NOVA SCHOOL OF SCIENCE & TECHNOLOGY

DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING

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BSc in Sciences of Environmental Engineering

CLIMATE CHANGE ADAPTATION STRATEGIES AT A LOCAL SCALE: THE PORTUGUESE CASE STUDY

MASTER IN ENVIRONMENTAL ENGINEERING

PROFILE OF ENVIRONMENTAL SYSTEMS ENGINEERING

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ABSTRACT

Climate change adaptation has proven to be more effective on a local scale, contributing to a bottom-up approach to the problems related to the changing climate.

Portugal has approximately 2 000 km of coastal line, with 75% of the population living along the coast. Therefore, this dissertation had the main objective of understanding adaptation processes at a local scale, using the Portuguese coastal municipalities as a case study. To achieve this goal climate change adaptation strategies and plans were analysed, a questionnaire to coastal municipalities was prepared, and the existence of measures rooted on nature-based solutions, green infrastructures, and community-based adaptation was adopted as a variable to study.

The main conclusion from this research is that 86,7% of thein municipalities that answered the questionnaire have climate change adaptation strategies implemented or in development. Moreover, it was possible to conclude that 90% of the municipalities are familiar with the concept of nature-based solutions and all the municipalities with adaptation strategies include green infrastructure. However, it was also possible to infer that community-based adaptation is a concept that most municipalities do not know or undervalue.

Keywords: coastal areas; community-based adaptation; nature-based solutions; green infrastructure.

RESUMO

Portugal tem aproximadamente 2 000 km de linha costeira, sendo que cerca de 75% da população habita no litoral. Deste modo, o objetivo principal desta dissertação foi perceber o processo de adaptação às alterações climáticas ao nível local, utilizando como caso de estudo os municípios costeiros de Portugal. Para alcançar este objetivo, analisaram-se documentos como estratégias e planos de adaptação municipais, e foi elaborado um questionário que foi enviado para todos os municípios costeiros portugueses - onde a existência da medidas e ações de adaptação baseadas em soluções de base natural, infraestrutura verde e comunidades de adaptação foi adotada como variável.

A conclusão principal desta dissertação foi que 86,7% dos municípios inquiridos têm estratégias de adaptação às alterações climáticas implementadas ou em curso. Também a maioria dos municípios (aproximadamente 90%) está familiarizada com soluções de base natural e todos os municípios com uma estratégia de adaptação incluíram infraestrutura verde. Contudo, foi também possível concluir que o conceito de comunidades de adaptação não é conhecido pelos municípios, ou então é desvalorizado pelos mesmos.

Palavras chave: zonas costeiras; comunidades de adaptação; soluções de base natural; infraestrutura verde.

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ACRONYMS

CAP	Common Agricultural Policy.
CBA	Community-based Adaptation.
GFP	Common Fisheries Policy.
ENAAC	Estratégia Nacional de Adaptação às Alterações Climáticas (Portuguese National Strategy for Climate Change Adaptation).
EU	European Union.
GI	Green Infrastructure.
GDP	Gross Domestic Product.
IGT	Instrumentos de Gestão Territorial (Territory Management Instruments).
NBS	Nature-based Solutions.
NUTS	Nomenclatura das Unidades Territoriais para Fins Estatísticos (Nomenclature of Territorial Units for Statistical Purposes).
PNEC	Plano Nacional de Energia e Clima (National Plan of Energy and Climate).
PO SEUR	Programa Operacional Sustentabilidade e Eficiência no Uso de Recursos (Operation Programme for Sustainability and Efficient Use of Resources).

1

INTRODUCTION

1.1 Framework

In the last few decades, climate change has become a major topic of discussion all around the world. According to the Intergovernmental Panel on Climate Change (IPCC) (2021), climate change represents the natural or human-induced changes on climate, that can persist for an extended period and alters the composition of the atmosphere. Some examples of climate change include the increasing sea level, and more frequent extreme weather events (IPCC, 2022).

This phenomenon, which has become more severe since the 1950s, as a consequence of anthropological activity, has led to major changes in a wide range of economic activities, due to the long-term effect climate change will have on human lives and well-being, derived from the drastic changes in ecosystems' patterns and processes (Hoegh-Guldberg et al., 2018; Loucks, 2021; Teixeira et al., 2022).

1.1.1 Coastal areas

The coastal zone is the interface between the land and ocean, and as a result, is an extremely dynamic and sensitive zone. The sensitive characteristics of coastal areas derive from reactions to anthropogenic and natural inputs, with its main objective being the balance of the forces that act on the coast (Carmo, 2018; Martins et al., 2004; Santos et al., 2020).

Therefore, the processes that occur in coastal systems depend on the following (Martins et al., 2004):

• Intrinsic characteristics, namely: topography, sediments attributes, and physical and chemical characteristics of the water body;

• Outside inputs, such as meteorological forces, geodynamic forces, and human activity;

• Contribution of soluble material and other sediments.

In 2017, nearly 2,4 billion people, about 40 percent of the world's population, lived within 100 km of the coast, making these regions densely populated areas. Additionally, 600 million people lived

in coastal areas that are less than 10 meters above sea level, being directly exposed to the effects of sea level rise (United Nations, 2017).

Coastal communities and ecosystems are more vulnerable to climate change and its impacts on physical, biological, and human systems (Nelson Azevedo Pereira et al., 2022). This can be reflected specifically in more frequent extreme events, such as (de Lima et al., 2022; José Carlos Ferreira et al., 2021; Schleyer-Lindenmann et al., 2022):

- Sea level rise;
- Storm surges:
- Sea flooding;
- Coastal erosion;
- Rainfall patterns;
- Higher ocean temperature;
- Changes in the water chemical composition.

Furthermore, these effects can manifest in different ways, depending on the geographic location and the demographic characteristics of the area, particularly the density and location of urban centers and the social attributes of the community (de Lima et al., 2022).

Coastal ecosystems provide numerous services at local and urban scale, which contributes to their high impact on the economy and well-being of the population. Their overall value, however, is similarly felt at a global scale, for the following factors (Oliveira et al., 2022):

- Control of the climate:
- Production of oxygen;
- Production of food;
- Navigation;
- Recreation;
- Stormwater protection;
- Provision of energy from waves and offshore wind platforms.

Portugal, as the furthest country in the western part of Europe, is composed of approximately 2 000 km of coastal line, with 987 km of it being on its continental territory.

In addition, 75% of the Portuguese population lives on the coast. This area also generates approximately 80% of the Portuguese Gross Domestic Product (GDP), which proves its importance on a national level (Agência Portuguesa do Ambiente, 2017; F. Santos et al., 2014). The main economic activities that contribute to the high percentage of GDP are the fisheries, aquaculture, tourism and coastal leisure, and port activity (Agência Portuguesa do Ambiente, 2017).

Due to the amount of population that lives in the coastal area of Portugal and, consequently, its relationship with the activities described, there are more external pressures that leave the coast vulnerable to extreme events caused by climate change.

Additionally, the growing urbanization resultant from the housing crisis in Portugal, also contributes to the vulnerability of coastal zones, because of the expanding land artificialization. Land artificialization impacts the coastal line through the loss of dune systems and habitats, which has been prevalent in more recent years (Pires et al., 2012). Moreover, the lack of planning and management of the coastal areas of Portugal, as well as the addition of pollution and erosion, contribute to the vulnerability of these areas (Freire et al., 2009).

The Portuguese coastal line is a sandy shore, with some cliffs and rocky areas. Along the west coast of continental Portugal, the waves are mainly highly energetic, ranging between the 2 and 3 meters. However, during storms the height of the waves can reach 8 meters for several days. The frequency of storms is expected to increase, as a result of climate change and with the aggravation of the increasing urban occupation of these areas, which has enhanced the degradation of natural coastal ecosystems (Rosa-Santos et al., 2009; Carmo, 2018). Furthermore, the southern coast has a milder wave climate, with the more relevant wave height being 4 meters (Carmo, 2018).

Since the effects of climate change and global warming have become more severe in the last decade, many countries have decided to implement national and local strategies for climate change adaptation, to better prepare themselves for the adverse consequences that can be projected for each area.

1.1.2 The concept of Climate Change Adaptation

Considering the rising concerns regarding climate change amid the last decade of the 20th century, there has been some debate over the concept of adaptation and mitigation (Fankhauser, 2016).

Climate change adaptation, according to the 6th Assessment Report of the IPCC, is defined as "the process of adjustment to actual or expected climate and its effects in order to moderate harm or take advantage of beneficial opportunities (…)". This is the definition that is more widely accepted by researchers. In addition, climate change mitigation can be defined, by the same document, as the "human intervention to reduce emissions or enhance the sinks of greenhouse gases" (IPCC, 2021).

However, Smit and Pilifosova (2001) have defined adaptation as an adjustment in ecological, social, or economic systems to respond to anticipated climatic scenarios as well as their effects or impacts. The authors explored the concept, referring to the changes that might arise because of adaptation to climate change. These changes can occur in processes, practices, or structures.

The concept of adaptation can also be divided into more specific terms, according to the 4th IPCC Assessment Report (IPCC, 2007). These specific terms are as it follows:

• Anticipatory adaptation: adaptation that takes place before the climate change impacts are observed;

• Autonomous adaptation: adaptation that is triggered by ecological changes in nature and by market or welfare changes in human systems;

• Planned adaptation: adaptation that is the result of a deliberate policy decision.

It is also important to note that, according to Schmidt-Thomé (2017), the different definitions of this concept also "reflect the different contexts in which the term of climate change adaptation is used."

1.1.3 Adaptation in Portugal

Portugal has had a National Strategy for Climate Change Adaptation (ENAAC) since 2010, introduced by resolution no. 24/2010 of the Council of Ministers, of Abril 1st 2010.

ENAAC 2010-2013 also defined strategic economic sectors, which were key to the successful implementation of the strategy: urban planning, water resources, security of people and goods, health, energy and industry, biodiversity, agriculture, forests and fisheries, tourism, and the coastal area of Portugal. The resolution defined a working group to each sector, to execute guidelines and adaptation measures.

Regarding this strategy, an assessment was made in 2013, that presented the strengths and weaknesses of the implementation of the ENAAC, both on a general and sectorial level. One of the main conclusions the evaluation noted was the need to involve local stakeholders in the process of adaptation in the municipalities (Agência Portuguesa do Ambiente, 2013). This document also presented some recommendations for the following steps of the ENAAC, and individual reports for the working groups of the key sectors.

In 2015, the strategy was renewed, originating ENAAC 2020, which was supposed to run until 2020, but was extended to 2025 due to the approval of the National Plan of Energy and Climate (PNEC 2030). According to resolution no. 53/2020 of the Council of Ministers, of July 10th 2020, this strategy is also accompanied by an action plan, which defines concrete lines of action for adaptation to climate change.

ENAAC 2020 was approved in resolution no. 56/2015 of the Council of Ministers, of July 30th 2015, renewing ENAAC 2010-2013 and with the following main objectives:

• Better the knowledge level about climate change, by updating and developing information about climate change, while assessing its risks, impacts, and consequences. This material must be exposed by communication platforms and awareness campaigns;

• Implement adaptation measures, through two options: consulting stakeholders from the sectorial working groups and through the collection of information regarding best practices, both on a national and international level (specially south European countries);

• Promote the integration of adaptation in sectorial policies.

The strategy includes six thematic areas, that were selected through the knowledge obtained in the ENAAC 2010-2013, which are seen in most activity sectors. The areas are research and

development (R&D), financing, international cooperation, communication, territory planning and water resources management.

Moreover, the nine updated priority sectors are the basis of ENAAC 2020, and are as follow:

- Agriculture;
- Biodiversity;
- Economics;
- Energy;
- Forests;
- Health;
- Security of people and goods;
- Transport and communications;
- Coastal areas.

For the mentioned sectors, and as it happened on the first ENAAC, it was defined a working group by the competent public authority.

According to this strategy, most scenarios for 2080-2100 for Portugal, project the following climate change effects:

- A general increase of the average yearly temperature in every region of the country;
- An increase of until 3ºC for the highest temperature in summer, for the coastal areas, and an increase of until 7ºC for the countryside. For the Madeira and Azores islands it is projected an increase between 1ºC and 3ºC;
- A reduction in frost days and an increase in hotter days and tropical nights;
- An increase in forest fires risk, change of land use, and implications on water resources;
- Significant change in the precipitation cycle, which may include a reduction of precipitation during spring, summer, and autumn in mainland Portugal. There is also a possibility of a decrease in yearly precipitation and an increase in winter, due to the rise in the number of days with stronger rain.

Due to the mentioned projections, as well as other factors, the Portuguese Government presented the new Portuguese Climate Law, of 31st December 2021. This law establishes several objectives related to the environment and the climate emergency, among them the need to "reinforce resilience and the national capacity to adapt to climate change".

Climate change causes more relevant impacts at a local scale and as a result there has been a continuous effort to shift policies from national and regional level to the local one (Baker et al., 2012). In view of the new Climate Law, each Portuguese municipality must have adaptation strategies and action plans implemented by the end of 2023.

As mentioned earlier in the chapter, for the present dissertation, ClimAdaPT.Local assumes particular relevance. This network was created in 2016 and its main goal is to encourage local climate change adaptation in Portugal, through the following steps (ClimAdaPT, 2016):

- Facilitate experience exchange between municipalities;

• Promote knowledge exchange between municipalities, universities and research centers, as well as local companies;

• Promote international cooperation relations;

• Promote the empowerment of municipalities.

ClimAdaPT chose partner-municipalities strategically, having one municipality per intermunicipal community (a community with several municipalities, in the same geographic area). According to Mourato et al. (2018), this was arranged "in the hope that neighbouring municipalities would engage a copycat process". This choice of partner municipalities also allowed the network to have a different range of municipalities, which allowed the results to be representative of different geographical areas.

While this network was an innovative concept for the Portuguese adaptation landscape, tackling 26 municipalities with different configurations and with a very diverse group of stakeholders, it is also important to note that despite the positive things ClimAdaPT has done, it does not guarantee long-term community support. This could happen because stakeholders should have a greater sense of ownership of the entire adaptation process, not only in some steps (Mourato et al., 2018).

1.1.4 Climate change adaptation options

Due to the more frequent effects and consequences of extreme phenomenon's caused by climate change, there has been a focus on implementing local scale climate change adaptation actions that help reduce the vulnerability of the receiving environment (Holden et. al, 2022).

These interventions make up the concept of nature-based solutions (NBS), which can be defined as solutions that are inspired and supported by nature and are cost-effective, while simultaneously providing environmental, social, and economic benefits and building resilience, and bringing more natural features into urban spaces through resource efficient and systemic interventions (Ascenso et al., 2021).

Moreover, NBS are interventions that are supported by nature, which can be evolving and changing. This implies the active management of these systems, to ensure that their services are provided (Fernandes & Guiomar, 2018).

Nature-based solutions can also be considered as an umbrella concept, that includes ecosystem restoration approaches, issue-specific ecosystem-related approaches, infrastructure-related approaches, ecosystem-based management approaches, and ecosystem protection approaches (Al Sayah et al., 2022).

This research will focus on infrastructure-related approaches, that include natural and green infrastructures.

NBS present several benefits, mainly in the regulation of ecosystem services – namely in the improvement of air, water and soil quality, climate regulation, and carbon sequestration. Other

ecological advantages include noise attenuation through vegetation or the reconnection of habitats (Ommer et al., 2022).

Furthermore, some more advantages can be found in NBS, through their benefits to society, such as new jobs and businesses opportunities, tourism, recreation, health and well-being, and energy (Ommer et al., 2022).

Some examples of NBS include green building–integrated systems and technologies - green roofs and walls (Basu et al., 2021; Pineda-Martos & Calheiros, 2021), green parks ((Sekulova & Anguelovski, 2017), permeable pavements, and stormwater ponds (Ascenso et al., 2021; Le Coent et al., 2021)

Green infrastructure (GI) is a relatively recent concept, originated in the 1990s, associated with green spaces. One of its different definitions is that it is an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human beings. However, GI have both an ecological and engineering approach to it, which makes it a priority for the decision makers (Monteiro et al., 2022; Washbourne, 2022).

Additionally, GI can aid in adaptation to climate change on three main aspects (Sussams et al., 2015):

• Urban heat island effect – by cooling urban spaces, especially in population dense location;

• Flood risk management – through green cover that can reduce water runoff;

• Ecosystem resilience – by preventing ecosystem fragmentation while increasing the number of protected areas and maintaining habitat connectivity.

Furthermore, the more widely accepted definition of GI comes from the European Commission (2013) and can be defined as "as strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings". As such, GI is able to respond to a wide range of environmental, social and economic challenges, including climate change adaptation (Monteiro et. al, 2022).

As mentioned, GI can have an ecological approach, for instance in the form of a natural system composed of national parks, parkways, forests, community gardens, green corridors, among others (Nieuwenhuijsen, 2020). Additionally, in more urban spaces, the concept of urban green infrastructure has become a more specific study of GI (Liberalesso et al., 2020).

GI interventions can include the integration of vegetation in buildings, both in its rooftops (green roofs) and facades (green walls), which have several benefits, namely stormwater management, urban noise reduction, urban heat island mitigation, air quality improvement, carbon storage increase, reduce alteration on precipitation patterns and flooding risk, increase in thermal performance of buildings, and inclusion of biodiversity in urban spaces (Ferreira et al., 2021; Liberalesso et al., 2020;

Razzaghi Asl & Pearsall, 2022). According to Davies and Lafforteza (2017), in urban environments GI can also include natural systems and man-made infrastructure, such as green corridors, parks, forests and green routes.

Additionally, various authors have presented GI has having key characteristics: multifunctionality, ecosystem services, ecological networks, connectivity, multiscale, integration, diversity, applicability, governance, and continuity (Monteiro et al., 2020; Valeri et al., 2022).

The community-based adaptation (CBA) concept has evolved in recent years, due to the more frequent impacts of climate change, especially in coastal communities, and namely sea level rise. These accumulated effects and consequences have become the drive needed for the development in community-based approaches in terms of climate change adaptation (Mcnamara & Buggy, 2016; Tan Phong et al., 2022).

CBA tends to happen in local communities that are vulnerable to the impacts of climate change, by identifying, assisting, and implementing activities that will help strengthen the adaptative capacity of these populations. CBA is a bottom-up approach to climate change adaptation that aims to enhance adaptive capacity to climate change. As such, the activities mentioned are usually related to participatory processes, connecting local stakeholders and the local communities in the reduction of risk associated with the rising effects of climate change (Ayers & Forsyth, 2009; Duus & Montag, 2022)

Since CBA is also a place-based approach, the planning process for the communities must consider the social and ecological dynamics and priorities. According to Basel et. al (2020) the integration of the CBA process "is achieved through a high level of trust and community engagement and input, over a long duration to establish meaningful relationships and understand community priorities and drivers".

Moreover, CBA can also be cost-effective - through the knowledge and experiences of locals, the communities might have some insight on how they have dealt with climate change effects and can identify the problems that result from them (Jarillo & Barnett, 2021). As mentioned, this process tends to happen in places that are not only vulnerable themselves but also where vulnerable populations live. Therefore, CBA is also based on human rights approaches (Reid, 2016).

Nevertheless, this process is not without criticism. One recurrent criticism of CBA is that there is a need to make the process more relevant to risks and policies outside of communities, that is in a bigger scale – upscaling. Another criticism is that CBA's techniques can be difficult to replicate, due to their adaptation to the specifics of the community they are applied to. Additionally, there are concerns about how to make this process a mainstream approach, in a way that makes decision makers adapt it through policies (Forsyth, 2013; Jarillo & Barnett, 2021).

Through the consultation of the Portuguese climate change adaptation strategies, it was possible to verify success cases regarding the inclusion of the local community in the elaboration of the document. The two documents that stood out the most considering this particular aspect were the

Lisbon Metropolitan Area Climate Change Adaptation Plan and the Arrábida Local Plan for Climate Change Adaptation.

1.2 Scope and Objectives

The new Portuguese Climate Law, of 31st December 2021, establishes several objectives related to the environment and the climate emergency, among them the need to "reinforce resilience and the national capacity to adapt to climate change". In face of this legislation, the Portuguese municipalities must have adaptation strategies and action plans implemented by the end of 2023.

As such, the present dissertation intends to analyse the progress in the elaboration and execution of adaptation to climate change strategies by the coastal municipalities of Portugal, which has not been done before. Considering the Portuguese Climate Law, it is important to track the progress made by municipalities regarding climate change adaptation strategies.

This dissertation will also focus on the use of nature-based solutions, green infrastructure, and community-based adaptation within the mentioned strategies.

The main objectives of the dissertation are as follows:

- Analyse the readiness of the Portuguese coastal municipalities regarding adaptation to climate change;
- Grasp the inclusion of nature-based solutions, such as green infrastructure, in the adaptation strategies of each municipality;
- Understand the inclusion of the community in the process of adaptation to climate change for the municipality;
- Draw conclusions and recommendations to a broader scale, based on the results of the Portuguese case study.

In order to achieve the objectives proposed for the dissertation, a documental analysis was made, as well as a questionnaire to coastal municipalities in Portugal.

The documental analysis consisted of the consultation of municipalities' documents regarding climate change adaptation, specifically strategies and action plans.

To obtain these documents, the author browsed the municipalities' websites as well as the internet. The municipalities' websites were difficult to browse because most of them do not update the documents regarding the municipality and some of the websites are not well organized, which difficulted the process of consultation.

When the municipalities did not have the documents in their website, the next step was to browse Google for a wider search, which led to results in some cases. After the broader research was finished and if there was no result, the search for the documents was stopped.

The questionnaire to the municipalities was introduced by a small text that contextualized the theme. The questionnaire itself consisted of the following sections: general data, the inclusion of NBS and GI, and the inclusion of CBA in the strategies.

The first section, the general data section, included a question about the existence of a climate change adaptation strategy for the municipality. If the municipalities answered they didn't have a strategy, a question about the motive for such was presented with several options to choose from, as well as a free-text field. In case the municipalities answered they had a strategy, the questionnaire would progress to other strategy-related questions, such as the year of the strategy, the scale, and if the strategy is being implemented.

The second section, which was compromised of questions related to both NBS and GI, included a main question for each adaptation option, asking if the strategy included these concepts. If the municipalities answered they did, several options were presented for the municipalities to choose from, as well as a free-text field. In case the municipalities selected they didn't include these adaptation options question about the motive for such was presented with several options to choose from, as well as a free-text field.

The final section, related to CBA, also followed the same structure as the second section. Both sections had a short text that presented the concepts at study superficially.

This questionnaire was sent from the author's institution e-mail address to the municipality's e-mail addresses that were available on the respective websites. Some municipalities had a full listing of e-mail addresses of their departments, while others only provided their general address.

As such, when possible, the questionnaire was sent to the planning, environmental and urbanism departments. In other cases, due to past partnerships between NOVA School of Science and Technology, specific people working for the municipalities were contacted. The e-mail sent to the e-mail address of the entities mentioned is presented in the Annexes chapter.

1.3 Structure of the Dissertation

This dissertation is divided into 4 chapters: the introduction, which includes the framework, scope and objectives, and structure of the dissertation; the second chapter, which presents the manuscript of the scientific article that was published; the third chapter that presents the conclusions of the dissertation, as well as future developments and the limitations faced during the making of the dissertation; the references chapter and the final chapter, which includes the annexes, where the formatted accepted article is presented.

2

CLIMATE CHANGE ADAPTATION STRATEGIES AT A LOCAL SCALE: THE PORTUGUESE CASE STUDY [1]

The current chapter displays the scientific article accepted in manuscript format. The submitter paper includes the following sections: Abstract, Introduction, Research Framework, Methodology, Results, Discussion, Conclusion, Acknowledgements, and References. Nonetheless, for presentation purposes, this chapter only displays the Introduction, Research Framework, Methodology, Results, Discussion and Conclusion.

2.1 Introduction

In the last few decades, climate change has become a major topic of discussion all around the world. This has led to some change in a wide range of economic activities, due to the long-term effect climate change will have on human lives and well-being, derived from the drastic changes in ecosystems' patterns and processes (Teixeira et al., 2022; Hoegh-Guldberg et al., 2018; Loucks, 2021).

To address climate change and the consequences that derive from it, various authors have produced the concept of climate change adaptation, which has resulted in the concept having no single definition (Schmidt-Thomé, 2017; Fankhauser, 2016; Smit and Pilifosova, 2001; IPCC, 2007; IPCC 2022).

However, according to the 6th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (2022), climate change adaptation can be defined as "the process of adjustment to

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actual or expected climate and its effects in order to moderate harm or take advantage of beneficial opportunities (…)".

Since the effects of climate change and global warming have become more severe in the last decade, many countries have decided to implement national and local strategies for climate change adaptation, to better prepare themselves for the adverse consequences that can be projected for each area (Nalau & Cobb, 2022; Hossen et. al, 2022) . It has also been studied that climate change impacts are mainly experienced at a local level, which helped prompt the mentioned strategies (Aguiar et al., 2018).

Climate change adaptation has more success when applied at a local scale, contributing to bottom-up approaches instead of top-down approaches, and the potential transferability of the best adaptation processes. (Aguiar et al., 2018; Schlingmann et al., 2021).

As such, climate change policies, including adaptation strategies, must be local, mainly because of the different contexts provided by a variety of community stakeholders, which contribute to the proximity to the challenges and an understanding of bigger problems at a local scale (Aguiar et al., 2018; Kirby, 2021).

It is important to note that larger cities in developed countries have easier access to resources for climate change adaptation planning – benefiting from the presence of research institutions, conferences, and other entities. However, smaller cities, generally have less resources and have more difficulty being engaged in national and international networks (Lioubimtseva & da Cunha, 2020). Therefore, it is crucial to evaluate case studies of implemented climate change adaptation strategies, to identify current good practices and, simultaneously, surpass discrepancies such as the ones mentioned.

This research aims to draw conclusions on adaptation processes at a local scale, using the Portuguese study case, and how to replicate it to a global context, since it is understood that local adaptation planning is the way most communities can adapt to climate change effects.

Additionally, this research also intends to make a national survey of the local adaptation strategies of coastal municipalities in Portugal, particularly considering the new Portuguese Climate Law (Lei de Bases do Clima), that mandates municipalities to have local adaptation strategies by the end of 2023, as well as their inclusion of nature-based solutions, green infrastructure, and community-based adaptation.

2.2 Research Framework

2.2.1 Climate change adaptation in the European Union

The first European Union (EU) adaptation strategy was presented in April of 2013. This document had three main objectives: promoting action by the Member States, promoting better-informed decision-making, and promoting adaptation in key vulnerable sectors (European Commission, 2013)

The implementation of the strategy was based on eight actions, (European Commission, 2013):

1. Encourage all Member States to adopt comprehensive adaptation strategies;
2. Provide LIFE funding to support capacity building and step-up adaptation action in Europe (2014-2020);
3. Introduce adaptation in the Covenant of Mayors framework (2013/2014);
4. Bridge the knowledge gap;
5. Further develop Climate-ADAPT as the "one-stop shop" for adaptation information in Europe;
6. Facilitate the climate-proofing of the Common Agricultural Policy (CAP), the Cohesion Policy and the Common Fisheries Policy (CFP);
7. Ensuring more resilient infrastructure;
8. Promote insurance and other financial products for resilient investment and business decisions.

In 2018, the 2013 Strategy was evaluated, to understand the progress the Member States have made since the implementation of the strategy. The main conclusions from the evaluation draw on the need of a greater focus on adaptation effort at the EU level, specifically on water and drought, local and urban adaptation, agriculture policy, climate finance, insurance, and business. It is also concluded that the EU Strategy has likely enhanced the political focus of Member States on adaptation issues, in addition to the Paris Agreement (European Commission, 2018).

In 2021, the European Commission released a new EU Strategy on Adaptation to Climate Change. This document has three main objectives, building on the 2013 strategy and its evaluation (European Commission, 2021):

• Make adaptation smarter, by improving knowledge and availability of data;

• Make adaptation more systemic, through the support of policy development;

• Speed up adaptation across the board, by accelerating the development and rollout of adaptation solutions.

With these goals in mind, the strategy presents the long-term vision for the EU in terms of adaptative capacity, to minimize vulnerability to the effects of climate change while being in synergy with other Green Deal policies. It is also noted by the Commission that there is an urgent need to develop

effective and inclusive governance mechanisms that can connect policymakers and scientists (European Commission, 2021).

Through this document it is also reinforced the importance of the Climate-ADAPT Platform, which the EU aims to make the authoritative European platform for climate change adaptation.

Climate-ADAPT is a partnership between the European Commission and the European Environment Agency (EEA), which aims to share data and information about adaptation, national adaptation strategies and actions of Member States, case studies, and also tools that support adaptation planning.

2.2.2 Adaptation in Portugal

Portugal has had a National Strategy for Climate Change Adaptation (ENAAC) since 2010, introduced by resolution no. 24/2010 of the Council of Ministers, of 1st of April.

The main objectives of this strategy were the following:

• Information and knowledge, by developing a scientific a technical basis of information;

• Reduce vulnerability and increase the capacity of response, by identifying and defining priorities in terms of climate change adaptation measures;

• Participate, raise awareness, and publicize, through the contribution of stakeholders;

• International cooperation, by approaching the national responsibilities in terms of cooperating with international adaptation policies.

In 2015, the same strategy was renewed, originating ENAAC 2020, which was supposed to run until 2020, but was extended to 2025 due to the approval of the National Plan of Energy and Climate (PNEC 2030). According to resolution no. 53/2020 of the Council of Ministers, of 10th July, 2020, this strategy is also accompanied by an action plan, which defines concrete lines of action for adaptation to climate change.

ENAAC 2020 was approved in resolution no. 56/2015 of the Council of Ministers, of 30th July, 2015, renewing ENAAC 2010-2013 and with the following main objectives:

• Better the knowledge level about climate change, by updating and developing information about climate change, while assessing its risks, impacts, and consequences. This material must be exposed by communication platforms and awareness campaigns;

• Implement adaptation measures, through two options: consulting stakeholders from the sectorial working groups and through the collection of information regarding best practices, both on a national and international level (specially south European countries);

• Promote the integration of adaptation in sectorial policies.

The strategy includes six thematic areas, that were selected through the knowledge obtained in the ENAAC 2010-2013, which are seen in most activity sectors. The areas are research and development (R&D), financing, international cooperation, communication, territory planning and water resources management.

Moreover, the nine updated priority sectors are the basis of ENAAC 2020, and are as follow:

• Agriculture;

• Biodiversity;

• Economics;

• Energy;

• Forests;

• Health;

• Security of people and goods;

• Transport and communications;

• Coastal areas.

For the mentioned sectors, and as it happened on the first ENAAC, it was defined a working group by the competent public authority.

According to this strategy, most scenarios for 2080-2100 for Portugal, project the following climate change effects:

• A general increase of the average yearly temperature in every region of the country;

• An increase of until 3ºC for the highest temperature in summer, for the coastal areas, and an increase of until 7ºC for the countryside. For the Madeira and Azores islands it is projected an increase between 1ºC and 3ºC;

• A reduction in frost days and an increase in hotter days and tropical nights;

• An increase in forest fires risk, change of land use, and implications on water resources;

• Significant change in the precipitation cycle, which may include a reduction of precipitation during spring, summer, and autumn in mainland Portugal. There is also a possibility of a decrease in yearly precipitation and an increase in winter, due to the rise in the number of days with stronger rain.

Due to the mentioned projections, as well as other factors, the Portuguese Government presented the new Portuguese Climate Law, of 31st December 2021. This law establishes several objectives related to the environment and the climate emergency, among them the need to “reinforce resilience and the national capacity to adapt to climate change”.

Climate change causes more relevant impacts at a local scale and as a result there has been a continuous effort to shift policies from national and regional level to the local one (Baker et al., 2012). In view of the new Climate Law, each Portuguese municipality must have adaptation strategies and action plans implemented by the end of 2023.

As mentioned earlier in the chapter, for the present paper, ClimAdaPT.Local assumes relevance in the present paper. This network was created in 2016 and its main goal is to encourage local climate change adaptation in Portugal, through the following steps (ClimAdaPT, 2016):

• Facilitate experience exchange between municipalities;

• Promote knowledge exchange between municipalities, universities and research centers, as well as local companies;

• Promote international cooperation relations;

• Promote the empowerment of municipalities.

2.2.3 Natured-based solutions

Due to the more frequent effects and consequences of extreme phenomenon's caused by climate change, there has been a focus on implementing local scale climate change adaptation actions that reduce that help reduce the vulnerability of the receiving environment (Holden et. al, 2022; Moosavi, 2022).

These interventions make up the concept of nature-based solutions (NBS), that can be defined as solutions that are inspired and supported by nature and are cost-effective, while simultaneously providing environmental, social, and economic benefits and building resilience, while bringing more nature and natural features into urban spaces through resource efficient and systemic interventions (Ascenso et al., 2021; Raška et al., 2022; Tyllianakis et al., 2022).

Moreover, NBS are interventions that are supported by nature, which can be evolving and changing. This implies the active management of these systems, to ensure that their services are provided (Fernandes & Guiomar, 2018).

2.2.4 Green infrastructure

Green infrastructure (GI) is a relatively recent concept, originated in the 1990s, associated with green spaces (Monteiro et al., 2022). One of its different definitions is that it is an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human beings. However, GI have both an ecological and engineering approach to it and becoming a priority for the decision makers (Monteiro et al., 2022; Washbourne, 2022).

Additionally, GI can aid in adaptation to climate change on three main aspects (Sussams et al., 2015):

• Urban heat island effect – by cooling urban spaces, especially in population dense locations;

• Flood risk management – through green cover that can reduce water runoff;

• Ecosystem resilience – by preventing ecosystem fragmentation while increasing the number of protected areas and maintaining habitat connectivity.

Furthermore, the more widely accepted definition of GI comes from the European Commission (2013) and can be defined as "as strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services.

On land, GI is present in rural and urban settings, incorporating green spaces (or blue, if aquatic ecosystems are concerned) and other physical features in terrestrial areas [European Commission, 2013). GI can have an ecological approach, in the form of a natural system composed of national parks, parkways, forests, community gardens, and green corridors, among others (Nieuwenhuijsen, 2020).

Because of this, GI can respond to a wide range of environmental, social, and economic challenges, including climate change adaptation (Monteiro et al., 2022)

2.2.5 Community-based adaptation

The community-based adaptation (CBA) concept has evolved in recent years, due to the more frequent impacts of climate change, especially in coastal communities, namely sea level rise. These accumulated effects and consequences have become the drive needed for the development in community-based approaches in terms of climate change adaptation (Mcnamara & Buggy, 2016; Tan Phong et al., 2022).

CBA happens in local communities vulnerable to the impacts of climate change, by identifying, assisting, and implementing activities that will help strengthen the adaptative capacity of these populations (Forsyth, 2013). CBA is a bottom-up approach to climate change adaptation with the aim to enhance adaptive capacity to climate change (Picketts et al., 2012). As such, the activities mentioned are usually related to participatory processes, connecting local stakeholders and the local communities in the reduction of risk associated with the rising effects of climate change (Ayers & Forsyth, 2009; Duus & Montag, 2022)

Since CBA is also a place-based approach, the planning process for the communities must consider the social and ecological dynamics and priorities. According to Basel et. al (2020) the integration of the CBA process "is achieved through a high level of trust and community engagement and input, over a long duration to establish meaningful relationships and understand community priorities and drivers".

2.3 Methodology

The methodological presented in this section has four main steps, as described in Figure 2.1. Each of these steps will be explained in depth later in this chapter.

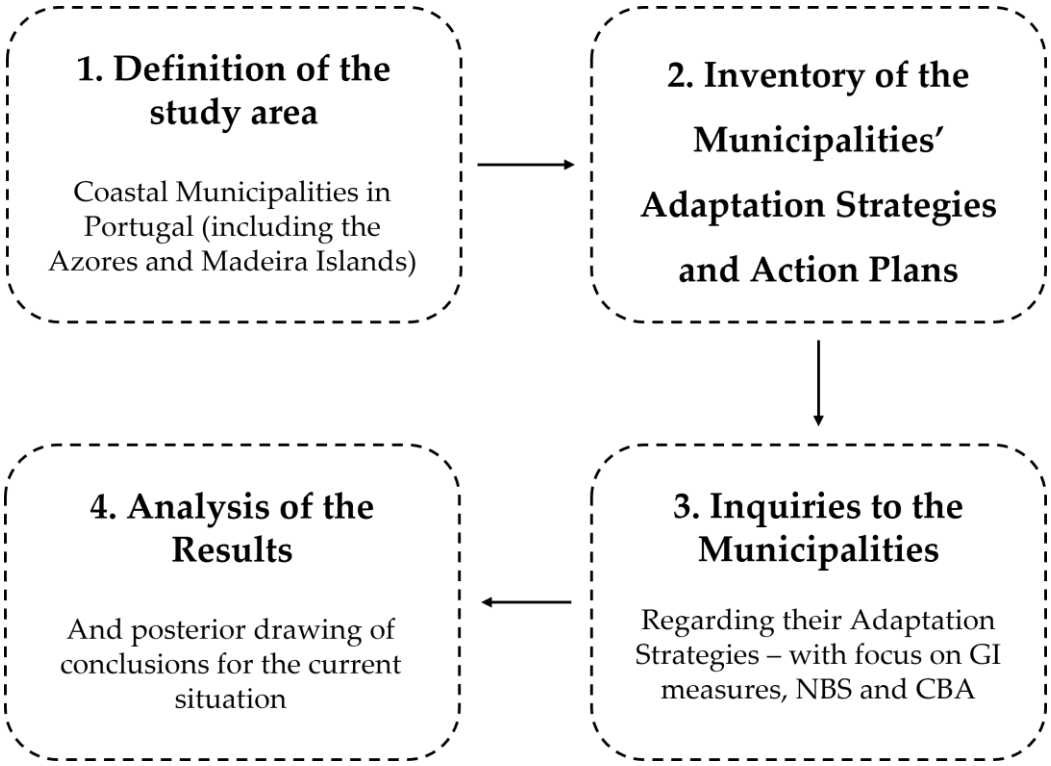

Figure 2.1 - Methodological Framework followed.

2.3.1 Step 1 – Definition of the study area

The study area defined for the purpose of this research are the coastal municipalities in Portugal, which also include the coastal municipalities of the islands of Madeira and Azores, as seen in Figure 2.2.

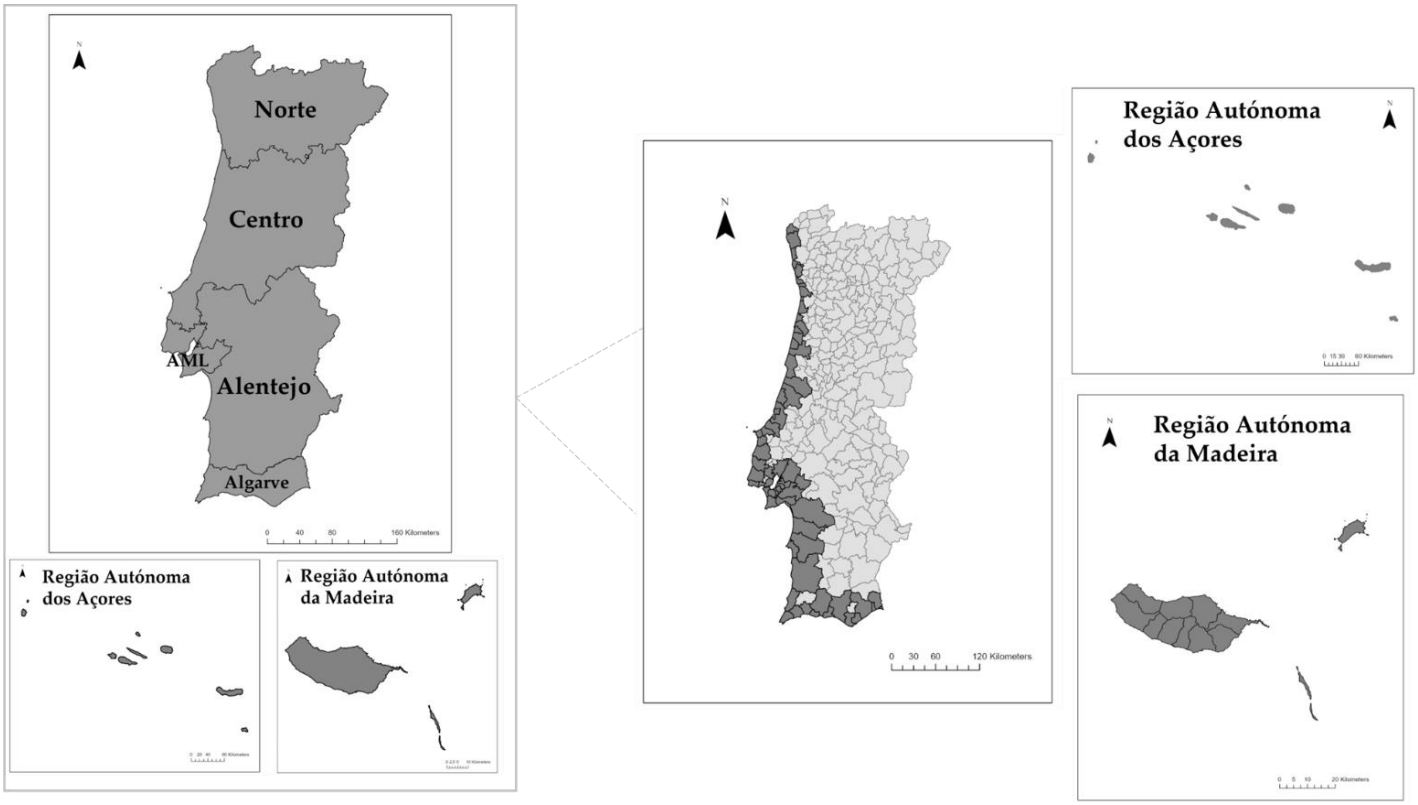

Figure 2.2 - NUTS II and study area (coastal municipalities), where AML is Lisbon Metropolitan Area (Data from: CAOP 2021).

The coastal line of Portugal, including the Azores and Madeira islands, is approximately 2 000 km long and, as such, 75% of the Portuguese population is concentrated on the coast. This area also generates approximately 80% of the Portuguese Gross Domestic Product (GDP), which proves its importance on a national level (F. Santos et al., 2014).

Due to the length of its coast, as well as its exposure to the sea waves from the Atlantic North, Portugal is one of the most affected countries by coastal erosion in Europe. With the increasing frequency of events caused by climate change, it is expected that coastal erosion will worsen on the Portuguese coast (Schmidt & Mourato, 2015).

Therefore, it is necessary to establish and implement measures and solutions to adapt the coastal cities and towns of the country. Such measures and solutions are one of the bases of the current study.

2.3.2 Step 2 – Documental analysis

One of the first actions related to this research was the making of an inventory of all the Portuguese coastal municipalities and their work towards climate change adaptation so far.

To do this inventory, it was necessary to read and analyse the adaptation strategies and plans made by each municipality. It is important to note that not all coastal municipalities have climate

change adaptation strategies implemented. This will be presented in the following chapter, which is dedicated to the results of this study.

In this step of the methodological framework, the authors of this research aimed to answer the following questions to categorize the municipalities' adaptation strategies and plans:

1. Is the municipality a participant in the ClimAdaPT network?
2. What was the methodology used for the elaboration of the strategy?
3. What are the main climate change projections for the municipality?
4. Does the adaptation strategy mention green infrastructure or infrastructure measures?
5. How many adaptation options are mentioned in the strategy?
6. What is the priority of green infrastructure among the other adaptation options?
7. Does the adaptation strategy plan how to integrate the strategy on the territory management instruments (IGT)?

It is important to note that questions 5 and 6 were only asked if the municipality was a part of the ClimAdaPT network. This happened because all ClimAdaPT's participants are required to follow a similar structure for their adaptation strategy structure.

2.3.3 Step 3 – Inquiries to the coastal municipalities

To achieve the purpose of this research, there was a need to do a survey of the adaptation strategies of coastal municipalities in Portugal.

The initial survey was directed to all 92 municipalities on the Portuguese coast, including Madeira and Azores islands. For these municipalities, the questions asked focused on the adaptation strategies and their respective inclusion of green infrastructure, natured-based solutions, and community-based adaptation.

The inquiries were made on Google Forms, since this tool also allows the exportation of data and, consequently, a better data treatment.

The inquiries were sent to all 92 municipalities at study via the author's institutional e-mail, with the period of response being between the 3rd of June and the 7th of October.

The inquiries were divided in the following sections:

- General information about the strategy of the municipality;
- Green infrastructure and nature-based solutions and their inclusion on the strategy;
- Community-based adaptation;

The last two sections of the inquiry were only presented if the municipality answered that they had a climate change adaptation implemented.

2.3.4 Step 4 – Data treatment

After obtaining the responses to the inquiry, the data was explored further using Microsoft Excel.

As such, a group of parameters were explored, namely:

1. General data concerning the inquiry;
2. Data from municipalities that answered they did not have an adaptation strategy;
3. Data from municipalities that have an adaptation strategy in development.
4. Data from, municipalities that answered they have an adaptation strategy.

For 1) the results obtained through the data from the questionnaire, were the characterization of the municipalities, in terms of their answers to the inquiries and if said municipalities have a climate change adaptation strategy.

As for the second point, the data acquired, allowed to explore the reasons why municipalities don't have climate change adaptation strategies implemented.

Moreover, the third point reflects on the municipalities that have a strategy in development, and at which state of development it is.

Lastly, the final point allowed for a wider data treatment and more conclusive results, due to extensive questions asked to municipalities with adaptation strategies. As such, it was possible to divide this point into four sub-sections of results: general data, nature-based solutions, green infrastructure, and community-based adaptation.

2.4 Results

2.4.1 Results from the documental analysis

From the documental research, it was possible to observe that out of all 92 municipalities, only 18 have an individual climate change adaptation strategy available for consultation online. In the following table, the mentioned municipalities are presented, along with their Nomenclature of Territorial Units for Statistical Purposes (NUTS II).

Table 2.1 - Municipalities with individual adaptation strategies, by NUTS II

NUTS II	Municipalities
Norte	Viana do Castelo Esposende Vila do Conde Porto Espinho

NUTS II	Municipalities
Centro	Aveiro Ílhavo Leiria Torres Vedras
Lisbon Metropolitan Area	Mafra Barreiro Cascais
Alentejo	Benavente Odemira
Algarve	Loulé Faro
Região Autónoma da Madeira	Funchal
Região Autónoma da Açores	Vila Franca do Campo

Table 2.1 shows that Norte is the region with more individual adaptation strategies, with a total of 5, which corresponds to 56% of the coastal municipalities in this NUTS II.

From the municipalities that do not have a climate change adaptation strategy available for consultation online, it was possible to understand that the region with fewer strategies is the Azores and Madeira islands, with 95% and 91%, respectively, of their municipalities, not having the documents.

Another parameter observed was the participation of municipalities in the ClimAdaPT network. Approximately 60% of municipalities that have strategies are participants of this project, meaning that 11 municipalities have elaborated their strategy in compliance with this programme and its methodology.

Additionally, the documental research showed that 44 municipalities are included in either inter-municipal or metropolitan plans, such as the Lisbon and Porto Metropolitan Areas adaptation strategies, the plans from the Madeira and Azores islands, the Algarve and the Oeste inter-municipal adaptation plans, and the inter-municipal plan of the region CIM of Coimbra.

However, if only individual municipal strategies are considered, then the total of municipalities that do not have an adaptation strategy document is 74. This means that 80,4% of Portuguese municipalities do not have an individual adaptation strategy in place.

Another factor that was examined in the climate change adaptation strategies was their inclusion of green infrastructures. It was possible to verify that, of the 18 individual strategies, 15 mentioned and included adaptation options regarding green infrastructure. However, 3 municipalities did not consider GI in their documents. The three municipalities that did not include GI are all from the Norte: Espinho, Vila do Conde and Esposende.

2.4.2 Results from the questionnaire

For this inquiry, all 92 coastal municipalities of Portugal were contacted and invited to answer a questionnaire about adaptation strategies.

2.4.2.1. General data

Firstly, it is important to acknowledge that 50% of the Portuguese coastal municipalities answered the questionnaire. Therefore, the results of this evaluation are not completely representative of all coastal municipalities in Portugal and only represent 46 municipalities.

Considering the NUTS II, the NUTS II with a higher percentage of responses to the questionnaire was the Norte, with 66,7% of the municipalities inquired answering. However, the NUTS II with the smaller percentage of response was Alentejo, with only 16,7% of the inquired municipalities of this region answering.

Due to the higher number of municipalities contacted, it was expected that the Metropolitan Area of Lisbon, had a higher percentage of response. Nevertheless, this NUTS II had 56,3% of responses out of the 16 municipalities contacted.

Regarding the municipalities from the islands, Azores had responses from 52,6% of its municipalities, while Madeira had 27,3% of responses.

Concerning only the municipalities that answered the inquiry, and if they have a climate change adaptation strategy implemented or in development, the results are described in Figure 2.3.

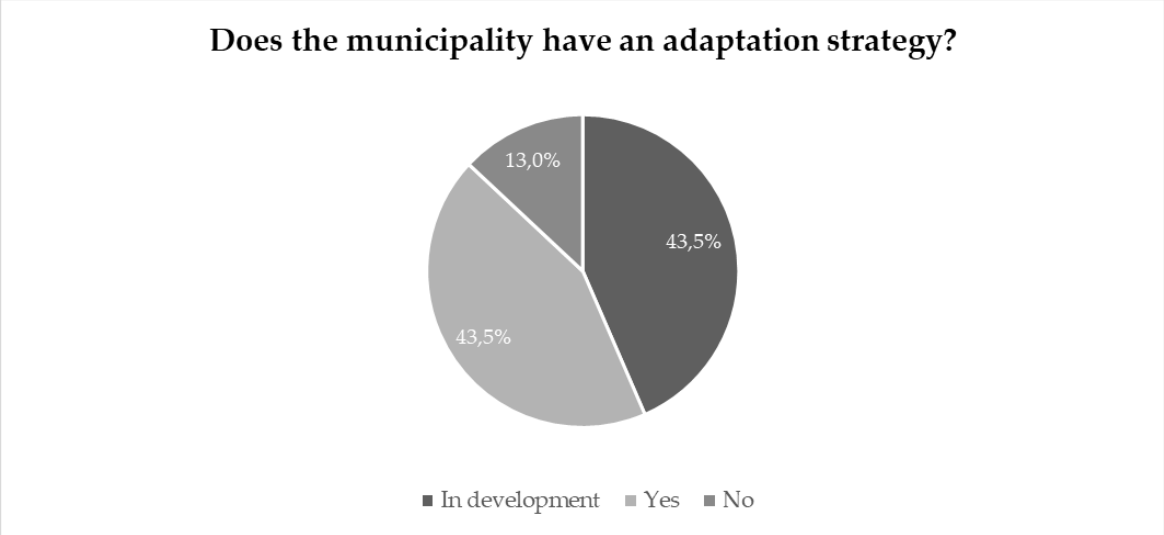

Figure 2.3 - Percentage of inquired municipalities that have climate change adaptation strategies.

From this graphic, it is possible to understand that 13,0% of the municipalities do not have an adaptation strategy, while 43,5% do and the remaining 43,5% have adaptation strategies in development.

Considering the existence of the climate change adaptation strategies, the NUTS II with fewer strategies is Madeira – with one of the three municipalities not having a strategy implemented.

Regarding strategies in development, it is possible to verify that the NUTS II with more climate change adaptation strategies in development is the Azores. Out of the 11 answers, 7 municipalities are developing strategies.

As for the region with more adaptation strategies, the Norte, all the municipalities that have answered the questionnaire have strategies in place. After the Norte, the Lisbon Metropolitan Area is the NUTS II with more municipal adaptation strategies implemented, as 6 out of the 9 municipalities that have answered the inquiry have these documents put into effect.

2.4.2.2 Municipalities that do not have a climate change adaptation strategy

Out of the 46 municipalities that answered the inquiry, 6 of them do not have a climate change adaptation strategy. In the table below the municipalities that do not have individual strategies and correspondent NUTS II are presented.

Table 2.2 - Municipalities that don't have EMAACs and their corresponding NUTS II

NUTS II	Municipalities
Centro	Marinha Grande Vagos
Algarve	Olhão
Região Autónoma dos Açores	Horta Santa Cruz da Graciosa
Região Autónoma da Madeira	Câmara de Lobos

Olhão Municipality, although part of the intermunicipal plan for climate change adaptation of the Algarve Metropolitan Area (PIAAC AMAL), stated they did not have a climate change adaptation strategy. The specific reason Olhão indicated for not having an individual adaptation strategy is that it did not have an environment department until recently.

The same happened with Câmara de Lobos Municipality and Horta and Santa Cruz, which are included in the regional climate change adaptation plans for the Madeira and Azores islands, respectively. These municipalities claimed the following reasons for not having individual adaptation strategies:

- Lack of decision by the executive and lack of human resources (Câmara de Lobos);
- The adaptation strategy is not planned (Santa Cruz da Graciosa);
- Lack of interest by the executive (Horta).

Regarding Marinha Grande and Vagos, when asked about the lack of development for the adaptation strategies, answered the following reasons:

- Lack of human resources;
- Lack of funding for the elaboration of the document.

2.4.2.3 Municipalities that have a climate change adaptation strategy in development

To better explore the results obtained through the inquiry, municipalities that have strategies in development were also accounted for. In total, 20 municipalities have climate change adaptation strategies in development, which are presented in the following table alongside the correspondent NUTS II.

Table 2.3 - Municipalities that have strategies in development and their corresponding NUTS II

NUTS II	Municipalities
Região Autónoma dos Açores	Praia da Vitória Ponta Delgada Angra do Heroísmo Povoação Velas Madalena Santa Cruz das Flores
Alentejo	Santiago do Cacém
Algarve	Tavira Albufeira Castro Marim Silves
Centro	Ovar Caldas da Rainha Nazaré
Lisbon Metropolitan Area	Oeiras Seixal Sesimbra
Região Autónoma da Madeira	Calheta Ribeira Brava

Table 2.3 shows that, apart from the municipalities from the Norte region, all of the NUTS II have municipalities with strategies in development. The Norte region is not represented because all the municipalities that responded to the inquiry, and that are from this NUTS II, have strategies implemented.

To study how far along the climate change adaptation strategies are, results showing their stages in development are presented in Figure 2.4.

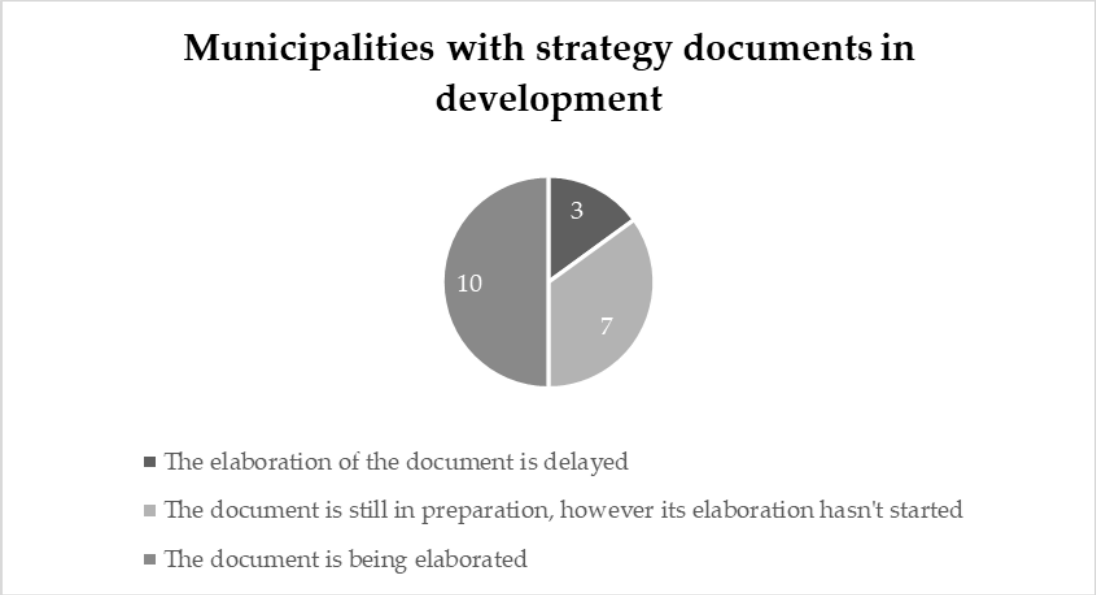

Figure 2.4 - Municipalities with strategies in development

From the graphic in Figure 2.4, it is possible to observe that 10 municipalities have their strategy documents in elaboration, while 7 municipalities have the strategy in preparation and 3 municipalities admit that the process is delayed. In this last parameter it was not possible to verify why the process is delayed.

Moreover, these results show a clear interest from these municipalities in developing an adaptation strategy to comply with the New Climate Law and to implement measures that can adapt these municipalities and avoid a higher risk.

2.4.2.4 Municipalities that have a climate change adaptation strategy

As it was already mentioned earlier, 20 municipalities out of the 46 municipalities that answered the inquiry have a climate change adaptation strategy implemented. In Table 2.4 these municipalities are presented, as well as their corresponding NUTS II.

Table 2.4 - Municipalities that have strategies and their corresponding NUTS II

NUTS II	Municipalities
Norte	Esposende Viana do Castelo Vila do Conde Matosinhos Vila Nova de Gaia Porto
Centro	Ílhavo Figueira da Foz Leiria Óbidos Torres Vedras
Área Metropolitana de Lisboa	Almada Cascais Lisboa Loures Setúbal Sintra
Algarve	Loulé Faro
Região Autónoma dos Açores	Ribeira Grande

From Table 2.4 it is possible to observe that, according to the answers to the inquiry, no municipality from Alentejo and Madeira islands has a climate change adaptation strategy.

Regarding the remaining answers, the results presented show that they are well distributed within the NUTS II, with representation in 5 out of the 7 NUTS II.

Through the questionnaire, it was possible to obtain the dates when the strategies of the municipalities above were published/elaborated, with the results being shown in Figure 2.5.

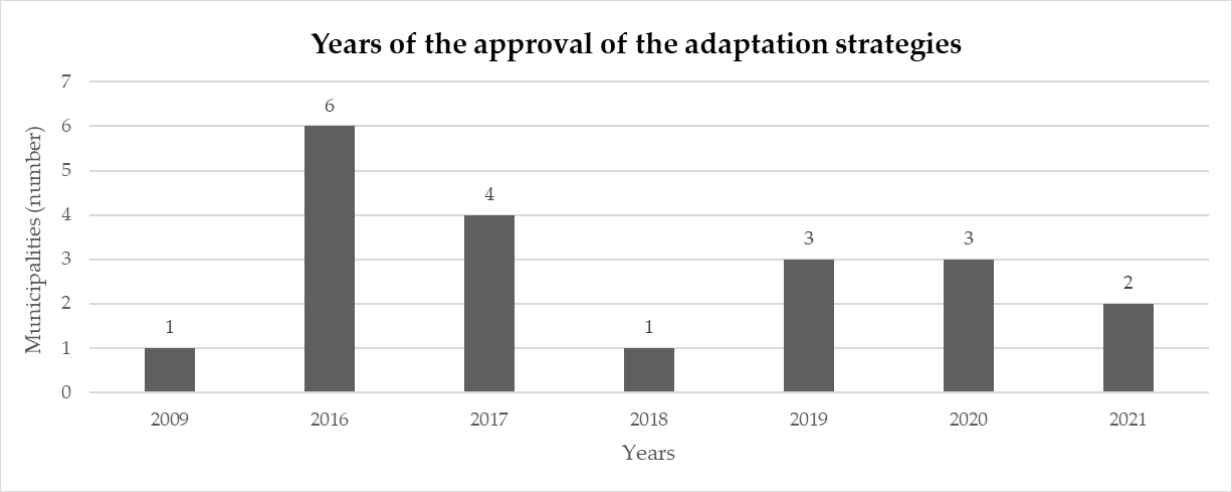

Figure 2.5 - Climate change adaptation strategies approved by year

From this graphic, it is shown that 2016 was the year when most adaptation strategies were launched, followed by 2017, 2019, and 2020.

The responses to the inquiries also allowed to get the scale of the strategy - whether it acts at a municipal or intermunicipal scale. In Figure 2.6 the results are presented.

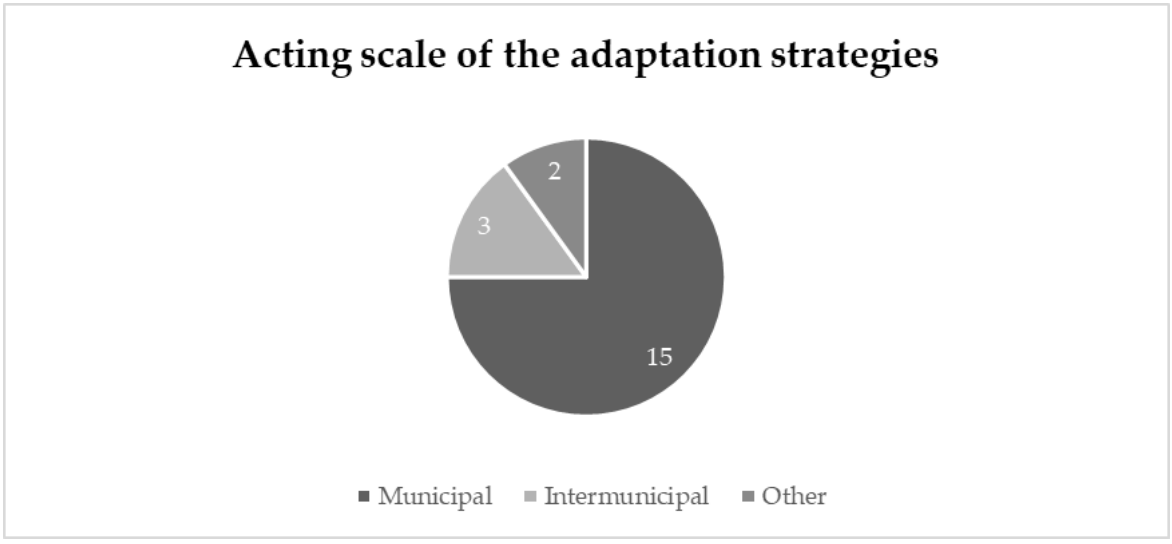

Figure 2.6 - Scale of action of the adaptation strategies

Through Figure 2.6 it is possible to verify that most adaptation strategies act on a municipal level. However, 3 municipalities have strategies that act on an intermunicipal scale, and the scale of the remaining 2 municipalities is metropolitan.

The responses to the questionnaire also made it possible to understand at what phase the adaptation strategies from the municipalities are. As such, 11 municipalities have concluded their document, while the remaining 7 are in the process of executing their strategies.

As mentioned earlier in this chapter, through the inquiry the municipalities were questioned about their inclusion of nature-based solutions in their climate change adaptation strategies. The following graphic presents the number of municipalities that utilized this measure in their documents.

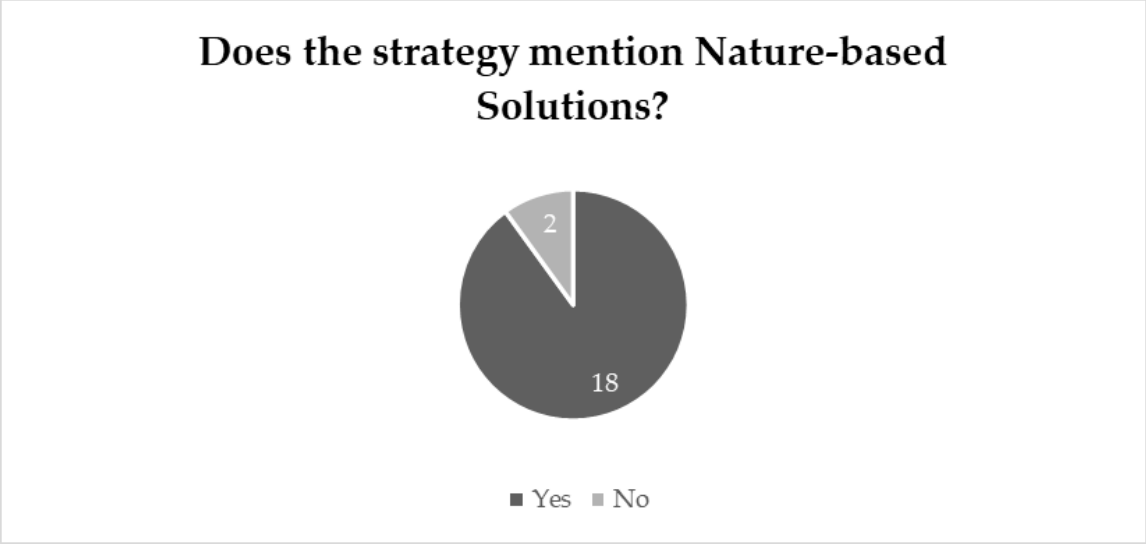

Figure 2.7 - Nature-based solutions in adaptation strategies

As presented in Figure 2.7, 18 municipalities consider nature-based solutions in their strategies and 2 municipalities don't. As per this distribution in NUTS II, it was verified that the 2 municipalities that don't include NBS in their strategies are from the Norte region, namely, Vila do Conde and Matosinhos. The remaining 18 municipalities are distributed on all the Portuguese NUTS II, except the Madeira islands and Alentejo.

The motives stated by Vila do Conde and Matosinhos for the lack of NBS in their strategies were the following: even though NBS were not explicit in the document, they are implicitly integrated in the adaptation strategy, and that the NBS were already contemplated in another action plan from the municipality.

Regarding specific NBS measures adopted in the climate change adaptation strategies, results are presented in Figure 2.8.

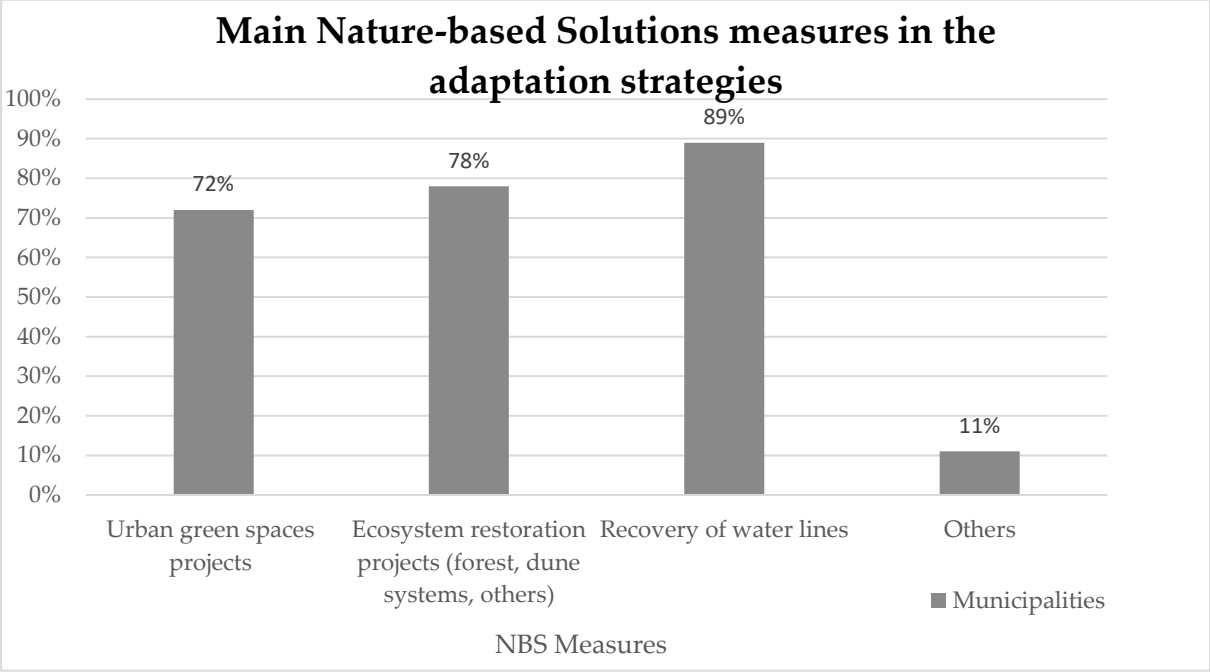

Figure 2.8 - Main Nature-based Solutions measures in the adaptation strategies

Figure 2.8 shows that 89% of the municipalities that have adaptation strategies expect to recover and restore water lines in their territory, 78% want to restore the ecosystems in their municipality and 72% hope to accomplish more urban green spaces. As for the other NBS measures mentioned by 2 municipalities, they englobe sustainable drainage systems.

NBS are well-known to municipalities, as it is possible to see from the above results. In most municipalities adaptation options consider NBS, whether in its green infrastructure component or in the recovery of ecosystems and water lines.

GI data was also obtained as a result of the inquiry sent to the coastal municipalities, specifically the ones that answered they have an EMAAC in motion.

All the municipalities that have a climate change adaptation strategy mention and plan to implement GI.

As such, Figure 2.9 presents the results obtained regarding the types of GI the municipalities expect to execute through their adaptation strategies.

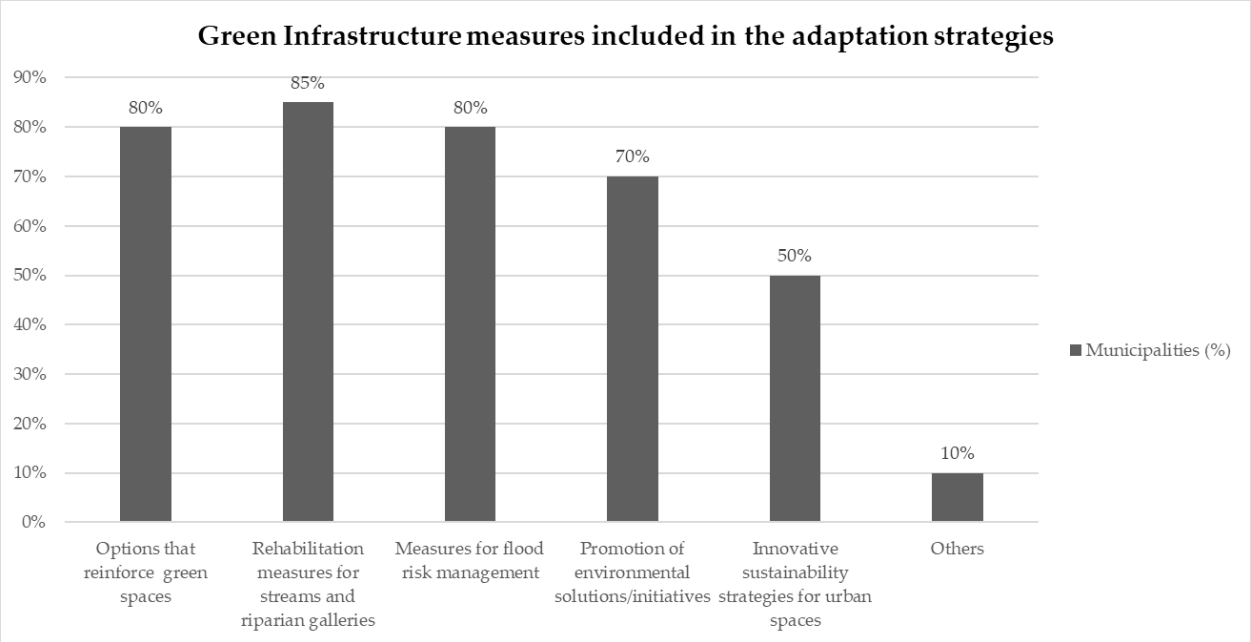

Figure 2.9 - Green Infrastructure measures mentioned in the adaptation strategies

Figure 2.9 shows that the top GI measure for the inquired municipalities are related to the rehabilitation measures for streams and associated riparian galleries, with 85% of the municipalities having this GI option in their strategy.

80% of the municipalities consider options that reinforce green spaces in their territory and specific measures for flood risk management.

Most municipalities also regard the promotion of sustainable solutions and initiatives in their strategies and half of the municipalities have innovative sustainability strategies for urban spaces.

10% of the municipalities also refer other GI options, such as the promotion of sustainable agriculture practices and the adaptation of more resilient species in the management of green infrastructure in the territory.

Through the questionnaire, it was possible to verify that 15 municipalities do not include community-based adaptation in their strategies, while 5 do. These five municipalities are Ribeira Grande, Ílhavo, Matosinhos, Loures, and Cascais from the Azores, Centro, Norte, and Lisbon Metropolitan area NUTS II respectively.

In order to know in which way the municipalities are utilizing the CBA concept, a question was inquired to the municipalities about the measures used that can be englobed by CBA. The results are presented in Figure 2.10.

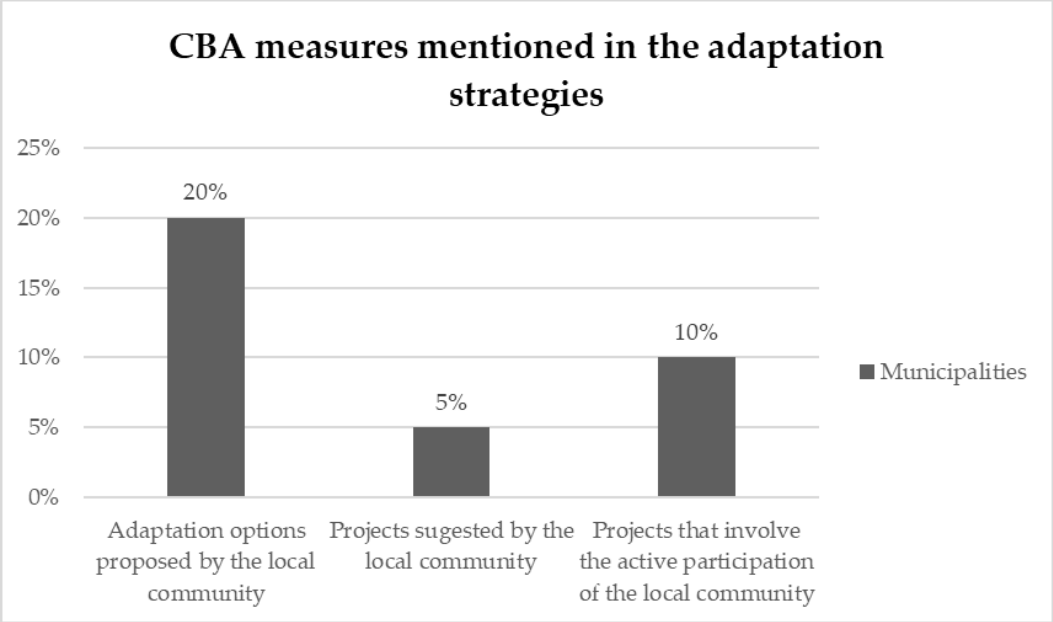

Figure 2.10 - Community-based Adaptation measures mentioned in the adaptation strategies

Out of all the municipalities that have an EMAAC, 10% have implemented CBA in their strategies through adaptation options proposed by the local community, 5% have applied projects suggested by the local population and 20% have projects that require active participation from the community.

Concerning the municipalities that do not include CBA in their strategies, the main reason why municipalities did not include CBA in their adaptation strategies is that they did not understand the need for it. 2 municipalities also answered they were unaware of the utility of this concept and, finally, 6 municipalities referred other motives. 3 municipalities did not answer to this question.

The motives included in "others" were the following:

- The creation of a stakeholders commission already covers the active participation of the local community in strategies like the EMAAC;
- The municipality followed the ClimAdaPT methodology, which not include CBA at that date;
- The municipality is contemplating the creation of a climate change adaptation local network.

2.5 Discussion

2.5.1 Documental analysis

Through the results presented in the previous chapter for the documental analysis, it was possible to verify that approximately 60% of municipalities that have climate change adaptation strategies are participants of the ClimAdaPT network.

To get a better geographical distribution of the participating municipalities, ClimAdaPT invited several municipalities throughout the Portuguese territory, including those from NUTS II that usually

do not have the resources (either human resources or financial resources) to elaborate these documents.

NUTS II like the Azores and Madeira islands, Alentejo and Algarve are regions that have a lower population and, therefore, a lower number of local administration employees. Data from the national database PorData shows that in 2020, the Azores Islands have 2 878 local administration employees, while the Madeira islands has 3 133. Additionally, the Alentejo region has 15 963 employees, and the Algarve has 9 733.

As such, this choice can contribute to the sharing of know-how about local climate change adaptation to neighbouring municipalities.

2.5.2 Questionnaire to the coastal municipalities

Through the results from the questionnaire, it was also possible to conclude that half of the coastal municipalities answered it.

The lack of response to this questionnaire might have underlying problems, namely the number of public administration employees of each municipality.

As it is understandable, bigger municipalities, or municipalities in certain areas of influence, have more employees and as such there are more human resources to either answer the inquiry or to participate in the team that will work on the strategies.

Moreover, it was possible to verify that almost half of the municipalities that responded to the inquiry have an adaptation strategy and approximately 40% have their own strategy in development.

For municipalities that do not have adaptation strategies, 4 out of the 6 municipalities are included in regional or intermunicipal climate change adaptation plans. Several reasons were given by the municipalities for the lack of individual strategies, such as lack of human resources and lack of funding.

As mentioned before, these responses can relate to the number of employees in the local administration of municipalities. Data collected from PorData shows that as of, 2020 there were 135 125 people working in the local administration in Portugal.

The Azores Islands have 2 878 local administration employees, while the Madeira islands have 3 133. Moreover, the Centro region has 29 242 employees, and the Algarve has 9 733. This can contribute to the lack of implemented adaptation strategies in municipalities from this NUTS II.

Exploring the data by the municipalities that do not have strategies implemented on an individual scale it is possible to see the number of employees in local administration in these areas:

Table 2.5 - Number of local public administration employees (data from: PorDATA 2022)

Municipality	Number of local public administration employees
Marinha Grande	266

Municipality	Number of local public administration employees
Vagos	247
Olhão	593
Horta	54
Santa Cruz da Graciosa	166
Câmara de Lobos	248

For the municipalities in the islands, the number of public employees is justifiable. However, for the mainland municipalities, the data shows there could be enough human resources for the development of an adaptation strategy.

Another reason these municipalities give for not having an adaptation strategy is that it is not planned, or that there is no interest in it. This reveals that the executive is not attentive to climate laws, namely the New Climate Law, of 31st of December 2021 which requires municipalities to have a municipal or regional adaptation strategy implemented. . This may reveal a lack of interest of the executive regarding climate laws, namely the New Climate Law, of 31st of December 2021 which requires municipalities to have a municipal or regional adaptation strategy implemented.

Results from the municipalities that have adaptation strategies in development allowed to verify a clear interest from municipalities in developing an adaptation strategy to comply with the New Climate Law and to implement measures that can adapt these municipalities and avoid a higher risk in face of climate change.

As for the municipalities that do have adaptation strategies, most of the documents were approved in 2016 and 2017. This also derives from the ClimAdaPT.Local network, which took place between January 2015 and December 2016. Of the 6 strategies approved in 2016, 4 were from municipalities that participated in this network, and from the 3 strategies approved in 2017, 2 were also from participating municipalities.

The fact that some municipalities have strategies that are not on a municipal/individual level is a concern, mainly because it means these documents are not as specific as they ought to be, since it is only considered the role of the municipality when integrated into an intermunicipal community or in a metropolitan region.

As such it is necessary that these municipalities adopt adaptation strategies on a municipal scale, making them more specific and in accordance with local problems and with common solutions led by the different stakeholders that are relevant to the municipality while ensuring active participation throughout the whole process.

The information from the results allows concluding that municipalities have an overall knowledge of the concept of NBS and GI, and adaptation options that fall into this later concept are

included in all strategies. This will ensure that there is less risk for damages in the municipalities, either on a social, environmental, or economic point – which can also be interconnected.

However, the results concerning CBA are not optimistic. A big percentage of municipalities have no knowledge of this concept and did not include it in the adaptation strategy.

As mentioned in the introduction chapter, the participation of the community is a huge part in the success of climate change adaptation. The community can contribute with different knowledge and that can contribute to better solutions to the problems.

Therefore, there is a knowledge gap in Portuguese coastal municipalities regarding CBA. It must be addressed to succeed in the adaptation strategies and consequent adaptation measures that come from it.

2.6 Conclusion

This research had the main purpose of addressing climate change adaptation strategies at a local scale, using Portuguese coastal municipalities as a case study. Moreover, this research also aimed to understand the inclusion of the local communities in the elaboration of these strategies.

From the questionnaire sent to the coastal Portuguese municipalities, it was possible to understand that most municipalities have climate change adaptation strategies implemented or in development (86,7% of the inquired municipalities). For the municipalities that do not have strategies, the main reason given was the lack of human resources to work on this document.

This can also be connected to the evaluation made by the European Commission in 2018, regarding the member-states adaptation preparedness. For Portugal's fiche, it was assessed that few adaptation plans were moving onto the implementation stage - with this being the weakest part of the process, along with monitoring and evaluating policies (European Commission, 2018).

It was also concluded that there is a deep knowledge of nature-based solutions and green infrastructure by the municipalities, with most adaptation strategies having adaptation options and measures that reference these notions.

However, a concerning conclusion was made through the results obtained - most coastal municipalities in Portugal have little knowledge of the concept of community-based adaptation. In fact, because it is such a recent concept, there are still not many scientific articles published on this topic, with most of them being studies regarding the indigenous population and their knowledge of nature (Ford et al., 2018; Nalau et al., 2018; Bronen et al., 2020).

The engagement of the community in local processes is essential for the success of public policies. This is also applied to climate change adaptation since the different local stakeholders have knowledge of different themes, which can contribute to solutions that better serve the community.

As such, it is important to invest in the education of the local public administration regarding CBA, to ensure the engagement of people in the decision-making process. In this process, it would be relevant to include stakeholders such as R&D and universities, as well as companies and the community as well (Forsyth, 2013).

This can be done through short-term mandatory courses or seminars aimed mainly at employees that work directly with these policies or, ultimately, through law enforcement – as a more serious measure required by the executive power.

One example of the engagement of the local community in climate change adaptation in Portugal is the PLAAC-Arrábida Project. In this project, three municipalities, with the coordination of one energy agency, and the collaboration of two Universities and their local stakeholders, have successfully developed three local climate change adaptation strategies. Over the course of 15 months, all parties continuously collaborated in three different meetings, and five different workshops, to discuss which local community members should also be considered for this cooperation, to identify the main areas at risk, to elaborate the specific actions and measures for climate change adaptation and, finally, to choose the most relevant ones for their specific territory.

This project, and the results obtained throughout this research, exhibit the importance of community participation for the success of climate change adaptation at a local level, and should, therefore, be a driver to all coastal communities worldwide. Thus, it is crucial that more CBA studies are done, to consolidate a framework for its use in different places and communities, globally.

3

CONCLUSION OF THE DISSERTATION

3.1 Final summary

This research aimed to analyse climate change adaptation at a local level, due to its importance at this scale, where adaptation options have a bigger impact. For this research, the study area was composed of the Portuguese coastal municipalities – including the municipalities in the Azores and Madeira islands. This also made it possible to compare the progress in the implementation of these strategies to the new Climate Law, which requires municipalities to have either a municipal strategy or be included in a regional adaptation strategy until 2023.

Through the inquiry made to these municipalities, it was possible to verify that 86,7% of the Portuguese coastal municipalities either have implemented an adaptation strategy or have the document in development. Similarly, it was possible to verify the influence of ClimAdaPT network, with several municipalities having adaptation strategies due to their participation in this network. This network aims to capacitate municipalities to local adaptation to climate change, and as such several Portuguese municipalities are informed and experienced in climate change adaptation and its measures.

Moreover, this research also sought to study the inclusion and knowledge of municipalities of three key adaptation concepts: nature-based solutions, green infrastructure, and community-based adaptation.

Most Portuguese municipalities have sufficient knowledge of nature-based solutions and green infrastructure, which are two concepts that are well interconnected. As such, most adaptation strategies mention nature-based solutions, and all the strategies from municipalities that answered the inquiry include options that contemplate green infrastructure.

One of the NBS adaptation measures which gather more focus from municipalities is the recovery of waterlines. As for the GI options, most municipalities are focused on reinforcing green spaces and rehabilitating streams and associated riparian galleries.

For the concept of community-based adaptation, nearly all municipalities did not include this concept in their adaptation strategy. However, three municipalities did, mainly by including adaptation options proposed by the local community in the strategy.

Regarding the motives for not including CBA measures in the strategy, municipalities justified it by having active participation, being unaware of CBA's utility, and not considering the need for it in the adaptation strategy.

It is possible to conclude that the municipalities inquired are not aware of the CBA concept and its importance, especially for the success of climate change adaptation at a local level.

As such, it is important to invest in the education of the local public administration regarding community-based adaptation, to ensure the engagement of people in the decision-making process. This can be done through short-term mandatory courses or seminars aimed mainly at employees that work directly with these policies or, ultimately, through law enforcement – as a more serious measure required by the executive power.

One example of the engagement of the local community in climate change adaptation in Portugal is the PLAAC-Arrábida Project. In this project, three municipalities, with the coordination of one energy agency, and the collaboration of two Universities and their local stakeholders, have successfully developed three local climate change adaptation strategies. Over the course of 15 months, all parties continuously collaborated to discuss which local community members should also be considered for this cooperation, to identify the main areas at risk, to elaborate the specific actions and measures for climate change adaptation and, finally, to choose the most relevant ones for their specific territory.

Throughout this study it was possible to conclude that both the Azores and Madeira islands have some weaknesses when in comparison to mainland Portugal. During the consultation of climate change adaptation strategies, it was possible to gather that 95% and 91% of the municipalities in these regions do not have adaptation strategies published, or available for online consultation. This is the higher percentage out of all the Portuguese NUTS II.

Regarding the answers to the questionnaires, the same trend was detected. For the Azores' municipalities that answered the questionnaire most of them answered their strategy was in the development stage. As for the Madeira's municipalities, there wasn't a high percentage of response. Out of all the responses from this region, 2 mentioned their strategies were in development, while the other answered they did not have a strategy.

3.2 Future developments

This research was based mainly on a questionnaire to coastal municipalities in Portugal, however, there is room for improvement in several aspects.

Future developments for this study should contemplate interviews with the coastal municipalities about climate change adaptation strategies, which would allow for better results for each coastal municipality.

Other future step could be augmenting the scale of the research to every Portuguese municipality, including the interviews mentioned above.

It would also be beneficial to include some other aspects in the questionnaire, such as the existence of an environmental department and the number of employees of the department responsible for elaborating the strategy. This would allow for the thematic to be fully understood by the person answering the questionnaire, and it would also lead to better and more complete answers and, consequently, for improved results.

Another future development for this research should include a study of what the climate change strategy had planned to implement and what adaptation options and measures are effectively implemented in the municipality.

3.3 Limitations

One of the main limitations of this dissertation was the lack of response from the municipalities, even after multiple urgings.

The sample of municipalities obtained is approximately half of the coastal municipalities in Portugal and considering the half that did not respond more results could affect the overall results widely. As explored in the discussion of the dissertation, this derives mainly from the lack of human resources, especially in regions like Algarve and the islands. It is also concerning that one of the municipalities that responded to the inquiry only has an environmental department as recently, since the environment and its protection is crucial for the well-being of populations and to diminish the risk in face of extreme phenomenons caused by climate change. Therefore, there must be a collective effort concerning human resources in environmental departments in public institutions, at a local level.

Other limitation occurred during the consultation of climate change adaptation strategies. Some municipalities' websites had the strategies available, whereas others were more difficult to find. A similar thing happened when searching for more specific contacts to send the questionnaire to - some municipalities had several e-mail addresses, for different departments, available, while others only provided the general institutional e-mail address. This made more difficult to obtain both results.

Despite these limitations, the obtained results allowed for the understanding of how the Portuguese coastal municipalities are currently, and successfully, developing climate change adaptation strategies. Even though the CBA concept is still far from being as universally well-known as NBS and GI, there are still some great Portuguese examples of community engagement while elaborating climate change adaptation strategies - such as the Lisbon Metropolitan Area Metropolitan Plan for

Climate Change Adaptation, as well as the Arrábida Local Plans for Climate Change Adaptation. These examples should, therefore, be the main driver and inspiration for municipalities and regions world-wide, while elaborating their own strategies.

4

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5

ANNEXES

5.1 Email sent to the municipalities' e-mail address, to answer the questionnaire

Exmos. Senhores,

No âmbito da dissertação de Mestrado Integrado em Engenharia do Ambiente da FCT NOVA, pretende-se compreender em que fase de implementação se encontram as Estratégias Municipais de Adaptação às Alterações Climáticas (EMAAC) junto dos Municípios do litoral de Portugal Continental, bem como nos Municípios das Regiões Autónomas.

Deste modo, peço por favor que dispensem um pouco do vosso tempo, até dia 31 de Agosto, para responder ao seguinte inquérito, sobre Estratégias Municipais de Adaptação às Alterações Climáticas: https://docs.google.com/forms/d/e/1FAIpQLSchA9jcOYtMnatnjZ9mLwyCm14Ip2mF7NHOVABdjHz3drU7Gw/viewform

Muito obrigada pela atenção.

Margarida Ramalho

5.2 Questionnaire to the Portuguese coastal municipalities

Estratégias Municipais de Adaptação às Alterações Climáticas

No âmbito da dissertação de Mestrado Integrado em Engenharia do Ambiente pretende-se compreender em que fase de implementação se encontram as Estratégias Municipais de Adaptação às Alterações Climáticas (EMAAC) junto dos Municípios do litoral de Portugal Continental, bem como nos Municípios das Regiões Autónomas.

Pretende-se ainda entender a contribuição das Infraestruturas Verdes e Soluções de Base Natural nas referidas estratégias.

Obrigada pela sua atenção.

Para qualquer dúvida, queira por favor contactar através de:
mf.ramalho@campus.fct.unl.pt

*Obrigatório

1. O Município tem uma Estratégia Municipal de Adaptação às Alterações Climáticas (EMAAC)? *

Marcar apenas uma oval.

- ◯ Sim *Avançar para a pergunta 3*
- ◯ Não

Se respondeu "Não" na questão anterior...

2. Porque razão não tem o Município uma Estratégia Municipal de Adaptação às Alterações Climáticas? *

Marcar tudo o que for aplicável.

- ☐ O documento está ainda em elaboração
- ☐ O processo de elaboração do documento está atrasado
- ☐ O documento ainda está em preparação, não tendo sido iniciada a sua elaboração
- ☐ Falta de financiamento
- ☐ Falta de envolvimento dos técnicos
- ☐ Dificuldade de envolvimento de stakeholders
- ☐ Outra: _____

Se respondeu "Sim" na questão anterior...

3. Em que ano foi aprovada a EMAAC? *

_____

4. Qual a escala desta Estratégia? *

Marcar apenas uma oval.

- ◯ Municipal
- ◯ Intermunicipal
- ◯ Outra: _____

5. Em que fase se encontra o documento referente à EMAAC *

Marcar apenas uma oval.

- ◯ Adjudicação *Avançar para a pergunta 8*
- ◯ Execução *Avançar para a pergunta 8*
- ◯ Concluída *Avançar para a pergunta 6*

Se respondeu "Concluída" na questão anterior...

6. A EMAAC está a ser executada? *

Marcar apenas uma oval.

- ◯ Sim *Avançar para a pergunta 7*
- ◯ Não *Avançar para a pergunta 8*

Se respondeu "Sim" na questão anterior...

7. Como? *

Marcar tudo o que for aplicável.

- [ ] Integração das opções de adaptação nos Instrumentos de Gestão Territorial (IGT) municipais
- [ ] Integração da EMAAC nos planos estratégicos do município
- [ ] Execução das medidas de adaptação
- [ ] Outra: _____

Avançar para a pergunta 8

Infraestruturas Verdes e Soluções de Base Natural

Infraestrutura verde é um conceito que se define como sendo "uma rede multifuncional de espaços verdes, planeados de forma estratégica e monitorizados por forma a fornecerem uma série de benefícios a nível ambiental, social e económico" (Ayele, 2021).

Já as soluções de base natural podem definir-se como soluções inspiradas
e apoiadas pela natureza, sendo uma solução de custo-benefício na medida em que oferecem, simultaneamente, benefícios ambientais, sociais e económicos e ajudam a construir resiliência (Ascenso et al., 2021).

8. A EMAAC faz menção a Infraestruturas Verdes? *

Marcar apenas uma oval.

- ◯ Sim *Avançar para a pergunta 9*
- ◯ Não *Avançar para a pergunta 10*

Se respondeu "Sim" na questão anterior...

9. Como? *

Marcar tudo o que for aplicável.

- [ ] Opções de adaptação que reforcem os espaços verdes
- [ ] Medidas de reabilitação das ribeiras e galerias ripícolas associadas
- [ ] Medidas específicas para a gestão do risco de cheias
- [ ] Promoção de soluções/iniciativas de sustentabilidade ambiental
- [ ] Estratégias inovadoras de sustentabilidade em meio urbano
- [ ] Outra: _____

Avançar para a pergunta 11

Se respondeu "Não" na questão anterior...

10. Porquê? *

Marcar tudo o que for aplicável.

- [ ] O Município desconhece a utilidade das Infraestruturas Verdes
- [ ] O Município não considerou a necessidade de Infraestruturas Verdes
- [ ] Outra: _____

11. A EMAAC faz menção a Soluções de Base Natural? *

Marcar apenas uma oval.

- ◯ Sim *Avançar para a pergunta 12*
- ◯ Não *Avançar para a pergunta 13*

Se respondeu "Sim" na questão anterior...

12. Como? *

Marcar tudo o que for aplicável.

- [ ] Projetos para espaços urbanos verdes no Município
- [ ] Projetos de restauro de ecossistemas (florestais, dunares, entre outros)
- [ ] Recuperação de linhas de água
- [ ] Outra: _____

Se respondeu "Não" na questão anterior...

13. Porquê? *

Marcar tudo o que for aplicável.

- [ ] O Município desconhece a utilidade das Soluções de Base Natural
- [ ] O Município não considerou a necessidade de Soluções de Base Natural
- [ ] Outra: _____

Comunidades de Adaptação

As comunidades de adaptação são comunidades que fornecem às populações locais as ferramentas para determinarem os objetivos, bem como as medidas de adaptação, aos problemas locais (Forsyth, 2017).

14. A EMAAC inclui Comunidades de Adaptação? *

Marcar apenas uma oval.

- ◯ Sim *Avançar para a pergunta 15*
- ◯ Não *Avançar para a pergunta 16*

Se respondeu "Sim" na questão anterior...

15. Como? *

Marcar tudo o que for aplicável.

- [ ] Através de opções de adaptação propostas pela população local
- [ ] Através de projetos sugeridos pela população local
- [ ] Através de projetos que envolvam a participação ativa da população local
- [ ] Outra: _____

Se respondeu "Não" na questão anterior...

16. Porquê?

Marcar tudo o que for aplicável.

- [ ] O Município desconhece a utilidade das Comunidades de Adaptação
- [ ] O Município não considerou a necessidade das Comunidades de Adaptação
- [ ] Outra: _____

5.3 Documental analysis

NUTS II	Municípios	Tem estratégias de adaptação?	Faz parte do ClimaAdaPT?	Inquérito respondido?	Nº municípios contactados	Sim	%	Não	%
Norte	Caminha	Não	-		9	5	56%	4	44%
	Viana do Castelo	Sim	Sim	Sim					
	Esposende	Sim	Não	Sim					
	Póvoa do Varzim	Não	-						
	Vila do Conde	Sim	Não	Sim					
	Matosinhos	Não	-	Sim					
	Porto	Sim	Sim	Sim					
	Vila Nova de Gaia	Não	-	Sim					
	Espinho	Sim	Não						
Centro	Ovar	Não	-	Sim	18	3	17%	15	83%
	Murtosa	Não	-						
	Aveiro	Sim	Não						
	Ílhavo	Sim	Sim	Sim					
	Vagos	Não	-	Sim					
	Mira	Sim, plano intermunicipal da região CIM de Coimbra	Não						
	Cantanhede								
	Figueira da Foz			Sim					
	Pombal	Não	-						
	Leiria	Sim	Sim	Sim					
	Marinha Grande	Não	-	Sim					
	Alcobaça	Sim, plano intermunicipal do Oeste	Não						
	Nazaré			Sim					
	Caldas da Rainha			Sim					
	Óbidos			Sim					
	Peniche								
	Lourinhã								
	Torres Vedras		Sim	Sim					
AML	Vila Franca de Xira	Não, plano AML	Não		16	3	19%	13	81%
	Loures	Não, plano AML	Não	Sim					
	Mafra	Sim + plano	Sim						
	Sintra	Não	-	Sim					

	Cascais	Sim, plano de ação	Não	Sim					
	Oeiras	Não, plano AML	-	Sim					
	Lisboa	Não, plano AML	-	Sim					
	Almada	Não, plano AML	-	Sim					
	Seixal	Não, plano AML	Não	Sim					
	Barreiro	Sim	Sim						
	Moita	Não, plano AML	Não						
	Montijo	Não, plano AML	Não						
	Alcochete	Não, plano AML	Não						
	Palmela	Não, plano AML	Não						
	Sesimbra	PLAAC Arrá-bida	-	Sim					
	Setúbal	PLAAC Arrá-bida	-	Sim					
Alentejo	Alcácer do Sal	Não	Não		6	2	33%	4	67%
	Benavente	Sim	Não						
	Grândola	Não	Não						
	Santiago do Cacém	Não	Não	Sim					
	Sines	Não	Não						
	Odemira	Sim	Sim						
Algarve	Aljezur	Sim, plano in-termunicipal do Algarve	Não		13	2	15%	11	85%
	Vila do Bispo		-						
	Lagos		-						
	Portimão		-						
	Lagoa		-						
	Silves		-	Sim					
	Albufeira		-	Sim					
	Loulé		Sim	Sim					
	Faro		Não	Sim					
	Olhão		-	Sim					
	Tavira		-	Sim					
	Castro Marim		-	Sim					
	Vila Real de Sto António		-						
Madeira	Calheta	Não	-	Sim	11	1	9%	10	91%
	Câmara de Lo-bos	Não	-	Sim					
	Funchal	Sim	Sim						
	Machico	Não	-						

	Ponta do Sol	Não	-						
	Porto Moniz	Não	-						
	Porto Santo	Não	-						
	Santa Cruz	Não	-						
	Santana	Não	-						
	São Vicente	Não	-						
	Ribeira Brava	Não	-	Sim					
	Região Autónoma	Sim	Não						
Açores	Corvo	Não	-		19	1	5%	18	95%
	Santa Cruz das Flores	Não	-	Sim					
	Lajes das Flores	Não	-						
	Horta	Não	-	Sim					
	Santa Cruz da Graciosa	Não	-	Sim					
	Velas	Não	-	Sim					
	Calheta	Não	-						
	Madalena	Não	-	Sim					
	São Roque do Pico	Não	-						
	Lajes do Pico	Não	-						
	Praia da Vitória	Não	-	Sim					
	Angra do Heroísmo	Não	-	Sim					
	Ponta Delgada	Não	-	Sim					
	Ribeira Grande	Não	-	Sim					
	Nordeste	Não	-						
	Lagoa	Não	-						
	Vila Franca do Campo	Sim	Sim						
	Povoação	Não	-	Sim					
	Vila do Porto	Não							
	Região Autónoma	Não tem EMAAC mas tem documentos que substitutem	Não						

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NOVA SCHOOL OF SCIENCE & TECHNOLOGY