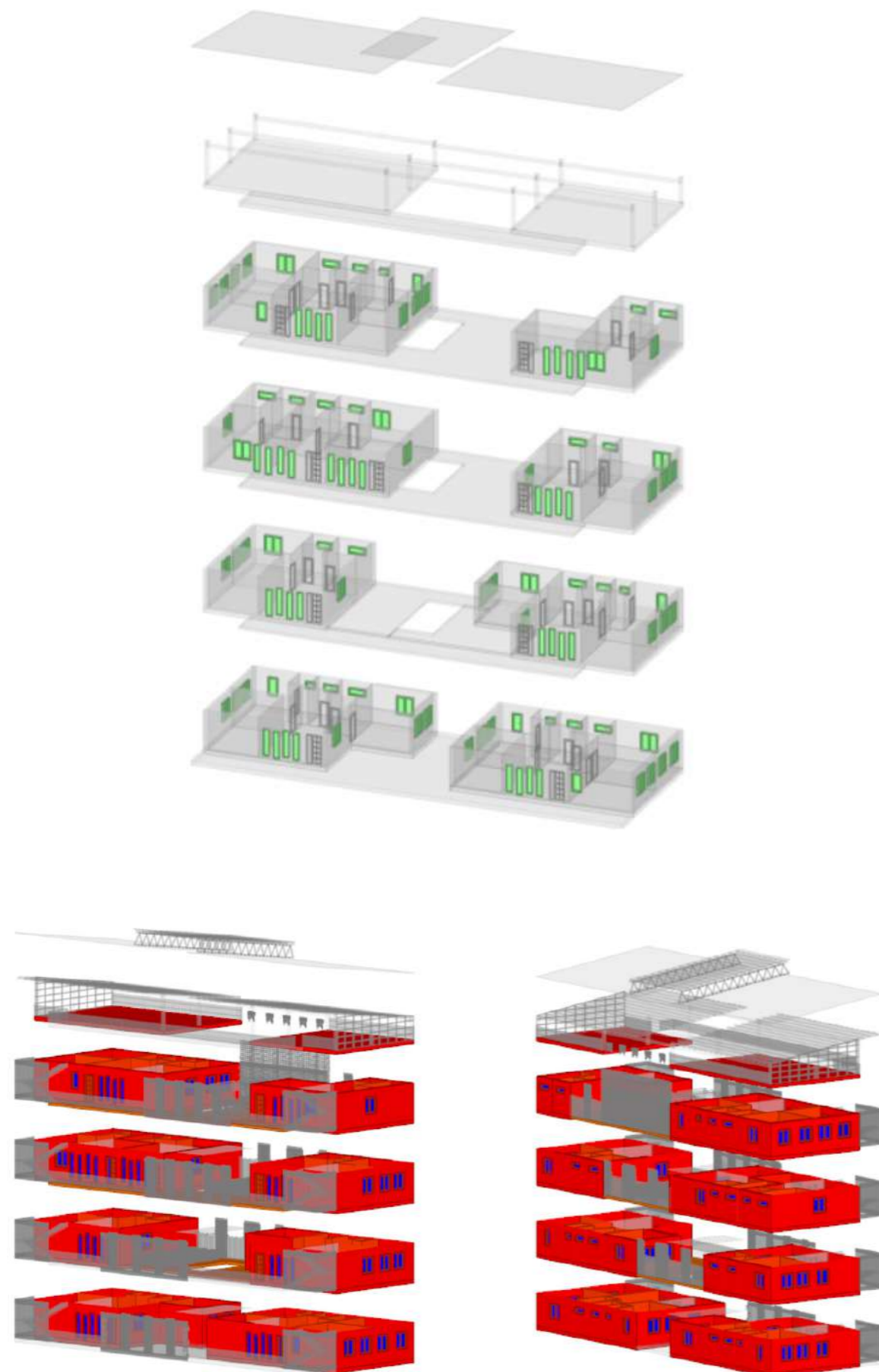
3. Intermediat slab-External.



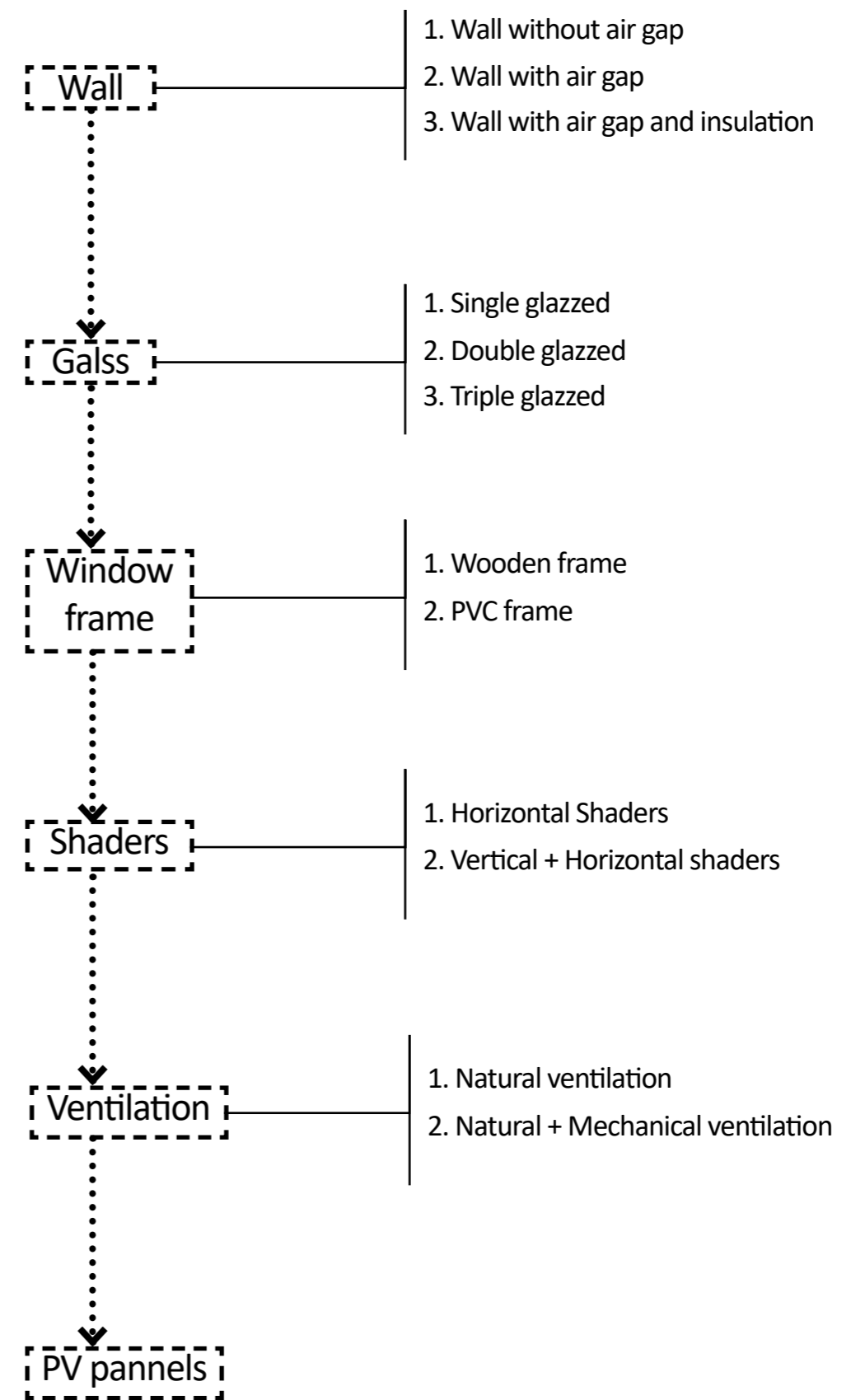
4. Roof.



6.1.1 Transperante elements in each floor

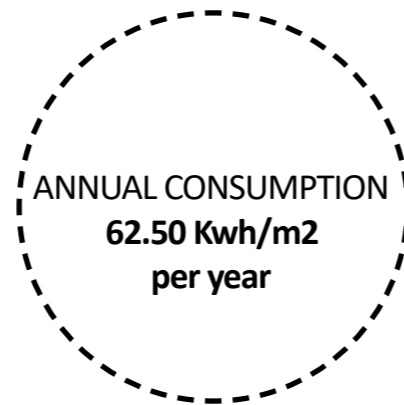


6.2. Energy Optioneering using Nzeb codes

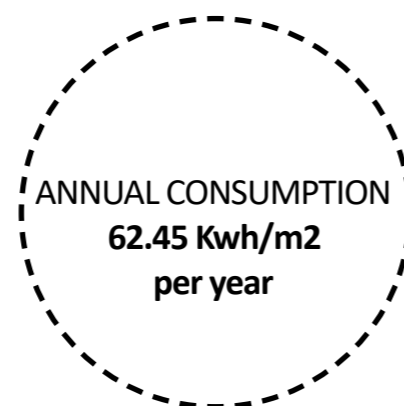
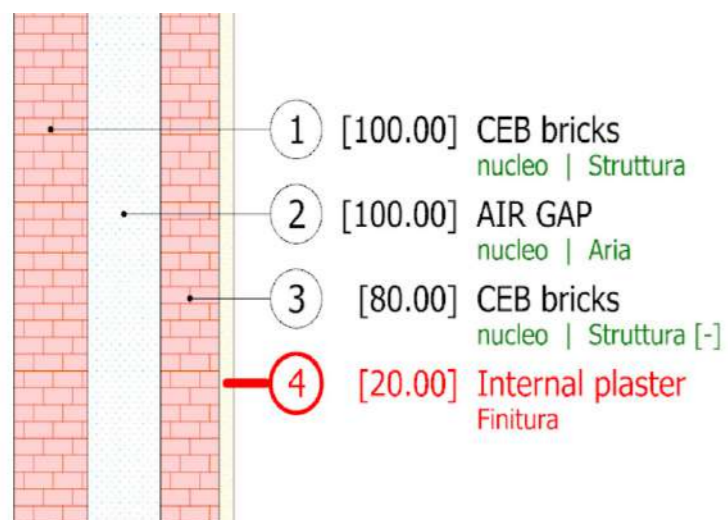


6.2.1 Wall optioneering

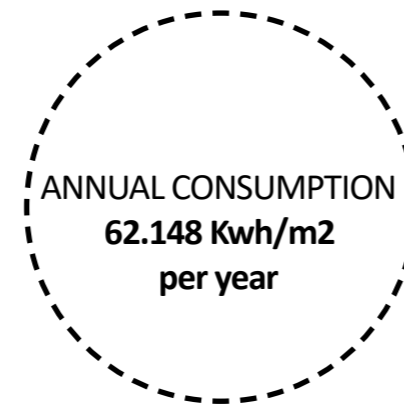
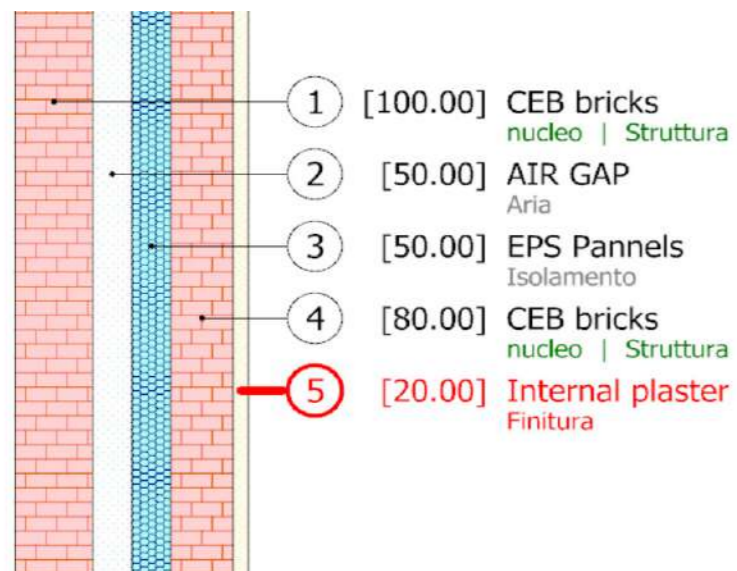
Wall-1_Wall without air gap



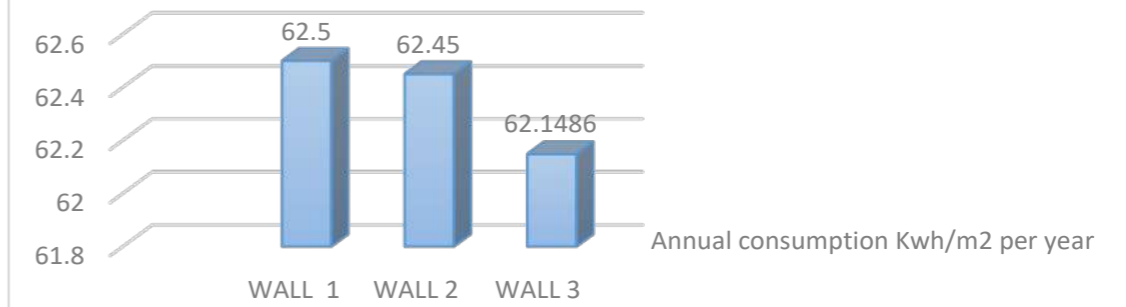
Wall-2_Wall with air gap



Wall-3_Wall with air gap and insulatio

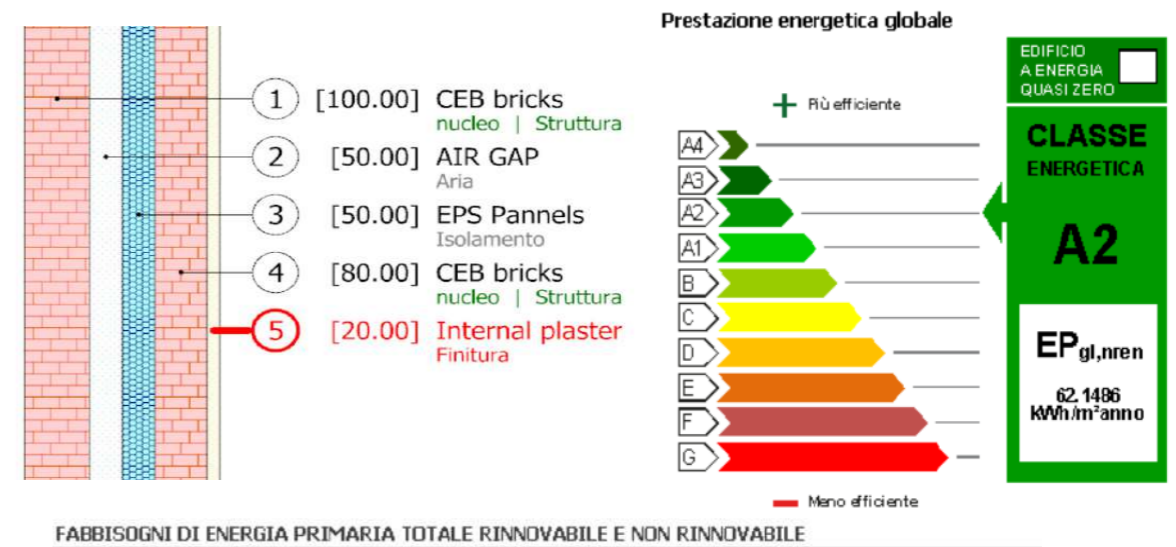


Annual consumption Kwh/m2 per year



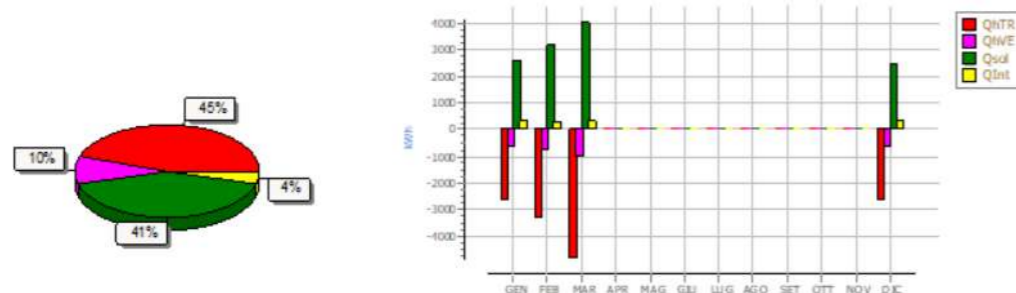
6.2.2 Analysis conclusion for wall

Selected - Wall 3

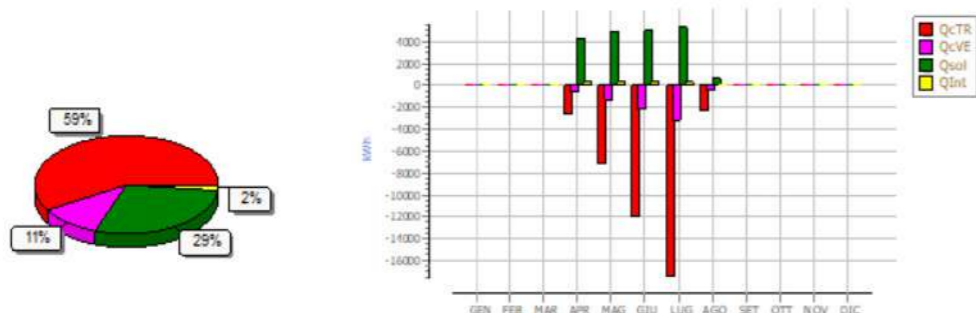


Performance of wall

FABBISOGNI DI ENERGIA PER RISCALDAMENTO

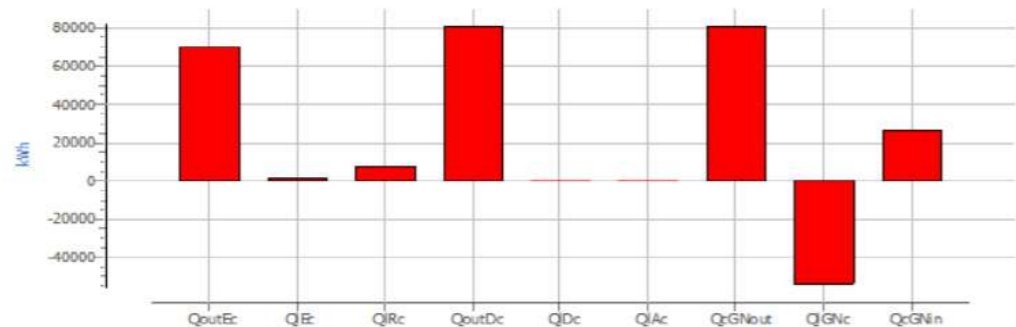


FABBISOGNI DI ENERGIA PER RAFFRESCAMENTO

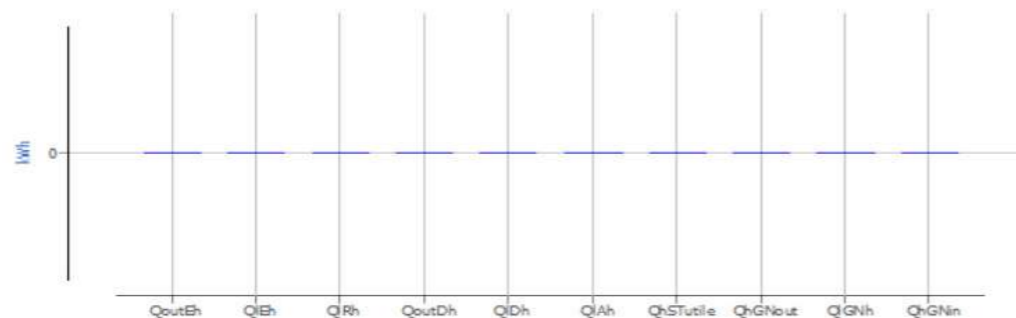


Energy required for heating and cooling

RAFFRESCAMENTO - Fabbisogni di impianto



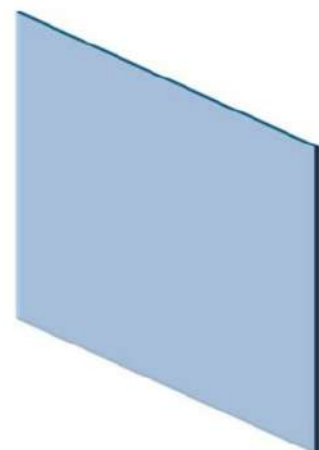
RISCALDAMENTO - Fabbisogni di impianto



Centralized HCW with natural ventilation			
Simbolo	Descrizione	Misura	Valore
Classe	Classe energetica		A2
NZEB	Edifici a energia quasi zero		NO
AreaN	Superficie netta calpestabile	m ²	847.18
AreaL	Superficie lorda	m ²	976.19
AreaN150	Superficie netta calpestabile con altezza inferiore a 1,5 m	m ²	0.00
VImN	Volume netto	m ³	2'435.06
VImL	Volume lordo	m ³	3'234.22
AltzM	Altezza netta media	m	2.87
SprfL	Superficie lorda disperdente	m ²	1'877.43
SprfVT	Superficie lorda disperdente delle vetrate (verso l'esterno)	m ²	185.28
RpSV	Rapporto di forma - S/V	1/m	0.5805
QhTRp	Dispersione massima per trasmissione (per il calcolo del carico termico di progetto)	W	24'814
QhVEp	Dispersione massima per ventilazione (per il calcolo del carico termico di progetto)	W	6'491
Cm	Capacità termica	kJ/K	132'403.56
RicAriaNAT	Ricambi d'aria per ventilazione naturale o di riferimento	m ³ /h	730.5189
Qp	Carico termico di progetto (trasmissione + ventilazione + fattore di ripresa)	W	31'305
Qx_rete	Fabbisogno di energia elettrica prelevata dalla rete	kWh	27'000.56
QwFR_perc	Percentuale di energia da fonti rinnovabili per acqua calda sanitaria	%	87.21
QwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per acqua calda sanitaria	%	60.00
QhcwFR_perc	Percentuale di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	20.45
QhcwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	60.00
PtzPV	Potenza di picco	kW	0.00
PeIFR_Lim	Potenza elettrica limite installata da fonti rinnovabili	kW	0.00
EPhwc,nren	Indice di prestazione energetica non rinnovabile D.Lgs 199/2021	kWh/m ² anno	62.149
EPhwc_lim	Indice di prestazione energetica LIMITE D.Lgs 199/2021	kWh/m ² anno	65.9876
EPh	Indice di prestazione energetica per la climatizzazione invernale	kWh/m ² anno	0.0000
EPc	Indice di prestazione energetica per la climatizzazione estiva	kWh/m ² anno	76.9403
EPw	Indice di prestazione energetica per l'acqua calda sanitaria	kWh/m ² anno	1.0004
EPv	Indice di prestazione energetica per la ventilazione meccanica	kWh/m ² anno	0.0000
EPI	Indice di prestazione energetica per l'illuminazione artificiale	kWh/m ² anno	0.0000
EPT	Indice di prestazione energetica per il trasporto	kWh/m ² anno	0.0000
EPgl	Indice di prestazione energetica globale totale	kWh/m ² anno	77.9407
EPgl_Lim	Indice di prestazione energetica globale totale LIMITE	kWh/m ² anno	82.3457
EPh,nd	Indice di prestazione termica utile per riscaldamento	kWh/m ² anno	0.000
EPh,nd_Lim	Indice di prestazione termica LIMITE per riscaldamento	kWh/m ² anno	0.0000
EPc,nd	Indice di prestazione termica utile per raffrescamento	kWh/m ² anno	83.2989
EPc,nd_Lim	Indice di prestazione termica LIMITE per raffrescamento	kWh/m ² anno	83.0457
EtaGh	Rendimento globale medio dell'impianto di riscaldamento		0.0000
EtaGc	Rendimento globale medio dell'impianto di raffrescamento		1.0826
EtaGc_Lim	Rendimento globale medio stagionale LIMITE per raffrescamento		1.0331
EtaGw	Rendimento globale medio dell'impianto di acqua sanitaria		0.9925
EtaGw_Lim	Rendimento globale medio stagionale LIMITE per acqua calda sanitaria		0.5072
Yie	Trasmittanza termica periodica media	W/m ² K	0.3332
H'T	Coefficiente globale di scambio termico medio per trasmissione	W/m ² K	0.7744
Area H'T	Superficie per il calcolo del coefficiente di scambio termico medio	m ²	1'877.43
H'T_Lim	Coefficiente globale di scambio termico medio per trasmissione LIMITE (riscaldamento)	W/m ² K	0.63
Asol'	Area solare equivalente estiva		0.0469
Asol_Lim	Area solare equivalente estiva LIMITE		0.0300
periodo RSC	periodo riscaldamento		1 dic - 31 mar
periodo RFS	periodo raffrescamento		1 apr - 4 ago

6.2.2 Glass optioneering

1. Single glazed

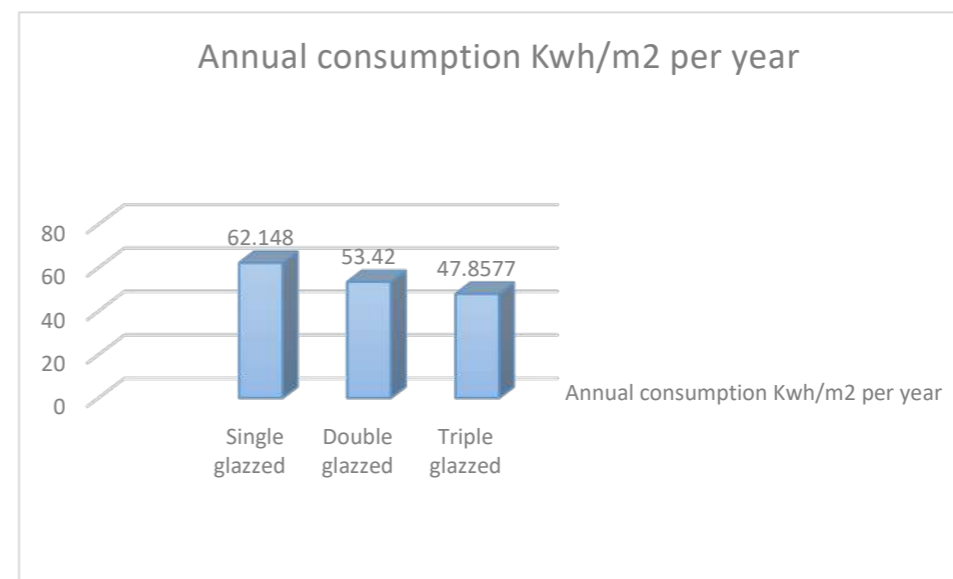
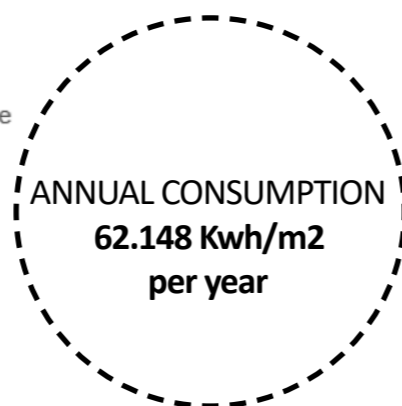


VETRO

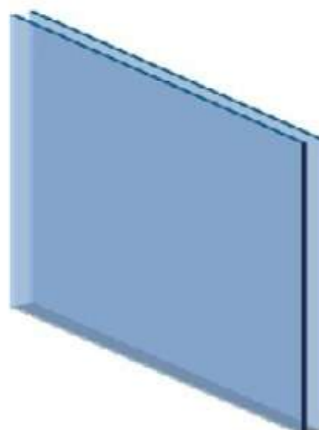
Tipo vetro Singolo
Valutazione della trasmittanza Fornita dal produttore

CARATTERISTICHE TECNICHE

Spessore totale [mm] 4
Fattore solare normale 0.85
Trasmittanza termica Ug [W/m²K] 5.4



2. Double glazed

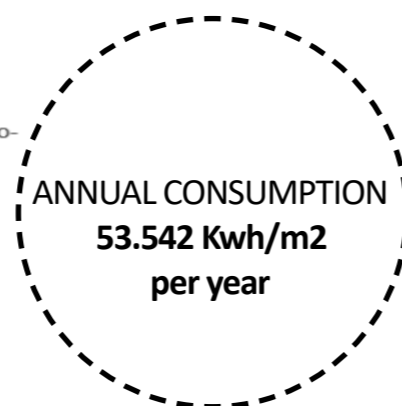


VETRO

Tipo vetro Doppio (rivestimento basso-emissivo)
Valutazione della trasmittanza Prospetto B.1 UNI/TS 11300-1

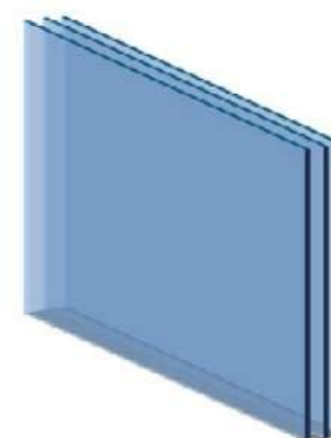
CARATTERISTICHE TECNICHE

Spessore totale [mm] 16
Spessore intercapedine [mm] 8
Tipo gas 1 Argon
Fattore solare normale 0.67
Trasmittanza termica Ug [W/m²K] 2



6.2.2 Analysis conclusion for glass

Selected - Triple glazed



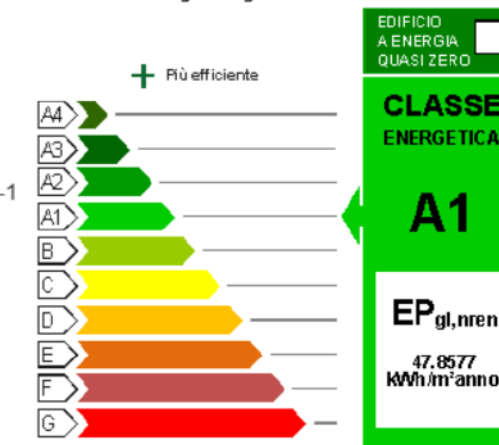
VETRO

Tipo vetro Triplo (doppio rivestimento basso-emissivo)
Valutazione della trasmittanza Prospetto B.1 UNI/TS 11300-1

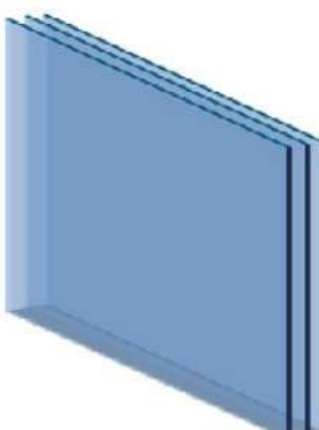
CARATTERISTICHE TECNICHE

Spessore totale [mm] 24
Fattore solare normale 0.50
Trasmittanza termica Ug [W/m²K] 1.5

Prestazione energetica globale



3. Triple glazed

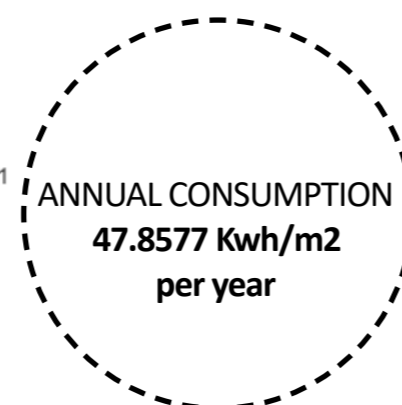


VETRO

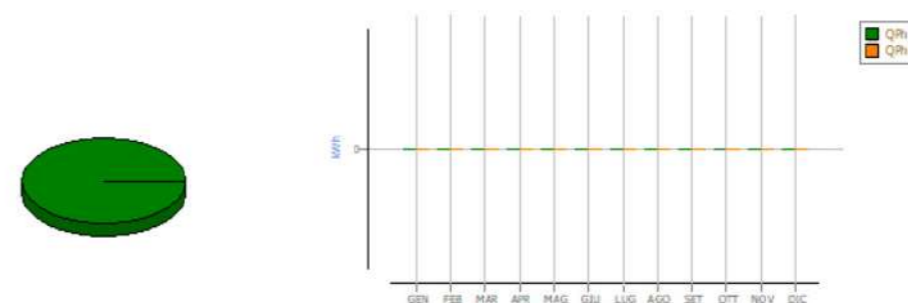
Tipo vetro Triplo (doppio rivestimento basso-emissivo)
Valutazione della trasmittanza Prospetto B.1 UNI/TS 11300-1

CARATTERISTICHE TECNICHE

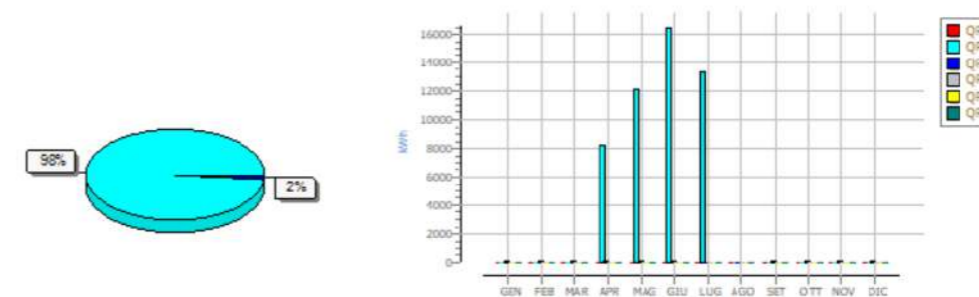
Spessore totale [mm] 24
Fattore solare normale 0.50
Trasmittanza termica Ug [W/m²K] 1.5



FABBISOGNI DI ENERGIA PRIMARIA TOTALE RINNOVABILE E NON RINNOVABILE

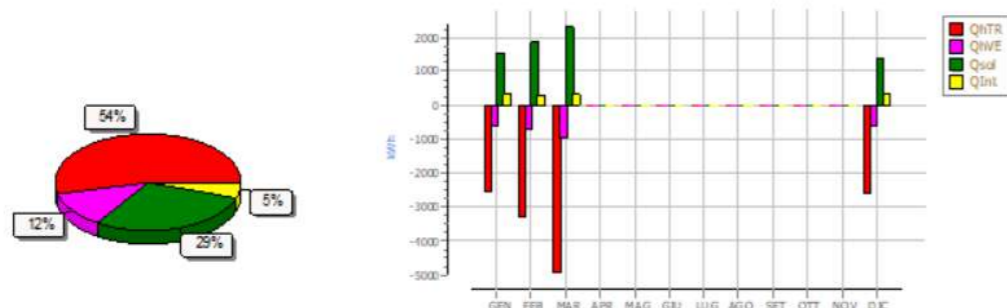


FABBISOGNI DI ENERGIA PRIMARIA PER SINGOLO SERVIZIO

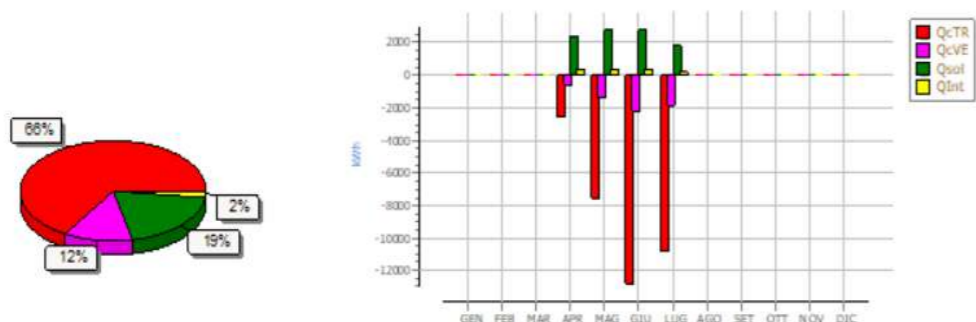


Performance of wall

FABBISOGNI DI ENERGIA PER RISCALDAMENTO

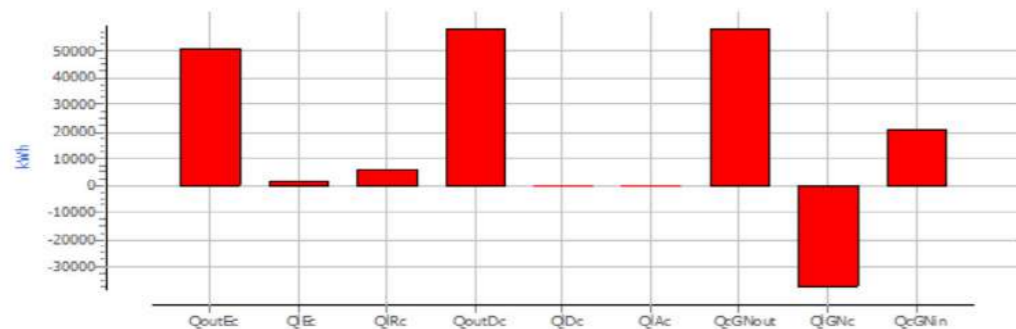


FABBISOGNI DI ENERGIA PER RAFFRESCAMENTO

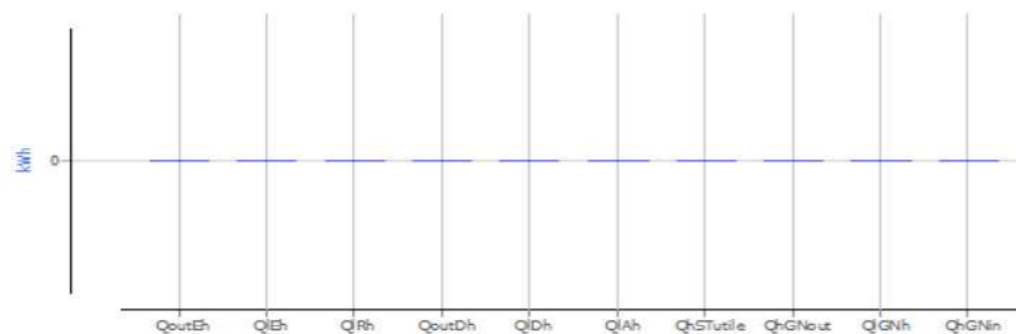


Energy required for heating and cooling

RAFFRESCAMENTO - Fabbisogni di impianto



RISCALDAMENTO - Fabbisogni di impianto



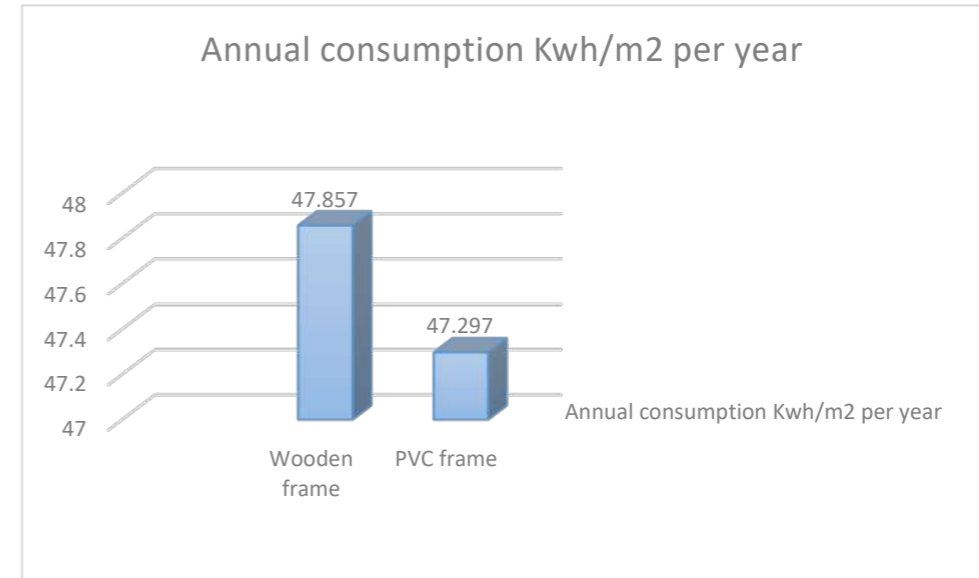
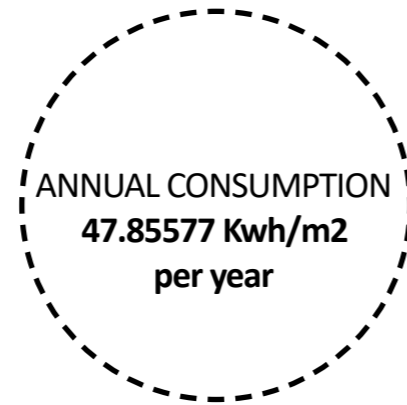
Centralized HCW with natural ventilation			
Simbolo	Descrizione	Misura	Valore
Classe	Classe energetica		A1
NZEB	Edifici a energia quasi zero		NO
AreaN	Superficie netta calpestabile	m ²	847.18
AreaL	Superficie lorda	m ²	976.19
AreaN150	Superficie netta calpestabile con altezza inferiore a 1,5 m	m ²	0.00
VImN	Volume netto	m ³	2'435.06
VImL	Volume lordo	m ³	3'234.22
AltzM	Altezza netta media	m	2.87
SprfL	Superficie lorda disperdente	m ²	1'877.43
SprfVT	Superficie lorda disperdente delle vetrate (verso l'esterno)	m ²	185.28
RpSV	Rapporto di forma - S/V	1/m	0.5805
QhTRp	Dispersione massima per trasmissione (per il calcolo del carico termico di progetto)	W	27'484
QhVEp	Dispersione massima per ventilazione (per il calcolo del carico termico di progetto)	W	6'491
Cm	Capacità termica	kJ/K	131'775.16
RicAriaNAT	Ricambi d'aria per ventilazione naturale o di riferimento	m ³ /h	730.5189
Qp	Carico termico di progetto (trasmissione + ventilazione + fattore di ripresa)	W	33'975
Qx_rete	Fabbisogno di energia elettrica prelevata dalla rete	kWh	20'791.85
QwFR_perc	Percentuale di energia da fonti rinnovabili per acqua calda sanitaria	%	87.21
QwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per acqua calda sanitaria	%	60.00
QhcwFR_perc	Percentuale di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	20.75
QhcwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	60.00
PtzPV	Potenza di picco	kW	0.00
PeIFR_Lim	Potenza elettrica limite installata da fonti rinnovabili	kW	0.00
EPhwc,nren	Indice di prestazione energetica non rinnovabile D.Lgs 199/2021	kWh/m ² anno	47.858
EPhwc_lim	Indice di prestazione energetica LIMITE D.Lgs 199/2021	kWh/m ² anno	46.4557
EPh	Indice di prestazione energetica per la climatizzazione invernale	kWh/m ² anno	0.0000
EPc	Indice di prestazione energetica per la climatizzazione estiva	kWh/m ² anno	59.2049
EPw	Indice di prestazione energetica per l'acqua calda sanitaria	kWh/m ² anno	1.0004
EPv	Indice di prestazione energetica per la ventilazione meccanica	kWh/m ² anno	0.0000
EPI	Indice di prestazione energetica per l'illuminazione artificiale	kWh/m ² anno	0.0000
EPT	Indice di prestazione energetica per il trasporto	kWh/m ² anno	0.0000
EPgl	Indice di prestazione energetica globale totale	kWh/m ² anno	60.2053
EPgl_Lim	Indice di prestazione energetica globale totale LIMITE	kWh/m ² anno	58.1448
EPh,nd	Indice di prestazione termica utile per riscaldamento	kWh/m ² anno	0.000
EPh,nd_Lim	Indice di prestazione termica LIMITE per riscaldamento	kWh/m ² anno	0.0000
EPc,nd	Indice di prestazione termica utile per raffrescamento	kWh/m ² anno	59.7491
EPc,nd_Lim	Indice di prestazione termica LIMITE per raffrescamento	kWh/m ² anno	58.0448
EtaGh	Rendimento globale medio dell'impianto di riscaldamento		0.0000
EtaGc	Rendimento globale medio dell'impianto di raffrescamento		1.0092
EtaGc_Lim	Rendimento globale medio stagionale LIMITE per raffrescamento		1.0331
EtaGw	Rendimento globale medio dell'impianto di acqua sanitaria		0.9925
EtaGw_Lim	Rendimento globale medio stagionale LIMITE per acqua calda sanitaria		0.5072
Yie	Trasmittanza termica periodica media	W/m ² K	0.6961
H'T	Coefficiente globale di scambio termico medio per trasmissione	W/m ² K	0.8545
Area H'T	Superficie per il calcolo del coefficiente di scambio termico medio	m ²	1'877.43
H'T_Lim	Coefficiente globale di scambio termico medio per trasmissione LIMITE (riscaldamento)	W/m ² K	0.63
Asol'	Area solare equivalente estiva		0.0263
Asol_Lim	Area solare equivalente estiva LIMITE		0.0300
periodo RSC	periodo riscaldamento		1 dic - 31 mar
periodo RFS	periodo raffrescamento		1 apr - 19 lug

6.2.3 Window frame optioneering

1. Wooden frame



U = 2.2 W/m2K



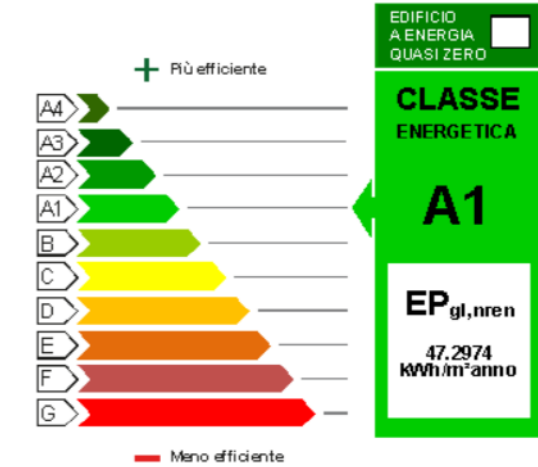
6.2.2 Analysis conclusion for window frame

Selected - PVC frame



U = 1.2 W/m2K

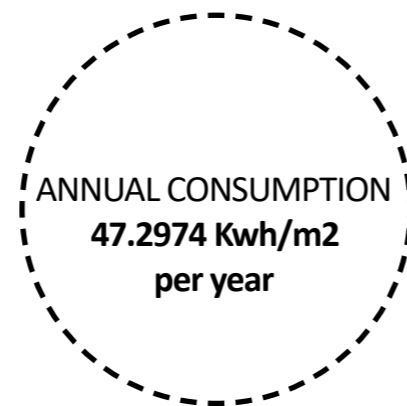
Prestazione energetica globale



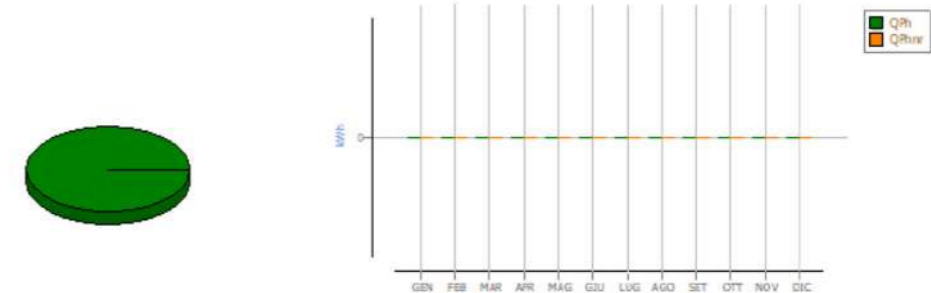
3. PVC framee



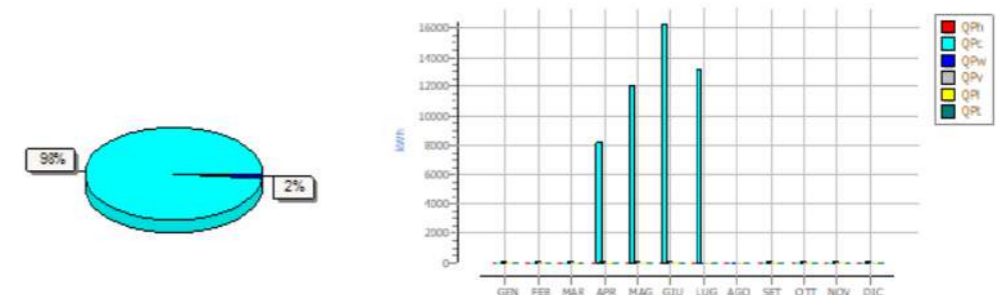
U = 1.2 W/m2K



FABBISOGNI DI ENERGIA PRIMARIA TOTALE RINNOVABILE E NON RINNOVABILE

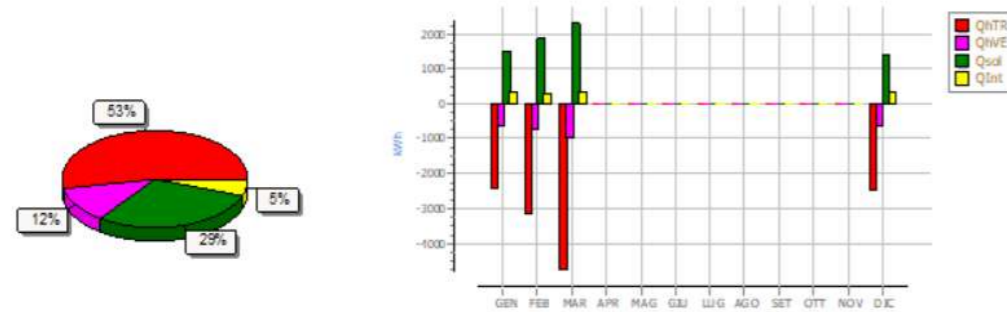


FABBISOGNI DI ENERGIA PRIMARIA PER SINGOLO SERVIZIO

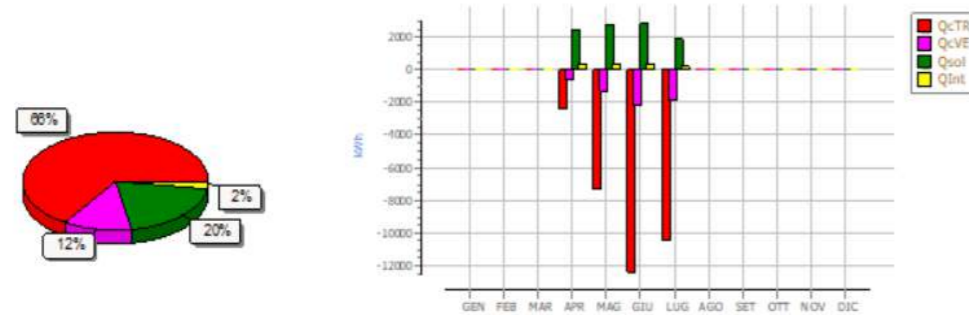


Performance of wall

FABBISOGNI DI ENERGIA PER RISCALDAMENTO



FABBISOGNI DI ENERGIA PER RAFFRESCAMENTO

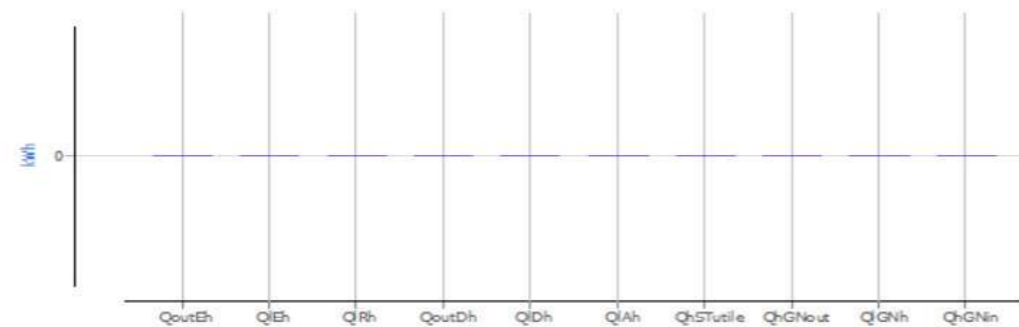


Energy required for heating and cooling

RAFFRESCAMENTO - Fabbisogni di impianto



RISCALDAMENTO - Fabbisogni di impianto



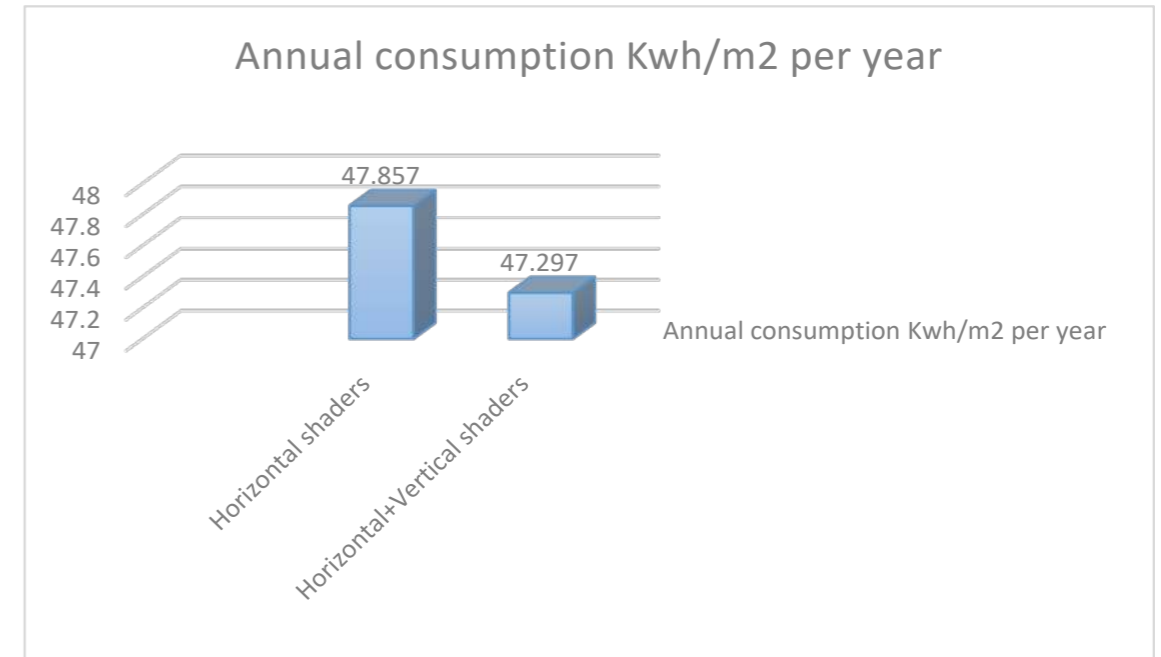
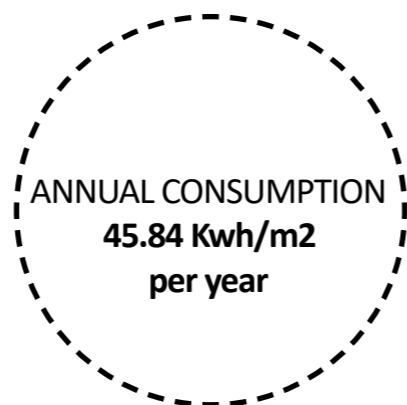
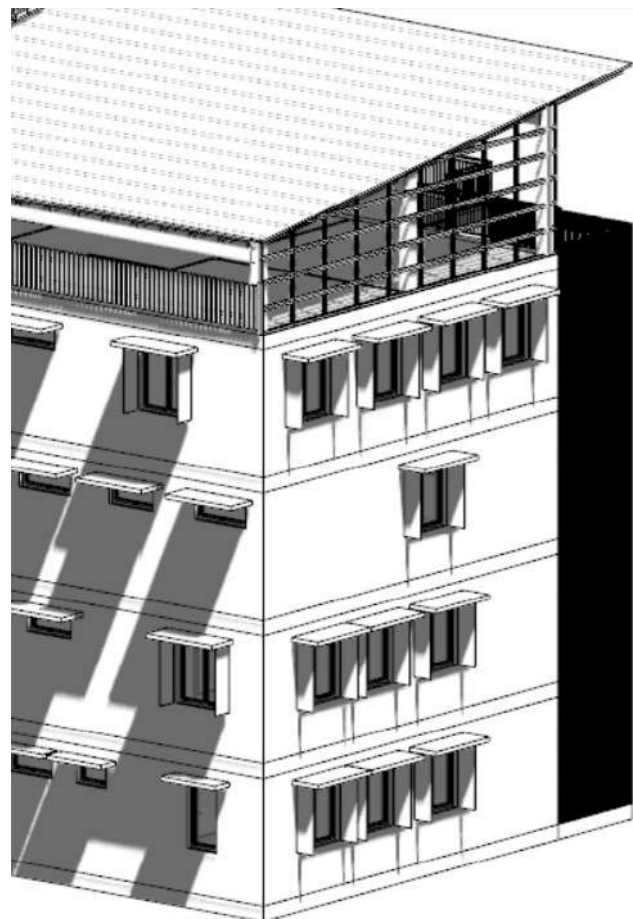
Centralized HCW with natural ventilation			
Simbolo	Descrizione	Misura	Valore
Classe	Classe energetica		A1
NZEB	Edifici a energia quasi zero		NO
AreaN	Superficie netta calpestabile	m ²	847.18
AreaL	Superficie lorda	m ²	976.19
AreaN150	Superficie netta calpestabile con altezza inferiore a 1,5 m	m ²	0.00
VImN	Volume netto	m ³	2'435.06
VImL	Volume lordo	m ³	3'234.22
AltzM	Altezza netta media	m	2.87
SprfL	Superficie lorda disperdente	m ²	1'877.43
SprfVT	Superficie lorda disperdente delle vetrate (verso l'esterno)	m ²	185.28
RpSV	Rapporto di forma - S/V	1/m	0.5805
QhTRp	Dispersione massima per trasmissione (per il calcolo del carico termico di progetto)	W	26'619
QhVEp	Dispersione massima per ventilazione (per il calcolo del carico termico di progetto)	W	6'491
Cm	Capacità termica	kJ/K	131'775.16
RicAriaNAT	Ricambi d'aria per ventilazione naturale o di riferimento	m ³ /h	730.5189
Qp	Carico termico di progetto (trasmissione + ventilazione + fattore di ripresa)	W	33'110
Qx_rete	Fabbisogno di energia elettrica prelevata dalla rete	kWh	20'548.42
QwFR_perc	Percentuale di energia da fonti rinnovabili per acqua calda sanitaria	%	87.21
QwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per acqua calda sanitaria	%	60.00
QhcwFR_perc	Percentuale di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	20.76
QhcwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	60.00
PtzPV	Potenza di picco	kW	0.00
PeIFR_Lim	Potenza elettrica limite installata da fonti rinnovabili	kW	0.00
EPhwc_nren	Indice di prestazione energetica non rinnovabile D.Lgs 199/2021	kWh/m ² anno	47.297
EPhwc_lim	Indice di prestazione energetica LIMITE D.Lgs 199/2021	kWh/m ² anno	46.4557
EPh	Indice di prestazione energetica per la climatizzazione invernale	kWh/m ² anno	0.0000
EPc	Indice di prestazione energetica per la climatizzazione estiva	kWh/m ² anno	58.5095
EPw	Indice di prestazione energetica per l'acqua calda sanitaria	kWh/m ² anno	1.0004
EPv	Indice di prestazione energetica per la ventilazione meccanica	kWh/m ² anno	0.0000
EPI	Indice di prestazione energetica per l'illuminazione artificiale	kWh/m ² anno	0.0000
EPT	Indice di prestazione energetica per il trasporto	kWh/m ² anno	0.0000
EPgl	Indice di prestazione energetica globale totale	kWh/m ² anno	59.5099
EPgl_Lim	Indice di prestazione energetica globale totale LIMITE	kWh/m ² anno	58.1448
EPh,nd	Indice di prestazione termica utile per riscaldamento	kWh/m ² anno	0.000
EPh,nd_Lim	Indice di prestazione termica LIMITE per riscaldamento	kWh/m ² anno	0.0000
EPc,nd	Indice di prestazione termica utile per raffrescamento	kWh/m ² anno	58.4253
EPc,nd_Lim	Indice di prestazione termica LIMITE per raffrescamento	kWh/m ² anno	58.0448
EtaGh	Rendimento globale medio dell'impianto di riscaldamento		0.0000
EtaGc	Rendimento globale medio dell'impianto di raffrescamento		0.9986
EtaGc_Lim	Rendimento globale medio stagionale LIMITE per raffrescamento		1.0331
EtaGw	Rendimento globale medio dell'impianto di acqua sanitaria		0.9925
EtaGw_Lim	Rendimento globale medio stagionale LIMITE per acqua calda sanitaria		0.5072
Yie	Trasmittanza termica periodica media	W/m ² K	0.6961
H'T	Coefficiente globale di scambio termico medio per trasmissione	W/m ² K	0.8285
Area H'T	Superficie per il calcolo del coefficiente di scambio termico medio	m ²	1'877.43
H'T_Lim	Coefficiente globale di scambio termico medio per trasmissione LIMITE (riscaldamento)	W/m ² K	0.63
Asol'	Area solare equivalente estiva		0.0263
Asol_Lim	Area solare equivalente estiva LIMITE		0.0300
periodo RSC	periodo riscaldamento		1 dic - 31 mar
periodo RFS	periodo raffrescamento		1 apr - 19 lug

6.2.3 Shadders optioneering

1. Horizontal shaders

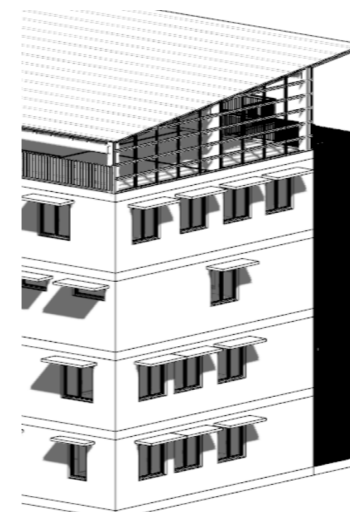


2. Horizontal + Vertical shaders

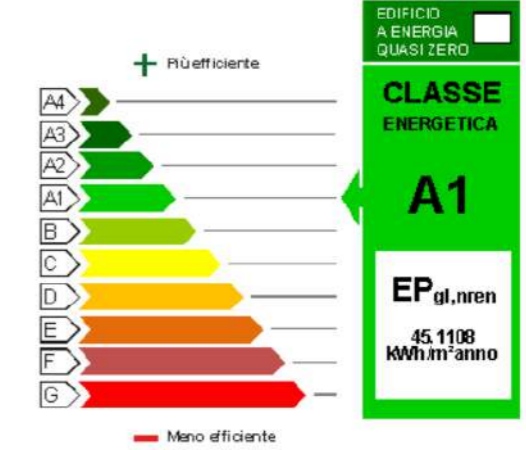


6.2.2 Analysis conclusion of shaders

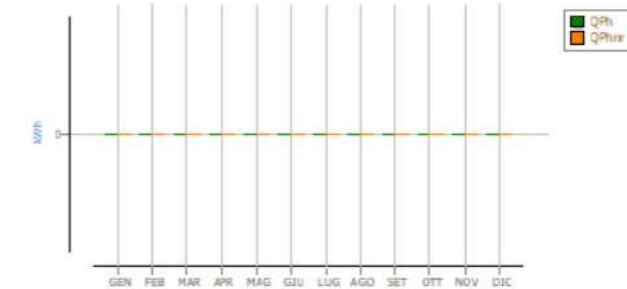
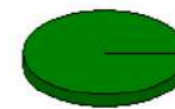
Selected - Horizontal



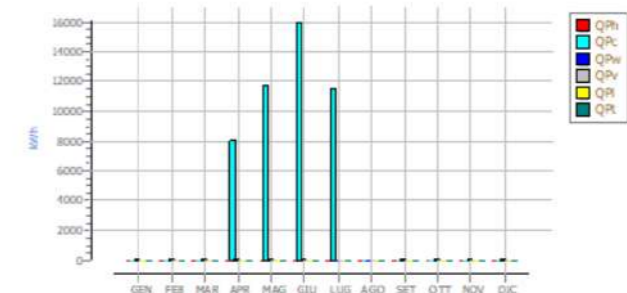
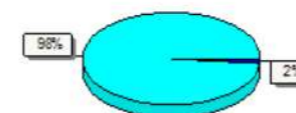
Prestazione energetica globale



FABBISOGNI DI ENERGIA PRIMARIA TOTALE RINNOVABILE E NON RINNOVABILE

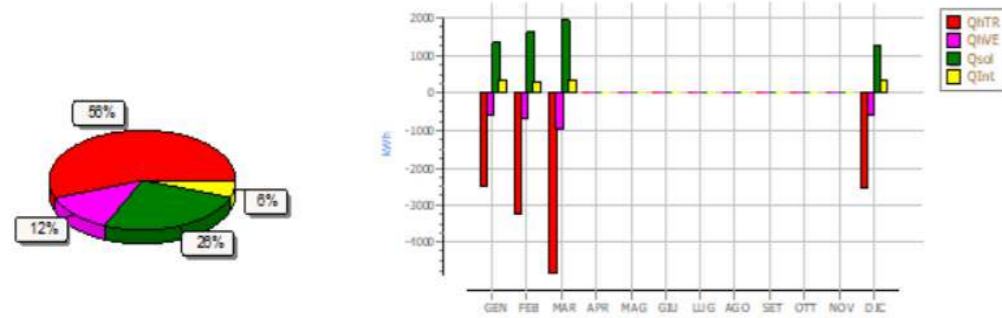


FABBISOGNI DI ENERGIA PRIMARIA PER SINGOLO SERVIZIO

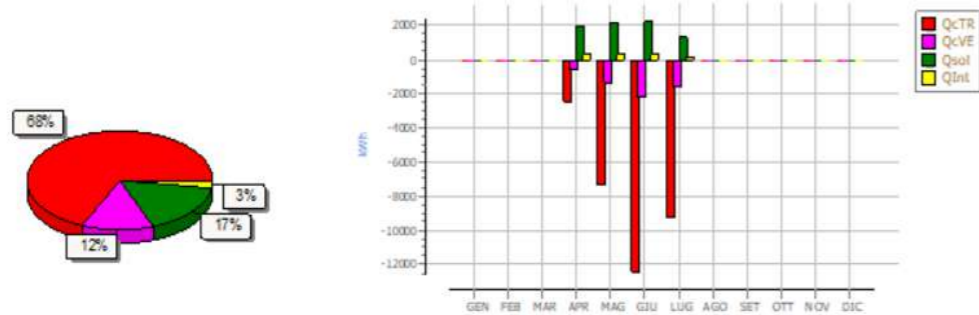


Performance of wall

FABBISOGNI DI ENERGIA PER RISCALDAMENTO

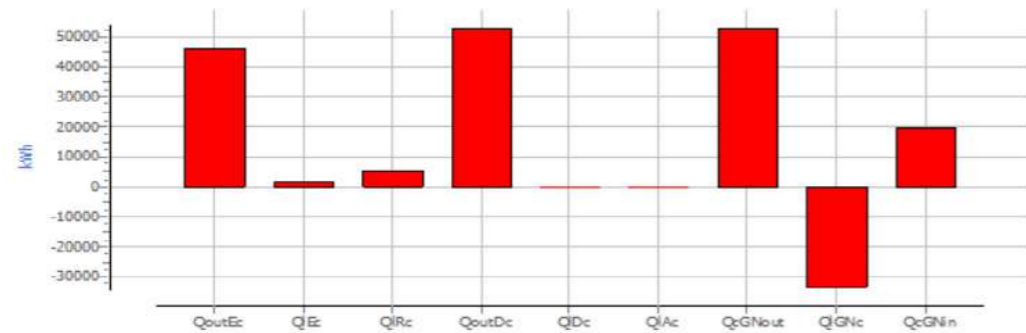


FABBISOGNI DI ENERGIA PER RAFFRESCAMENTO

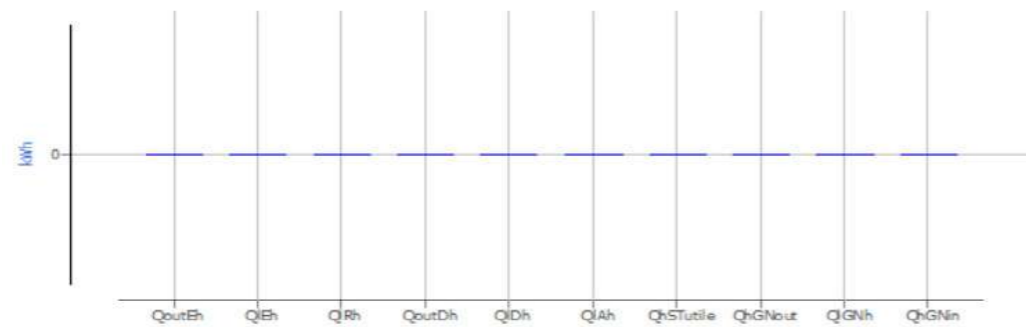


Energy required for heating and cooling

RAFFRESCAMENTO - Fabbisogni di impianto



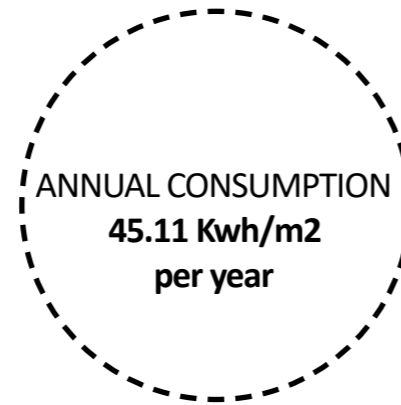
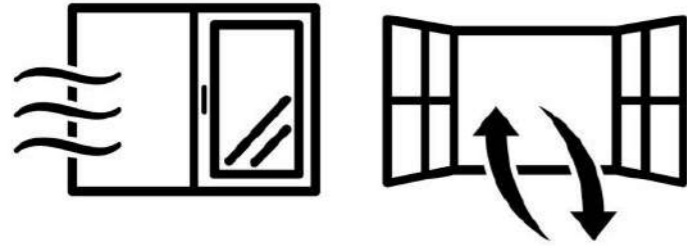
RISCALDAMENTO - Fabbisogni di impianto



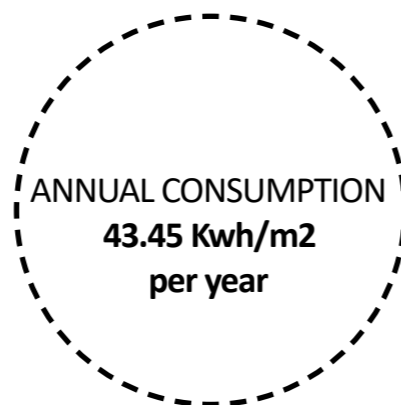
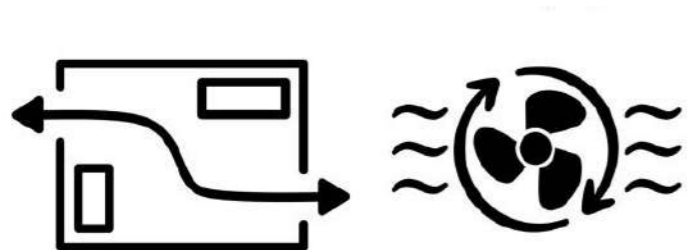
Centralized HCW with natural ventilation			
Simbolo	Descrizione	Misura	Valore
Classe	Classe energetica		A1
NZEB	Edifici a energia quasi zero		NO
AreaN	Superficie netta calpestabile	m ²	847.18
AreaL	Superficie lorda	m ²	976.19
AreaN150	Superficie netta calpestabile con altezza inferiore a 1,5 m	m ²	0.00
VImN	Volume netto	m ³	2'435.06
VImL	Volume lordo	m ³	3'234.22
AltzM	Altezza netta media	m	2.87
SprfL	Superficie lorda disperdente	m ²	1'877.43
SprfVT	Superficie lorda disperdente delle vetrate (verso l'esterno)	m ²	185.28
RpSV	Rapporto di forma - S/V	1/m	0.5805
QhTRp	Dispersione massima per trasmissione (per il calcolo del carico termico di progetto)	W	26'619
QhVEp	Dispersione massima per ventilazione (per il calcolo del carico termico di progetto)	W	6'491
Cm	Capacità termica	kJ/K	131'775.16
RicAriaNAT	Ricambi d'aria per ventilazione naturale o di riferimento	m ³ /h	730.5189
Qp	Carico termico di progetto (trasmissione + ventilazione + fattore di ripresa)	W	33'110
Qx_rete	Fabbisogno di energia elettrica prelevata dalla rete	kWh	19'598.46
QwFR_perc	Percentuale di energia da fonti rinnovabili per acqua calda sanitaria	%	87.21
QwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per acqua calda sanitaria	%	60.00
QhcwFR_perc	Percentuale di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	20.83
QhcwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	60.00
PtzPV	Potenza di picco	kW	0.00
PeIFR_Lim	Potenza elettrica limite installata da fonti rinnovabili	kW	0.00
EPhwc,nren	Indice di prestazione energetica non rinnovabile D.Lgs 199/2021	kWh/m ² anno	45.111
EPhwc_lim	Indice di prestazione energetica LIMITE D.Lgs 199/2021	kWh/m ² anno	43.4116
EPh	Indice di prestazione energetica per la climatizzazione invernale	kWh/m ² anno	0.0000
EPc	Indice di prestazione energetica per la climatizzazione estiva	kWh/m ² anno	55.7959
EPw	Indice di prestazione energetica per l'acqua calda sanitaria	kWh/m ² anno	1.0004
EPv	Indice di prestazione energetica per la ventilazione meccanica	kWh/m ² anno	0.0000
EPI	Indice di prestazione energetica per l'illuminazione artificiale	kWh/m ² anno	0.0000
EPT	Indice di prestazione energetica per il trasporto	kWh/m ² anno	0.0000
EPgl	Indice di prestazione energetica globale totale	kWh/m ² anno	56.7963
EPgl_Lim	Indice di prestazione energetica globale totale LIMITE	kWh/m ² anno	54.3731
EPh,nd	Indice di prestazione termica utile per riscaldamento	kWh/m ² anno	0.000
EPh,nd_Lim	Indice di prestazione termica LIMITE per riscaldamento	kWh/m ² anno	0.0000
EPc,nd	Indice di prestazione termica utile per raffrescamento	kWh/m ² anno	54.4678
EPc,nd_Lim	Indice di prestazione termica LIMITE per raffrescamento	kWh/m ² anno	54.1484
EtaGh	Rendimento globale medio dell'impianto di riscaldamento		0.0000
EtaGc	Rendimento globale medio dell'impianto di raffrescamento		0.9762
EtaGc_Lim	Rendimento globale medio stagionale LIMITE per raffrescamento		1.0331
EtaGw	Rendimento globale medio dell'impianto di acqua sanitaria		0.9925
EtaGw_Lim	Rendimento globale medio stagionale LIMITE per acqua calda sanitaria		0.5072
Yie	Trasmittanza termica periodica media	W/m ² K	0.6961
H'T	Coefficiente globale di scambio termico medio per trasmissione	W/m ² K	0.8285
Area H'T	Superficie per il calcolo del coefficiente di scambio termico medio	m ²	1'877.43
H'T_Lim	Coefficiente globale di scambio termico medio per trasmissione LIMITE (riscaldamento)	W/m ² K	0.63
Asol'	Area solare equivalente estiva		0.0208
Asol_Lim	Area solare equivalente estiva LIMITE		0.0300
periodo RSC	periodo riscaldamento		1 dic - 31 mar
periodo RFS	periodo raffrescamento		1 apr - 17 lug

6.2.3 Veentilation optioneering

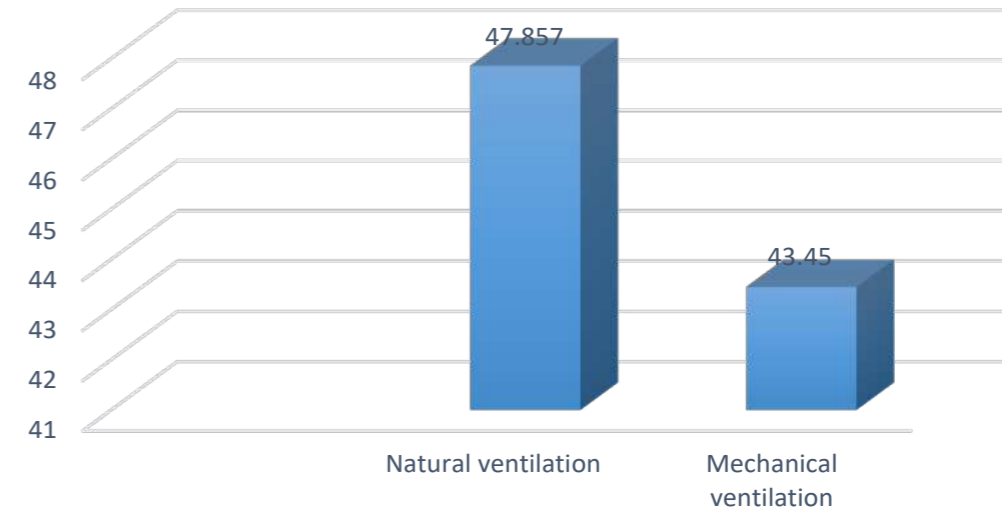
1. Natural ventilation



2. Mechanical ventilation

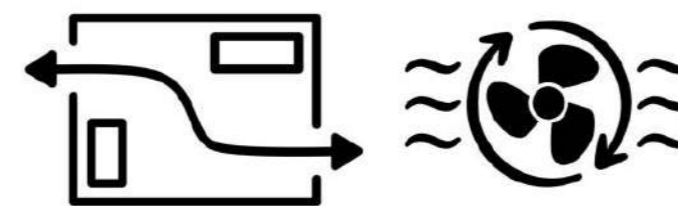


Annual consumption Kwh/m2 per year

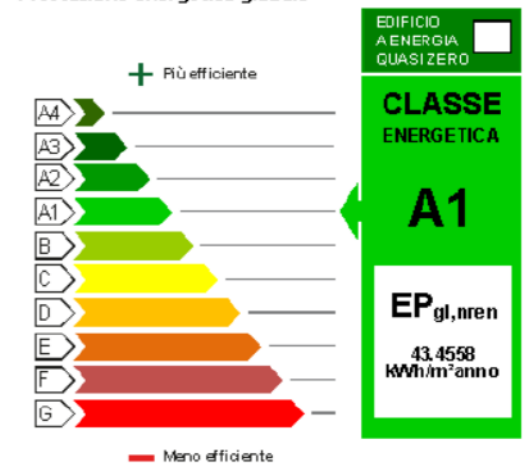


6.2.2 Analysis conclusion of Ventilation

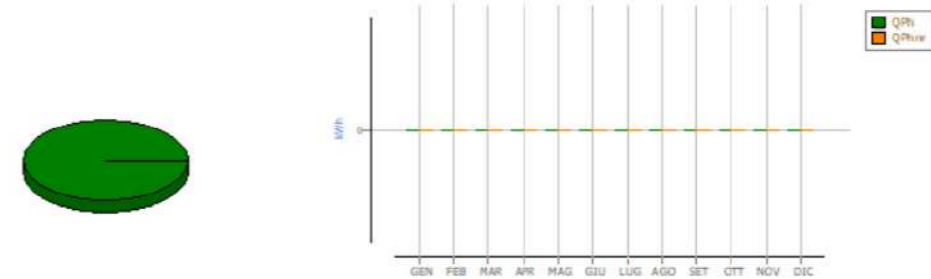
Selected - Mechanical ventilation



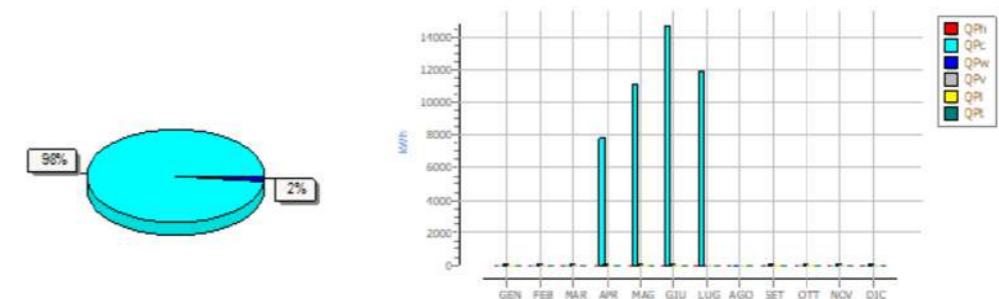
Prestazione energetica globale



FABBISOGNI DI ENERGIA PRIMARIA TOTALE RINNOVABILE E NON RINNOVABILE

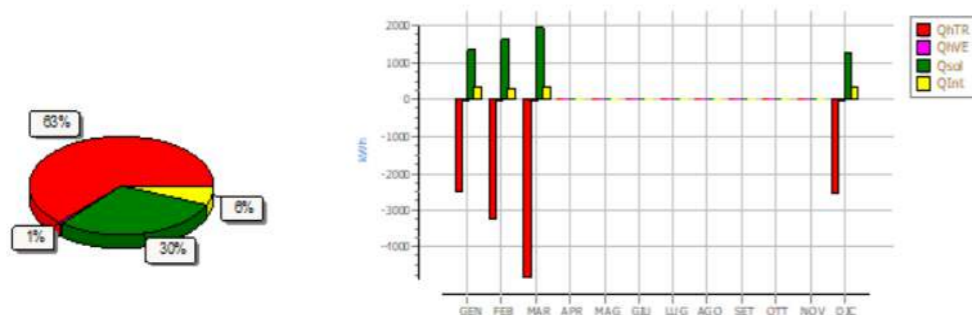


FABBISOGNI DI ENERGIA PRIMARIA PER SINGOLO SERVIZIO

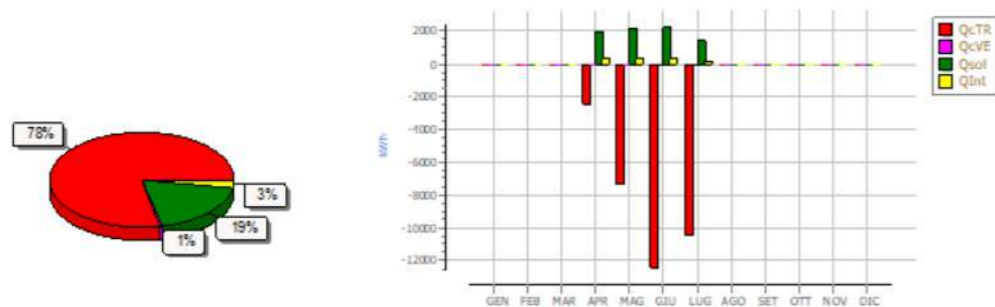


Performance of wall

FABBISOGNI DI ENERGIA PER RISCALDAMENTO

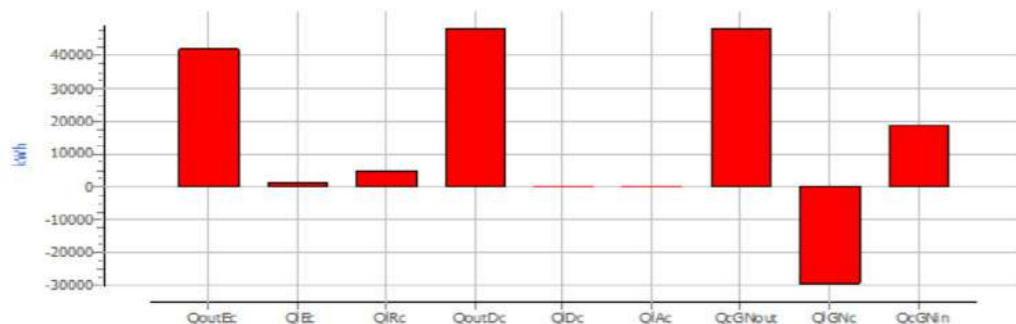


FABBISOGNI DI ENERGIA PER RAFFRESCAMENTO

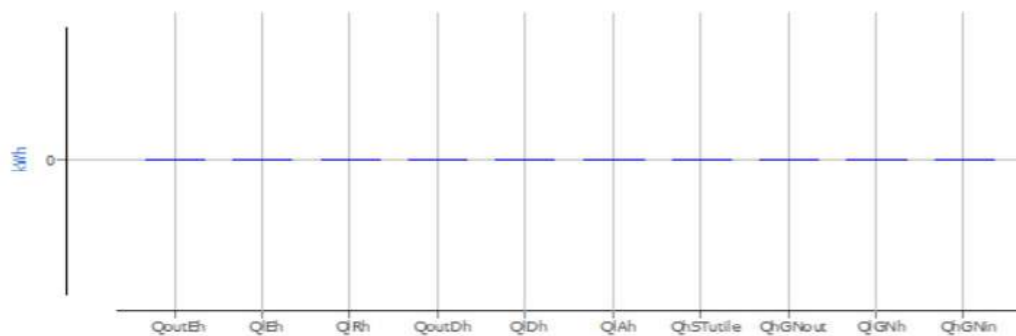


Energy required for heating and cooling

RAFFRESCAMENTO - Fabbisogni di impianto

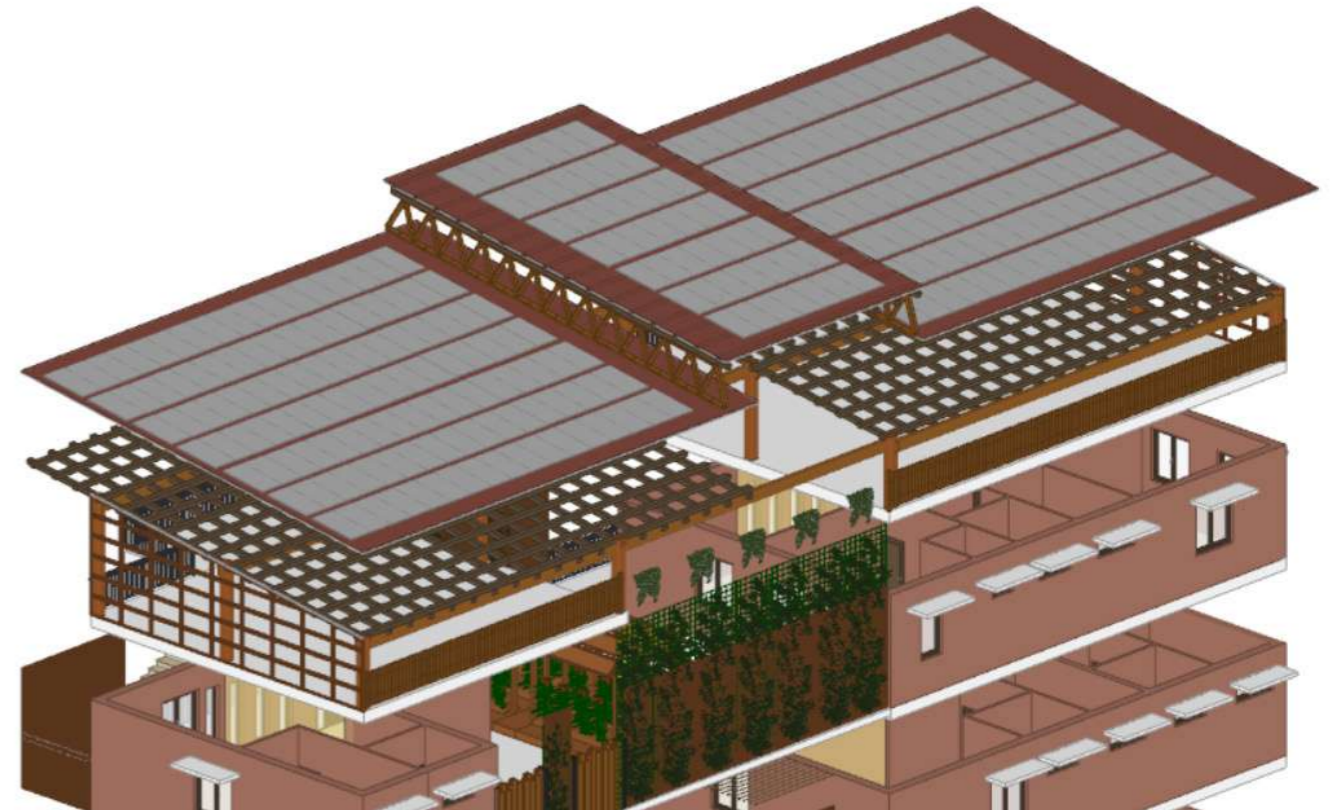
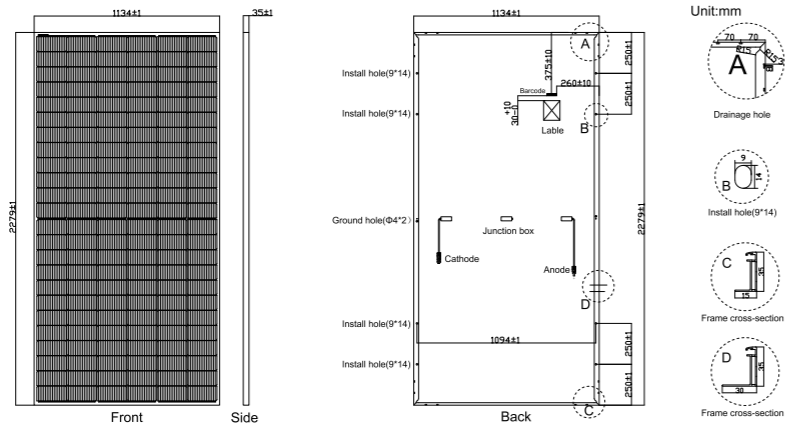


RISCALDAMENTO - Fabbisogni di impianto



Centralized HCW with natural ventilation			
Simbolo	Descrizione	Misura	Valore
Classe	Classe energetica		A1
NZEB	Edifici a energia quasi zero		NO
AreaN	Superficie netta calpestabile	m ²	847.18
AreaL	Superficie lorda	m ²	976.19
AreaN150	Superficie netta calpestabile con altezza inferiore a 1,5 m	m ²	0.00
VImN	Volume netto	m ³	2'435.06
VImL	Volume lordo	m ³	3'234.22
Altm	Altezza netta media	m	2.87
SprfL	Superficie lorda disperdente	m ²	1'877.43
SprfVT	Superficie lorda disperdente delle vetrate (verso l'esterno)	m ²	185.28
RpSV	Rapporto di forma - S/V	1/m	0.5805
QhTRp	Dispersione massima per trasmissione (per il calcolo del carico termico di progetto)	W	26'619
QhVEp	Dispersione massima per ventilazione (per il calcolo del carico termico di progetto)	W	6'491
Cm	Capacità termica	kJ/K	131'775.16
RicAriaNAT	Ricambi d'aria per ventilazione naturale o di riferimento	m ³ /h	730.5189
RicAriaMCN	Portata d'aria effettiva di immissione	m ³ /h	0.0060
Qp	Carico termico di progetto (trasmissione + ventilazione + fattore di ripresa)	W	33'110
Qx_rete	Fabbisogno di energia elettrica prelevata dalla rete	kWh	18'879.43
QwFR_perc	Percentuale di energia da fonti rinnovabili per acqua calda sanitaria	%	87.21
QwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per acqua calda sanitaria	%	60.00
QhchwFR_perc	Percentuale di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	20.88
QhchwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	60.00
PtzPV	Potenza di picco	kW	0.00
PeIFR_Lim	Potenza elettrica limite installata da fonti rinnovabili	kW	0.00
EPHwc,nren	Indice di prestazione energetica non rinnovabile D.Lgs 199/2021	kWh/m ² anno	43.456
EPHwc_lim	Indice di prestazione energetica LIMITE D.Lgs 199/2021	kWh/m ² anno	39.7855
EPH	Indice di prestazione energetica per la climatizzazione invernale	kWh/m ² anno	0.0000
EPc	Indice di prestazione energetica per la climatizzazione estiva	kWh/m ² anno	53.7420
EPw	Indice di prestazione energetica per l'acqua calda sanitaria	kWh/m ² anno	1.0004
EPv	Indice di prestazione energetica per la ventilazione meccanica	kWh/m ² anno	0.0000
EPI	Indice di prestazione energetica per l'illuminazione artificiale	kWh/m ² anno	0.0000
Ept	Indice di prestazione energetica per il trasporto	kWh/m ² anno	0.0000
EPgl	Indice di prestazione energetica globale totale	kWh/m ² anno	54.7424
EPgl_Lim	Indice di prestazione energetica globale totale LIMITE	kWh/m ² anno	49.8803
EPH,nd	Indice di prestazione termica utile per riscaldamento	kWh/m ² anno	-3.320
EPH,nd_Lim	Indice di prestazione termica LIMITE per riscaldamento	kWh/m ² anno	-3.3205
EPc,nd	Indice di prestazione termica utile per raffrescamento	kWh/m ² anno	56.2921
EPc,nd_Lim	Indice di prestazione termica LIMITE per raffrescamento	kWh/m ² anno	57.8526
EtaGh	Rendimento globale medio dell'impianto di riscaldamento		-28'130'470.5525
EtaGc	Rendimento globale medio dell'impianto di raffrescamento		1.0475
EtaGc_Lim	Rendimento globale medio stagionale LIMITE per raffrescamento		1.2072
EtaGw	Rendimento globale medio dell'impianto di acqua sanitaria		0.9925
EtaGw_Lim	Rendimento globale medio stagionale LIMITE per acqua calda sanitaria		0.5072
Yie	Trasmittanza termica periodica media	W/m ² K	0.6961
H'T	Coefficiente globale di scambio termico medio per trasmissione	W/m ² K	0.8285
Area H'T	Superficie per il calcolo del coefficiente di scambio termico medio	m ²	1'877.43
H'T_Lim	Coefficiente globale di scambio termico medio per trasmissione LIMITE (riscaldamento)	W/m ² K	0.63
Asol'	Area solare equivalente estiva		0.0208
Asol_Lim	Area solare equivalente estiva LIMITE		0.0300
periodo RSC	periodo riscaldamento		1 dic - 31 mar

6.2.4. Instalation of PV panels



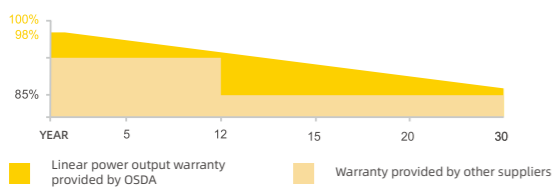
SPECIFICATIONS

Item No.	ODA570-36V-MH	ODA575-36V-MH	ODA580-36V-MH
Nominal peak power (W)	570.00	575.00	580.00
Voltage at nominal peak power (V)	42.07	42.22	42.37
Current at nominal peak power (V)	13.55	13.62	13.69
Open-circuit voltage(V)	50.74±3%	50.88±3%	51.06±3%
Short-circuit current(A)	14.31±3%	14.39±3%	14.46±3%
Module efficiency(%)	22.06	22.25	22.45
Power tolerance		0~+3%	
Pmax temperature coefficient		-0.300%	
Voc Temperature Coefficient		-0.250%	
Isc Temperature Coefficient		+0.046%	
NOCT Nominal Operating Cell Temperature		47±2	
Operating and Storage Temperature		-40~+85	
Standard test condition(STC)		1000W/m ² , AM1.5;25+/-2°C	

MECHANICAL CHARACTERISTICS AND PACKING

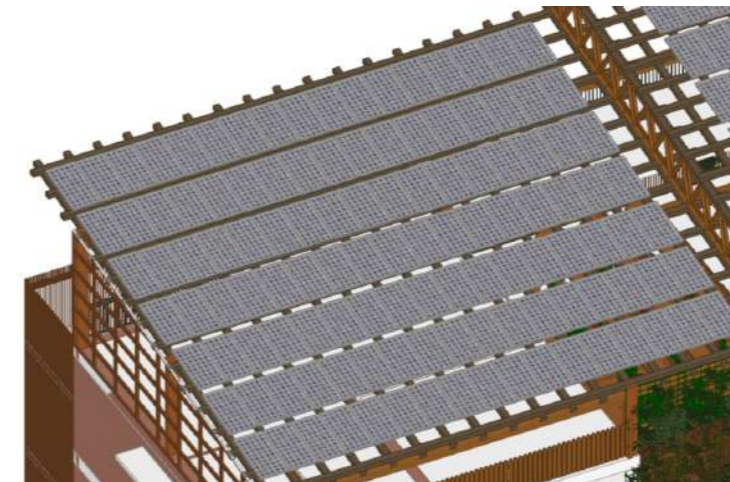
Solar cell type	182*91 (Mono/Black Mono)
No. of cells	144 (12*12)
Dimension(mm)	2279*1134*35
Weight	28.40
Front glass(mm)	3.2mm high transmission, low iron, tempered glass
Frame	Silver/Black anodized aluminium profile
Maximum system voltage (V)	1500
Maximum Series Fuse Rating Current (A)	25
Junction box	IP67 /IP68 3diodes
Output cable	4mm*cable*55cm (Including MC4 connector)
Max wind load/snow load	2400Pa/5400Pa
40HQ container	20Packages/620pcs

Warranty



12 YEAR 12 years warranty on product material and workmanship

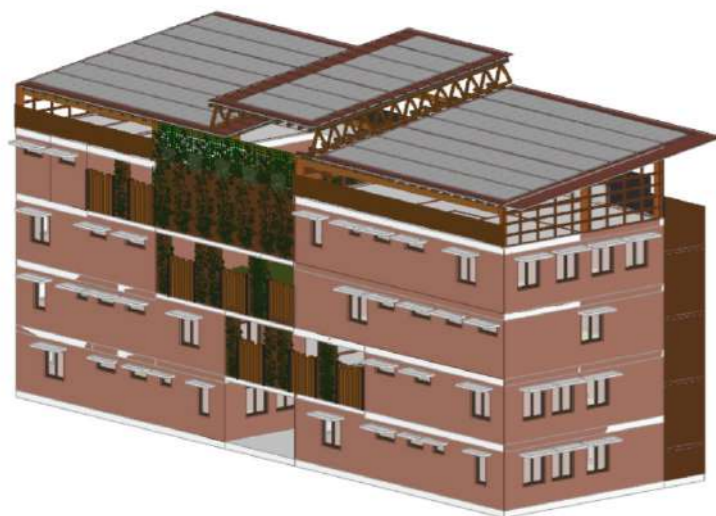
30 YEAR 30 years warranty on linear power output



SOLARE PANNELS CALCULATION

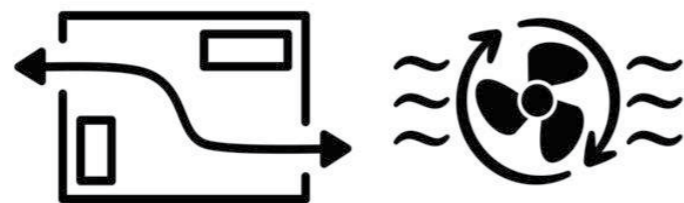
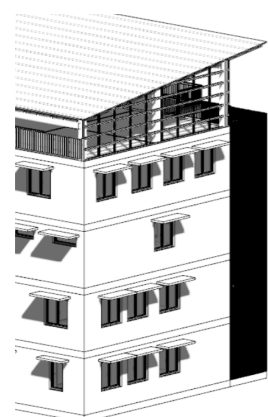
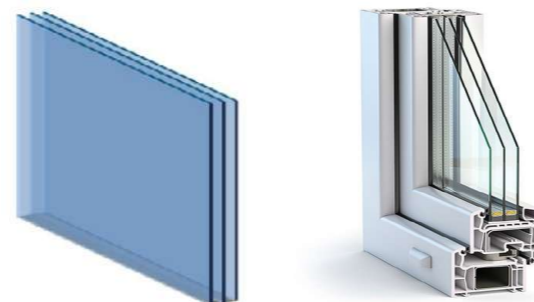
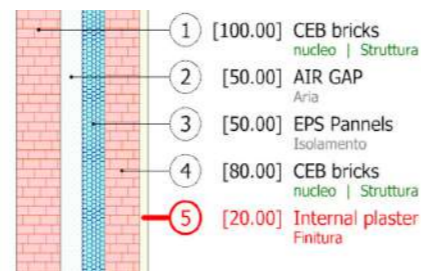
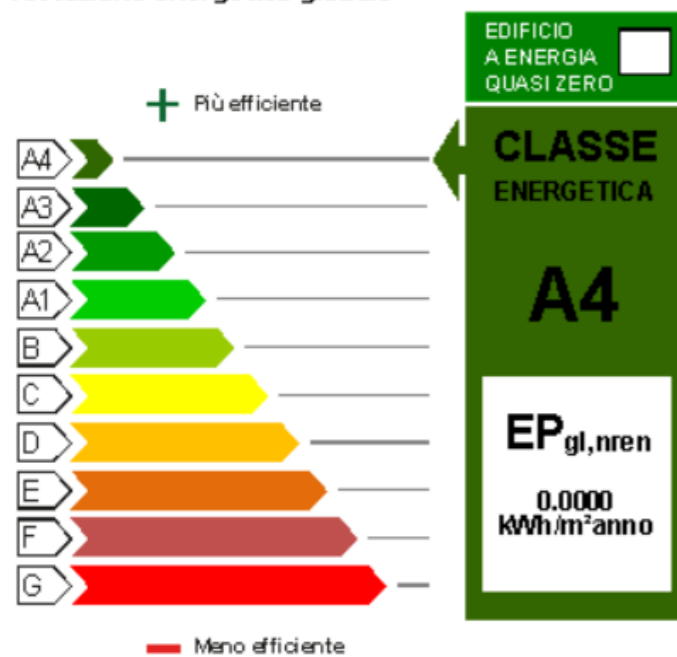
AVAILABLE ROOF AREA	430 m2
PANNEL AREA	2.57 m2
PANNEL OUTPUT	570 W
NO OF PANNELS	170
TOTAL OUTPUT ESTIMATED	97 kW

Net zero building



ANNUAL CONSUMPTION
0.0 Kwh/m2
per year

Prestazione energetica globale



Anual energy produced from PV panels

Fotovoltaico			
Simbolo	Descrizione	Misura	Valore
Falda: NORD_OVEST			
PtzPV	Potenza di picco	kW	95.70
AreaN	Area netta dei moduli	m²	429.00
Incl	Inclinazione	°	15
Annuale			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	1'433.72
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	96'044.60
gennaio			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	61.38
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	4'111.72
febbraio			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	77.59
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	5'197.78
marzo			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	110.51
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	7'402.91
aprile			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	134.73
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	9'025.43
maggio			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	170.53
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	11'423.87
giugno			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	174.68
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	11'701.83
luglio			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	187.52
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	12'561.99
agosto			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	163.05
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	10'922.47
settembre			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	125.00
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	8'373.81
ottobre			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	98.45
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	6'595.20
novembre			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	73.55
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	4'927.24
dicembre			
IrdzPV	Irradiazione mensile incidente sui moduli	kWh/m²	56.73
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	3'800.35

Centralized HCW with natural ventilation			
Simbolo	Descrizione	Misura	Valore
Classe	Classe energetica		A4
NZEB	Edifici a energia quasi zero		NO
AreaN	Superficie netta calpestabile	m ²	847.18
AreaL	Superficie lorda	m ²	976.19
AreaN150	Superficie netta calpestabile con altezza inferiore a 1,5 m	m ²	0.00
VImN	Volume netto	m ³	2'435.06
VImL	Volume lordo	m ³	3'234.22
AltzM	Altezza netta media	m	2.87
SprfL	Superficie lorda disperdente	m ²	1'877.43
SprfVT	Superficie lorda disperdente delle vetrate (verso l'esterno)	m ²	185.28
RpSV	Rapporto di forma - S/V	1/m	0.5805
QhTRp	Dispersione massima per trasmissione (per il calcolo del carico termico di progetto)	W	26'619
QhVEp	Dispersione massima per ventilazione (per il calcolo del carico termico di progetto)	W	6'491
Cm	Capacità termica	kJ/K	131'775.16
RicAriaNAT	Ricambi d'aria per ventilazione naturale o di riferimento	m ³ /h	730.5189
RicAriaMCN	Portata d'aria effettiva di immissione	m ³ /h	0.0060
Qp	Carico termico di progetto (trasmissione + ventilazione + fattore di ripresa)	W	33'110
Qx_rete	Fabbisogno di energia elettrica prelevata dalla rete	kWh	0.00
QwFR_perc	Percentuale di energia da fonti rinnovabili per acqua calda sanitaria	%	100.00
QwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per acqua calda sanitaria	%	60.00
QhcwFR_perc	Percentuale di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	100.00
QhcwFR_Lim	Percentuale LIMITE di energia da fonti rinnovabili per riscaldamento, raffrescamento e acqua calda sanitaria	%	60.00
PtzPV	Potenza di picco	kW	95.70
PeIFR_Lim	Potenza elettrica limite installata da fonti rinnovabili	kW	21.50
EPh	Indice di prestazione energetica per la climatizzazione invernale	kWh/m ² anno	0.0000
EPc	Indice di prestazione energetica per la climatizzazione estiva	kWh/m ² anno	22.2096
EPw	Indice di prestazione energetica per l'acqua calda sanitaria	kWh/m ² anno	0.8902
EPv	Indice di prestazione energetica per la ventilazione meccanica	kWh/m ² anno	0.0000
EPI	Indice di prestazione energetica per l'illuminazione artificiale	kWh/m ² anno	0.0000
EPT	Indice di prestazione energetica per il trasporto	kWh/m ² anno	0.0000
EPgl	Indice di prestazione energetica globale totale	kWh/m ² anno	23.0999
EPgl_Lim	Indice di prestazione energetica globale totale LIMITE	kWh/m ² anno	82.7606
EPh,nd	Indice di prestazione termica utile per riscaldamento	kWh/m ² anno	-3.320
EPh,nd_Lim	Indice di prestazione termica LIMITE per riscaldamento	kWh/m ² anno	-3.3205
EPc,nd	Indice di prestazione termica utile per raffrescamento	kWh/m ² anno	56.3016
EPc,nd_Lim	Indice di prestazione termica LIMITE per raffrescamento	kWh/m ² anno	57.8573
EtaGh	Rendimento globale medio dell'impianto di riscaldamento		-28'130'470.5526
EtaGc	Rendimento globale medio dell'impianto di raffrescamento		2.5350
EtaGc_Lim	Rendimento globale medio stagionale LIMITE per raffrescamento		1.1652
EtaGw	Rendimento globale medio dell'impianto di acqua sanitaria		1.1154
EtaGw_Lim	Rendimento globale medio stagionale LIMITE per acqua calda sanitaria		0.0300
Yie	Trasmittanza termica periodica media	W/m ² K	0.6961
H'T	Coefficiente globale di scambio termico medio per trasmissione	W/m ² K	0.8285
Area H'T	Superficie per il calcolo del coefficiente di scambio termico medio	m ²	1'877.43
H'T_Lim	Coefficiente globale di scambio termico medio per trasmissione LIMITE (riscaldamento)	W/m ² K	0.63
Asol'	Area solare equivalente estiva		0.0208
Asol_Lim	Area solare equivalente estiva LIMITE		0.0300
periodo RSC	periodo riscaldamento		1 dic - 31 mar
periodo RFS	periodo raffrescamento		1 apr - 19 lug
Fotovoltaico			
MillesimiPV	Quota millesimale del fotovoltaico	-	1'000
QxPVout	Energia elettrica prodotta dai moduli fotovoltaici	kWh	96'044.60
QeIPVutile	Energia elettrica totale prodotta dai moduli fotovoltaici e utilizzata dai servizi energetici	kWh	18'881.28

7. Conclusion.

Using the IMM identification of the problems was effective due to its segment analysis, after the in-depth analysis was carried out the problems were clearly understood. It was evident that the area is facing typical informal settlements problem and they were lacking in the basic facilities to achieve the livelihood of the people. The major issues like costal floods and storm surge affected regions were identified using the Qgis software. And the modern day problems like urban ground use, walkability and urban flow had a major impact on the city restricting it from achieving the sustainable development goals.

The Restructuring of the Dakar was carried along with the 2035 goals of the area planned by the municipality of Dakar.

With relocation of the industrial area, we had a large urban space for adding the new functions which helped us in combining the already existing informal settlements with the new sustainable adaptation. The retrofitting was carried out in the field of ground use, walkability and urban flow to improve the area, and the solution for costal floods and storm water surge affected areas was provided.

For the upcoming urban community, the new NZEb building design was proposed which includes sustainable building design techniques, with passive and design strategies. At first the effort of reducing the energy consumption was carried out using the energy optimization process and the pv Pannels was added to neutralize the energy consumption by producing the energy with renewable source

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