



TransformAr

Accelerating and upscaling transformational adaptation in
Europe: demonstration of water-related innovation
packages

**Stakeholder matrix and Innovation
Ecosystems Baseline Profiles**

Deliverable 1.2



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TABLE OF CONTENTS

EXECUTIVE SUMMARY	9
INTRODUCTION	12
1.0 CITY OF LAPPEENRANTA, FINLAND	14
1.1 General Context General Context.....	14
1.1.1 Geographical Context.....	14
1.1.2 Demographic Context.....	16
1.1.3 Economic Context.....	18
1.2 Vulnerability & Key Observed and Projected Impacts.....	20
1.2.1 Territorial Scale.....	20
1.2.2 KCS Scale.....	21
1.3 Governance Baseline	22
1.3.1 National Scale	22
1.3.2 Territorial Scale.....	22
1.4 Response Measures	23
1.4.1 Knowledge Production	23
1.4.2 Participatory Governance & Awareness Raising efforts	24
1.4.3 Policies & Action Plans	24
1.4.4 Implemented Grey/Green Adaptation Measures	24
1.5 Key Stakeholders	25
2.0 WEST COUNTRY REGION, THE UNITED KINGDOM (UK)	30
2.1 General Context General Context.....	30
2.1.1 Geographical Context.....	30
2.1.2 Demographic Context.....	31
2.1.3 Economic Context.....	33
2.2 Vulnerability & Key Observed and Projected Impacts.....	34
2.2.1 Territorial Scale.....	34
2.2.2 KCS Scale.....	36
2.3 Governance Baseline	37



2.3.1 National Scale	37
2.3.2 Territorial Scale.....	37
2.4 Response Measures	38
2.4.1 Knowledge Production	38
2.4.2 Participatory Governance & Awareness Raising efforts	38
2.4.3 Policies & Action Plans	39
2.4.4 Implemented Grey/Green Adaptation Measures	40
2.5 Key Stakeholders	40
3.0 GUADELOUPE ARCHIPELAGO, FRANCE.....	42
3.1 General Context General Context.....	42
3.1.1 Geographical Context.....	42
3.1.2 Demographic Context.....	43
3.1.3 Economic Context.....	45
3.2 Vulnerability & Key Observed and Projected Impacts.....	46
3.2.1 Territorial Scale.....	46
3.2.2 KCS Scale.....	48
3.3 Governance Baseline	50
3.3.1 National Scale	50
3.3.2 Territorial Scale.....	50
3.4 Response Measures	50
3.4.1 Knowledge Production	50
3.4.2 Participatory Governance & Awareness Raising efforts	52
3.4.3 Policies & Action Plans	53
3.4.4 Implemented Grey/Green Adaptation Measures	54
3.5 Key Stakeholders	55
4.0 GALICIA REGION, SPAIN.....	59
4.1 General Context General Context.....	59
4.1.1 Geographical Context.....	59
4.1.2 Demographic Context.....	61
4.1.3 Economic Context.....	63
4.2 Vulnerability & Key Observed and Projected Impacts.....	65
4.2.1 Territorial Scale.....	65
4.2.2 KCS Scale.....	68
4.3 Governance Baseline	70



4.3.1 National Scale	70
4.3.2 Territorial Scale.....	70
4.4 Response Measures	71
4.4.1 Knowledge Production	71
4.4.2 Participatory Governance & Awareness Raising efforts	71
4.4.3 Policies & Action Plans	72
4.4.4 Implemented Grey/Green Adaptation Measures	72
4.5 Key Stakeholders	73
5.0 ORISTANO, ITALY	76
5.1 General Context General Context.....	76
5.1.1 Geographical Context.....	76
5.1.2 Demographic Context.....	78
5.1.3 Economic Context.....	79
5.2 Vulnerability & Key Observed and Projected Impacts.....	81
5.2.1 Territorial Scale.....	81
5.2.2 KCS Scale.....	83
5.3 Governance Baseline	84
5.3.1 National Scale	84
5.3.2 Territorial Scale.....	84
5.4 Response Measures	84
5.4.1 Knowledge Production	84
5.4.2 Participatory Governance & Awareness Raising efforts	85
5.4.3 Policies & Action Plans	85
5.4.4 Implemented Grey/Green Adaptation Measures	86
5.5 Key Stakeholders	86
6.0 CITY OF EGALEO GREECE	90
6.1 General Context General Context.....	90
6.1.1 Geographical Context.....	90
6.1.2 Demographic Context.....	92
6.1.3 Economic Context.....	93
6.2 Vulnerability & Key Observed and Projected Impacts.....	94
6.2.1 Territorial Scale.....	94
6.2.2 KCS Scale.....	96
6.3 Governance Baseline	97



6.3.1 National Scale	97
6.3.2 Territorial Scale.....	97
6.4 Response Measures	98
6.4.1 Knowledge Production	98
6.4.2 Participatory Governance & Awareness Raising efforts	98
6.4.3 Policies & Action Plans	98
6.4.4 Implemented Grey/Green Adaptation Measures	99
6.5 Key Stakeholders	99
OBSERVATIONS	102
REFERENCES	103
ANNEX: SUPPORT FIGURE(S) RELEVANT FOR ALL LDS	109

LIST OF FIGURES

Figure 0.1	TransformAr’s lighthouse demonstrators	12
Figure 0.2	Key Stakeholders Diagram.....	13
Figure 1.1	Lappeenranta’s boundaries within South Karelia in relation to Finland’s map	14
Figure 1.2	The Salpa Line in Rutola, 12 km west of Lappeenranta’s city centre	15
Figure 1.3	Winter snow-cover in Lappeenranta.....	16
Figure 1.4	Population of Lappeenranta 2000–2013 and forecast for 2030	17
Figure 1.5	Population Structure of Lappeenranta by age group in 2013	18
Figure 1.6	Unemployment rates in 2019 in Lappeenranta in contrast with other Finnish cities.....	19
Figure 1.7	GDP sector composition in Finnish regions (%) for 2016	19
Figure 1.8	Flooding in Lappeenranta on July, the 2 nd , 2019	20
Figure 1.9	Lappeenranta climate steps	22
Figure 1.10	Flood risk areas in Lappeenranta	23
Figure 2.1	Map of the West Country including the three catchment areas of Somerset Moors and Levels, the river Axe and the river Camel where development is stalled due climate change exacerbating water quality pressures	30
Figure 2.2	Representative photo of the West Country Region	31
Figure 2.3	Annual UK population growth rate mid-1970 to mid-2020 (left) & District and County population growth rate 2019 to 2020 (right)	32
Figure 2.4	The population of the South West (left), Exeter (centre) and West Devon (right) showing the demographics range of different areas.....	32
Figure 2.5	Unemployment rate across the South West for the last five years	33
Figure 2.6	Gross domestic product per capita in 2019 per region.....	33
Figure 2.7	Employee job by sector in Cornwall compared to the South West region and UK.....	34
Figure 2.8	Coverack 2017 flash floods.....	35
Figure 2.9	Risk to people from rivers and sea flooding.....	38
Figure 3.1	Guadeloupe Map and its location in the lesser Antilles.....	42
Figure 3.2	Cascade aux Ecrevisses in the Guadeloupe National Park	43
Figure 3.3	Demographic Pyramid: 2010 population census and 2020 population estimates	44
Figure 3.4	GDP sector composition in Guadeloupe	45
Figure 3.5	Photo from Météo France taken from "Brume de sable: an important episode affecting the Caribbean, Guadeloupe on red alert"	47
Figure 3.6	Banana plantation devastated by Hurricane Maria, in Capesterre-Belle-Eau	48
Figure 3.7	Damages as a result of Hurricane Maria at La Boucan à Sainte-Rose – Guadeloupe (2017)	50
Figure 4.1	Coastal Inlets (Rias) of Galicia.....	59
Figure 4.2	Cíes Islands – Galicia.....	60
Figure 4.3	Population density map of Galicia.....	62
Figure 4.4	The Demographic Pyramid of Galicia (Contrasted with the National Demographic Pyramid)	63
Figure 4.5	The Galician GDP Sector Composition.....	64
Figure 4.6	Total Fisheries Sector Employment in Europe	64
Figure 4.7	Wildfires 2017: top photo seen from the sea of fires. Bottom photo, satellite images show how the flames surrounded the urban area	66
Figure 4.8	Mussel raft stranded on a beach after loosening from its anchor due to a storm, 2016 .	69
Figure 4.9	Pieces of a mussel raft destroyed during a storm, stranded on a beach, 2015	69
Figure 5.1	Map of the territory of Oristano with a zoom on the wetland of the NBS Implementation	76



Figure 5.2 Key bird species: Purple Swamp-hen, Black-winged Stilt, Purple Heron 77

Figure 5.3 Oristano’s landscapes and cultural heritage: the lagune and coastal tower of Marceddi (left) and the archaeological remains of Tharros on the Sinis Peninsula (right) 77

Figure 5.4 Demographic Pyramid of 11 municipalities in the Gulf of Oristano Territory 79

Figure 5.5 The Sardinia GDP Sector Composition 80

Figure 5.6 Wildfires raging across Sardinia, 2021 82

Figure 5.7 Flood damages in Sardinia, 2020..... 82

Figure 6.1 Egaleo’s borders 90

Figure 6.2 Museum of Asia Minor Culture 91

Figure 6.3 Baroutadiko Grove 91

Figure 6.4 Mean Annual Temperature in Celsius, of Egaleo Area for historic period (1980-2004) and two IPCC climate scenarios (RCP4.5 & RCP8.5) 92

Figure 6.5 Demographic Pyramid of Western Attika..... 93

Figure 6.6 GDP Composition in Greece 94

Figure 6.7 Municipalities of West Attica under examination, drainage network and extent of past flooding phenomena; Flooding in Eleonas area 95

Figure 7.1 Map of observed and projected climate change and impacts for the main biogeographical regions in Europe..... 109

LIST OF TABLES

Table 1.1	List of key local stakeholders in Lappeenranta per type, sector, influence, motivation to take climate action and link with TransformAr
Table 2.1	List of key local stakeholders in West Country Region per type, sector, influence, motivation to take climate action and link with TransformAr
Table 3.1	List of key local stakeholders in Guadeloupe per type, sector, influence, motivation to take climate action and link with TransformAr.
Table 4.1	List of key local stakeholders in Galicia per type, sector, influence, motivation to take climate action and link with TransformAr.
Table 5.1	Population distribution per age groups in Oristano.
Table 5.2	List of key local stakeholders in Oristano per type, sector, influence, motivation to take climate action and link with TransformAr.
Table 6.1	List of key local stakeholders in Egaleo per type, sector, influence, motivation to take climate action and link with TransformAr.



EXECUTIVE SUMMARY

The impacts of climate change are already prevalent, affirmed – the new EU Strategy on Adaptation to Climate Change, underlining the need to intensify adaptation efforts and “build a more resilient tomorrow” (European Commission-EC, 2021). To address climate-related challenges, the Intergovernmental Panel on Climate Change (IPCC) and the European Commission (EC) have acknowledged the need for transformational adaptation. In response, the European project TransformAr has set itself the ambition to develop tools, methods, and products allowing to introduce and accelerate large-scale adaptation processes to increase the resilience of vulnerable regions and communities across Europe. In this context, the project seeks to demonstrate the potential of co-innovation process in adaptation through the building of 6 local Innovation Ecosystems (IEs) in selected lighthouse demonstrators (LDs). Concretely, the lighthouse demonstrators present a community or administrative jurisdiction (municipality, province, region etc.) collaborating to create favourable conditions and test actionable solutions for transformational adaptation.

For TransformAr, 6 LDs facing common water-related challenges have been selected to construct, test, and demonstrate transformational adaptation pathways. The 6 LDs retained for this project represent a variety of territorial scales as well as situations with regard to vulnerability and preparedness to climate change across the EU (including EU overseas territories). The LDs are the city of Lappeenranta (Finland), the West Country region (the UK), the Guadeloupe archipelago (France), Galicia region (Spain), Oristano (Italy) and the city of Egaleo (Greece).

For each lighthouse demonstrator, the report presents the general context by introducing an overview of geographical, social and economic information. It also sheds light on the territory’s climate vulnerability, , existing adaptation-relevant policy plans as well as response measures increasing the adaptive capacity of the demonstrator in question. Not to mention, the report introduces key actors that play a role in accelerating adaptation efforts via a stakeholders’ matrix developed for each LD, defining the influence of the territory’s actors and their role and their motivation to develop and implement transformational climate adaptation measures.

LIST OF ACRONYMS

ADEME	French Agency for Ecological Transition
AFD	French Agency for Development
ARPAS	Regional Sardinian Agency
BRGM	French National Geological Survey
C3AF	Climate Change and Consequences on the French Antilles project
CC	Climate Change
CCA	Climate Change Adaptation
CCI IG	Chamber of Commerce and Industry of Guadeloupe Islands
CCP	Cities for Climate Protection
CCRA	Climate Change Risk Assessment
COAST	Coastal Contract
CSO	Civil Society Organization
CTIG	Guadeloupe Islands Tourism Committee
DAAF	Regional Department of Food, Agriculture and Forest (Guadeloupe)
DEAL	Regional Department of the Environment, Planning and Housing
EC	European Commission
EU	European Union
GREC	Regional Group of Experts on Climate (Guadeloupe)
HAB	Harmful Algal Blooms
IBVA	Indicator-based Vulnerability Assessment
IEs	Innovation Ecosystems
ISTAT	Italian Institute for Statistics
INSEE	French National Institute of Statistics and Economic Studies
INRAE	French National Institute for Research for Agriculture, Food and the Environment
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
KCS	Key Community Systems
LDs	Lighthouse Demonstrators
MOE	Municipality of Egaleo
NAS	National Adaptation Strategy

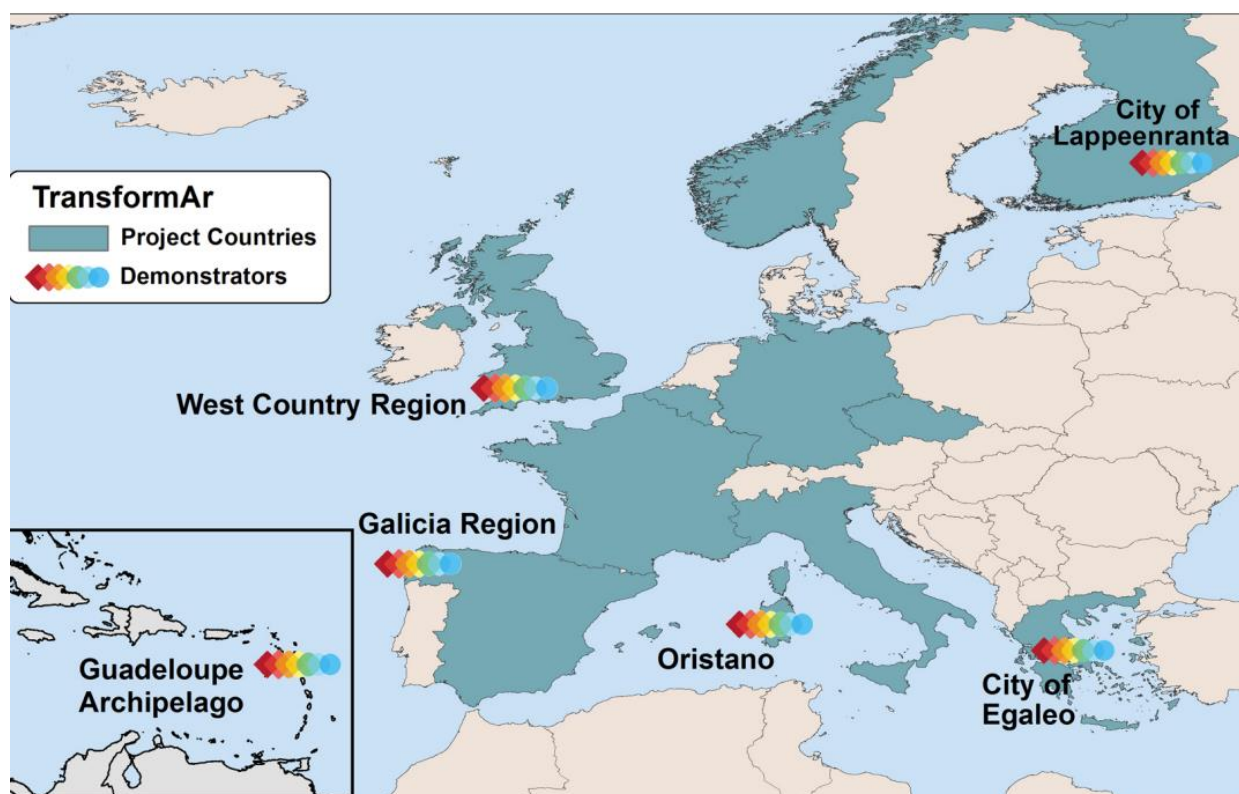
NBS	Nature-Based Solutions
OCCAP	OECS Climate Change Advisory Panel
OECS	Organization of Eastern Caribbean States
OREC	Regional Observatory for Energy and Climate (Guadeloupe)
PAI	Hydrological Management Plan
PPG	Planning Practice Guidance
PVD	Small Towns for Tomorrow (Petite Ville de Demain)
SCI	Site of Community Interest
SECAP	Sustainable Energy and Climate Action Plan
SPAs	Special Protection Areas for birds
SSSI	Sites of Special Scientific Interest
SRACC	Regional Climate Adaptation Strategy (Italy)
SRCAE	French regional scheme of climate, air and energy
TEPCV	Positive Energy Territories for Green Growth
UK	United Kingdom
WWF	World Wide Fund for Nature

INTRODUCTION

The TransformAr project seeks to accelerate transformational adaptation across Europe and to demonstrate the potential of co-innovation process in adaptation through the building of local Innovation Ecosystems (IEs) in selected lighthouse demonstrators (LDs). The latter is defined as an administrative jurisdiction (municipality, province or region) or a community collaborating in the H2020 project to create favourable conditions and test transformational adaptation actionable solutions. The adopted methodology, focusing on various LDs allows for the sharing of knowledge and beneficial experiences and for the replication of best practices. The idea behind this approach concentrates on supporting a variety of cases, to identify common challenges and barriers to transformational adaptation, leverage points, as well as promising solutions. The conclusions to be drawn from this project could serve to replicate and scale up transformational adaptation solutions in Europe and, eventually at an international scale.

To reach the stated objectives and to develop, test and demonstrate tools, methods, and services, TransformAr considers 6 LDs (mapped in Figure 0.1) including: the city of Lappeenranta (Finland), the West Country region (the UK), the Guadeloupe archipelago (France), Galicia region (Spain), Oristano (Italy) and the city of Egaleo (Greece).

Figure 0.1 TransformAr's lighthouse demonstrators



In TransformAr, the 6 LDs, facing common water-related challenges, were chosen for their geographical location and diversity in respect to climate conditions, climate risks, socio-economic conditions and climate action.

This reports seeks to identifies the particularities of each LD, through presenting for every territory the general context with information on the territory's geography, demography and economy and presents the relevance of this information from a climate perspective. It also identifies, based on a literature review, the territory's vulnerability and key observed and projected impacts, and presents the governance baseline as well as the developed response measures to overcome the ramifications of

climate change at a territorial scale. To add to that, the report maps and identifies, for each demonstrator, key stakeholders, and presents them in matrixes determining the actors' type, sector, influence, motivation to take climate action as well as the stakeholders' possible contribution to TransformAr and how the project could benefit them. The diagram below presents the different types of actors considered as key for the acceleration of transformation adaptation efforts at a territorial scale and was produced to help map key stakeholders in each LD.

Figure 0.2 Key Stakeholders Diagram

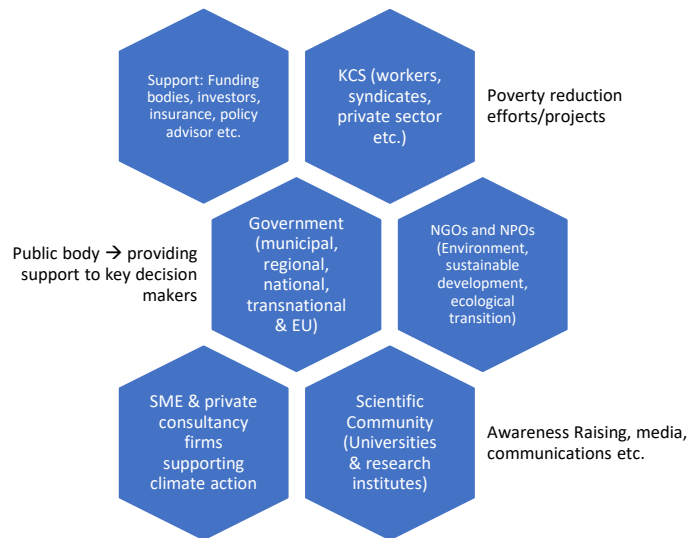


Diagram identifying various categories of key local stakeholders that play a role in accelerating transformational adaptation - Developed by Rim Khamis (ACTERRA Consulting).

The compilation and synthesis of all available information, concerning climate change, relevant socio-economic data, impacts and risks, will help estimate the need to produce specific climate data to bridge knowledge gaps. It will also allow to identify areas that require focus and successful initiatives at a territorial scale which permits to guide the efforts of decision makers to accelerate transformational adaptation.

1.0 City of Lappeenranta, Finland

1.1 General Context General Context

1.1.1 Geographical Context

Lappeenranta (61-06°N, 28-19 °E) is a Finnish city covering an area of 1,724 km² situated in the region of 'South Karelia' (aka. Etelä-Karjala) on the south-eastern frontier of Finland, 30 kilometres away from the Russian border. The city is located on the shores of Lake Saimaa, which is the biggest lake in Finland and the fourth biggest lake in all of Europe. Because of that, Lappeenranta is considered one of the major urban centres in the Saimaa region. The city's main water intake is the lake water, which a decade ago was polluted by the proliferation of algae. To address the issues, a pollution control station, designed by Lappeenranta University of Technology and built by a local company, cost the city around 2.5 million euros (LCI, 2021). Since, water conservation has been a major area of interest for the city.

The city centre is located on the First Salpausselkä ridge, which is an ice-marginal formation laid down by the last Ice Age. Salpausselkä is mainly formed of sand and gravel and holds massive reserves of high-quality groundwater. During the last Ice Age, the continental ice sheet and meltwaters have also shaped the rocky geosites of the area.

Figure 1.1 Lappeenranta's boundaries within South Karelia in relation to Finland's map



Lappeenranta has historical buildings and monuments as well as historical objects and dwelling sites from the stone age. There are five Natura2000¹ areas in Lappeenranta.

Built cultural heritage sites of national significance represent the development stages of the country and are reflectors of history. These sites should be taken into account in planning as they can restrict the implementation of stormwater management asserted the city of Lappeenranta in its Stormwater Management Plan (2021). These sites could be for instance churches, the industrial environment of Kaukas, the Saimaa channel, the residential areas of Kanavansuu and Mälkiä.

The city also accommodates the Salpa Line- a 1,200 km long bunker line on the eastern border of Finland- constructed after the Winter War in 1940-1944. Today, the Salpa Line (Figure 1.2) serves as a tourist attraction.

Figure 1.2 The Salpa Line in Rutola, 12 km west of Lappeenranta's city centre



Source: VisitLappeenranta. (n.d.). Retrieved December 10, 2021, from <https://www.visitlappeenranta.fi/en/Experience/Sights-and-history/The-Salpa-Line-fortifications>.

According to the Köppen climate classification, Finland has a continental subarctic/boreal climate and Lappeenranta has a southern-boreal climate. The city's climate is influenced by Salpausselkä, the lake areas of Saimaa and Laatokka (in Russia) and the Gulf of Finland.

Typical of the city's climate are four distinct seasons, each season lasting approximately three months. In Lappeenranta, winter is longer than summer. Precipitation has an annual average of 614 millimetres of which 40-50 % usually falls as snow. The snow cover typically melts in April and May which can contribute

¹ A network of natural protected areas in the EU made up of Special Protection Areas and Special Areas of Conservation under the Birds Directive and the Habitats Directive, respectively.

to flooding. In this context it is important to underline that the meltwaters are recognised to consist of large amounts of nutrients and heavy metals.

Figure 1.3 Winter snow-cover in Lappeenranta



In Lappeenranta, the annual average temperature is around 5°C. The coldest months are January and February (with average temperatures between -7.5 and -9°C) and the warmest month is July having an average temperature of +17 °C.

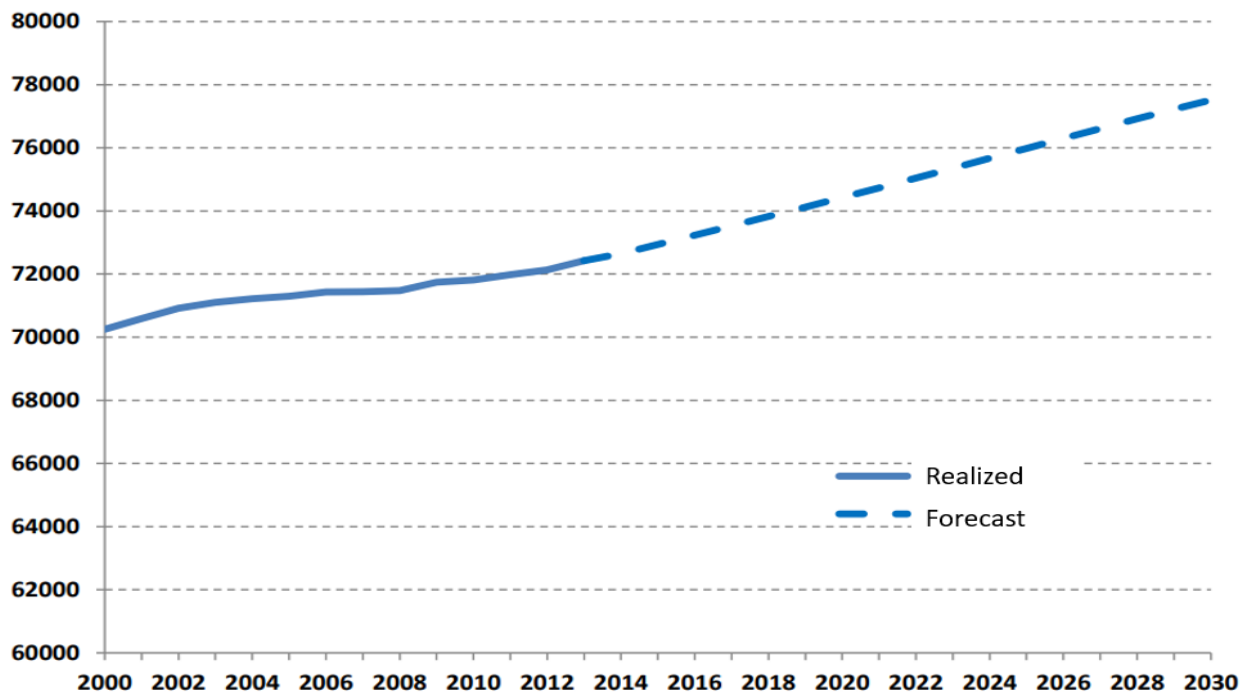
1.1.2 Demographic Context

Demographic changes could increase the territory's sensitivity to climate impact; i.e., an ageing population could be more vulnerable to climate change, or, a significant population growth could increase the pressure on the environment. Therefore, the Innovation Ecosystem (IE) baseline profile pays an attention to the demographic context.

In Finland, the population growth is witnessing a decreasing trend. According to Statistics Finland's population forecast, if birth rates remain at current levels, in 15 years' time there will be no province in the country in which more people will be born than deceased. With the current trend, the population of Finland is expected to start declining in 2031 and is expected to decrease by 100,000 people by 2050.

According to Finland's Environmental Institute, in urban settlements, in 2016, the population density was on average 1053 inhabitants per square kilometre. In densely populated areas, the functions are located close to each other and are easily accessible, which reduces the costs and environmental impact of daily travel and freight transport asserts the Finnish environmental institute. This underlines the benefits of developing denser urban environments and raises related issues such as the degradation of the environment in dense urban areas.

Figure 1.4 Population of Lappeenranta 2000–2013 and forecast for 2030



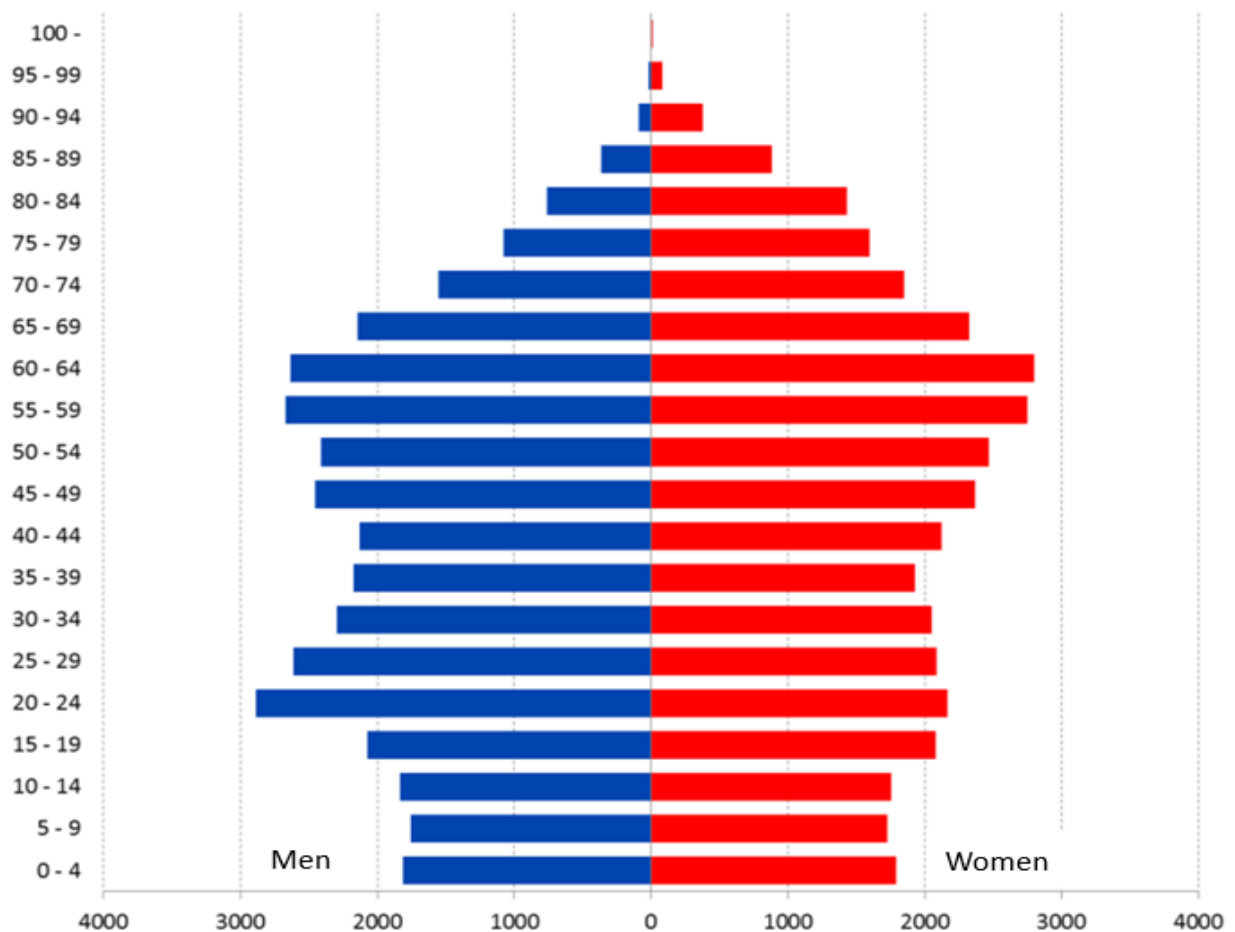
Population growth in Lappeenranta. Source: Population Forecast of Lappeenranta, 2014.

As portrayed in the figure above (Figure 1.4), Lappeenranta is home to 74,000 inhabitants approximately. Between 2001 and 2012, the population growth was averaged to 153 person/year. Even though the population in Lappeenranta is slowly growing, the natural population growth in Lappeenranta is negative, as the younger age groups are outnumbered by older age groups. This is problematic as, on one hand, the negative population growth is resulting in an ageing population that is more vulnerable to climate change. On the other, the decrease in population growth could present an opportunity to reduce the pressure on the environment.

In the city, the precondition for population growth is migration, which in turn requires a positive increase in the number of jobs. According to the Population Forecast (2014), as a university city, Lappeenranta has the possibility to attract young people to settle in. In recent years, the number of immigrants has increased with about 300 foreign residents annually. It is likely that this phenomenon will increase, and that internationalization will become even more pronounced in the city’s demographics.

The demographic pyramid (Figure 1.5) illustrates that adults between ages 20 and 74 represent approximately 70 % of the population. According to the Population Forecast (2014), in Lappeenranta, as elsewhere in Finland, the population structure will change with an anticipated increase of the number and proportion of elderly. The situation is critical as this population represents the one that is most vulnerable to climate change due to their reduced mobility (e.g., inability to move quickly following climate-related events such as floods), and their increased susceptibility to diseases and health complications (especially those with underlying health conditions). In the oldest age groups (above 70) women present a larger share of the population than men. In this context it is nevertheless important to underline that Finland is a world’s leading country and pioneer in gender equality which limits the increased vulnerability of women accentuated by gender inequality.

Figure 1.5 Population Structure of Lappeenranta by age group in 2013



Source: Population Forecast of Lappeenranta, 2014.

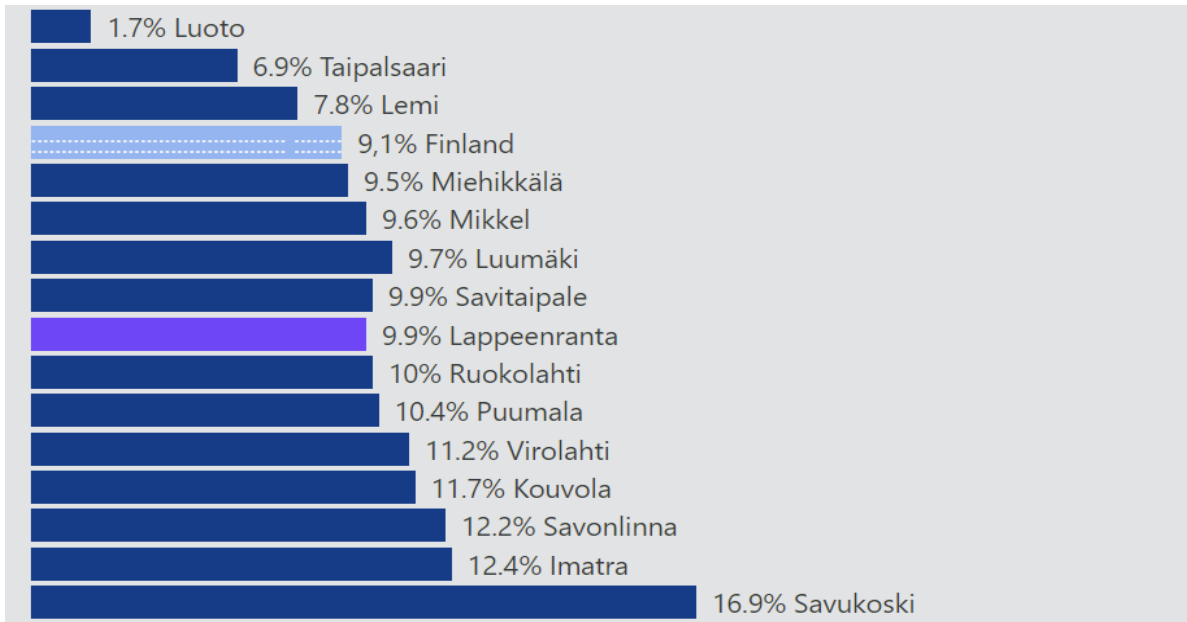
1.1.3 Economic Context

In Finland, between 2010 and 2020, unemployment rates reached a peak (9.6%) in 2015, and since then decreased steadily to 6.8% in 2019 (Clausnitzer, 2021). In 2020, the unemployment rate in the country stood at 7.9%. The stagnation of employment opportunities during this year (2021), leading to an increase of the unemployment rate by 1.1% (in comparison to 2019) could be linked to the Covid-19 sanitary crisis.

In October 2021, the unemployment rate of Lappeenranta stood at 9,9% according to figures of the Ministry of Economic Affairs (Savolainen, 2019) . This percentage is somewhat higher than the national unemployment average (9.1%) which could underline an increased sensitivity of the territory from a climate perspective, given that underprivileged people could be more vulnerable to the impacts of climate change. Concretely, people with lower income are likely to have fewer resources to adapt their dwellings to climate events (e.g., thermal insulation, adequate cooling/heating) and less access to information (low awareness and low preparedness to prepare for and avoid climate impacts).

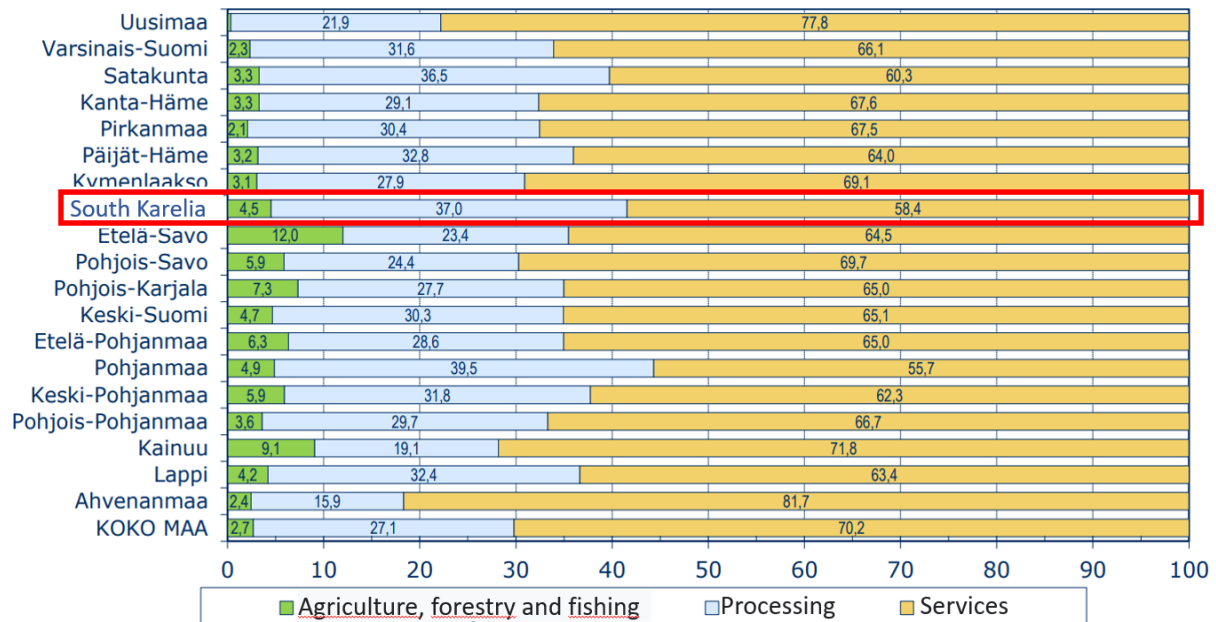
The figure below (Figure 1.6) puts the unemployment rates in Lappeenranta in perspective with the unemployment rates of other Finnish cities.

Figure 1.6 Unemployment rates in 2019 in Lappeenranta in contrast with other Finnish cities



Source: Savolainen, P. (2019, April 27). Lappeenranta. Valitse kotikunta. Retrieved December 10, 2021, from <https://kotikunta.fi/lappeenranta.php?a=5677>.

Figure 1.7 GDP sector composition in Finnish regions (%) for 2016



Source: Ministry of Economic Affairs.

The figure above (Figure 1.7) shows that in South Karelia (the region in which Lappeenranta is situated) services accounted for 58.4% of the GDP in 2016, industry (processing) constituted 37% of the GDP, whereas the primary sector (agriculture, forestry and fishing) accounted for 4.5%. The results underline the importance of the secondary sector in the area, especially in comparison to other Finnish regions.

For TransformAr, the key community systems (KCS) that were retained are water quality protection as well as flood and stormwater load prevention. Increased loads containing nutrients, organic and solid materials are especially harmful for the sensitive, shallow and isolated waterbody of Lake Saimaa. It remains crucial to increase the resilience of the KCS to climate change as Lake Saimaa is the main source of the drinking water for the city, not to mention that the lake is a valued touristic attraction.

1.2 Vulnerability & Key Observed and Projected Impacts

This section presents an overview of climate vulnerability and impacts at the scale of Lappeenranta with a particular focus on KCS that were briefly presented in the section above (Water quality protection and flood & stormwater load prevention).

1.2.1 Territorial Scale

According to EEA (2017), Lappeenranta, located in the Boreal region, is likely to be impacted by an increase in heavy precipitation events. Water and the number of days with precipitation are expected to increase in wintertime. Substantial amounts of storm water have a negative influence on the quality of the lake water and increase damage risk from heavy rainfalls. The territory is also likely to deal with a decrease in snow as well as lake and river ice cover. For example, in January and February 2020, the average temperature remained at $-0,6^{\circ}\text{C}$, as a result, no permanent snow cover was observed throughout winter. Whereas, on July the 2nd, 2019 a five-kilometre-wide thunder front crossed the city accumulating an average of 43.4 mm of precipitations and causing severe flooding of the city centre.

Figure 1.8 Flooding in Lappeenranta on July, the 2nd, 2019



Mauri Backman©

In this context it is important to mention that the severe flooding of Valapato -which took place in the summer of 1899- caused the surface of the lakes to rise by more than 2.5 metres than the norm. This event raised the alert of concerned actors. As a result, the Hydrographic Office (the predecessor of the Finnish Environment Institute) was established and Finland was the first to systematically measure water levels.

In Lappeenranta various factors are increasing the territory's vulnerability to climate change, notably the city's stormwater management and urban planning.

According to Saarelainen (2006), the main drainage system in an urban area is normally the storm drain, which is located under the streets with inlets from the pavement. The pipelines should be capable of transmitting accumulated flow caused by climate change, but the capacity of most of the pipelines in Lappeenranta is already full. The infrastructure has been designed for prevailing conditions, not taking into account climate projections. The capacity of the existing drainage is thus not capable of processing increased precipitation in light of climate change which increases flood events and risks. Overflow routes should therefore be well-designed to minimise the damage². Stormwater management should also consider other solutions rather than the mere discharge of precipitation into drains, such as decentralised methods and Nature-based solutions (NBS).

In urban planning more attention should be paid to identifying areas that are vulnerable to flooding and setting regulations as well as restricting construction in these risk areas (Ala-Outinen et al, 2004). As Lappeenranta is located in groundwater area, the absorption of stormwaters into aquifers is crucial. Urban planning should thus stress the importance of increasing green areas to limit flood risks, specially that climate change is expected to increase the amount and intensity of rainfall in Europe (JRC Scient Policy Report, 2020).

In light of climate change, some opportunities may arise at the scale of Lappeenranta, including the increase of water availability as well as an increase in forest growth, crop yields and the potential of tourism due to milder weather conditions. This is important to underline as adaptation is not solely about increasing the resilience of the territory in the face of shocks and stresses but also entails profiting from opportunities that are likely to arise (Burch & Harris, 2014).

1.2.2 KCS Scale

For Lappeenranta, the KCS (representing the territory's viable sectors and systems and the ones that are most vulnerable to climate impacts) that were retained are water management and urban planning. These KCS seem to be vulnerable to climate change.

I- WATER MANAGEMENT

Climate change impacts on water in Lappeenranta could create new water-related challenges and exacerbate existing ones in light of changing rainfall seasonality, climate variability and extreme weather events. This is likely to have a series of ramifications on a range of economic sectors that depend and rely on water such as tourism, industry, agriculture, among others. Not to mention, water quality could be affected as heavy rainfall could lead to the dilution of polluted water, which makes treating it more challenging and requires more costly and energy-intensive technologies. Therefore, addressing water issues and ensuring a sound water management is crucial for the city of Lappeenranta.

II- URBAN PLANNING

As the city of Lappeenranta is one of the major urban centres in the Saimaa region, urban planning needs to consider and adapt to climate change. Water from melting snow and flood water bring contaminants (e.g., oils, chemicals, microplastics, as well as organic and solid matters) which are likely to decrease the

² If overflows are not properly designed, they could cause additional damage to the environment such as being an important source of pollution.

quality of water in the city and the lake. An adaptive urban planning could be a key to solve these issues and improve the living conditions of Lappeenranta’s citizens.

1.3 Governance Baseline

1.3.1 National Scale

Finland is a republic with an elected president as well as a parliament with a cabinet and a prime minister. The country has a great history of multi-party politics, where no single party taking majority control for long. Due to decentralization, local authorities have a significant amount of autonomy and responsibility. Finland started preparing a national adaptation strategy (NAS) in 2003 as a collaborative effort between the Ministry of Environment, the Ministry of Agriculture and Forestry, and representatives from the Ministry of trade and industry, the Ministry of traffic and communications, the Ministry for foreign affairs, and the Ministry of social affairs and health. Each ministry worked on identifying impacts and sector-based measures. The Finnish Environment institute as well as the Finnish Meteorological Institute also took part in the preparation of the NAS.

The country’s National Climate Change Adaptation Plan 2022 was published in 2014. A mid-term evaluation was published in April 2019 and the new National Adaptation Plan is currently in preparation (Ministry of Agriculture and Forestry).

1.3.2 Territorial Scale

Figure 1.9 Lappeenranta climate steps

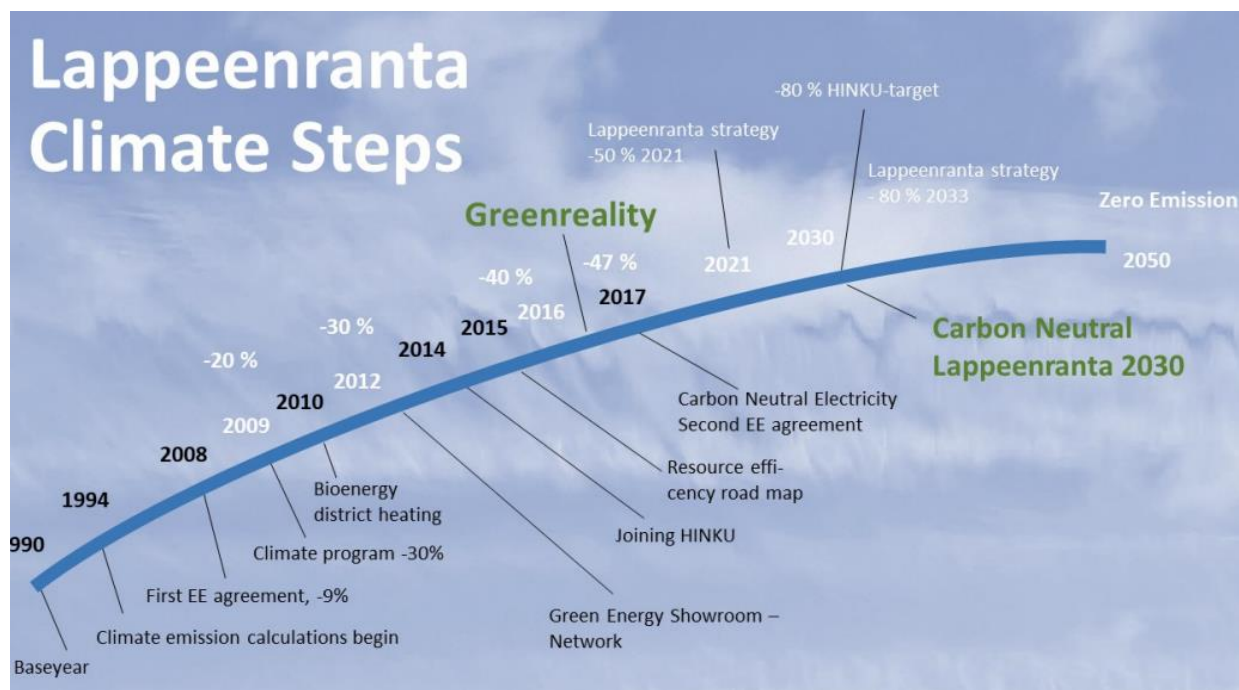


Figure presented by Ilkka Räsänen Environmental Director of Lappeenranta to inform the city’s application to the European Green Leaf award.

The city of Lappeenranta developed a climate programme in 2009 declaring its intention to reduce its emissions by -30% (considering 1994 as a baseline year). In 2016 “Greenreality” – an ecological reflection, knowledge, responsible choices and actions for a sustainable future as a result of collaborative efforts with communities, residents and businesses- was founded.

The city committed to conducting a Sustainable Energy and Climate Action Plan (SECAP) when joining the Covenant of Mayors in 2016. Climate change risks and adaptation in the city of Lappeenranta were included in the city’s SECAP. The city’s vulnerability was assessed using Indicator-based Vulnerability

Assessment (IBVA) method. Additionally workshops were organised in Lappeenranta - bringing together experts from different organizations of the city- to feed the conducted assessments. In its SECAP, the city of Lappeenranta (2020) defined its priorities in terms of adaptation and underlined the importance of securing water supply, rainwater management, regional security management, and securing the green and forest network. To secure its water supply, the city suggests the protection of groundwater areas as part of land use planning. To reduce the impact of future floods and heavy rains, the measures proposed in the SECAP (City of Lappeenranta, 2020) suggest different water retention, evaporation and absorption methods, such as the installation of green roofs, the addition of sand beds and the permeabilization of asphalt areas. To add to that, to ensure the operation of road traffic and transport, a contingency plan for emergencies traffic disruptions, road damage and flood risks on the road are being prepared by the city of Lappeenranta.

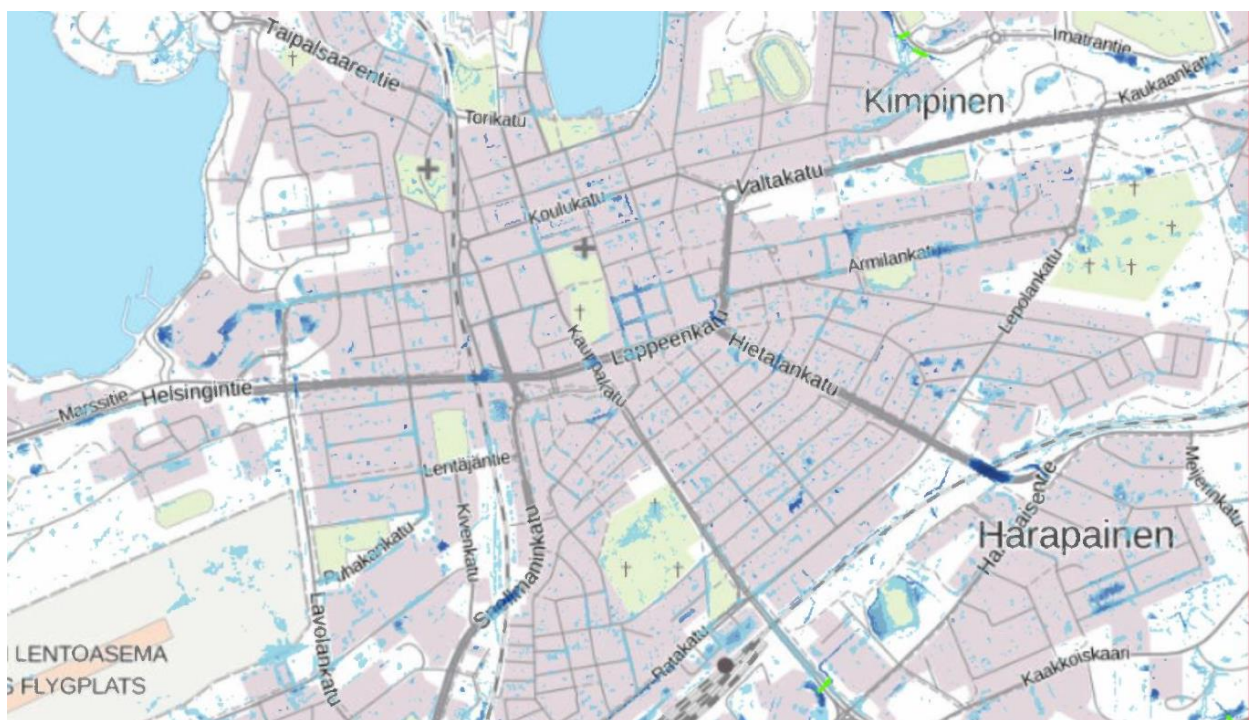
Based on the SECAP, the city established a climate programme for the years 2021-2030 as a basis for its emission reduction and “carbon neutral” ambitions. The aforementioned programme supports and underlines the city’s aspiration of leading ecological transition and developing energy and climate policies. It also respects the reporting model of the Covenant of Mayors for Climate & Energy.

A stormwater management plan (Ramboll Finland Oy, 2021) was developed for Lappeenranta to prevent problems caused by stormwater, such as flood damage and water pollution, and to maintain the natural water cycle, such as the formation of groundwater. The also intends to manage stormwater as cost-effectively as possible. The stormwater management plan (2021) underlines the importance of promoting stormwater management consideration at all stages of development and construction (i.e., land use planning, building control and maintenance). The plan directs construction and design through is providing guidance on a catchment-by-catchment basis and for each land use type.

1.4 Response Measures

1.4.1 Knowledge Production

Figure 1.10 Flood risk areas in Lappeenranta



Source: Stormwater management plan 2021.



The city collaborates with Lappeenranta University of Technology (LUT) to produce knowledge at a territorial scale through various means. According to the City Strategy of Lappeenranta, this collaboration seeks to actively develop a university and tourism city. The collaboration with the local university creates growth for companies and attracts entrepreneurship and new residents. To ensure water quality, new rehabilitation methods are being developed as a result of a collaboration between the city and LUT. As Lappeenranta aims to be a global leader in urban energy and climate policy promotion, its green actions are based on LUT's expertise (City Strategy). Not to mention, the city's Greenreality network -an active corporate network- is working for a more sustainable future.

Flood maps of Lappeenranta have been developed by the Finnish Environment Institute, showing the most vulnerable locations for stormwater flooding. These maps have been updated in 2020.

1.4.2 Participatory Governance & Awareness Raising efforts

Lappeenranta is engaged in various initiatives to exchange knowledge and expertise with other municipalities and territories. These initiatives allow to re-instate the city's climate commitments and to place it on the world map as a pioneer in climate action. Lappeenranta is committed to:

- Covenant of Mayor
- ICLEI network
- Cities for Climate Protection (CCP)
- Carbon Neutral Municipalities network (HINKU³) since 2014. Municipalities aim for carbon neutrality by 2030.
- Greenreality Network (A network including citizens, communities and companies, Lappeenranta is the co-ordinator)
- Finnish Sustainable Communities (FISU) Network, which includes 11 pioneering Finnish communities. The network's theme is the implementation of the resource wisdom roadmap launched by The Finnish Innovation Fund SITRA in its operations.
- Green City Accord. A network of municipalities set up by the EU Commission with the aim of sustainable and healthy cities.
- Green Leaf Network

1.4.3 Policies & Action Plans

Various policies and action plans developed at a national, sub-national and territorial scale serve to increase the resilience of KCS to climate change. At a national scale, a management plan of water resources and marine environments (2016-2021) was established. A new programme is to be developed for the period: 2022-2027. According to Ministry of Environment, the aim of this programme is to secure and maintain a good status of surface waters and groundwater. The work is led by the Centres for Economic Development, Transport and the Environment. At a local scale, a stormwater plan (2021) was developed to increase the resilience of the territory to storm waters.

1.4.4 Implemented Grey/Green Adaptation Measures

The Stormwater management plan of the city is currently being implemented. As part of this plan, the mapping of stormwater flood risk areas has been done by the Finnish Environment Institute. The plan emphasises the use of nature-based solutions (NBS) and green adaptation approaches. The city of Lappeenranta has also an ongoing Meadow network project to ensure the preservation of biodiversity and landscape.

³ <https://www.hiilineutraalisuomi.fi/en-US/Hinku>

Lappeenranta has received various awards/labels rewarding its climate and environmental commitments. As a case in point, the city received the European Green Leaf award – recognizing the territory’s commitment to better environmental outcomes, with a particular focus on efforts that create new jobs and generate green growth – for addressing the themes of Nature, Climate Change, Water and Green electrification.

The city was also chosen as the ‘climate capital of Finland’ by the World Wide Fund for Nature (WWF) in 2014 and 2016. To add to that, it received an award for laudable climate actions by regional and local government Finland in 2016.

1.5 Key Stakeholders

Table 1.1 List of key local stakeholders in Lappeenranta per type, sector, influence, motivation to take climate action and link with TransformAr.

It is important to note that the “motivation of actor to take climate action” is based on the activity of the organisation, considering the public information available. This is a relative characteristic or one that is likely to evolve in time and may not reflect the real motivation of all actors within a particular organism.

Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder’s contribution to TransformAr	Added value of TransformAr for this actor
Ministry of Environment	Government	Delegation of the minister of ecological transition and solidarity à Environment, planning and housing	Regulatory role (development of policies & regulatory monitoring)	Reactive & limited to policy making	Provide knowledge on developed (or planned) laws, regulations in the area of climate adaptation.	Guide regulatory action from a climate adaptation perspective
Lappeenranta: urban planning	Government (departmental)	Environment & sustainable development	Guiding role in land use planning and stormwater management	Reactive	Partner in KCS	Guide regulatory action from a climate adaptation perspective in regional scale.
Greenreality Network	NPO	Sustainable development, CCA	Raise awareness	Active role	Partner in KCS	Raise the awareness of citizens and network
LUT	Scientific Community	Knowledge and potential valuation of water quality and water protection	Develop research Bridge knowledge gaps Raise awareness	Active/reactive role	Provide knowledge produced by the research units	Provide researchers with materials/knowledge (feed the scientific discussion) Propose changes to the curriculum Raise the awareness of young adults
The Finnish Association for Nature Conservation	NPO	Environment & sustainable development	Raise awareness	Active role	Provide knowledge	Increase resilience to CC



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Association of Finnish Municipalities	Public body	Development	Advance the interests of municipalities and provide services for them. The Association brings the voice of local governments to social debate and decision-making.	Reactive/Active role	Provide knowledge Sharing of best practices	Increase resilience to CC
GoSaimaa	KCS	Tourism	Awareness raising	Supportive/active	Provide knowledge	Raise awareness, economic opportunities
Saimaa Geopark	NPO	Environment	Awareness raising	Active role	Provide sector-specific knowledge	Raise awareness, increase resilience to CC
Regional Council of South Karelia	Government	Regional council	Operates as the authority for regional planning. Also promotes economic development and cultural well-being in South Karelia. The Council has a statutory responsibility for regional development and planning	Reactive/Active	Support	Raise awareness, economic opportunities, increase resilience to CC
Citizens of Lappeenranta	KCS	Citizens	Voice the concerns of the local population	Active/supportive/indifferent	Provide opinions of people living in the area	Raise awareness
Lappeenrannan Energiaverkot Oy	KCS	Water management, waste water management	Provides water supply + maintenance of waste water management	Supportive/Active	Provide sector-specific knowledge, Partner in KCS	Raise awareness
Rejlers Finland Oy	Consulting	Knowledge in infrastructure planning	Awareness raising, part of the Greenreality Network	Active	Provide sector-specific knowledge	Raise awareness, increase the resilience of urban areas

Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Conservation association of Pien-Saimaa	NPO	Improve the suitability of the water and coastal areas of Pien-Saimaa for housing, recreation and other uses, and promote their ecological conservation	Awareness raising, voice the concerns of local population	Active, supportive	Provide sector-specific knowledge	Raise awareness, increase the resilience
Raija ja Ossi Tuuliaisien Säätiö	NPO	Nature conservation foundation	Awareness raising, voice the concerns of local population	Active	Provide sector-specific knowledge	Raise awareness, increase the resilience
Ministry of agriculture and forestry	Government		Agriculture, environment	Active	Provide sector-specific knowledge	Raise awareness; increase the resilience; boost economic opportunities
FCG Finnish Consulting Group Oy	Consulting	Knowledge in stormwater management and water quality	Part of the Greenreality Network	Reactive	Provide knowledge/technical support	Raise awareness
LAB University of Applied Sciences	University	Knowledge institute	Infrastructure, stormwater management	Supportive	Provide knowledge/technical support, student cooperation	Raise awareness
Laitex Oy	SME	Supplier of material handling equipment	Part of the Greenreality Network	Supportive	Technical support	Boost economic opportunities
LCA Consulting Oy	Consulting	Environmental expert service	Part of the Greenreality Network	Active	Provide knowledge/technical support	Raise awareness, increase the resilience
Municipality of Taipalsaari	Municipality	Environment, tourism, Lake Saimaa	Part of the Greenreality Network	Active	Provide knowledge in local aspect	Raise awareness
Municipality of Savitaipale	Municipality	Environment, tourism, Lake Saimaa	Part of the Greenreality Network	Active	Provide knowledge in local aspect	Raise awareness
WSP Finland	Consulting	Knowledge in stormwater management and water quality	Develop research	Reactive/active	Provide knowledge/technical support	Raise awareness, increase the resilience, boost economic opportunities



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Ramboll Finland Oy	Consulting	Knowledge in stormwater management and water quality	Awareness raising, develop reseach	Active	Provide knowledge	Raise awareness, increase the resilience, boost economic opportunities
Lappeenranta: infrastructure	Government	Knowledge in stormwater management and water quality	Awareness raising, develop reseach	Active	Provide knowledge	Raise awareness, increase climate resilience
Lappeenranta: environmental department	Government	Knowledge in stormwater management and water quality	Awareness raising, develop reseach	Active	Provide knowledge	Raise awareness, increase climate resilience
Etelä-Karjalan Kesäyliopisto	Scientific community	Knowledge in social, health, administrative and working life	Awareness raising	Supportive	provide sector-specific knowledge in social and health aspects to CCA	Raise awareness, increase resilience to CC
Afry	Consulting	Knowledge in stormwater management and water quality	Develop research	Active	Provide knowledge/technical support	Raise awareness, increase climate resilience, boost economic opportunities
Business Finland	Funding	Government organization for innovation funding			Raise awareness, increase climate resilience, boost economic opportunities	Raise awareness
Centre for Economic Development, Transport and the Environment	Funding	Knowledge institute, enviroment			Raise awareness, increase climate resilience, boost economic opportunities	
Salpausselkä Geopark	NPO	Environment, tourism	Awareness raising, tourism	Active	Raise awareness, increase climate resilience, boost economic opportunities	Raise awareness, increase climate resilience, boost economic opportunities
Luode Consulting	Private consultancy	Water quality and measurement technology	Provides water quality measurement techonlogy	Active	Provide knowledge/technical support	Raise awareness, increase climate resilience, boost economic opportunities
VRJ Group	Consulting	National multi-sector construction enterprise	Provides knowledge	Active	Provide knowledge/technical support	Raise awareness, increase climate resilience, boost economic opportunities



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Vahanen	Consulting	Environmental	Provides knowledge	Active	Provide knowledge/technical support	Raise awareness, increase climate resilience, boost economic opportunities
Sensmet	Measurement	Water quality	Provide technical support	Supportive	Provide technical support	Raise awareness, increase climate resilience, boost economic opportunities
Endress+Hauser Oy	Private	Equipment manufacturer, measurement, software and system products	Provide technical support	Supportive	Provide technical support	Raise awareness, increase climate resilience, boost economic opportunities
EHP Environmental Solutions	Private consultancy	Equipment manufacturer	Provide technical support	Supportive	Provide technical support	Raise awareness, increase climate resilience, boost economic opportunities
GWM Engineering	Private consultancy	Equipment manufacturer	Provide technical support	Supportive	Provide technical support	Raise awareness, increase climate resilience, boost economic opportunities
Burkert Fluid Control System	Private consultancy	Equipment manufacturer	Provide technical support	Supportive	Provide technical support	Raise awareness, increase climate resilience, boost economic opportunities
Vaisala	Private consultancy	Equipment manufacturer	Provide technical support	Supportive	Provide technical support	Raise awareness, increase climate resilience, boost economic opportunities
Flowrox	SME	Equipment manufacturer	Provide technical support	Supportive	Provide technical support	Raise awareness, increase climate resilience, boost economic opportunities

2.0 West Country Region, the United Kingdom (UK)

2.1 General Context General Context

2.1.1 Geographical Context

The entire South West region spreads over an area of 23,800km² and is bordered by the Atlantic to the North and West, and the English Channel to the South and East. The area is typified by maritime rolling countryside, which is dominated by agriculture, with areas of high habitat value upland which are extensively grazed. There is also a significant area of coastline within the region, supporting tourism and fisheries interests.

The three catchments that form the TransformAr West Country Demonstrator are located within the South West Region of England (North West Europe) in the counties of Cornwall, Devon and Somerset (see Figure 2.1).

Figure 2.1 Map of the West Country including the three catchment areas of Somerset Moors and Levels, the river Axe and the river Camel where development is stalled due climate change exacerbating water quality pressures



Source: Westcountry Rivers Trust.

The South West region embraces some of the UK's high valued and rarest habitats (Biodiversity South West, 2021) including: Calcareous grassland; Lowland heathland; Flower rich pastures & wetlands – such as Culm grasslands, Somerset Levels and Moors; Offshore reefs; and, Ancient Semi - Natural Woodland.

There are over 70,000 ha of SSSI (Sites of special Scientific interest) and 7 designated wetland sites encompassing 25 internationally important species (West Country Water Resources, 2021). The landscape has large areas of grassland and heath in upland areas along with a dense network of hedges, providing corridors, and areas of woodland, often in steeper river valleys.

In addition to its rich natural heritage, the region also has a range of buildings and monuments of differing ages (e.g., Stone and Bronze age). Hut circles can be found particularly in some of the moorland areas and there are remnants of the Celtic culture within the area.

The South West has a predominantly maritime climate with wet mild winters and around 1000mm of rain each year. The Atlantic coast and uplands are generally wetter, while the South coast is more sheltered and drier. This could however be variable locally with most coastal areas of Cornwall and Devon having 900-1000 mm, but up to double this amount falls on upland such as Dartmoor, Bodmin Moor and Exmoor. The strong maritime control of temperature is best seen in the annual temperature range, or the difference between the mean temperature of the warmest and coldest months. In west Cornwall this is about 9 °C, which is similar to that found in western Ireland or the Outer Hebrides, but it increases to around 12 °C near Bristol and nearly 14 °C in the English Midlands (Met Office, 2021a).

The Atlantic depressions are more vigorous in autumn and winter and most of the rain which falls in those seasons in the South West is from this source. In summer, convection caused by solar surface heating sometimes forms shower clouds and a large proportion of rainfall falls from showers and thunderstorms at this time of year. The South West England is one of the more exposed areas of the UK, with wind speeds on average only greater in western Scotland. The strongest winds are associated with the passage of deep depressions close to or across the British Isles. The frequency and strength of depressions is greatest in the winter half of the year and this is when mean speeds and gusts are strongest.

Figure 2.2 Representative photo of the West Country Region



2.1.2 Demographic Context

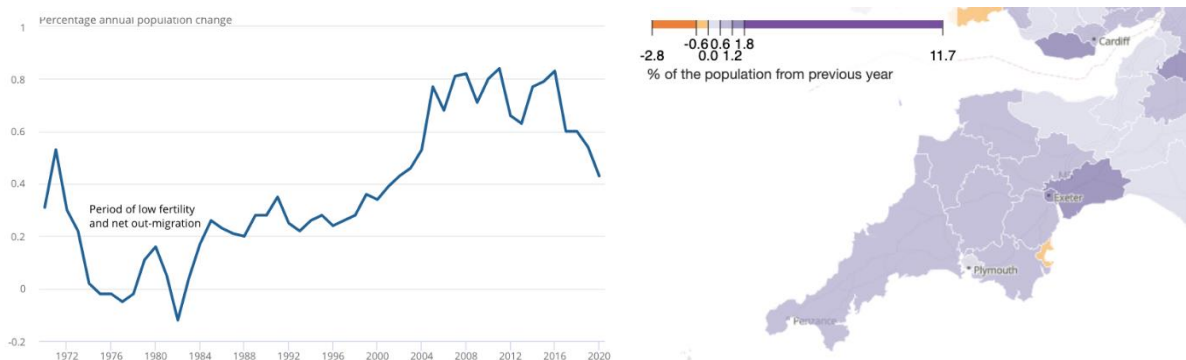
There are just over 5.6 million people within the South West region (Office for National Statistics, 2021). This can be broken down further into the three main Counties in the area including Somerset (563,851), Devon (810,716) and Cornwall (573,299).

The population density across the South West region was estimated at 237/km² in 2020 (Office for National Statistics, 2021). The region has seen a significant population growth and was the highest in the UK from 2002 to 2008 due to in-migration. This relatively high and growing population density, when compared to other European regions can lead to pressure on water resources and ecosystems. This is a particular issue during the summer when the population swell's due to Tourism. For instance, the population of Cornwall (570,000 approx.) can rise to 850,000 during the summer months, putting

additional strain on infrastructure and resources. The increasing population coupled with increased intensity of land use can lead to erosion of soils and further degradation of water quality.

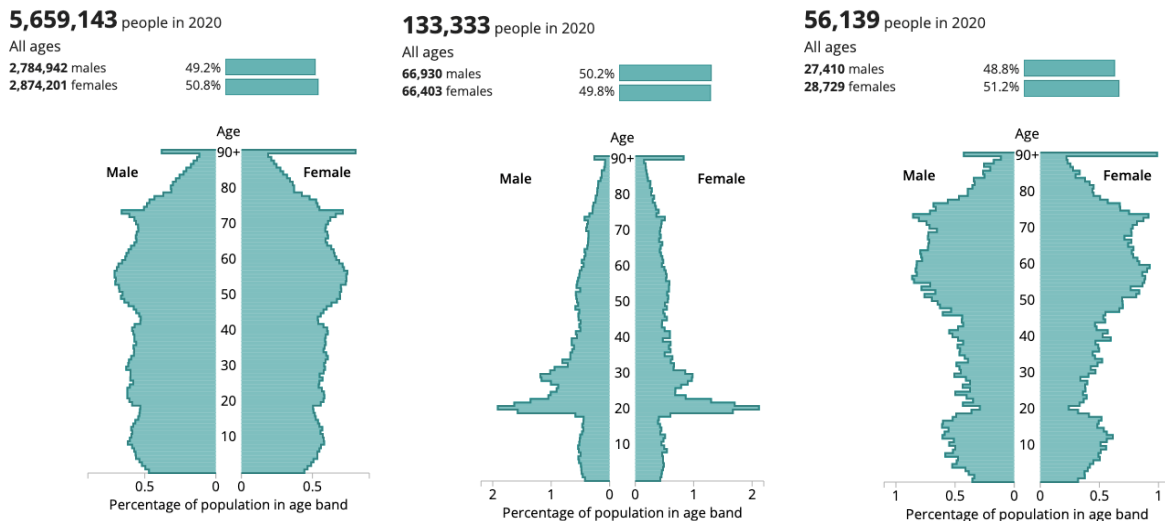
The population growth rate for the UK (Figure 2.3 - left) shows that the current level of growth is at its lowest since 2001, representing a fall in a recent trend of high growth, between 0.5 and 0.8%, from mid-2004 to mid-2019. Despite the decline in the rate of population change, it is still higher than in any year between mid-1972 and mid-2001 (Office for National Statistics, 2021). The increasing populations in the region (Figure 2.3 - right) can put pressure on water treatment systems and current infrastructure, with a greater number of connections to the sewage network required. There shall also be more pressure on areas of high value due to tourism.

Figure 2.3 Annual UK population growth rate mid-1970 to mid-2020 (left) & District and County population growth rate 2019 to 2020 (right)



Source: Office for National Statistics, 2021.

Figure 2.4 The population of the South West (left), Exeter (centre) and West Devon (right) showing the demographics range of different areas

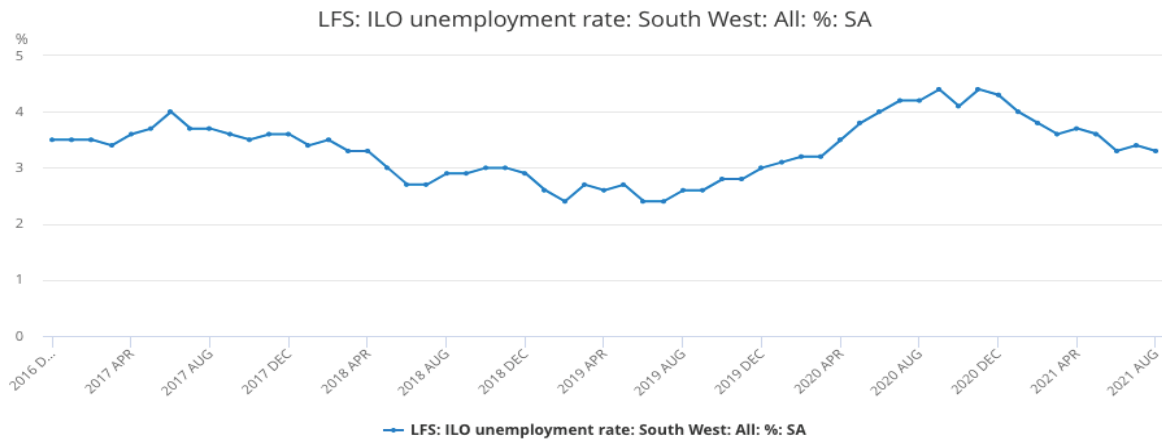


Source: Office for National Statistics, 2021.

The demographic of the South West is relatively balanced between genders as well as age ranges (see Figure 2.4) but this varies from place to place (Office for National Statistics, 2021). For example, Exeter (Figure 2.4 – centre) has a higher proportion of 20-25 year olds due to the University while West Devon (Figure 2.4 – right) has a higher number of retirees. These specific populations have different vulnerabilities to climate change as students are often living in rented accommodation with limited flood protection and elderly may be more impacted by severe weather.

2.1.3 Economic Context

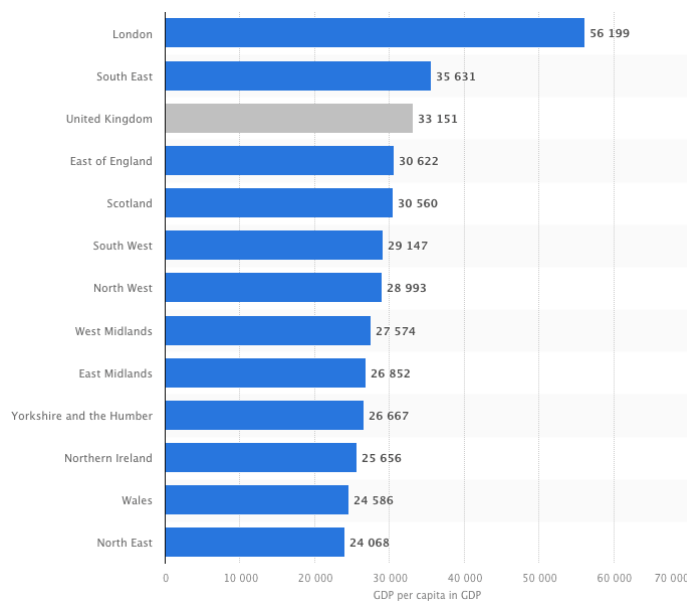
Figure 2.5 Unemployment rate across the South West for the last five years



Source: Office for National Statistics, 2021c.

In the South West, the proportion of working-age people living in poverty was around 20% in 2010/11, and 19% in 2019/20 (TUC, 2021), with unemployment at 3.2% in 2020 (Figure 2.5) (Office for National Statistics, 2021c). Unemployment spiked above 4 % during the Covid pandemic but has been relatively stable between 6% and 4%. The rate of unemployment in the Cornwall and the South West is actually lower than the UK median, however on average jobs are lower paid, with less high salary professions such as finance, insurance or science. Gross value added per head in Cornwall is the fourth lowest region in the UK at around £20,000 per head, while house prices in the county are in comparison relatively high as they stood at around £313,000 in May 2021 which means that there could be a significant gap between income and property values.

Figure 2.6 Gross domestic product per capita in 2019 per region



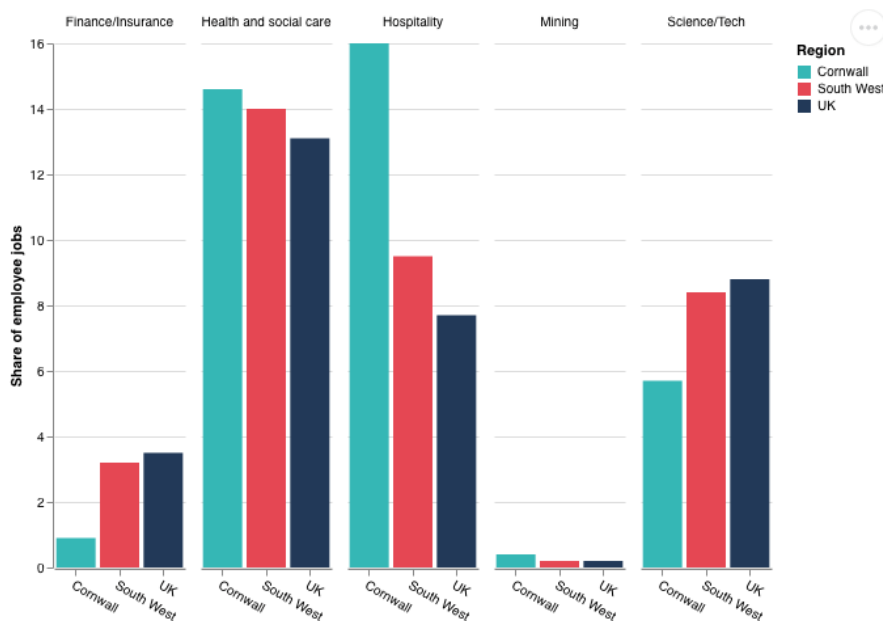
Source: Statista, 2021.

The South West region’s GDP is predominantly rural, with its main industries being tourism, agriculture and mineral extraction. In 2018, the GDP per capita stood at £22,096 for Cornwall, £25,116 for Devon

and £23,524 for Somerset (Office for National Statistics, 2021c). Figure 2.6 highlights the differences between regions with the South West being behind London, the South East, the East of England and Scotland (Statista, 2021).

There are sectoral differences between Cornwall, the South West and the UK. For example, in Cornwall people are more likely to work in hospitality or health and social care, but there is less employment in professions like finance, insurance, science and technology (see Figure 2.7 - Economic observatory, 2021).

Figure 2.7 Employee job by sector in Cornwall compared to the South West region and UK



Source: Economic observatory, 2021.

Some of the key sectors to be affected by climate change include the water industry, energy sector, transport and agriculture in the UK. These sectors are to be adapted to climate change (Adapting to Climate change: DEFRA 2012)

The Key community systems defined in TransformAr for the region are 1) Agriculture, 2) Developers and 3) River Habitat and species. The South West is a predominantly a rural region and agriculture is a major part of the economy, therefore building the climate resilience of the sector is very important. Also, as most of the South West is a farmed landscape, this has a knock-on impact on river habitat and species.

2.2 Vulnerability & Key Observed and Projected Impacts

2.2.1 Territorial Scale

The West Country demonstrator lies in the Atlantic Region with the major Climate Change impacts coming from increases in heavy precipitation, river flow, risk of river and coastal flooding, damage from winter storms and multiple climatic hazards (EEA, 2017). The demonstrator is also likely to witness drier summers and an increased in the frequency of extreme weather events (South West Water, Climate change adaption report). High energy rainfall events can also cause mobilization of sediment and nutrients leading to water quality issues.

The Meteorological Office highlights detailed impacts for the South West (Met Office, 2021a) including:

- More frequent intense rainfall and wind driven rain causing river and surface water flooding
- Warmer wetter winters causing problems with crop management
- Hotter drier summers causing problems for water quality and supply
- Increase in extreme weather and disruptive events such as flooding, droughts, landslides or heatwaves interrupting or limiting access to vital services and impacting on people's physical and mental health.
- Sea level rise affecting the viability of coastal communities and coastal infrastructure through flooding and erosion

In August 2004 there was a significant flooding event in Boscastle with 75mm of rain falling in two hours, the same amount as usually falls in the whole of August (Met office, 2021b). This led to the destruction of houses and businesses and the loss of 50 cars.

In 2014 the Somerset Levels and Moors experienced widespread flooding, with an estimated 100million cubic metres of floodwater covering an area of 65km² (UK Government, 2021a).

In July 2017 the village of Coverack in West Cornwall witnessed flash flooding with 50 properties being flooded following an intense deluge of rainfall over a short period (Figure 2.8).

Figure 2.8 Coverack 2017 flash floods



Photo by Peter Wood retrieved January 4, 2022 from <https://www.cornwalllive.com/news/cornwall-news/gallery/coverack-one-year-2017-flash-1800585>.

In the West Country Region, various factors are increasing the pressure on the environment and the territory's vulnerability to climate change such as declines and degradations in soil through unsustainable agriculture. High risk crops are leading to soil compaction and the speeding up of overland flow from rainfall. Warm summer temperatures and elevated nutrients within rivers and lakes can lead to the formation of algae blooms, which can occur after extended periods of dry weather. Roadford reservoir on the Cornwall and Devon border faces the issue of algal blooms from diffuse and point agriculture. This is a drinking water supply reservoir and area for recreational use, therefore maintaining good water quality is paramount.



In this context, it is however important to underline that, in addition to the presented negative impacts, climate changes could present some opportunities in the area of West Country Region. For instance, there may be benefits from higher year-round temperatures that can lead to a longer growing period for crops and particularly grass, which can be grazed by livestock, with potential economic benefits to agriculture. Energy demand maybe reduced due to warmer winters, requiring less fuel and energy to heat homes (EEA, 2017). Warmer weather may also extend the holiday season in the South West, with tourism being a major part of the economy.

2.2.2 KCS Scale

Climate change could have a series of impacts on the KCS retained for the demonstrator (agriculture, developers and river habitat), as presented below.

I- AGRICULTURE

The environmental impacts of climate change on agriculture are many and varied. Changes in the UK's climate will, on the long run, have both positive and negative impacts on agricultural production (Living with Environmental Change, 2016). The impacts of climate change on production will vary across the UK with warmer temperatures bringing longer growing seasons counter-balanced by reductions in water availability. Heat stress in livestock, particularly dairy cows, may reduce productivity. Changing rainfall patterns, increased evaporative demand and reduced availability of water for irrigation all threaten agricultural production, particularly in areas where water supplies are already under pressure. Drier soil conditions will reduce growth of crops, pasture and trees. Damaging periods of summer drought are likely to become more frequent. Climate change will affect the range and quality of the ecosystem services that agriculture not only provide, but also rely on. These include climate control, flood regulation, biodiversity, pollination and nutrient cycling.

Agriculture is part of a larger biophysical, social and economic systems which will all be reacting and adapting to climate change in different ways, resulting in complex global changes whose impacts at local level are not easy to predict (Living with Environmental Change, 2016). Despite the above environmental impacts, in the short term it is likely that technology and socio-economic factors will continue to be more influential drivers of change. Currently, the impact of Brexit is causing considerable uncertainty amongst the farming community both in terms of changing policy and changing trade agreements. This is highlighted by the breath of UK parliament guidance notes to farming, fishing and animal welfare regarding Brexit (UK Parliament, 2021a)

II- DEVELOPERS

All environmental impacts of climate change on housing developers is cumulated when plans are sent for approval by the local planning authority. The housing plans are assessed against the Local Plan ensuring they are in-line with Section 19(1A) of the Planning and Compulsory Purchase Act 2004 which requires local planning authorities to include in their Local Plans "policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of, and adaptation to, climate change". Additionally, the Climate Change Act 2008 establishes a legally binding target to reduce the UK's greenhouse gas emissions by at least 80% in 2050 from 1990 levels. To drive progress and set the UK on a pathway towards this target, the Act introduced a system of carbon budgets including a target that the annual equivalent of the carbon budget for the period including 2020 is at least 34% lower than 1990.

The socio-economic ramifications of the above environmental impacts mean that developers must account for all local plans and national Planning Practice Guidance within all development proposals (UK Government, 2021b). This includes incorporating examples of mitigating climate change by reducing emissions (e.g. Providing opportunities for renewable and low carbon energy technologies) and examples

of adapting to a changing climate (e.g. Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality).

III- RIVER HABITAT

The environmental impacts of climate change on river habitats will affect various parts of the UK in different ways. In 2008, a major study of climate change and UK rivers by scientists working for the Environment Agency modelled the likely impacts on five very different rivers throughout the country (Whitehead et al. 2008). Impacts differed from river to river but the general ones include:

- Changes in the flow of rivers will affect water quality.
- Reduced flow means less dilution and higher concentrations of pollution.
- Climate change will increase the temperatures of rivers and lakes, as well as oceans, with knock-on effects on aquatic life.
- Climate change will increase the nutrient levels in rivers, and greater algal blooms in rivers could increase the cost of drinking water.
- More storms will lead to an increased use of combined sewage overflows and sewage pollution and more polluted runoff entering rivers in urban areas.
- Greater rainfall intensity could lead to more suspended solids, sediments, and other contaminants entering rivers, leading to more “silting up”.

The socio-economic ramifications of degraded river habitats are felt across society and the economies linked to them through reduced angling, fisheries and shellfisheries potential, increased dredging costs in harbours and estuaries, increased drinking water treatment costs, increased flood damage, decreased tourism at bathing water sites as well as a broader loss of the innate value of rivers to society.

2.3 Governance Baseline

2.3.1 National Scale

The United Kingdom is governed through a parliament consisting of the Prime Minister who leads the government with the support of the Cabinet and ministers to create national policy and legislation. This is supported by Departments (e.g. Department for Environment, Food and Rural Affairs) and their agencies (e.g. Natural England) who are responsible for putting government policy into practice. Locally, governance efforts are endorsed by devolved local Councils and Authorities that make and carry out decisions on local services. Many parts of the UK have 2 tiers of local government: county councils and district, borough or city councils (UK Government, 2021c).

The United Kingdom has a UK adaptation policy that consists of the UK Climate Change Risk Assessment (CCRA)⁴ as well as a National Adaptation Programme⁵ produced every five years (Climate Change Committee, 2021). The third CCRA evidence report is due to be published in 2021 followed by the third CCRA Government report in 2022.

2.3.2 Territorial Scale

The local Councils and Governments have their own strategies that sit under the national plans. The West Country demonstrator covers the three main County Councils of Cornwall, Devon and Somerset and each have embarked on their own plans and strategy. Devon and Cornwall have worked on a shared

⁴ THE CCRA is a five-yearly assessment of the major risks and opportunities from climate change to the UK

⁵ The national adaptation programme is the Government’s strategy to address the main risks and opportunities identified in the risk assessment for England

Adaptation Plan for Devon, Cornwall and the Isles of Scilly (Devon Climate Emergency, 2021). This local adaptation plan is intended to help communities across the South West to better understand the risks their area might face in future, as climate change is increasingly affecting the UK. It will also help them to adapt to these changes, by identifying the parties responsible for ensuring community safety. On top of this, each Council is implementing local plans and drives such as the Forest for Cornwall (Cornwall Council, 2021).

2.4 Response Measures

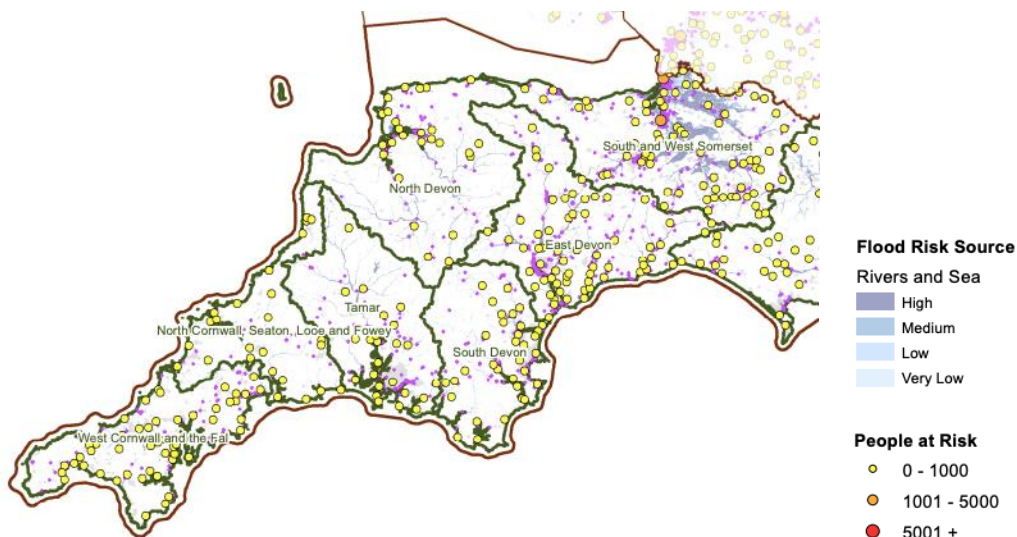
2.4.1 Knowledge Production

The West Country region has strong collaborative relationships with the territorial academic institutes. This includes the University of Exeter and its Centre for Resilience, Environment, Water and Waste, the University of Plymouth and its Sustainable Earth Institute as well as the Meteorological Office based out of Exeter. These institutes provide research, data and understanding at local, regional, national and international scales.

The West Country has multiple regional maps showing the vulnerability to climate change from water quality to water resource and from flooding to nature decline. The West Country Water Resources group covers the Western Peninsula of the UK from Bristol and Wiltshire down to Devon and Cornwall formed to establish a long-term, reliable supply of water as it is vital to supporting the economy, which is particularly important in the West Country especially in the summer months due to the high levels of tourism (West Country Water Resources, 2021).

Flood vulnerability maps have been created both in terms of risks to people but also risks to economic infrastructure (Environment Agency, 2013) and these are being updated with more local analyses detailing specific flood risk at key locations across the West Country (Figure 2.9).

Figure 2.9 Risk to people from rivers and sea flooding



Risk Map for the South West. Purple dots are services at risk. Source: Environment Agency, 2013.

2.4.2 Participatory Governance & Awareness Raising efforts

There are several awareness campaigns that aim to shed the light on climate impacts and the importance of adapting to climate change operating at various scales. Extinction Rebellion are a national group with regional and local representation to highlight the impacts of climate change on local nature decline. There are also local Citizen Science Investigation groups that chart the health of the rivers to highlight pollution



and the impacts of climate change on the quality and quantity of water leaving the rivers (Westcountry Rivers Trust, 2021).

The academic groups and partners in the West Country are part of many local, regional, national and international initiatives to address environmental and climate issues. For example, the Westcountry Rivers Trust are part of an international group reviewing and promoting the myriad of Climate Change Adaptation project funded by the European Union. This Triple-C project is focused on the analysis, evaluation and capitalization of successful EU projects on the prevention and management of risks deriving from climate change, aiming at disseminating and transferring the best practices and results identified into policy making (Triple-C, 2021).

2.4.3 Policies & Action Plans

I- AGRICULTURE

Since the United Kingdom left the European Union the UK government has been diverging its policies and action plans but is still looking to increase resilience to climate change. A key component of this within the agricultural sector is the divergence away from a Common Agricultural Policy towards a Domestic Agricultural Policy. This is currently under development but it is expected to consist of a Sustainable Farming Incentive, Local Nature Recovery, and landscape scale recovery, aimed at increasing the resilience at a larger landscape or catchment scale. These schemes are intended to support the rural economy while achieving the goals of the 25 Year Environment Plan and a commitment to net zero emissions by 2050. Through these schemes, farmers and other land managers may enter into agreements to be paid for delivering the following: clean and plentiful water; clean air; thriving plants and wildlife; protection from environmental hazards; reduction of and adaptation to climate change; and, beauty, heritage and engagement with the environment (UK Government, 2021d).

II- DEVELOPERS

There have been a variety of policies and plans developed to increase resilience to climate change within housing development through Planning Practice Guidance (PPG) and the National Planning Policy Framework, which was published on 27 March 2012 and revised in 2018, 2019 and most recently 20 July 2021. It sets out the government's planning policies for England and how these are expected to be applied. There is a Climate Change PPG last updated in 2019 that advises on how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.

In November 2018, the European Court of Justice passed judgement on the joined cases C-293/17 and C-294/17 Coöperatie Mobilisation for the Environment UA and others vs College van Gedeputeerde Staten van Limburg and Others (Landmark Chambers, 2018). Known colloquially as the Dutch N case, this ruling has required greater scrutiny of the effects of plans or projects that, either directly or indirectly, increase nutrient loads to internationally important nature conservation sites where a reason for unfavourable condition is an excess of a specific pollutant.

III- RIVER HABITATS

The UK Government has further clarified the protection of river habitats and the wider environment through the Environmental Bill 2021, which gained royal assent into UK law on November 2021. The bill makes provision about targets, plans and policies for improving the natural environment; for statements and reports about environmental protection; for the Office for Environmental Protection; about waste and resource efficiency; about air quality; for the recall of products that fail to meet environmental standards; about water; about nature and biodiversity; for conservation covenants; about the regulation of chemicals; and for connected purposes (UK Parliament, 2021b). This builds on past European Directives which the UK can diverge from since leaving the EU.

2.4.4 Implemented Grey/Green Adaptation Measures

There are several green adaptation measures implemented at a territorial scale including environmental land management schemes such as the South West Water funded Upstream Thinking Programme to improve raw drinking water sources.

The project is delivered through a range of partnerships including South West Water, Westcountry Rivers Trust, Devon and Cornwall Wildlife Trusts, government agencies, environmental experts, landowners and tenant farmers, whilst the evaluation of the change in water quality at catchment scale is undertaken by the University of Exeter (South West Water, 2021). The partnership is changing the way communities think about water and the landscape and ensuring a better future for farming, water customers and wildlife habitats by restoring wetlands, building resilient farms and ensuring future water supplies.

2.5 Key Stakeholders

Table 2.1 List of key local stakeholders in West Country Region per type, sector, influence, motivation to take climate action and link with TransformAr.

It is important to note that the “motivation of actor to take climate action” is based on the activity of the organisation, considering the public information available. This is a relative characteristic or one that is likely to evolve in time and may not reflect the real motivation of all actors within a particular organism.

Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
County Council	Government	Local government	Governs planning, local infrastructure	Key policy driver	Planning, developing Nutrient neutrality	Develop Long term solutions to offset phosphate from development
District council	Government	Local government	Local planning and infrastructure	Embedded in policy	Local planning and phosphate off-setting	Develop solutions to offset phosphate from development
Environment Agency	Public Body	Non-departmental public body	Lead authority rivers and flooding	Key Policy driver	WFD, reducing P levels, WQ	K Improvements to water quality and finding novel solutions
Natural England	Public Body	Non-departmental public body	Lead authority habitats and protected species	Key Policy driver	Reducing P in Failing SAC's, enhancing habitats	Help to facilitate P reductions and meet SAC objectives
Catchment Sensitive Farming	Public Body	Non-departmental public body	Improving water quality through tackling diffuse pollution	Key Policy driver	Reducing P and diffuse pollution in catchments	Additional opportunities to improve water quality
Area of Outstanding National Beauty AONB	Public Body	Non-departmental public body	Provide additional protection, including planning in high value landscapes	Key Policy driver	Enhancing habitats in high value areas	Improvements to key habitats
National Farmers Union	Private	Private Farmer membership group	Represent farming interests	Impact of climate change on farming value	Ownership and access to land	Vehicle to make farming for sustainable and provide market opportunity

Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Country Land Association	Private	Private landowner group	Represent landowner interests	Impact of climate change on land value	Ownership and access to land	Provide options for landowners
Fishing interests	Private	Private river fishing interests	Represent fishing interests, value of recreational angling	Impact of climate change on fisheries value	Ownership and access to river sites	Benefits to WQ
South West Water	Private	Regional water supplier	Provide public water	Key Policy driver	Key stakeholder for nutrient neutrality, phosphate reduction, ICW	Options to meet compliance and reduce P levels
Developers	Private	Construction and house building	House builders and Construction	Need to building in climate change adaption and policies	Involvement required to develop workable phosphate mitigation package	Provide options for development to continue
Westcountry Rivers Trust	NGO	Regional charity – enhancement and preservation of rivers-catchment scale	Innovation and delivery of nature bases solutions	Building climate change resilience at catchment scale	Transform AR partners	Taking forward NBS to build in resilience and improve WQ
Wildlife Trusts	NGO	Protecting wildlife and key habitats	Conservation projects	Protection of habitats & wildlife with changing climate	Landowners, climate change adaption for wildlife	Benefits to SAC and habitats
Farming and Wildlife Advisor Group	NGO	Wildlife & Environmental features in the farmed landscape	Conservation projects in agricultural sector	Climate change adaption Environment and Farming	Active within key areas providing farm advice	Alignment with creating habitats in farmed landscape

3.0 Guadeloupe Archipelago, France

3.1 General Context General Context

3.1.1 Geographical Context

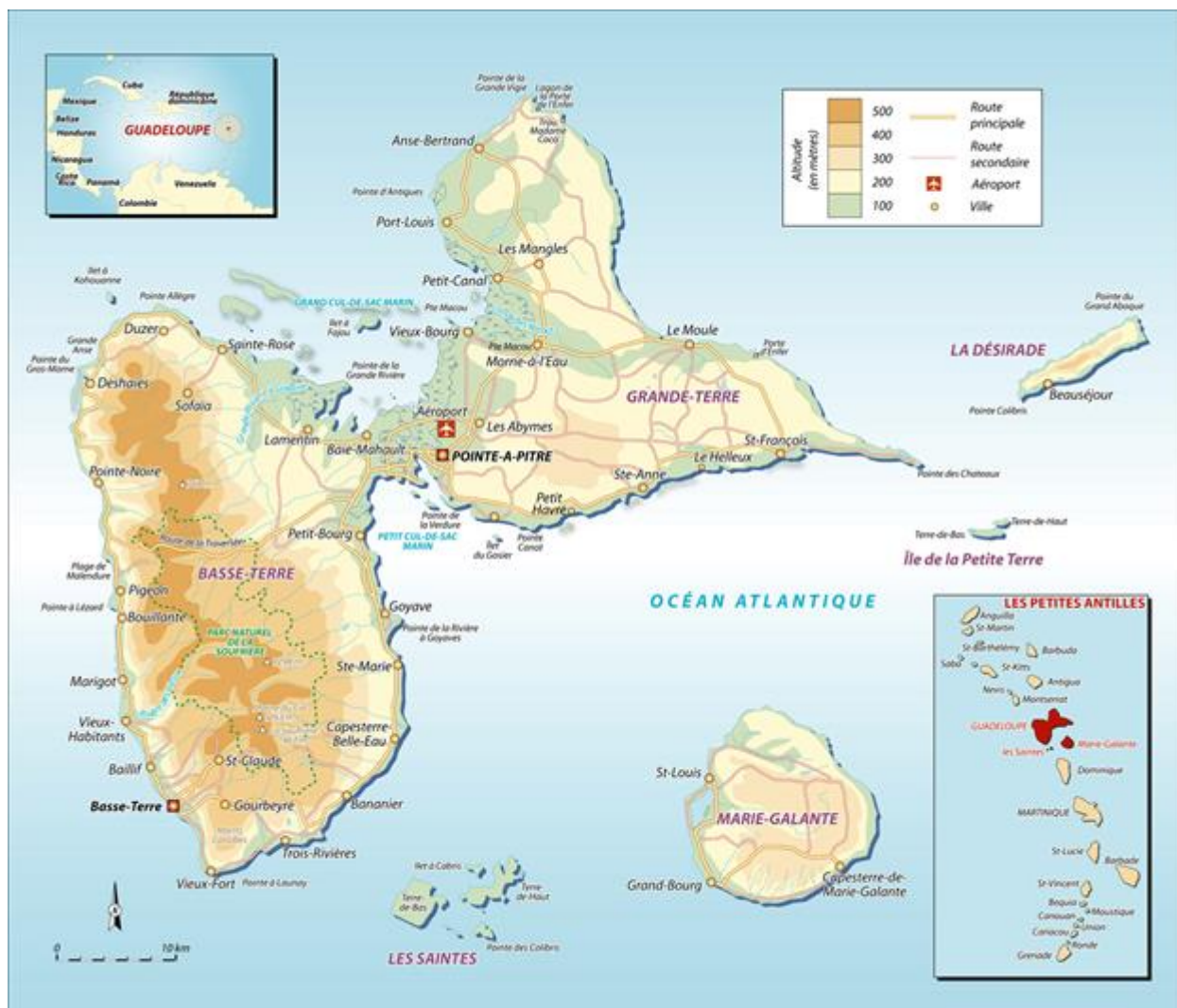
Guadeloupe (16-15° N, 61-35° W), an overseas French department and region, is an archipelago located in the Caribbean. It covers an area of 1,628 km². It is bordered by the Atlantic Ocean to the east and the Caribbean Sea to the west.

The archipelago - consisting of 6 inhabited islands and multiple uninhabited islets- is approximately 6,800 km away from mainland France.

Guadeloupe’s inhabited islands are:

- Basse-Terre and Grande-Terre (the two main islands located side by side and linked by two bridges)
- Marie-Galante
- La Désirade
- Terre-de-Haut and Terre-de-Bas, part of the little archipelago of Les Saintes.

Figure 3.1 Guadeloupe Map and its location in the lesser Antilles



Guadeloupe's geographical location in the Caribbean makes it a biodiversity hotspot with volcanos mountain ranges, rivers, waterfalls, coral reefs, and tropical forests. The archipelago is rich in natural habitats including a wide range of ecosystems and a significant number of native species (e.g., the Guadeloupe Serotine bat, the Pinchon frog, the Eleutherodactylus barlagnei frog, the Guadeloupe woodpecker, etc.). A large part of the island of Basse-Terre and parts of the surrounding lagoons lie within the boundaries of Guadeloupe National Park, established in 1989.

In addition to its rich natural heritage, the archipelago has many historical buildings and monuments with a strong influence of colonial architecture such as former banana, coffee or sugar plantations (i.e., La Grivelière) and colonial houses. The territory's rich cultural, natural and built-heritage underline the importance of protecting existing systems and their resilience to climate events.

Figure 3.2 Cascade aux Ecrevisses in the Guadeloupe National Park



Photo by Jean-Philippe Vantighem / Guadeloupe National Park.

Guadeloupe has a subtropical climate tempered by moderately high humidity and trade winds. Its rainy season extends from June to October. The territory is highly exposed to hurricanes which increases its vulnerability in light of climate change.

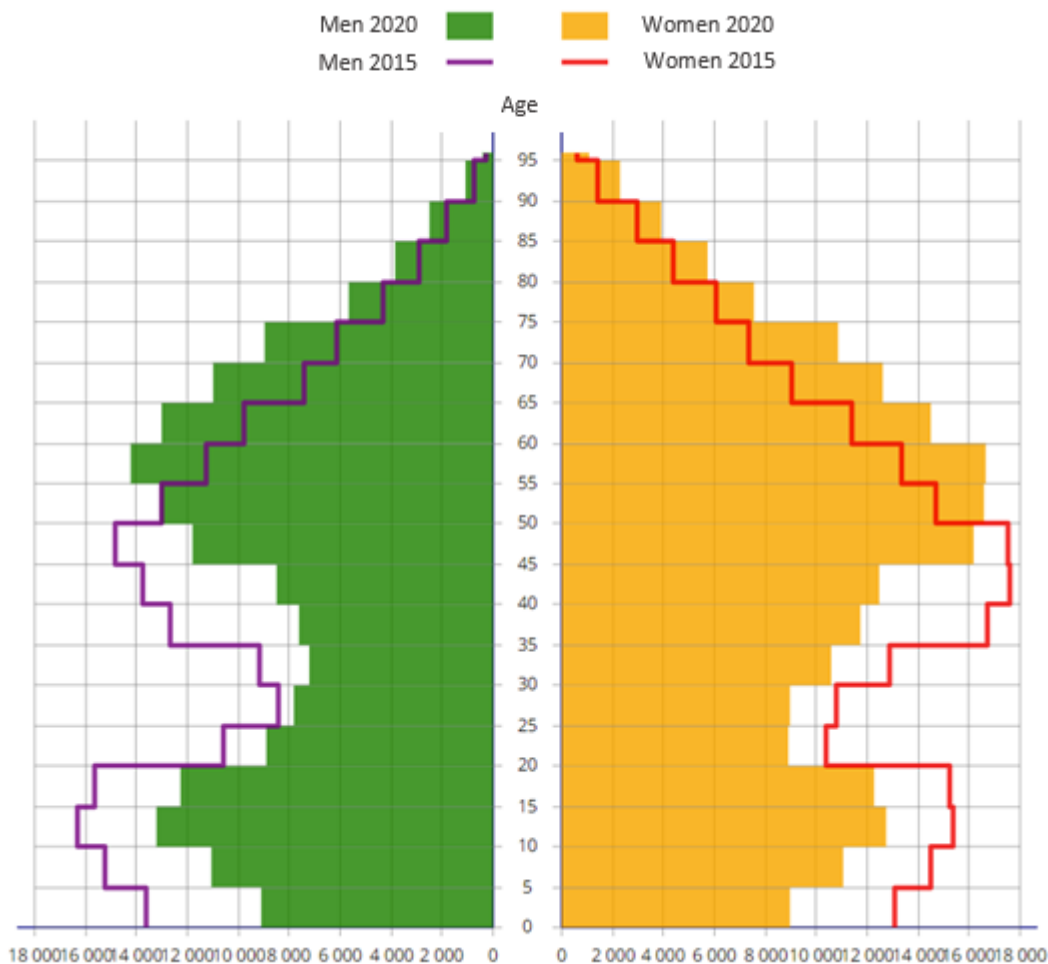
3.1.2 Demographic Context

According to a census conducted by the French national institute of statistics and economic studies (INSEE, 2019) the population of Guadeloupe was nearly of 390,000 inhabitants at the beginning of 2018. The census elucidated that, since 2011, the territory has lost on average -0.5% of its inhabitants per year. Concretely, as of January 1st, 2016, the population stood at 394,000 inhabitants (approx.), whereas two years later, the population dropped by around 4000 inhabitants. The increase in Guadeloupe's population has gradually slowed down between 1990 and 2011 showing a decreasing trend in population growth. This situation can be explained by a persistent migratory deficit (many young students move to Europe and North America to pursue higher education and do not come back afterwards) and reproduction rate below the generation renewal threshold. This could present both challenges and opportunities from a

climate perspective. On one hand, the negative population growth is resulting in an ageing population that is more vulnerable to climate change. On the other, the decrease in population growth could present an opportunity to reduce the pressures on the environment.

The population density of the archipelago is of 237 inhabitants per km² based on the Worldometer elaboration of the most up to date United nations data. The EC (2014) in its report ‘the economic impact of climate change and adaptation in the Outermost Regions’ affirmed that “Guadeloupe is densely populated” and that “there are settlements in sensitive areas, resulting in deforestation, pressure on natural resources and pollution”. This was also asserted by the International Union for Conservation of Nature (IUCN) in its report ‘Climate Change and Biodiversity in the European Union Overseas Entities’ which has underlined that cultivation and extractions (fishing and hunting) as well as urbanization have led to the retreat and degradation of forests and have affected the island’s biodiversity.

Figure 3.3 Demographic Pyramid: 2010 population census and 2020 population estimates



Source : INSEE, 2019.

The Guadeloupean demographic pyramid (Figure 3.3) illustrates that the children under the age of 10 and adults above the age of 60 represent the largest part of the population. INSEE (2019) clarified that there is a strong wave of adults leaving the archipelago to seek employment or continue their studies abroad. The arrival of new inhabitants to the territory does not compensate for the departures of residents. The depopulation is therefore mainly affecting young adults. The Guadeloupean population is

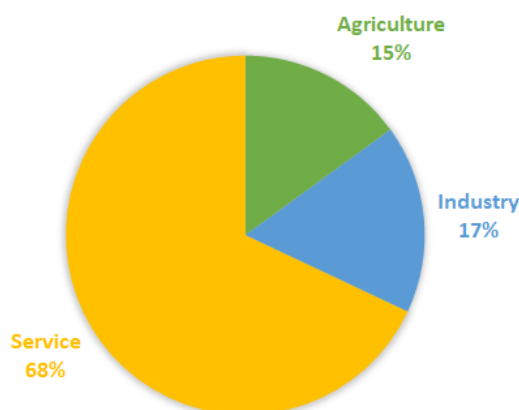
ageing as more and more baby boomers are entering the senior population. Women also present a larger share of the population than men. This present both challenges and opportunities given that, as presented in an IUCN (2015) brief on gender and climate, women can be more susceptible to climate change due to gender inequality; yet, “women have proven to be leading the way towards more equitable and sustainable solutions to climate change”. This underscores the importance of increasing the participation of women in decision making.

3.1.3 Economic Context

In Guadeloupe and according to the INSEE (2021), the unemployment rate for the year 2020 stood at 17% of the working population aged 15 or over, more than twice that of metropolitan France for the same year (8%). In the archipelago, one in three young workers is unemployed as the unemployment rate for young adults aged between 15 and 29 year olds is around 35%. Guadeloupean women are more affected by unemployment: the unemployment rate of women is 19% whereas the unemployment rate of men is 16% (INSEE, 2021). In 2017, 34% of the population lived below the national poverty line of 1,010 euros per month, compared to 14% in metropolitan France. Nearly 60% of the income of the poorest households was made up of social benefits (31% in metropolitan France).

Other indicators underline the difficulties encountered by Guadeloupeans such as the frequent water cuts due that have been experienced for years to the decaying network⁶. To add to that, the situation in Guadeloupe is particularly challenging, as it is a French territory thus considered a department belonging to a developed country – which makes it harder in comparison to other Caribbean territories to obtain funds and aids from the UN and other support bodies – whereas, in reality the territory is lagging behind in terms of development when compared to mainland France.

Figure 3.4 GDP sector composition in Guadeloupe



Source: The data is retrieved from the CIA World Factbooks.

According to stakeholder consultations allowing for the development of the Guadeloupean regional scheme of climate, air and energy (SRCAE), the sectors that are vulnerable to CC are: Resources (nature systems and water), Agriculture and fisheries, Planning and land use development, and Public health.

⁶ Capital (2021, November 24). *Chômage, Tourisme... ce qu'il faut savoir sur la Guadeloupe*. Capital.fr. Retrieved January 4, 2022, from <https://www.capital.fr/economie-politique/chomage-tourisme-ce-qui-faut-savoir-sur-la-guadeloupe-1420914>

The European Commission in its report on climate impacts and adaptation for outermost regions including Guadeloupe identified priority sectors for climate adaptation. These sectors include Tourism, Construction & Buildings, Transport, Biodiversity, and Coastal zone management.

For TransformAr, the key community systems (KCS) (representing the territory's key economic sectors that are vulnerable from a climate perspective) that were retained are tourism and agriculture. It remains crucial to increase the resilience of these sectors to climate change as, according to the regional council of Guadeloupe and as presented on its official website, the agricultural sector employs around 12% of the working population and 90% of agricultural products are exported. The agricultural land - constituting a third of the archipelago's surface area – is devoted mainly to two crops: banana and sugar cane. Based on key figures for 2013 presented by the regional council of Guadeloupe on its online platform, 448,002 tons of crushed sugar canes and 45,366 tons of sugar were produced as well as 71,512 tons of marketed banana. The latter presents the leading export product for Guadeloupe in terms of volume.

Furthermore, the catering and accommodation sector, supporting the tourism industry, account for 8% of Guadeloupean businesses. On average, tourists spend around 505 million euros per year in the archipelago according to the Regional Council of Guadeloupe. In this context it is however important to mention that the tourism sector has since 2020 been hit hard by the Covid-19 pandemic, which has further aggravated the economic precariousness of the archipelago's residents.

3.2 Vulnerability & Key Observed and Projected Impacts

This section presents an overview of climate vulnerability and impacts at the scale of Guadeloupe at a territorial scale with a particular focus on KCS presented in the section above (Tourism and agriculture).

3.2.1 Territorial Scale

According to the IPCC (2018) Special Report of Global Warming of 1.5 °C (IPCC, 2018), the number of hot days is expected to increase in most regions, with highest rises in the Torrid Zone (Tropical region). Countries in the tropics are expected to face the largest impacts on economic growth if the global temperature increases from 1.5°C to 2°C due to extreme weather events and sea level rise. Heavy precipitation coupled with tropical cyclones are likely to be higher for 2°C when compared with a 1.5°C global temperature increase (IPCC, 2018). Not to mention, climate projections expect sea levels to rise between 0.26 to 0.77 metres by 2100 for 1.5°C of global warming which amplifies the exposure of low-lying coastal areas and islands to associated risks. The IPCC's special report (IPCC, 2018) elucidated that “the slower rate of sea level rise at global warming of 1.5°C reduces these risks, enabling greater opportunities for adaptation including managing and restoring natural coastal ecosystems and infrastructure reinforcement”.

Because of its geographical characteristics and position in the heart of the Caribbean, the archipelago is exposed to several natural risks including hurricanes, floods, tsunamis, earthquakes, landslides, and volcanos (with the presence of Soufrière, an active volcano which last eruption dates back to 1976). Climate change contributes to the increase of intensity and occurrence of these risks.

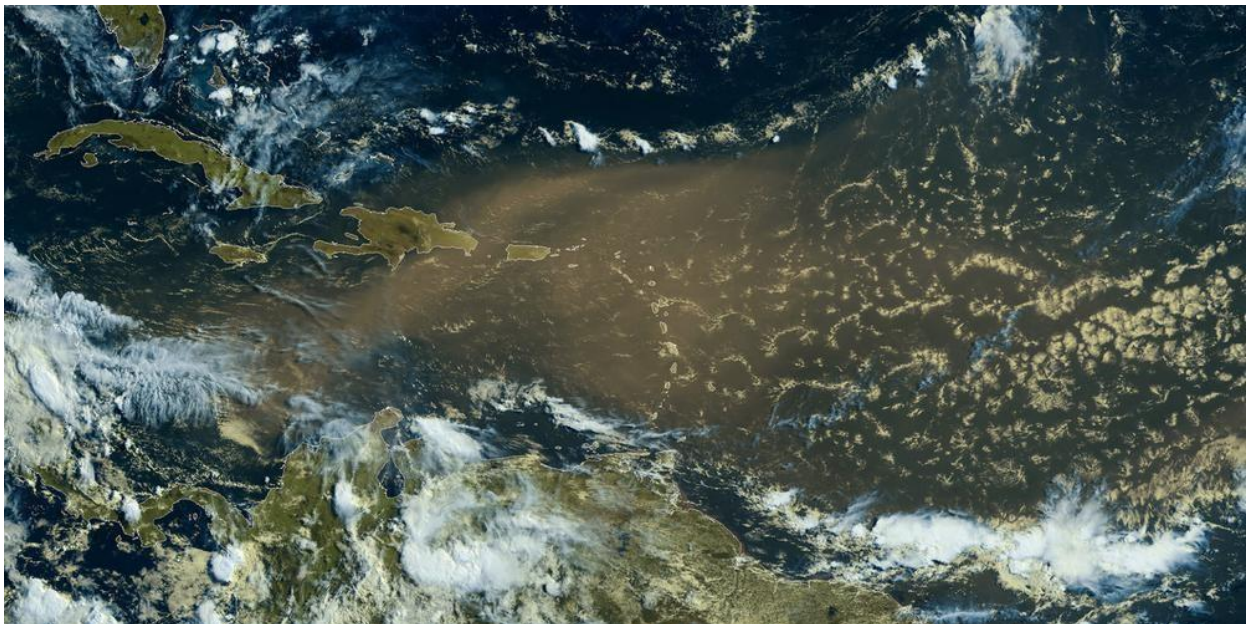
Sargassum seaweed can also be mentioned as a natural risk. Its proliferation is due in part to deforestation in the Amazon: As the mangrove no longer blocks the nutrients present in the Amazonian forest, Sargassum develops and migrates to the West Indies by sea currents. “Since 2011 a large stranding of brown algae named “Sargassum” took place along the beaches of the Caribbean islands, including the French West Indies, the Gulf of Mexico and the South East region of the United States of America” (ADEME⁷). The National Park of Guadeloupe (2015), on its online platform asserted that “Sargassum”,

⁷ <https://clubinternational.ademe.fr/en/project/beaching-of-sargassum-in-guadeloupe-a-network-of-cairnet-micro-sensors-maps-out-the-h2s-and-nh3-emissions/>

when in the sea, does not represent a threat. It added that it could even be considered by fishermen as excellent nurseries as they attract large fish that come to feed. Nevertheless, the National Park of Guadeloupe (2015) clarified that when seaweed reaches the coast- stranded on the sand or trapped by the mangroves- it can cause a danger. The degradation of Sargassum produces hydrogen sulphide, a toxic gas can be particularly harmful for sensitive people (the elderly and children). The invasion of algae could also be detrimental to turtles and fish; specifically in the egg-laying season, in which many species find themselves unable to go to the beaches to bury their eggs. To add to that, large algae rafts could prevent sunlight to penetrate the surface of water which could cause the death of coral reefs.

Guadeloupe is also impacted by the arrival of Sahara dust clouds. This more and more common phenomenon is exacerbating heat and air pollution and has effects on human health (e.g., the worsening of respiratory problems).

Figure 3.5 Photo from Météo France taken from "Brume de sable: an important episode affecting the Caribbean, Guadeloupe on red alert"



Source: Sud-Ouest (2020, June, 23).

The last episode of severe droughts experimented in Guadeloupe archipelago was from April to July 2020 and was recognised as an "agricultural calamity" by a local government decree of August 31 (DAAF, 2021). The Inter-ministerial Committee for the Relief Fund had to allocate a total of 1,099,830 euros to 213 farmers who had requested assistance.

The two last severe floods were from the 3rd to the 4th of January 2011 (very localised downpour causing five deaths according to an AFP press release) and more recently, from the 8th to the 10th of November, 2020 (71 damaged or destroyed public facilities were recognised as eligible for compensation by the government. 1,230,181.00 euros was therefore intended to compensate these goods as affirmed by a 'Guadeloupe la 1ère' press article).

In 2017, the Caribbean and American continent have known one of the more extreme hurricane season with a total of 17 events, 7 tropical storms and 10 hurricanes including 6 major ones (reaching or above category 3) (Barthélémy, 2017). Guadeloupe was mostly impacted hurricane Maria, particularly the agricultural sector (hurricane Irma strongly impacted the French territories of Saint Barthélémy and Saint Martin). Maria was classified as a natural disaster and around 10 million of Euros of funding was provided by the government to compensate for the damages.

Other extreme hurricanes had previously affected the entire economy of the archipelago such as hurricane Hugo in 1989 which required humanitarian help, Wilma in 2005, Dean in 2007 which destroyed around 80% of banana crop plantation. "This was devastating to the country, as bananas are one of Guadeloupe's three top exports, in addition to sugar and rum" (Kesserling, 2017).

Figure 3.6 Banana plantation devastated by Hurricane Maria, in Capesterre-Belle-Eau



Guadeloupe, September 22, 2017. Helene Valenzuela / AFP.

Dupont (2014) presented a series of existing pressures in Guadeloupe amplifying the territory's vulnerability including the decline and degradation of forests due to urbanization. Not to mention, coal mining is a prevailing practice despite its harmful effects. To add to that, unsustainable agricultural practices increase the pressure on the environment. Notably, the uncontrolled use of fertilizers, pesticides and insecticides (particularly the use of chlordecone⁸ against weevil in banana plantations) which has permanently poisoned the population, part of the soil and waters of Guadeloupe. Finally, a mainly seaside tourism also contributes to the pressure on the environment (construction, stamping...)

3.2.2 KCS Scale

In Guadeloupe for the TransformAr project two key community systems are retained: Agriculture & Tourism. Given that these sectors are, on one hand crucial to the archipelago's economy, and on the other vulnerable to climate change, the impacts of climate change on of these KCS is further elaborated below.

⁸ Chlordecone, a pesticide banned in France in 1990, continued to be authorised in West Indian banana fields by ministerial decision until 1993, causing significant and lasting pollution. More than 90% of the adult population in Guadeloupe and Martinique is contaminated by chlordecone, according to Public Health France.

I- AGRICULTURE

Agriculture is at risk due to the increase in the intensity of hurricanes, which leads to severe damage of cultivated yields (Banana plantations are particularly impacted by strong winds as the plant is fragile and tall). The increase of temperatures could limit the production of desirable crops while enhancing pest and weed proliferation. Furthermore, irregular precipitations are likely to increase the risk of pluvial floods and extend drought periods which has ramifications on crops produces. Not to mention, changes in rainfall patterns along with the rise of sea levels is likely to impact soil salinization which would lead to diminished agricultural production.

In Guadeloupe, increasing temperatures -in light of climate change- are not expected to affect banana yields but could lead to a shortening of the cultivation cycle. In fact, banana is a C3 specie that could benefit from the increase in the atmospheric CO₂ content by increasing photosynthesis and the speed of growth. This could partially compensate for the shortening of the cycle. In it is however important to underline that, in the archipelago, banana plantations are dealing with an increase in fungal diseases (e.g., black sigatoka) due to high humidity which reduces the production of the fruit.

Sugarcane growing is also likely to be affected by climate change: it is sensitive to higher temperatures, and this situation can lead to lower yields. In Guadeloupe, sugarcane crop yields are becoming increasingly inconsistent with a reduction of sugar level.

The lack of water availability, due to climate change and water mis-management, could further impact agricultural productivity and increase existing conflicts and tension related to water usages. In this context it is important to underline that climate-related disturbances could also affect the entire agricultural supply chain, including the distribution and the transportation of agricultural products domestically and internationally.

Consequently, climate events –impacting water security, food supply and quality as well as access to food- would have ramifications on workers in the agricultural field as well as consumers of agricultural products.

II- TOURISM

The Caribbean archipelago attracts tourists from all over the world. However, the occurrence of extreme weather events due to climate change could have a series of ramifications on touristic activity.

In Guadeloupe, due to climate change, meteorological events (e.g., heavy rains, strong winds, floods, etc.) are likely to increase in frequency and intensity. Temperature shifts are likely to impact the biodiversity, which is considered one of the archipelago's main assets increasing the territory's attractiveness. The rise of sea level will increase the risk of the erosion of beaches, inundations as well as saltwater intrusion affecting water and food security. Not to mention, the increase in sea water temperatures is likely to lead to the deterioration and the bleaching of coral reefs.

The impacts of climate change on tourism could have ramifications on both, the host community and tourists. On one hand, an increase in the intensity of meteorological events and tropical cyclones in the light of climate change could lead to the destruction of infrastructure and buildings accommodating touristic activities and have a series of financial burdens on the host community. On the other, extreme meteorological events could cause inconvenience to tourists, this would affect the inflow of tourists and have further ramifications on the economic sectors that rely on touristic activities. To add to that, water scarcity due climate change could increase conflicts between users as tourism is expected to increase the demand for water. The rise of temperatures would increase the pressure on energy due to an increase demand for electricity to power air conditioners. Furthermore, changes in temperature and water availabilities could increase the risk of the surge of water-borne viruses and tropical diseases.

Figure 3.7 Damages as a result of Hurricane Maria at La Boucan à Sainte-Rose – Guadeloupe (2017)



Photo Retrieved January 4, 2022 from Guadeloupe Region's main twitter account: https://twitter.com/RCL_GP/status/910114703778697216/photo/1.

3.3 Governance Baseline

3.3.1 National Scale

Guadeloupe has been a French overseas department since 1946. As a French department, Guadeloupe is an integral part of the EU (even though it is geographically located in the Caribbean), thus should follow and respect European directives.

In France, given that it is one of the most centralised developed countries (Samuel, 2017), departments and regions (including overseas French territories) do not have large competencies and are subject to central French obligations, regulations and rights.

At a national scale, a French National Observatory for the Effects of Global Warming (ONERC) was established in 2001 with a responsibility to adapt the country to climate change. 5 years later, a French national adaptation strategy was developed. A national adaptation plan (NAP) (2011-2015) was developed based on consultation workshops with the French Outermost regions including Guadeloupe, consequently the NAP responds to the need of the overseas territories without addressing them specifically. The recommendations presented in the national adaptation plan were rather general, yet nine complementary recommendations addressed the specific needs of the French outermost regions.

3.3.2 Territorial Scale

In respect to law 2010-788, Guadeloupe developed its Regional Climate-Air-Energy Scheme (SRCAE). The latter does not particularly address adaptation needs, however it presents the vulnerability of the territory to climate change and identify priority actions on the horizons 2020 and 2050.

3.4 Response Measures

3.4.1 Knowledge Production

On December 9, 2013, the Regional Energy and Climate Observatory (OREC) was launched by the Guadeloupe Region, ADEME, DEAL, Météo France, and EDF Archipel Guadeloupe. OREC provides figures,

an inventory on energy and the climate to communities, businesses and state services. It also supports decision-makers in implementing Guadeloupe's energy and climate transition.

In 2019, OREC set up the Regional Group of Experts on Climate (GREC), which intends to bring together all the different actors (researchers, businesses, non-profits), evaluate their needs and help them to get familiar with the most recent scientific knowledge. GREC is also promoting the participation of regional experts in existing research projects.

ADEME Guadeloupe is currently restructuring a Regional Adaptation Network which was co-directed by ADEME Guadeloupe, the French Agency for Development (AFD) and a State-owned investment bank (Caisse des Dépôts). The network aims to reinforce stakeholder's adaptive capacities by creating capitalization spheres (knowledge, feedback) and by bringing together local authorities, CSOs, NGOs, international and regional organizations.

Guadeloupe is also a member of the Organisation of Eastern Caribbean States (OECS) and thus benefits from their work on climate change. ADEME Guadeloupe has been chosen by the Regional Council of Guadeloupe to represent the archipelago at the OECS Climate Change Advisory Panel (OCCAP). The Panel takes place twice a year and aims to bring a technical support to research and development projects on climate change, collect and disseminate relevant documentation on the matter and advises on the negotiation procedures of the United Nations and within the IPCC.

On another hand, the National Institute for Research for Agriculture, Food and the Environment (INRAE) has created a consortium, the "Caribbean and Amazonian Bioeconomic Network" (CambioNet). The latter brings together the main organizations of research and development and agricultural bodies of 10 countries. The project, launched in March 2021, aims to support the achievement of food security with sustainable practices in agriculture to cope with climate change.

In 2008, the International Union for Conservation of Nature (IUCN) developed a 'Climate Change and Biodiversity in the European Union Overseas Entities' presenting the impacts of climate change on European overseas territories, including Guadeloupe. The report presented various climate risks such as the bleaching of coral reefs due to an increase in water temperatures. The French initiative on Coral Reefs (IFRECOR) asserted that the mortality rate of the island's coral reefs stood at 80% because of changing sea water temperatures.

A study, led by CETMEF and carried out in collaboration with CETE Méditerranée and CETE de l'Ouest, provided a national synthesis of current knowledge on coastal risks (erosion of low-lying coasts and cliffs, dune advances, marine submersion) and established a simple cartographic representation of areas currently vulnerable to coastal risks in Guadeloupe. For instance, the Pointe-à-Pitre / Jarry area – constituting the economic heart of the island – is among the many vulnerable urbanised coastal areas. Consequently, a study was carried out to analyse the consequences of the rise of sea level and identify the problems that are likely to arise. A modelling of different areas has been established and vulnerable points have been mapped.

A Guadeloupean Regional Climate-Air-Energy plan (SRCAE) was published in December 2012, providing an analysis of the vulnerability of the island to climate change. The SRCAE also prioritised adaptation to be implemented by 2020-2050. However, it is crucial to underline that the SRCAE itself is not specific to climate adaptation, it consists of policies to address air pollution and ensuring sustainable development, climate mitigation and adaptation.

According to the SRCAE (2012), the impacts of climate change on the territory include: An increase of average temperature by 5 °C by 2100 ; Sea level rise of 80 cm; An increase in the intensity of tropical cyclones, coupled with more rainfall and higher wind speeds. There is an uncertainty concerning the

change in precipitation patterns, however, it is likely for the territory to face water shortages in dry reason. An increase in the frequency of drought is already observed.

The Guadeloupean regional observatory of energy and climate (OREC) developed a territorial profile determining the island's vulnerability to climate change.

Otherwise, the Regional Direction of the Environment, Planning and Housing (DEAL) has published several environmental reports of Guadeloupe and mappings of ecological continuities.

From 2018 to 2020, the Geological and Mining Research Office (BRGM) has worked on an "Economic assessment of the impacts of coastal risks related to climate change in Guadeloupe" with a focus on the vulnerability of the city of Pointe-à-Pitre (capital of Guadeloupe) and of the main industrial zone (Jarry) based in Baie Mahault city. Financed by ADEME Guadeloupe, the study assessed on the physical impacts of the retreat of the coastline, marine submersion and sea level rise by 2050 in these areas.

The Regional Group of Experts on Climate (GREC) of the Regional Observatory for Energy and Climate produced assessments and studies on various thematic areas. Since their creation in 2019, they published a study on water resources and climate change and the impact of climate change on coastal ecosystems. Their next publication will address the topic of transportation.

The "Climate Change and Consequences on the French Antilles" (C3AF⁹) project is coordinated by the University of the Antilles, in collaboration with Météo-France, the University Paul Valéry Montpellier 3 and the Geological and Mining Research Office (BRGM). This ongoing project is funded by the European Commission and the Regional Council of Guadeloupe. Its objective is to identify the main impacts of climate change in Guadeloupe, Martinique, Saint-Martin and Saint-Barthélemy. Climate projections were made with a global atmospheric model with a variable resolution grid reaching about 15-20 km over the West Indies. This makes it possible to explicitly represent climate change on the French islands, which are usually not taken into account in IPCC models due to their small sizes. The projections were adjusted after collecting data from 69 rainfall stations (1980-2013) and 17 thermal stations (1988-2013) spread over the 4 islands¹⁰.

The 50 Geometric Steps Agency, in charge of regularizations of land located in the 81 first metres on the littoral, and the Coastal Conservatory Agency also produce maps of coastal erosion from time to time.

3.4.2 Participatory Governance & Awareness Raising efforts

In view of the COP 21, the regional federation organised an awareness week from November 2 to 7, 2015. Guadeloupe was selected to represent the French overseas departments and territories and took the event as an opportunity to highlight the actions carried out at the scale of the territory towards a low-carbon model and the solutions envisaged in the face of climate disturbances and energy transition.

The Guadeloupe National Park offers each year for Guadeloupeans and tourists a programme of activities around the natural and cultural heritage which contributes to the emergence of the public's awareness on the importance of preserving the environment. Moreover, various activities led by local authorities and non-profits are supported throughout the year by the Guadeloupe National Park.

Most of awareness campaigns are developed by non-profits and civil society. At the end of 2021, UNITE Caribbean (a consulting firm) launched a project call, "Karayib Klima" (Caribbean Climate), to support non-profits with climate related projects. The funders of this project call were ADEME Guadeloupe and Martinique, the Ministry of Foreign Affairs through the French Embassy of Haïti and the Foundation of

⁹ <https://c3af.univ-montp3.fr/>

¹⁰ http://www.drias-climat.fr/document/Doc_DRIAS_database_C3AF_CNRM-CM5_ARPEGE62v5.pdf



France. Some climate awareness projects are also expected to start within the next few months, such as a project with 'Climate Fresk¹¹', short documentaries, etc.

Besides the aforementioned projects, there are other initiatives addressing environmental and climate issues. For instance, the National Institute of Research for Agriculture, Food and the Environment (INRAE) have set up an experiment programme, EXPLORER¹², financed by ADEME. EXPLORER aims to design transition scenarios for cropping systems to increase the social, economic and the environmental performance of the farms, experiment good practices to cope with climate change, increase farmers average salary, achieve food security with quality food and polyculture farming system.

The Maritime Harbour of Guadeloupe (Grand Port Maritime de Guadeloupe) is financed by the LIFE European programme to implement "Adapt Island¹³", a programme aiming on testing methodology to restore marine ecosystems and replicate them in other territories. The project will also contribute to raise awareness around climate change issues.

Regional intervention platform in the America-Caribbean zone of the French Red Cross (PIRAC¹⁴) is leading a project called Ready Together. Financed by the Interreg programme (European Union). The project aims to (1) strengthen regional coordination and disaster management mechanisms, (2) increase the preparedness and resilience of small and medium entrepreneurs, (3) raise awareness and promote adaptation to climate change.

Existing labels also indirectly contribute to address environmental and climate issues in Guadeloupe such as: Positive Energy Territories for Green Growth (TEPCV)¹⁵, Eco Neighbourhoods Label (Eco Quartier¹⁶), Territories Committed to Nature¹⁷, Marine and Land Educational Areas programme¹⁸, Cit'Ergie¹⁹, and Small Town for Tomorrow programme (PVD²⁰).

3.4.3 Policies & Action Plans

I- AGRICULTURE

A national policy (Loi d'avenir on agriculture, 2014) is inciting the diversification and the plantation of multifunctional agricultural crops (Monotonous agriculture is more prone and vulnerable to climate change). The Regional Development Plan (SAR) has set itself the objective of preserving 50,000 hectares of useful agricultural area to ensure agricultural production for the market local and export. As part of the Grenelle de l'Environnement, the ECOPHYTODOM plan, which is currently being applied in

¹¹ The Climate Fresk is a French NPO whose aim is to raise public awareness about climate change.

¹² <https://www.inrae.fr/actualites/microfermes-guadeloupe-transition-agroecologique-route>

¹³ <https://climate-adapt.eea.europa.eu/metadata/projects/adaptisland>
;https://webgate.ec.europa.eu/life/publicWebsite/index.cfm?fuseaction=search.dspPage&n_proj_id=7120

¹⁴ <https://interreg-caraibes.eu/ready-together>

¹⁵ <https://www.ecologie.gouv.fr/territoires-energie-positive-croissance-verte>

¹⁶ <http://www.ecoquartiers.logement.gouv.fr/le-label/>

¹⁷ <https://engagespourlanature.ofb.fr/territoires>

¹⁸ <https://ofb.gouv.fr/aires-educatives>

¹⁹ <https://www.territoires-climat.ademe.fr/ressource/128-43>

²⁰ <https://agence-cohesion-territoires.gouv.fr/petites-villes-de-demain-45>

Guadeloupe, underlines the commitment of all stakeholders to reduce the use of pesticides at national level by 50% in 2018.

Additionally, the agricultural research organizations INRAE and CIRAD, present in Guadeloupe, have been developing innovative High Environmental Performance (HPE) agricultural systems for several years promoting tropical biodiversity and limiting the environmental impact of agriculture. The gradual implementation of these systems by farmers will have the effect of allowing Guadeloupe to maintain, boost and diversify agricultural and agro-industrial production in order to meet the needs food and non-food products of the population while improving the quality of its natural environment²¹.

II- TOURISM

In its Tourism Development and Planning Strategy, the Guadeloupe Region asserted the importance of positioning Guadeloupe as a destination of excellence through improving governance systems, increasing tourism flows, preserving the environment and placing Guadeloupe on the map as a reference for ecotourism. The Sea Enhancement Scheme (SMVM) underlined the importance of developing and better organizing port activities and improving their environmental quality. It also proposed preserving protected areas and maintaining the various coastal functions (activities, habitat, recreation, agriculture) as well as the balance between urban, natural, agricultural and forest environments.

Guadeloupe's regional development plan (SAR) presented various objectives to ensure ecological optimization for a protected environment including limiting urban sprawl, the enhancement of the built heritage, the preservation of biodiversity and landscape. The SAR also presented the region's ambition in developing small establishments of high environmental quality fully integrated in nature permitting for tourists to discover tropical forests. The SAR also introduced guidelines for the establishment of blue and green infrastructure systems.

3.4.4 Implemented Grey/Green Adaptation Measures

In Guadeloupe several efforts have been employed to develop knowledge and improve the understanding of impacts and vulnerability of the territory to climate change, some efforts have been put to raise the awareness of various stakeholders and engage them in climate matters. The French overseas territory has also developed various policies and action plans to protect biodiversity and increase the resilience of various systems to climate events, yet, to date, no grey/green adaptation measures have been implemented at the scale of the territory to increase the resilience of KCS to CC.

The Ministry of the Environment, Energy and the Sea praised the quality of the Cayoli programme for the management of natural areas in the district of Guadeloupe Port Caribbean. By awarding it the special "Biodiversity & Business" jury prize during the 2016 Pollutec trade fair. The award was given to reward exemplary actions and projects carried out by businesses for the preservation or restoration of biodiversity.

Each year, the Guadeloupe Region launches a call for projects: "my archipelago my environment" as part of its regional policy in environmental education. The selected associations benefit from 10,000 Euros.

There are various national awards which have been attributed to several municipalities and conurbations of the archipelago. Among them:

- The National award for eco actions trophies
- French capital for biodiversity/best small town for biodiversity
- The Sustainable Overseas Prize

²¹ a report developed by the regional socio-economic council of the Guadeloupe in 2011 à <http://www.guadeloupe.developpement-durable.gouv.fr/IMG/pdf/RAPPORT.pdf>.



- Positive Energy Territories for Green Growth (TEPCV)
- Eco Neighbourhoods Label (Eco Quartier)
- Cit'Ergie
- The Energy trophies
- Small Town for Tomorrow Programme (PVD)

3.5 Key Stakeholders

Table 3.1 List of key local stakeholders in Guadeloupe per type, sector, influence, motivation to take climate action and link with TransformAr.

It is important to note that the “motivation of actor to take climate action” is based on activity of the organisation, considering the public information available. This is a relative characteristic or one that is likely to evolve in time and may not reflect the real motivation of all actors within a particular organism.

Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Conseil Regional de la Guadeloupe (Regional Council of Guadeloupe)	Government (regional)	Infrastructures, Water, Energy, Transport, Economic development etc.	Decision making and development of climate policies/action plans Development of transport systems, water management, electricity and energy management Funding of public policies	Active -> working at close proximity with key actors and financing projects at a local scale Specific representatives and technicians for climate change	Provide knowledge on strategies/projects developed to increase the resilience of the region to climate events	Propose transformational adaptation solutions/projects to be implemented at the scale of the territory
DEAL (Department of the Environnement, Planning and Housing)	Government (regional)	Environment, planning & housing	Delegation of the minister of ecological transition. Regulatory role (development of policies & regulatory monitoring)	Reactive & limited to policy making and control	Provide knowledge on developed (or planned) laws, regulations in the area of climate adaptation. Provide report on the environment profile of Guadeloupe	Guide regulatory action from a climate adaptation perspective



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Conseil Départemental de la Guadeloupe (Department Council of Guadeloupe-as a department of France)	Government (regional)	Environment & sustainable development	Decision making role & development of social, economic and environmental policies Managerial role (schools, elderly cares etc.)	Not much involved/active in addressing climate action but they have a specific service for environment and sustainable development	Provide knowledge on social, economic and environmental development at a territorial level.	Guide policy-making to accelerate transformational adaptation
Conservatoire du littoral (Littoral Conservatory)	Public body (national with a regional representation in Guadeloupe)	Littoral conservation	Decision making role on littoral	Active -> working close with key actors specialised on the littoral	Provide knowledge / information on legislation. Its objective is to acquire a third of the French coastline, wetlands, lake... so that it is not built or artificialised.	Propose transformational adaptation solutions/projects to be implemented at the scale of the territory
Organisation of Easter Caribbean States (OECS)	Inter-Governmental organization (regional-Caribbean)	Water, Energy, Transport, Tourism, Economic development etc.	Regional organization joined by Guadeloupe two years ago. Guide and support decision making.	Active à Benefit from regional and international funds to address climate change issues	Provide knowledge on the Eastern Caribbean region climate and policies, lead international events and groups on the matter	Development of knowledge necessary for ensuring transformational adaptation, awareness raising, and environmental management
Agency for Ecological Transition (ADEME)	Public Body	Environment and Energy agency	Guide & Support decision making Raise Awareness Technical and financial support for ecological transition	Supportive role (-> pushing for environmental and energy measures)	Key link: ensure coordination with key stakeholders at a demonstrator scale Provide environmental info at the scale of the territory	Development of knowledge necessary for ensuring transformational adaptation, awareness raising, and environmental management
Agence Française de Développement de Guadeloupe (French Agency for Development - Afd)	Public Body	Water, Energy, Climate change, Transport, Tourism, Economic development etc.	Active	Financial and technical support for governments (particularly local authorities in Guadeloupe) and entreprises. Loans, investments and to a lesser extent subsidies	Ensure financial viability of key stakeholders (treasury, experienced in financing research and development project)	Propose transformational adaptation solutions/projects to be implemented at the scale of the territory



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Banque des Territoires/ groupe Groupe Caisse des dépôts (Bank of Territories, in the group of Deposit Office)	Support	Housing, Social Cohesion, Communication, Ecological transition...	Growing interest	Loans, investments, advices	Conduct investment, provide treasury, identify key stakeholders	Propose transformational adaptation solutions/projects to be implemented at the scale of the territory
Chamber of Commerce and of Industry of Guadeloupe Islands (CCI IG)	KCS	Businesses in all sectors	Its main missions are to defend business owners interests and improve their performance	Not much involved but growing interest as they are really at risk (eco labels...)	Define key challenges faced by key workers as CCIIG is managed by business leaders	Development of knowledge necessary for ensuring transformational adaptation, awareness raising, and environmental management
Le Comité du Tourisme des Iles de Guadeloupe-CTIG (The Guadeloupe Islands Tourism Committee)	KCS (public body)	Tourism	Provide support for various actions to influence the flow of tourists to Guadeloupe	Indifferent -> concerned more with rentability and the economic aspect	Define key challenges faced by key workers in the tourism sector due to CC.	Develop sector-specific adaptation measures/approaches to increase the climate resilience of the territory and ensure the stability of the tourism sector.
Chambre de l'Agriculture (Chamber of Agriculture)	KCS	Agriculture	Research and development, training, advice, and project management, and organization to defend the interests of agri-related professions at the territorial level	Not much involved but growing interest as they are really at risk	Define key challenges faced by key workers in the agricultural sector	Develop sector-specific adaptation measures/approaches to increase the climate resilience of the territory and ensure the stability of the agricultural sector.
The university of the Antilles (Guadeloupe Campus)	Scientific	Knowledge on climate change, tourism, the environment, agriculture...	Conduct research Bridge knowledge gaps Raise awareness	Active role (growing interest)	Provide maps and knowledge produced by the research units.	Propose transformational adaptation solutions/researches to be implemented at the scale of the territory



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Geological and Mining Research Office (BRGM)	Scientific	Knowledge natural risks, climate change, water and the environment	Conduct research Bridge knowledge gaps Raise awareness	Active role	Provide research, maps and charts produced by the institute.	Propose transformational adaptation solutions/ researches to be implemented at the scale of the territory
National Institute for Research for Agriculture, Food and the Environment (INRAE)	Scientific	Knowledge from a large panel of researchers contributing on various thematic areas	Conduct research Bridge knowledge gaps Raise awareness	Active role with ongoing projects to address environmental issues	Provide charts, maps and research produced by the group. Networking with key stakeholders. Support dissemination as a government institute	Propose transformational adaptation solutions/ researches to be implemented at the scale of the territory
Regional Group of Experts on Climate (GREC) of the Regional Observatory for Energy and Climate	Scientific	Knowledge from a large panel of researchers contributing on various thematic areas	Conduct research Bridge knowledge gaps Raise awareness	Active role in support for decision making at the local level	Provide charts, maps and research produced by the group. Networking with key stakeholders	Propose transformational adaptation solutions/ researches to be implemented at the scale of the territory
UNITE Caribbean	Private	Bringing expertise in climate change and project/policies management		Active role in supporting development projects and policies implementation	Provide feedbacks on adaptation related projects, networking with key stakeholders	Propose transformational adaptation solutions/ researches to be implemented at the scale of the territory

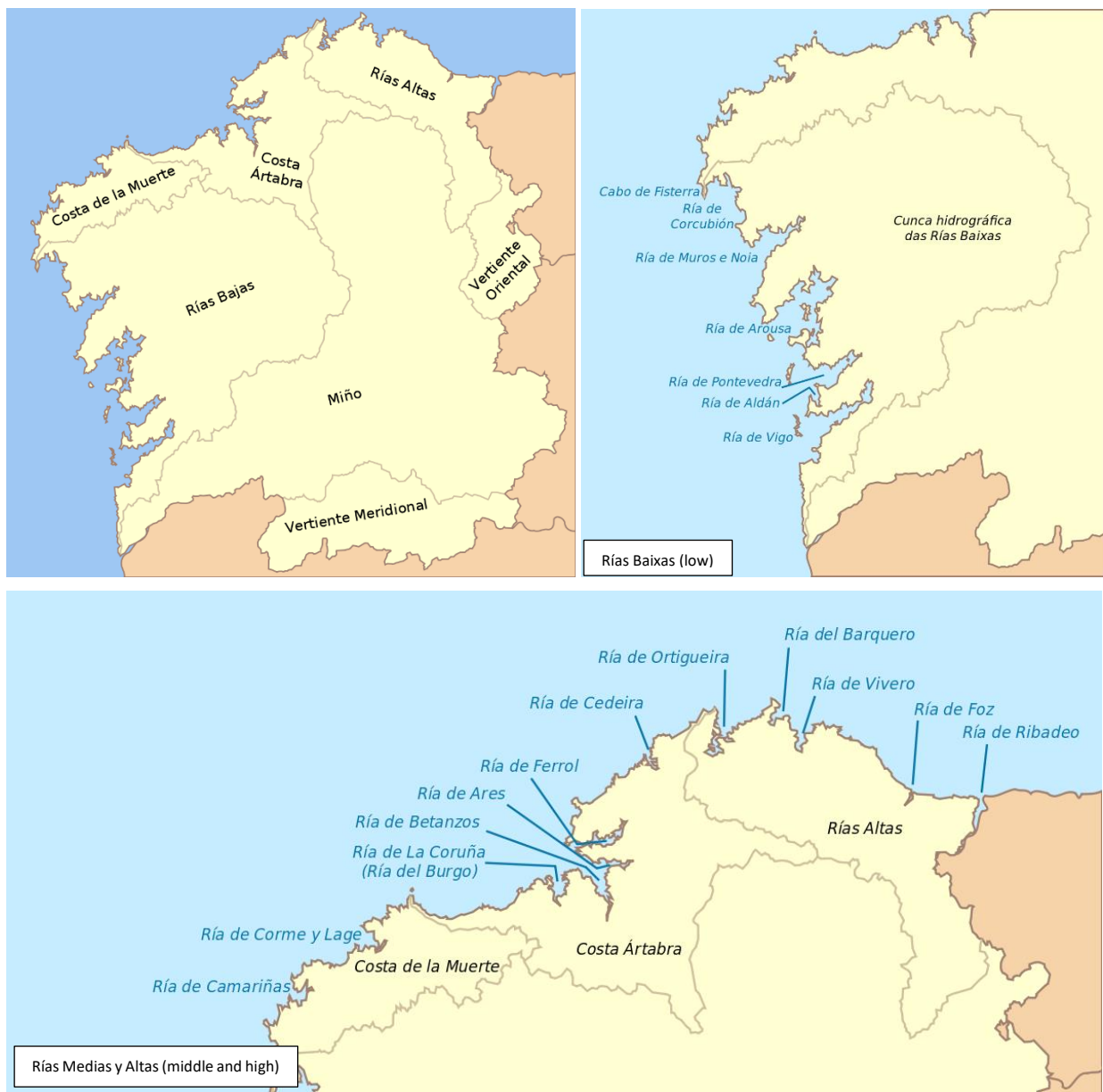
4.0 Galicia Region, Spain

4.1 General Context General Context

4.1.1 Geographical Context

Galicia (6.4 - 9.6°W, 41.5 - 44.2°N), is located in the North West quarter of Spain surrounded by the Bay of Biscay to the North, the Atlantic Ocean to the West, and Portugal to the South. The region covers 29,576 km², representing 5.8% of Spanish territory, with a coast line of 1,659 km (32.8% of the Spanish coast line).

Figure 4.1 Coastal Inlets (Rias) of Galicia



The intricate Atlantic coast of Galicia is mainly characterised by the presence of multiple coastal inlets known as Rías²². They are classified in three groups: Baixas (Low), Medias (Middle) and Altas (High).

The Rías Baixas are a group of four wide and long coastal embayment situated between the River Miño and Cape Fisterra. From North to South Muros-Noia, Arousa, Pontevedra and Vigo are found. These inlets are funnel-shaped flooded valleys, and they are surrounded by mountains of 400-600 m high. The Rías Baixas are between 19-30 km long, with its central axis lying in a SW-NE direction, and an approximately 8-12 km wide in their external part, and from 1-3 km in their inner part. Depth varies from 50-60 m in the external part to 5-10 m at the mouth of the main river. All of the Rías, with the exception of Muros, present rocky islands at their entrance, acting as a shield against incident waves and giving rise to two entrances, the North and the South, each Ría being with its own particular features. All the Rías present a main river discharging at the head and a grid of small tributaries along the margins. Along a Ría, the balance between marine and fluvial forcings changes progressively from outer to inner sectors (Vilas et al., 2005).

The "Rías Medias" are between Cape Fisterra and Cape Ortegal, and the largest are the Rías of the Artabro Gulf: A Coruña, Ares-Betanzos and Ferrol. These Rías are smaller (< 1/4 the size of the Rías Baixas) and with a much stronger continental influence (Alvarez-Salgado et al., 2011).

Finally, the Rías Altas including Ortigueira, O Barqueiro, Viveiro, Foz and Ribadeo, are to the East of Cape Ortegal, in the Cantabrian Sea (Bay of Biscay) are the smallest and most influenced by the tide and the river discharge.

Figure 4.2 Cíes Islands – Galicia



Source : Image retrieved January 4, 2022, from <https://sworld.co.uk/02/100040/photoalbum/galicia-the-c%C3%A4des-islands-eamp;quot;les-%C3%A4es-des-dieux-eamp;quot;-;>

²² Rias are funnel-shaped estuaries that occur at a river mouth and are formed by the submergence of the lower portion of the river valley.

Galicia is the final destination of the Camino de Santiago or Way of Saint James, which is Europe's oldest pilgrimage route and also the most travelled. The region is home to natural wonders such as the Cíes Islands (Figure 4.2) and the cliffs at Vixía Herbeira as well as World Heritage Sites such as the Walls of Lugo and the Tower of Hercules. It also embraces areas with rich landscapes and architecture such as the Ribeira Sacra or the Ferrol of the Age of Enlightenment, and others of outstanding mythological or historical value, such as Cape Finisterre or the Hill Fort of Santa Trega.

The territory of Galicia is home to 56 types of habitats of community interest, with 10 of them being considered as priorities. According to the data extracted from the "Master Plan of the Natura 2000 Network" prepared in 2012 by the Xunta (Ramil-Rego et al., 2012), 12.7% of the territory of Galicia is considered a Site of Community Interest (SCI) and 3.4% corresponds to Areas of Special Protection for Birds (SPAs), which are usually part of SCIs.

The most relevant natural spaces are 1) National Park – the Parque Nacional Marítimo-Terrestre das Illas Atlánticas de Galicia; 2) five Biosphere Reserves, 3) six Natural Parks so varied in nature that they range from the one in Complejo Dunar de Corrubedo e Lagoas de Carregal e Vixán – a wetland near the sea – to the mountains of O Invernadeiro, 1,500 metres above sea level. Over 50 spaces belonging to the Natura 2000 Network and numerous Special Protection Area for Birds (SPAs) scattered throughout the geography of Galicia, give an idea of what nature offers in Galicia. The sea outlines a unique landscape. The attraction of its Rías (or coastal inlets), together with its unique cultural and natural heritage have made Galicia an attractive area for locals and tourists, a fishing hub and a site known for its rich gastronomy based on the delicacies that the ocean provides²³.

The climate of Galicia undergoes a progression between a predominance of the pure oceanic climate and climatic zones that can be considered as sub-oceanic and that were also characterised as having a Mediterranean tendency. The spatial distribution of temperatures presents a coast-inland variation, related to the presence of the Atlantic Ocean, and another north-south, related to the annual balance between the temperate and subtropical climatic components. The region has a weighted average annual temperature of 13.3°C, and a weighted average rainfall of 1,180 mm, which occurs mainly in the autumn-winter semester.

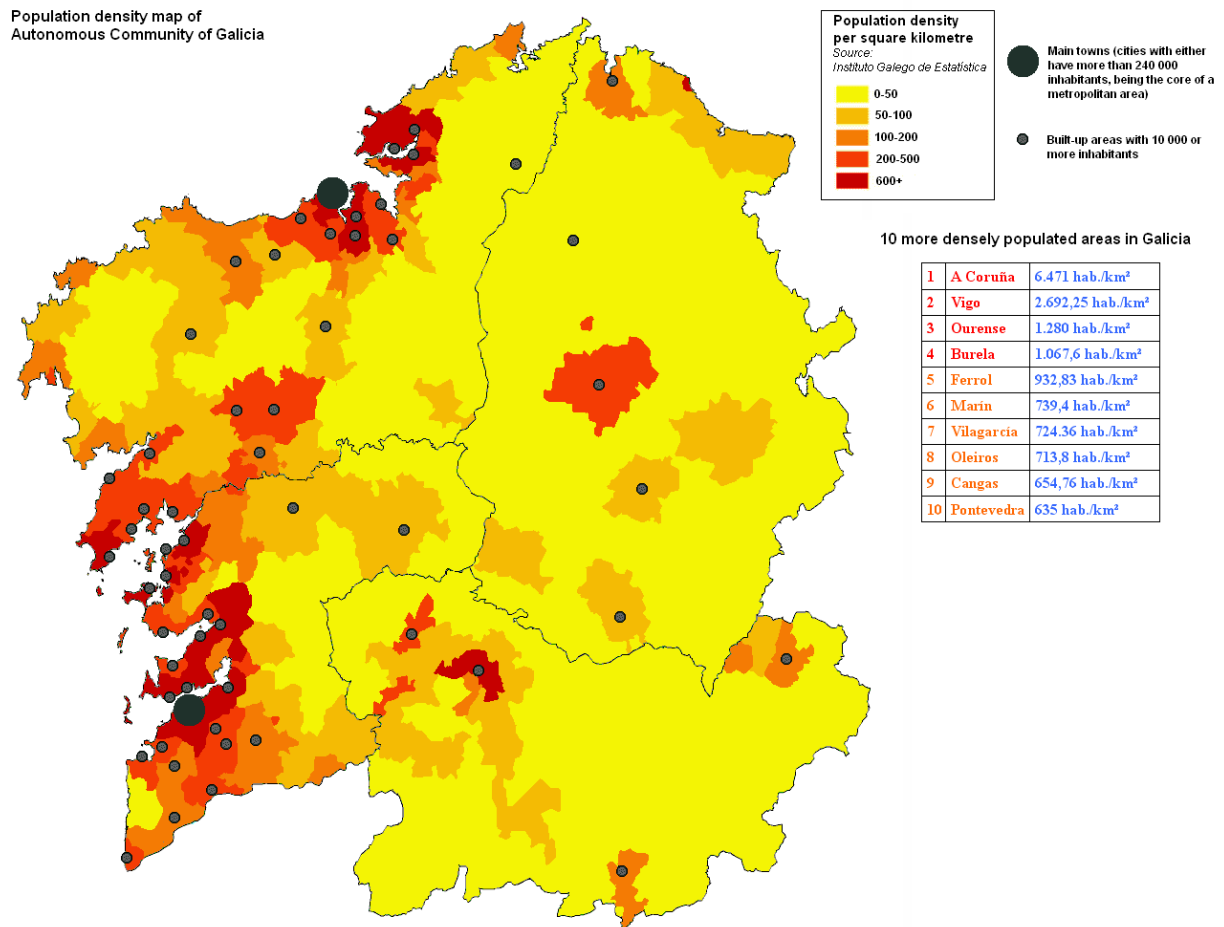
4.1.2 Demographic Context

According to Eurostat (2021), Galicia is home to 2,702,592 inhabitants. The IGE - Instituto Galego de Estatística (2021) in its report "Spatial distribution of the characteristics of the population of Galicia by grid of 1km²", underlined that 97.1% of Galicians live in 34.4% of the surface of the territory, which means the population density is not homogeneous across Galicia with a clear concentration of habitability and industrial activity in the Rías Altas and Rías Baixas. In 2001, 60% of the Galicia population was living in coastal municipalities, representing only 16% of the territory (Alvarez-Salgado, 2006).

The coastal line of Galicia is a particularly sensitive area to the possible effects of climate change. On one side, this population density increases the pressure on the coastal ecosystems where both treated and untreated agricultural, industrial and urban waste discharges occur and fisheries and aquaculture activities may unbalance the natural functioning of the ecosystems. On the other side, the sea level rise together with winter storms (e.g. increase of extreme wave and precipitation events) may cause flooding and the disablement or even the disappearance of port infrastructures, coastal roads, or industrial and residential areas that may be relocated to nearby areas, causing a high socio-economic impact and increasing even more the current density.

²³ Galicia, the best way, Xunta de Galicia https://www.turismo.gal/inicio?langId=en_US

Figure 4.3 Population density map of Galicia

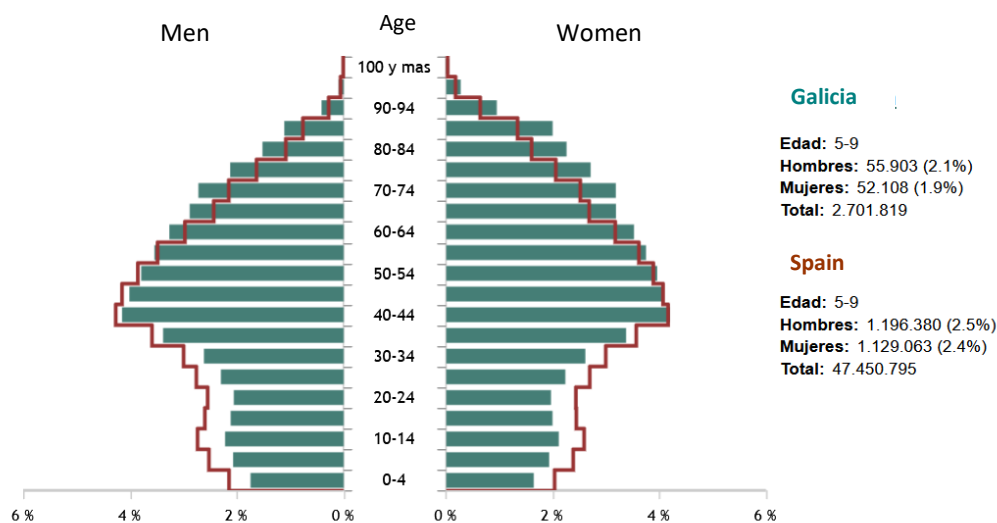


Source: Figure retrieved January 4, 2022 from https://upload.wikimedia.org/wikipedia/commons/8/89/Galicia_densidade_de_poboacion.PNG.

Overall, Galicia has had a global negative population growth rate since 2012, ranging from -0.54% to -0.1%, and only recently in 2019 the population growth rate increased by +0.08%. Nevertheless, the geographic distribution is not uniform. The coastal provinces of A Coruña and Pontevedra have increased their weight in the Galician total, while the population decreased in the inland provinces of Lugo and Ourense. This results in a growing density in the coastal areas, increasing the human pressure in these environments. Local disturbances caused by the high population density in the coast (e.g. modification of the coastline by port infrastructures, source-point and diffused agricultural, industrial and urban inputs) act in combination with climate change impacts (e.g. warning, acidification, deoxygenation and fertilization).

Galicia has an aging population pyramid (Figure 4.4), with a reduction in birth and fertility rates, and a progressive increase in life expectancy.

Figure 4.4 The Demographic Pyramid of Galicia (Contrasted with the National Demographic Pyramid)



Reference Date: 1st of January 2020

Source: Instituto Nacional de Estadística <https://www.ine.es/covid/piramides.htm>.

According to the Galician institute of Statistics, in 2019, in the territory the average age of the population was 47.48 years, and life expectancy at birth reached 83.82 years. The aging index, which calculates the ratio of people older than 65 and people under the age of 20, has been steadily increasing since 1975, being higher in the case of women. For the whole of Galicia, the aging index was 160.4 in 2020. In 2019, on average in Galicia a women gave birth to 1.02 children.

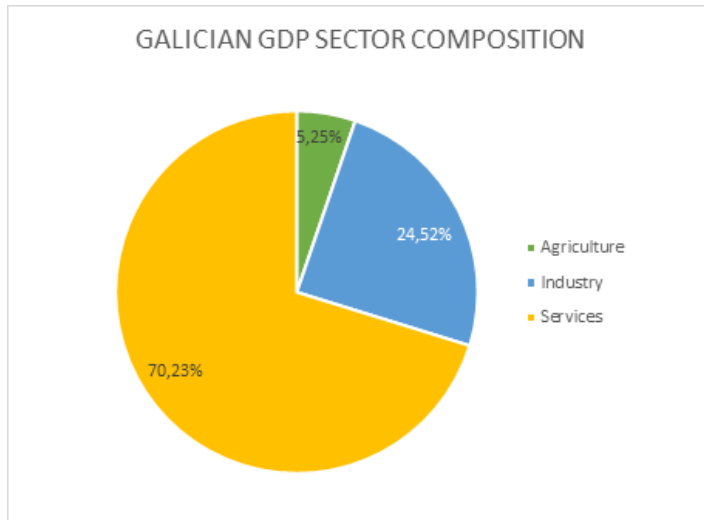
In summary, the demographic situation in Galicia presents both challenges and opportunity. On the one hand, the negative population growth is resulting in an aging population, which is more vulnerable to extreme events and effects of environmental degradation. On the other hand, the decrease in population growth could present an opportunity to reduce the pressure on the environment.

4.1.3 Economic Context

According to Eurostat (2021), the percentage of Galicians at risk-of-poverty rate stood at 22.1% in 2020, this rate is slightly higher than the European and Spanish average (which stood at 21.9% and 21%, respectively during the same year). In Galicia, the unemployment rate amounted to 12% in 2020, which is higher than the EU average (7.1%) but lower than the Spanish unemployment rate (15.5%). Galician women are among the most affected by unemployment, with a rate of 13.2%, in comparison to 10.9% for men. Also, the young adults (population between 25 and 35 years of age) are among the most affected by unemployment in Galicia, with a rate of 17.4%, well above the European rate (8.8%) and, again, below the Spanish average (19.6%).

According to the Ministry of Equality of the Spanish government (2020) in its report “Gender and Climate Change. A diagnosis of the situation”, Climate change affects the most vulnerable, and within these, women and young people (under 35 years old). In general, women and young people suffer greater risks and burdens associated with climate change, due to situations of poverty, but also to roles associated with gender and their own cultural norms.

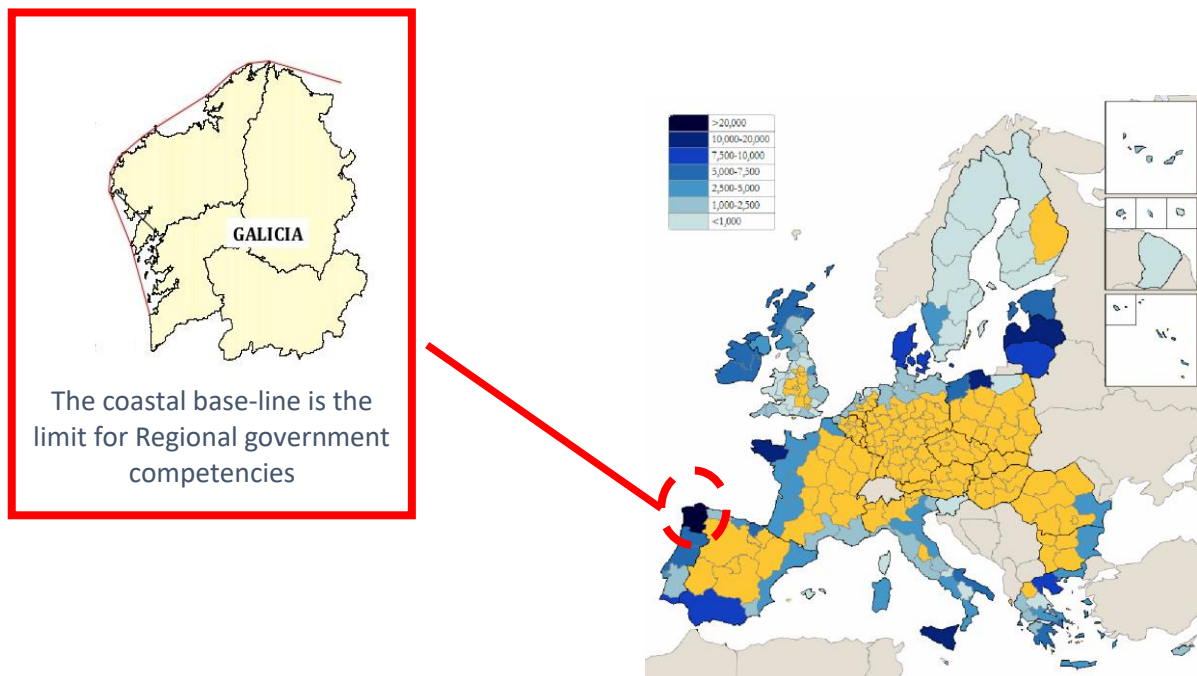
Figure 4.5 The Galician GDP Sector Composition



Source: IGE - Instituto Galego de Estadística (2021): Contas económicas trimestrais. Revisión Estadística 2019. Oferta, demanda e rendas. Retrieved December 1, 2021 from <https://www.ige.eu/igebdt/selector.jsp?COD=9621&paxina=001&c=0307007002>.

According to the Galician Institute of statistics, the Galician GDP is composed of 5.25% of Agriculture, 17% of Industry and 68% of Services. This shows the prominence of the tertiary sector.

Figure 4.6 Total Fisheries Sector Employment in Europe



Galicia is one of the most important European Union (EU) fishing regions: in a study of 128 European coastal regions, Salz & Macfadyen (2007) pointed out that Galicia is the region with the highest employment and dependence on income from fishing sectors. There are around 60 ports and landing

points with a fleet of approximately 4,800 ships (representing 42 % of the Spanish fleet) according to data retrieved from the online platform on fishing in Galicia²⁴.

Marine aquaculture and shellfish harvesting take place in coastal facilities on land or in marine zones considered as inland waters (Rías). The Regional Government (Xunta de Galicia) has the regulatory authority over these activities.

Mussel aquaculture represents about 40% of European and 15% of World cultured mussel production. It takes place in 3,337 floating rafts distributed in five Rías (Vigo, Pontevedra, Arousa, Muros-Noia and Ares-Betanzos), about 70% in the Ría de Arousa. Mussel aquaculture directly employs 3.890 people in the region (Xunta de Galicia, 2021a).

Clam culture farming and shell-fish harvesting take place on land (on foot) and afloat: in coastal sand banks across most of the Rías Baixas, Medias and Altas. 652 land concessions in the intertidal areas of Galicia are dedicated to shell-fish farming and harvesting, employing 801 people in 2019. To add to that, about 3,500 self-employed people work (on foot) in the harvesting of bivalves and polychaetes on beaches and intertidal sandbanks, among which 90% are women (Suris et al., 2014).

In Galicia, the number of people directly working in mussel and clam aquaculture amounts to 8,190²⁵ and represents 0.8% of total employed in Galicia. Nevertheless, these are important segments to Galicia fisheries, accounting for an important value of its fisheries and aquaculture production. In 2020, mussel aquaculture represented 97% of Galician aquaculture production, reaching a value of 100,917 K€, 56% of the total value of aquaculture production. The clam culture and harvesting reached a value of 18,938 and 50,087 K€, representing 10% of the value for the aquaculture, and 12% of the value of the fisheries production in the region (Xunta de Galicia, 2021b,c). As part of the Galician fisheries, this KCS is involved in an economic activity with a high drag power in a large number of sectors in the region such as commercialization, processing, canning industry, facilities, ship building, and tourism (with tourists eating fish, taking gastronomic tours and paying for boat and fishing trips) (García Negro et al., 2018).

4.2 Vulnerability & Key Observed and Projected Impacts

4.2.1 Territorial Scale

Galicia, located in the Atlantic region is, according to the EEA (2017) at risk of more frequent and intense winter storms that will lead to an increasing risk of coastal infrastructure damage and heavy precipitation events, which in conjunction with sea level rise, could lead to more intense riverine and coastal floods. Other climate hazards are also expected like an intensification of heatwaves, droughts, and a longer fire season which will increase the risk of wildfires and could affect shellfish aquaculture due to the impacts of post-fire ash and runoff sediment in the shellfish zones. However, a decrease in energy demand for heating is also likely to occur.

According to the Galician Climate Change and Energy Strategy 2050 (Xunta de Galicia, 2019a), variations in oceanographic conditions (e.g. increase in temperature, changes in upwelling-favourable coastal winds and precipitation regimes), the alteration of nutrient fertilisation patterns (Sousa et al., 2020, Fuentes-Santos et al., 2021), the presence of invasive species or even new pathogens, as well as an increase in harmful algal bloom (HAB) episodes (Álvarez-Salgado et al.; 2008, Pérez et al., 2010), can pose threats to which the aquaculture sector has to adapt (Cramp et al., 2021).

²⁴ Plataforma pescadegalicia.gal, Xunta de Galicia <https://www.pescadegalicia.gal/>.

²⁵ 3890 people working in mussel aquaculture and 4300 working in clam culture farming and shell-fish harvesting.

Some aspects could further exacerbate the vulnerability of Galicia such as landslides, wildfires, and earthquakes. In coastal areas we can add extreme wave events and storms, coastal erosion or red tides (harmful algal blooms) (Fra Paleo, 2010; de Castro et al., 2010; Quinteiro Seoane and Fernández Núñez, 2018; Salvador et al., 2019; Mingarro-López et al., 2019).

Figure 4.7 Wildfires 2017: top photo seen from the sea of fires. Bottom photo, satellite images show how the flames surrounded the urban area



Photo by Vigo Burns. Retrieved December, 2021 from <https://www.euroweeklynews.com/2017/10/15/galicia-blazes-146-fires-reported-two-dead-and-500-military-deployed/>



Galicia has faced a series of severe weather events in the past, including storms, droughts, wildfire and heatwaves. During the European Heatwave of 2003, for example, the temperatures in Galicia exceeded the 95th percentile of the maximum temperature, which impacted the mortality in the region. In winter 2002-2003 and 2013-2014, storm events significantly eroded beaches along the Galician coast and caused damage to infrastructures (e.g., ports, ships, mussel rafts) and generated the inability to work at sea (e.g., small-scale fisheries, mussel aquaculture, shellfish harvesting activities). The region also witnessed one of its worst droughts in the last hundred years in 2016-2017, with an overall decrease in rainfall by about 500 mm. To add to that, in 2017, Galicia was shook by wildfires destroying a total of 43,000 hectares in the southern region. Although these fires are human-induced, the drought situation magnified the



catastrophe. One direct consequence of the fire was a greater soil erosion increasing the sedimentary contribution to the Rías by runoff.

Similar events -as the aforementioned weather-related catastrophes- could re-occur in Galicia with an increased frequency and intensity due to climate change if no proper mitigation and adaptation measures are implemented.

In the report “Environmental awareness of shellfish areas”, FUNDAMAR²⁶ (2020) presented the main factors that negatively affect shellfish farming in the territory:

- The proliferation of forest plantations of highly flammable species, such as pines and eucalyptus, favours the rapid spread of fires: The ash carried by the rain pollutes rivers, reservoirs, the Rías and can even reach the sea. This ash causes a decrease in oxygen in the water, increases turbidity and dirt that prevents light from penetrating and changes the pH of the water. The ashes settle and remain deposited at the bottom, on shellfish banks and obstruct the breathing and filtering ducts of bivalve molluscs such as clams, razor clams or cockles, increasing their mortality rate. The mussel is also affected by ash, although to a lesser extent, because it is suspended in the water. The fires also increase the entry of organic matter into the Rías, which can cause an increase in the growth of species of toxic phytoplankton, known as red tides.
- The landfills and infrastructures -derived both from concentration of industrial and leisure activities as well as residential areas in coastal municipalities- have led to irreversible loss and damages to the marine area and the ecosystems linked to it. This is one of the greatest anthropogenic aggressions in the Rías, since it is land reclaimed from the sea, and makes the territory especially vulnerable to future sea level rises.
- Invasive species come mainly attached to the hulls of boats entering the Rías from other parts of the world. These species would likely compete with the local fauna and flora for space and food. If global warming affects seawater temperature, tropical invasive species would gain an advantage over native fauna.
- The increasing concentration of population and industry in the coastal areas leads to the augmentation of untreated or inadequately treated agricultural, industrial and urban effluents. Thereby, a significant increase of rainfall derived from more frequent extreme events would intensify its polluting effect on the sea.

Some studies revealed that an increase of 1°C in the average temperature for the whole year and for the months of the high season (summer) could present some positive opportunities to the tourism season in the northern part of the Iberian Peninsula (Cantabrian coast, Galicia) and also Barcelona and Girona (Olcina and Vera-Rebollo, 2016). The warming of coastal waters is attractive for tourism in Galicia because of the cold temperature of the region’s water during spring and summer due to coastal upwelling. Besides, biological modelling results developed in the EU project ClimeFish shows that future increase of surface water temperature and food availability, dictated by water circulation and fertilization patterns forced by continental runoff and coastal winds, will increase mussel growth rate slightly, by about 10%. Consequently, mussels will reach the commercial size faster according to the harvesting strategy. To add to that, the increase in the wind intensity in light of climate change can also be considered as an opportunity for energy production, especially considering the increased potential of marine wind energy. Yet, in this context it is important to underline that climate change could decrease the photovoltaic potential.

²⁶ Foundation for fishing and shellfishing.

4.2.2 KCS Scale

I- MUSSEL AQUACULTURE

The main climate-related threats for mussel aquaculture are related to the negative impact of extreme weather events on the mussel raft structures and the biomass losses associated to mussel detachment from the ropes, the availability of mussel seeds (Fuentes-Santos et al., 2021), the frequency and intensity of harmful algal blooms (Alvarez-Salgado et al., 2008; Pérez et al., 2010) and the increase of water temperature and stratification (Des et al., 2020). Ocean acidification may also affect the growth and survival of shellfish species, but due to the current carbonate oversaturation of the waters that upwell in the Galician coast, this should not be a risk until the end of the XXI century (Ruiz et al., 2021). Interestingly, Lassoued et al. (2019) found in a laboratory experiment that while mussels may be able to resist the impacts of ocean acidification under optimal food availability, this is not the case for a sub-optimal diet.

Studies such as Fuentes-Santos et al. (2021) point out further research is required to incorporate higher resolution regional scale climate models accounting for the ocean-land interactions in coastal areas to forecast future trends in key environmental factors, such as sea surface temperature, continental runoff, coastal winds, food availability and pH. This approach focused on mussel growth but a proper estimation of climate change impact on suspended mussel aquaculture should also be tested for climate related changes on seed availability and harmful algal blooms (HAB), which affect management decisions such as the seeding and harvesting schedule, the presence of seed predators in the farming areas or the occurrence of extreme weather events which produce massive detachment of mussels on hanging ropes or can damage the mussel rafts. In contrast with Fuentes-Santos et al. (2021), predictions developed by Des et al. (2020), related to water temperature and stratification during summer in the NW Iberian upwelling system and assumed thermal stress conditions above 20°C led them to conclude that the expected sea surface temperature increase during the 21st century shall have a dramatically negative effect on mussel aquaculture production in the Galician Rías.

There is no consensus on the consequences of climate change on mussel aquaculture due to large uncertainties of global and regional climate models, as well as in the downscaling process to the local scale. Future trends are highly dependent on the climate model used, and accurate local-scale climate change projections for primary production in the Galician coastal upwelling area are not available. Therefore, it remains a challenge to evaluate the response of mussels to future shifts in food availability (Fuentes-Santos et al., 2021).

The predicted future increase of the intensity and persistence of winter storms, harmful algal blooms and, likely, seed predators would all have negative socio-economic impacts, focused especially on the reduction of production capacity which would lead to an increase in unemployment in the sector and a reduction in purchasing power.

Adaptive measures to counteract these threats would be, for example, advance in the design of mussel rafts and ropes able to better resist wave energy, develop an operative early warning system to alert mussel farmers about the occurrence of HAB events, or design protective nets at the rope scale to avoid seed predation. The predicted effect of future increasing water temperature and coastal upwelling, would favour the growth rate of cultured mussels because of the positive effect of temperature and food availability (associated to coastal upwelling), which would reduce the culture time allowing the cultured mussels to be exposed to negative impacts (e.g. winter storms, HABs) for a shorter period of time. However, future increase of surface temperatures above the optimal thermal range of the mussel could finally have a negative impact on growth. Nevertheless, the current uncertainty of global, regional and local climate and oceanographic models in the Galician coast do not allow to produce solid estimates of the future trends of mussel aquaculture production in the area.

Figure 4.8 Mussel raft stranded on a beach after loosening from its anchor due to a storm, 2016



Photo by Iñaki Abella. Retrieved December 22, 2021 from: <https://www.farodevigo.es/arousa/2016/04/11/bateas-desguace-cambados-acabavardas-16642190.html>

Figure 4.9 Pieces of a mussel raft destroyed during a storm, stranded on a beach, 2015



Source: Figure retrieved December 22, 2021 from <https://loqueyotedigo.net/2015/12/18/o-barbanza-el-temporal-costero-destroza-una-bateay-arrastra-hasta-barrana-parte-de-su-plataforma/>.

II- CLAM CULTURE AND HARVESTING

Changes in water level, extreme weather events (heatwaves, winter storms) and precipitation (river floods) can induce relevant fluctuations in coastal oceanographic and hydrological variables (variations

in rates of change, historical ranges, etc.) that will directly affect the optimal thermal and -haline range for some species, the sediment transport pattern or the sediment origin in the intertidal zone and food availability for these filter feeders. These variations will have the potential to modify the sedimentary characterisation (substrate) on shellfish banks, reducing the shellfish productivity and increasing the mortality. In extreme cases, it could cause the loss of these habitats. Knowledge about the dynamic of the sediments is needed in order to predict and evaluate potential risks in the area. It is also important to mention the barnacle²⁷ harvesting in the rocky shores which is affected by food availability (i.e. circulation and fertilization patterns), winter storm and mussel seeds competition.

Clear negative socio-economic impacts are associated with heatwaves, sea level rise, winter storms and river floods, which produce punctual mass death of harvesting species, coastal erosion and, eventually, destruction of habitat. The aforementioned impacts increase clam mortality and the reduction in productivity. As in the mussels KCS, the impoverishment of the sector would have serious ramifications on the local population because clam culture and harvesting represents an economic engine in the areas where it is developed. In addition, the cultivation plots are limited and assigned to the producers by concession. A significant reduction in the productivity of the parks could be associated with a reduction in concessions causing, in addition to the above, social tensions.

4.3 Governance Baseline

4.3.1 National Scale

Spain is an EU member state whose political form is a parliamentary monarchy. Since 1978, the current Constitution distributes political and administrative power among the national and regional governments, being one of the most decentralised countries in Europe.

Galicia is a Spanish autonomous community, considered a historical nationality according to its Statute of Autonomy (1981). The community exercises its administrative functions through the Regional Government (Xunta de Galicia), its entities and dependent bodies.

The Xunta de Galicia, through the Regional Ministry of the Sea, has the regulatory authority over marine aquaculture and shellfish harvesting, which take place in coastal facilities on land or in marine zones considered inland waters and named Rías. The Regional Ministry of the Environmental Quality and Climate Change is the competent body on issues related to climate change.

The National Climate Change Adaptation Plan 2021-2030²⁸ constitutes the basic planning instrument to promote coordinated action against the effects of climate change in Spain. Its main objective is to avoid or reduce present and future damages derived from climate change and to build a more resilient economy and society. The Plan defines objectives, criteria, areas of work and lines of action to promote adaptation and resilience to climate change. It has been the result of a collective process of analysis, reflection and public participation.

4.3.2 Territorial Scale

In 2019, the Xunta de Galicia launched the Integrated Regional Energy and Climate Plan 2019-2023 for the development and implementation of the Galician Climate Change and Energy Strategy 2050. The strategy identifies aquaculture as one of the strategic sectors that should be taken in special consideration in the regional adaptation.

²⁷ Barnacles (*balanus glandula*) are sticky crustaceans associated with lobsters, shrimps, and crabs.

²⁸ English version of the Spanish National Climate Change Adaptation Plan 2021-2030 https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/pnacc-2021-2030-en_tcm30-530300.pdf

4.4 Response Measures

4.4.1 Knowledge Production

Galicia in general, and Vigo in particular, has a great impact in marine research at an international level. It has three universities with faculties, departments, Master's and Doctorate studies oriented to the sea, and a Centre in Marine Research (CIM), public research centres both national (IIM-CSIC, IEO) and regional (CIMA, CETMAR, INTECMAR, MeteoGalicia) as well as a strong relationship with the Universities of the North of Portugal through the International Campus of Excellence - Campus do Mar.

Besides, there are several examples showing the close relationships between fishing associations, public administration and research centres where CETMAR plays a bridge role. For example, RAlA cross-border Observatory has allowed to enhance observing and forecasting systems in the region fostering transnational cooperation between Galicia and Portugal and providing data, climate indicators, predictions and services to local end-users (MarRISK and RADAR ON RAlA POCTEP projects); ClimeFish project, analysing environmental and socio-economic impact of climate change on mussel aquaculture.

The Xunta de Galicia coordinated from 2007 to 2009 a research project entitled "Analysis of Evidences and Impacts of Climate Change in Galicia" (CLIGAL) which conclusions were published in the book Evidences and impacts of climate change in Galicia.

Flood risk maps focused on Galica River have been developed²⁹ and Coastal erosion and flood risk maps are expected to be available by February 2022. In the framework of MarRISK project, 38 environmental indicators were identified related to 12 key risks affecting the ecosystem services of the Euroregion Galicia-Northern Portugal³⁰. This could be a starting point for the development of future maps.

4.4.2 Participatory Governance & Awareness Raising efforts

Various projects and initiatives have been developed with the aim of understanding the impacts of climate change and raising awareness about this global issues. To name a few:

- CLIMANTICA³¹ -an environmental education project, aimed at connecting science, education and society- started in 2006 and is still ongoing. The Climantica team consists of four working groups – teaching, graphic edition, multimedia and scientific advice-, which develop teaching materials and resources addressed to secondary school students. The contents are translated into Galician, Spanish and English.
- Effect PO2³² is launched to promote a lifestyle and respect for the environment and the health of people. It is a firm commitment to increase urban quality in the city of Pontevedra and continue to be a pioneer in the construction of a city based on sustainable development and respect for the environment.
- The Xunta de Galicia (Galician regional government), aware that the Covenant of Mayors for Climate and Energy is the best instrument to involve the municipalities of Galicia in the fight against climate change, decided to participate in this initiative as coordinator of the agreement in the region, with the aim of promoting and supporting the Galician municipalities in their adherence to the pact.

²⁹ provided by Augas de Galicia (Xunta de Galicia). - <https://mapas.xunta.gal/visores/dhgc/>.

³⁰ <https://marrisk.inesctec.pt/public/#!/indicators>

³¹ <http://climantica.org/roller/proyectoPrensa/en/page/proyecto>

³² <https://www.pontevedra.gal/efecto-po2>

4.4.3 Policies & Action Plans

The PIMA Adapta Costas CCAA 2017, launched by the Ministry for the Ecological Transition and the Demographic Challenge, is a plan that aims to contribute to the development of the National Plan for Adaptation to Climate Change (PNACC, for its acronym in Spanish) and the implementation of the Strategy for Adaptation of the Spanish Coast for Climate Change. This plan facilitates detailed studies for sections of the coast of regional dimension, guaranteeing uniformity in the methodology applied to the generation, acquisition and collection of data and contributing to the evaluation of the vulnerability of the Spanish coasts to climate change. Within this study, the impact of climate change on the prediction of fishing unloads on the Galician coasts will be analysed; as well as the possible impact on aquaculture, algae and mussels production.

The Galician Strategy on Climate Change and Energy 2050 (Xunta de Galicia, 2019a) serves to set the main orientation in the fight against climate change from a regional perspective, and allows to contribute to the objectives established at a global level in this matter with a view to a 2050 time horizon. The Strategy addresses each of the major blocks of action on climate change: Mitigation (reduction of greenhouse gas emissions), Adaptation to the impacts of climate change, based on observation and research, which aims to improve the knowledge of the effects and awareness, training and education.

The integrated regional climate plan (2019-2023) (Xunta de Galicia, 2019b) established for the development and implementation of the regional climate strategy, presents lines of actions in terms of mitigation, adaptation, research as well as social governance and awareness raising. When addressing the objective of developing an adaptive sectorial management to guarantee the future positioning of the relevant sectors for Galicia, the plan (Xunta de Galicia, 2019b) sets “the line of action 18” which calls for: consolidating sustainable fisheries and aquaculture management that minimises the impacts of climate change and ensures the sector's current long-term positioning.

To add to that, the Strategy ‘Digital Galicia 2030’ and the Artificial Intelligence Galician Strategy 2030, both launched by the Regional Government in 2021, seek to contribute to create digital and intelligent solutions for climate change adaptation.

4.4.4 Implemented Grey/Green Adaptation Measures

Grey adaptation measures are implemented in the region to protect the sandbanks. The main problem is the loss of sediment or the change in texture from sandy to muddy sediments. This may be related to a wide variety of factors, i.e. the clams culture itself produces changes in the sediment, coastal infrastructures may change the sediment dynamics, but it will be exacerbated by the climate change. The most common measures are the sand-bank regeneration with quarry sand, and the construction of walls to protect beaches.

In Galicia various initiatives proved to be award worthy. For instance, the CLIMANTICA project³³ has received the label “Recommended by the high commissioner of the United Nations on Climate Change.”

The Galician Association of Industrial Engineers, in collaboration with the Galician College of Industrial Engineers, has recognised projects that fight against climate change since 2014 through awarding them the “Galicia Energy Award”.

The Provincial Council of Pontevedra, Diputación de Pontevedra, promotes the Reacción polo clima contest (Climate reaction contest), awarding the best audiovisual pieces focused on climate change, produced by young people from the province between 16 and 30 years old.

³³ <http://climantica.org/climanticaFront/en/page/Weblog>

Finally, an environmental initiative addressing the fisheries sector to promote their involvement in the protection of the environment is being promoted.

The Regional Ministry for the Sea has launched in 2020 the MARLIMPO Plan, which grants the contribution of the fishermen guilds, and fisheries sectoral associations to promote a clearer marine environment. Granted actions may be addressed at the collection and storage of marine litter, the creation of waste collection systems or awareness campaigns as well as training in this area

4.5 Key Stakeholders

Table 4.1 List of key local stakeholders in Galicia per type, sector, influence, motivation to take climate action and link with TransformAr.

It is important to note that the “motivation of actor to take climate action” is based on the activity of the organisation, considering the public information available. This is a relative characteristic or one that is likely to evolve in time and may not reflect the real motivation of all actors within a particular organism.

Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Galicia Regional Ministry for the Sea. Secretaria Xeral Técnica Consellería do Mar	Government (Regional)	Marine Environment	Decision making role & development of fisheries policies	Reactive. Contributes to the implementation of climate regulations/projects promoted by other regional/national departments	Key link: ensures the involvement of two key General directorates for the monitoring of the Galician Demonstrator. can ensure the uptake of the solutions depending on regional regulations. Can support further research or developments under European Fisheries and Maritime Fund	Developing transformational solutions to a key economic sector in Galicia. Guide regulatory action from a climate adaptation perspective. Provide information on the expected impact of climate change in the demonstrator KCS, and also on the acceptance of adaptive solutions.
Meteorological agency of Galicia. Regional Ministry of the Environmental Quality and Climate Change.	Regional Governmental Agency	Meteorology/Weather/Climate Change	Meteorological predictions for the Galicia Region	Pro-active. Participates in research projects to evaluate climate change impact in the region	Provide predictive models and knowledge produced by the research units	Provide knowledge on intertidal sedimentary dynamic (useful for meteorological models)
Regulatory Council of the Protected Designation of Origin “Mussel of Galicia”	KCS	Mussel Industry	Represents mussel producers. Promotes mussel quality	Concerned/reactive when seeing impacts of climate change on production. Working at close proximity with key actors	Ensures the communication with the mussel producers community, and their involvement when requested. Contributes to the definition of the solutions proposed to the mussel aquaculture KCSS (MRM and RI)	Provide a strategic tool to guide adaptation to climate change. Provide a technological application to guide production decision-making



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Galicia fishermen Guilds Federation / Pontevedra Fishermen Guilds Federation	KCS	Fisheries	Represents fishermen and shellfish gatherers	Concerned/reactive when seeing impacts of climate change on production. when seeing impacts of climate change on production	Ensures the communication with the clams aquaculturists and harvesters community, and their involvement when requested. Contributes to the definition of the solution proposed to the clams aquaculture and harvesting KCSs (INTERM)	Provide knowledge on the climate change impacts expected in shellfish banks, as well as adaptative solutions
Institute of Marine Research (IIM) from the Spanish National Research Council (CSIC)	Research Centre	Marine Environment	Develops knowledge relative to maritime environments	Pro-active. Participates in research projects to evaluate climate change impact in the region	Provide knowledge on the impact of climate change in mussel aquaculture. Ensures transfer of knowledge and results from Climefish H2020 project. Contributes to the definition of the solutions proposed to the mussel aquaculture KCSs (MRM and RI)	Provide researchers with materials and knowledge to feed the scientific discussion)
CIMA - Centro de Investigaciones Mariñas depending on Regional Ministry for the Sea	Research Centre	Marine Environment	Develops knowledge relative to maritime environments with a special focus on regional aquaculture	Pro-active. Participates in research projects to promote aquaculture adaptative change	Contributes to the definition of the solution proposed in the demonstrator (MRM, INTERM, RI)	<p>INTERM: Provide knowledge on the climate change impacts expected in shellfish banks, as well as adaptative solutions. Provide a strategic tool to guide adaptation to climate change.</p> <p>MRM: Provide a technological application to guide production decision-making.</p> <p>RI: Provide a technological application to guide production decision-making.</p>



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
INTECMAR	Regional Government Centre for the quality control of the marine environment	Marine Environment	Develops initiatives on operational oceanography and against accidental marine pollution. Has implemented a complete control system that covers all production areas of the Galician coast	Supportive to the implementation of measures to promote climate change adaptation	Contributes to the definition of the solution proposed in the demonstrator (in particular to RI)	Integrate the knowledge and solutions generated
Universidade de Vigo - REDE and GEOMA groups	University	Multi-disciplinary	Develops research and higher education: REDE: energy, innovation and environment GEOMA: Environmental and Marine Geology	Pro-active. Participates in research projects to evaluate climate change impact in the region	Project partner. Demonstrator technical support REDE: Socio-economic analysis. Resilience index (RI) GEOMA: Intertidal Monitoring (INTERM)	REDE: Further develop results from previous projects, enriching them with new data and models from TransformAr solutions. GEOMA: Provide experience on the studies of on the climate change impacts on the coast and deep knowledge of the studied area
CETMAR - Centro Tecnológico del Mar (Technological Centre for the Sea)	NPO - Foundation	Marine Environment	Interim organization between research, administrations, industry and education and training organisations. Training Department and Marine Technology Unit	Pro-active. Participates in research projects to evaluate climate change impact in the region	Project partner. Demonstrator coordinator Training Dep: Coordination, stakeholders mobilisation UTMar: Mussel Raft Monitoring (MRM)	Further develop results from previous projects, enriching them with new data and models from TransformAr solutions. Developing transformational solutions to a key economic sector in Galicia. Perform monitoring solutions based on the integration of COTS (Commercial off-the-shelf) components
IGafa: Instituto Galego de Formación en Acuicultura (Galician Institute for Aquaculture Training)	Others: VET Centre	Marine Environment/ Aquaculture	Vocational Education centre in aquaculture, also in charge of the trainings for shellfish gatherers, depending on the Regional Ministry for the Sea	Supportive to the implementation of measures to promote climate change adaptation and integrate them in the teaching	Integrate the knowledge and solutions generated in the trainings addressed to mussel aquaculture and shellfish gathering (MRM, INTERM, RI)	Provide teachers with materials and knowledge to promote the adaptative change through the learning process

5.0 Oristano, Italy

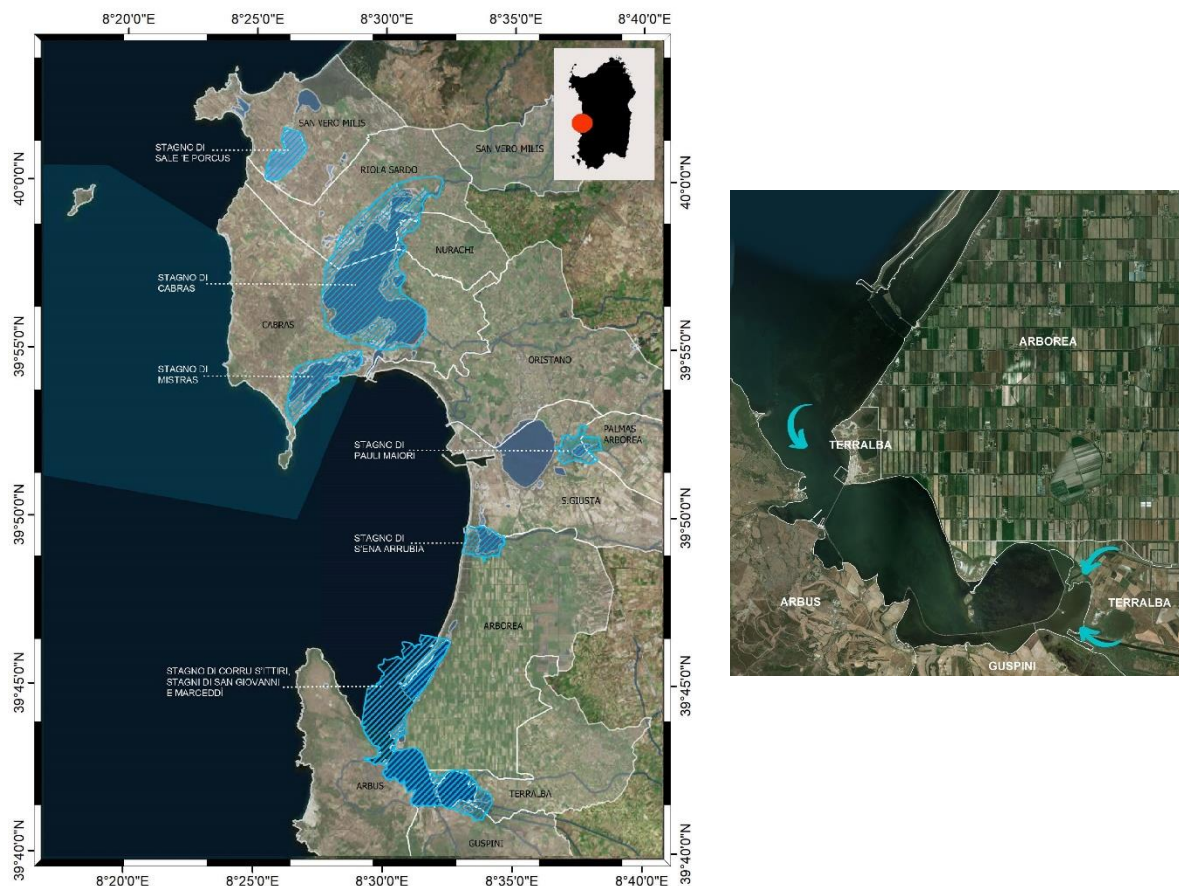
5.1 General Context General Context

5.1.1 Geographical Context

Oristano (39.9062° N, 8.5884° E), an Italian city and commune and the capital of the Province of Oristano, is located in the Central-west part of Sardinia (an Italian island in the Mediterranean sea).

The coastal area of Oristano is characterised by a complex and high density system of rivers, lagoons and salt marshes. Most of the wetlands are shallow eutrophic water bodies (approximately 0.5-2 m depth), around 7,700 hectares of which (over 60% of Sardinia's wetlands) are protected by the Ramsar convention and the Natura 2000 network. It extends from the south of the large basaltic promontory Capo Frasca, developing north through the coastal arc of the Gulf of Oristano, which includes part of the high plain of Campidano, and ends on the coastal rock formations of Capo Mannu, along 200 km of coastline. The coastal system of the Gulf of Oristano is a low-lying area characterised by the “Bonifica of Arborea”, reclamation works realised during the fascist period in the 30s, which makes the area particularly vulnerable.

Figure 5.1 Map of the territory of Oristano with a zoom on the wetland of the NBS Implementation



Three sub-basins converge in the Gulf of Oristano area: to the north, the Rio Mar'e Foghe basin, which flows into the Cabras and Mistras ponds; the Tirso basin, the longest river in Sardinia, which flows near the Santa Giusta Lagoon; and the Rio Mogoro and Flumini Mannu basins, which flow into the Marceddi-San Giovanni wetlands. The NbS will be implemented in this compendium which appears as a wetland

divided by a earth dyke into two different ponds: the internal pond of San Giovanni (700 ha) which receives mainly freshwater from the artificial canals, and Marceddì lagoon (900 ha), closer to the sea with brackish water.

The wetland system of the Gulf represents a hot-spot of biodiversity in the West-Mediterranean basin, with a large availability of habitats favouring the presence of peculiar species of plants, reptiles, mammals and more than 160 species of waterbirds, both permanent and migratory species, which come for nesting, breeding and wintering stage. In particular, the wetlands of Marceddì and San Giovanni host species of purple swamp-hen, greater flamingo, black-wiged stilt, purple heron, little tern, pratincole and little bittern. It is a wintering area for the osprey, spoonbill, golden plover, sandpiper, sandwich tern, wooded sandpiper, great egret and little egret.

Figure 5.2 Key bird species: Purple Swamp-hen, Black-winged Stilt, Purple Heron



Photos by Egidio Trinito.

Main examples of the local cultural heritage are represented by the Spanish coastal towers (Tower of Marceddì, Tower of San Giovanni e Tower of Capo Frasca) erected in the 16th century as part of the defensive system against the Saracen forays on the coast. Oristano is also home to a traditional fishermen village of Marceddì, and the village of San Giovanni di Sinis close to the archaeological remains of Tharros. Most of these villages are located in areas extremely vulnerable to climate hazards, in particular to coastal flooding.

Figure 5.3 Oristano's landscapes and cultural heritage: the lagune and coastal tower of Marceddì (left) and the archaeological remains of Tharros on the Sinis Peninsula (right)



Photos by Andrea Liverani and Egidio Trinito.

In Oristano, the temperature is mild in winter, while during the summer the maximum temperatures (July and August in particular) often exceed 35° C during the hottest hours of the day. The whole coastal area is dominated by the mistral wind, which blows from the northwest and represents the main

meteorological forcing. The distribution of rainfall shows a greater frequency in the autumn-winter period, with little to no rainfall during the summer³⁴.

5.1.2 Demographic Context

According to the Italian Institute for Statistics (ISTAT) the combined population of the 11 municipalities located in the area is 82,599 inhabitants on (as of 31 January 2021).

In 2020, a total of 133.918 tourist stayed in the official tourist accommodation settled in the Province of Oristano. Due to Italian legislation on data protection, we cannot access touristic population data for all the 11 municipalities. The 5 municipalities of Arborea, Cabras, Oristano, Riola Sardo and San Vero Milis accounts for the 49% of the total tourist population in the province with a registered number of 65,528 tourist in 2020 (data provided by Sardegna Statistiche, managed by the Statistical team of the Regional Government). The two municipalities of Arbus and Guspini (included in the Sud Sardegna Province) registered 10,900 tourists.

The Gulf of Oristano is characterised by the tight integration between the existing settlement structure and the environment typified by the system of coastal wetlands. It is a low density area, characterised by small concentrated urban zones, (even if 43% of the Province population lives in the 9 municipalities settled in the Gulf area out of a total of 88 municipalities in the Province), most of them located in the inland areas, with sprawl urbanization related to fishing cooperatives, agricultural and livestock farms and small touristic villages located along the coast (Satta, 2014). The population is decreasing (-4% from 2012) as people are moving to the main cities of the island or to the north of the country mainly driven by more jobs opportunity. This presents both challenges and opportunities as the negative population growth rate is resulting in an ageing population that is more vulnerable from a climate perspective. Yet, this decline in population growth, could present some opportunities to limit the pressure on the environment due to urbanization and land consumption.

In Oristano, the most vulnerable groups represents 35% of the whole population, mainly constituted by aging people while the percentage of young is only 10% (see table 5.1). The gender distribution is balanced in all the main age groups, with a higher presence of women in the older category.

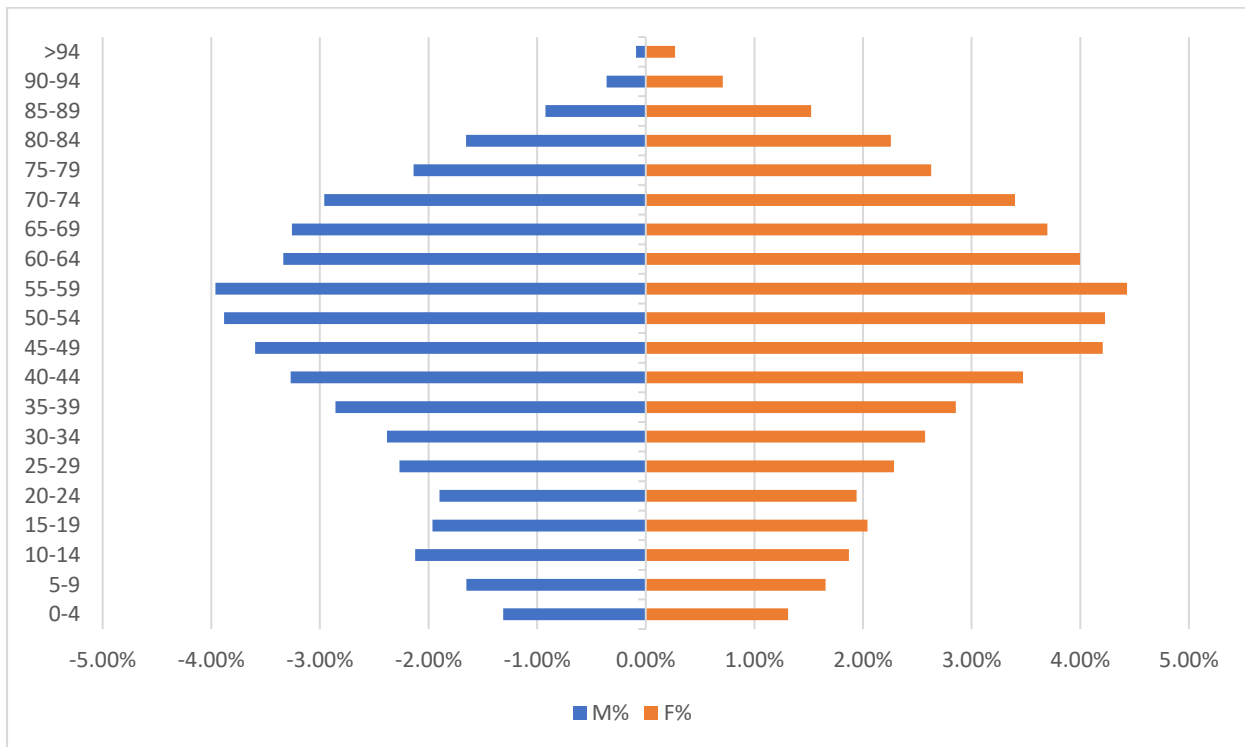
Table 5.1 Population distribution per age groups in Oristano

AGE GROUPS	MALE %	FEMALE %	TOTAL %
>65	23%	27%	25%
15 – 64	67%	63%	65%
<14	11%	9%	10%

Source: Istat, 2021 Retrieved 2022 January 13 from <http://dati.istat.it/Index.aspx?QueryId=20745>.

³⁴ Further details can be found on the Oristano Climate Profile developed within the Interreg IT-FR “ADAPT” project (http://interreg-maritime.eu/documents/374720/849015/ADAPT_profilo_climatico_Oristano_IT.pdf/df48018b-796d-4685-88f6-2ad54f6da3fe)

Figure 5.4 Demographic Pyramid of 11 municipalities in the Gulf of Oristano Territory



Source: Istat, 2021 Retrieved 2022, January 13 from <http://geodemo.istat.it> (demographic data).

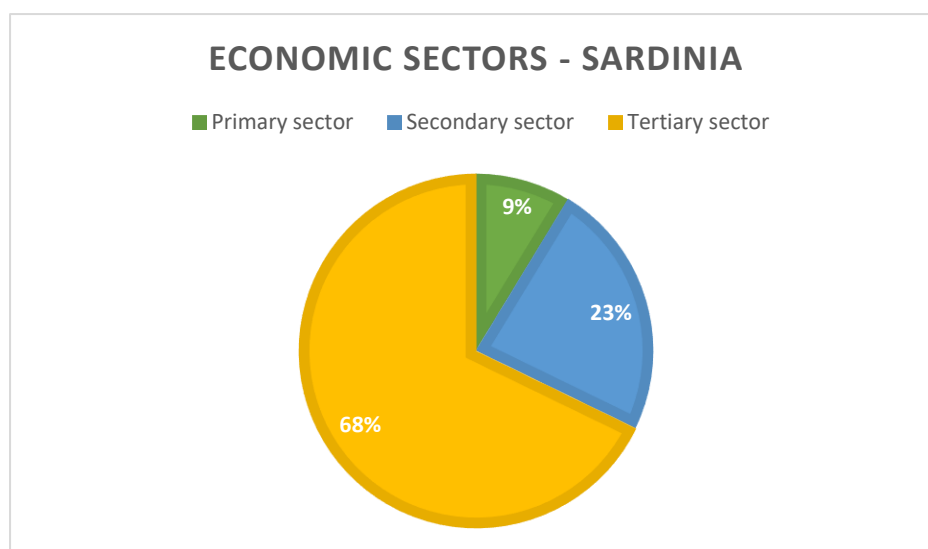
5.1.3 Economic Context

The average per taxpayer income in 2019 for the 11 municipalities in the Gulf of Oristano was 22,394€ higher than the Sardinian average which is 19,027€ and the total Province of Oristano which registered an average taxpayer income of 15.416€ (National Tax Agency, 2019).

The average annual unemployment rate in Sardinia is 13.3% against an average annual rate of 9.2 in 2020 in Italy (data provided by Istat). The average annual rate for the province of Oristano is 15.1% and 12.1% in the Sud Sardegna. While at regional level, data do not indicate a difference among gender, in the Province of Oristano, male average annual unemployment rate is 14.2% while the female rate reached 16.3%.

The data is not available at municipal level. However, we can calculate the percentage of population that stated to be unemployed in the last Census (2019, Istat). The percentage is estimated on the total currently economically active population with 15 years and more. In the 11 municipalities in the Gulf of Oristano unemployed people is 9%, against the 10% at the regional level.

Figure 5.5 The Sardinia GDP Sector Composition



Data retrieved January 5, 2022 from <https://docplayer.it/11770431-Sardegna-geografia-e-cultura-istituto-comprensivo-di-budduso-scuola-primaria-ins-dore.html>.

The diagram above (Figure 5.5) shows the prominence of the tertiary sector in Sardinia (68%) which employs the largest number of employees in trade, services and tourism. Due to the mild climate, the uncontaminated landscapes, the purity of the marine waters, Sardinia attracts a large number of tourists. In recent years the tourist offer has been oriented towards the inland areas of the island and enhancing culture, art and archeology, equestrian tourism, hiking, bird watching, sailing, and free climbing. The secondary sector in Sardinia constitutes 23 % of the island's GDP. Among the industries stand out: refineries, food, manufacturing, textile, cork processing, mechanical, metallurgical industries. Sardinian craftsmanship includes: the weaving of carpets, tapestries, cushions and curtains, goldsmithing in filigree, coral and semi-precious stones and pearls, woodworking, rattan baskets, and pottery.

The primary sector accounts for around 9% of the Sardinian economy. The territory's geography allows for the cultivation of rice, vegetables, wheat, barley, oats, olives, vines, artichokes, tomatoes and citrus fruits. Sheep and goat breeding represents a very important source of income, in addition to the breeding of Anglo-Arab horses.

Fishing is highly developed in the seas near Cagliari, Alghero and the Sulci's coasts, in ponds and fish ponds, in addition to the production of mussels, lobster fishing and coral harvesting.

The productive area of the Gulf of Oristano is characterised on one hand by an important prevalence of the primary sector, on the other, by a relative degree of industrialization, which locates the main productive activities around the town of Oristano. The main economic activities of the area are agriculture and livestock, with more than 1,800 of private companies working in the sector. There are more than 2,020 companies involved in fishery, industrial and commercial activities and 636 registered companies providing restauration or accommodation services (Istat, 2018). Also, in terms of employment, the agriculture sector is the most important for the territory.

Agriculture, fisheries and tourism are the sectors that are most affected by climate change. In particular, salt water intrusion and coastal flooding impact the agricultural areas and limit the types of crops that can be cultivated. The water quality of the wetland system is affected by the increased level of freshwater during inland flooding due to extreme precipitation events. The reduction of the salinity level is directly connected with a reduction of the fishing stocks. Coastal erosion reduces the extension of the accessible beaches which represent one of the main attractions for tourists.

Another sector that may be impacted by climate change is power production. The Tirso river and its dams provide electricity to the Sardinian system. In particular, it allows Oristano to be a 100% renewable municipality according to CDP³⁵. Changes in rainfall and water availability, with increasing concurrent demand from agriculture and tourism in the dry season, all together may impact the possibility to produce hydro-electricity.

5.2 Vulnerability & Key Observed and Projected Impacts

5.2.1 Territorial Scale

Sardinia is located in the centre of the Mediterranean region, and according to EEA (2017), this biogeographical region is likely to be impacted by severe climate hazards that include, among others: an increase of maximum temperatures and heatwaves especially in the summertime; more pronounced droughts and forest megafires; and heavier and more extreme rainfall events (especially in the fall) leading to severe flood. Severe droughts in the summer time are often associated with larger water demand from different competing sectors, leading to inter-sectorial conflicts and unsustainable overexploitation of water resources.

The Sardinian territory is witnessing consistent natural risks posed by the increasing variability of extreme climate conditions, with pronounced droughts especially marked in the summer, and heavy rainfall and Mediane events. Consequences of severe droughts have been particularly pertinent with risks for limited freshwater supplies and the incurrence of large fires affecting not only forest ecosystems, but also rural/urban interfaces. Flooding is a particularly crucial risk not only endangering human life and infrastructures, but also causing soil erosion and the transport of contaminants from industrial, mining and agriculture fields to natural and especially aquatic ecosystems.

A severe drought period has lasted few years over Sardinia since 2016, and peaking in 2017, when due to limited available freshwater supplies left in reservoirs, water irrigation in agriculture has been dramatically cut down causing limited production of food crop and forage for livestock. After 2017 no water restriction was in force as the average annual rainfalls increased and was aligned to average long term precipitation values. However, annual values hide peak rainfall or drought periods. Indeed, a short period of drought was registered in winter months in 2020 that induced the Reclamation Body (the local authority in charge of irrigation water supply) to anticipate the water distribution that started in the first weeks of March (while it usually starts in late spring to late summer).

Fire prevention activities have been particularly active in Sardinia over the last decades. However, extremely hot conditions and strong winds led to exceptional and dramatic megafires over the island. In July 2021, wildfires have raged through Sardinia and the province of Oristano with forests, pastures and villages engulfed in flames. Blazing flames have destroyed 20,000 hectares, killing livestock and forcing 1,500 people to be evacuated from their homes.

Many people have lost their lives due to several Flash Floods after heavy rains in Sardinia: 19 people died and thousands left homeless in November 2013, 3 people died in November 2020. These floods are becoming unfortunately very common over the last years, due also to occurrence of extra-tropical cyclones in the fall ashore Sardinia coasts.

³⁵ <https://www.cdp.net/en/cities/world-renewable-energy-cities>

Figure 5.6 Wildfires raging across Sardinia, 2021



Source: Photo retrieved December 22, 2021 from <https://www.wantedinrome.com/news/sardinia-wildfires-force-hundreds-of-evacuations.html>.

Figure 5.7 Flood damages in Sardinia, 2020



Source: Photo retrieved December 22, 2021 from <https://watchers.news/2020/11/29/sardinia-flood-catania-tornado-november-2020/>.

A series of factors leading to pressure on the environment and increasing the territory's vulnerability can be listed in Sardinia and particularly for the Oristano gulf area such as the nonpoint source pollution from the use of chemical fertilizers and pesticides over agricultural fields. To add to that, the coastal erosion from sea level/wave rise, have caused the degradation of dune systems, coastal infrastructures, tourism



and agricultural fields, as well as the sea water intrusion and contamination of coastal aquifers. In the territory, mining activities have been extremely relevant in the past. Abandoned mine waste piles are nowadays a major point source pollution for aquatic ecosystems. Also, the presence and abundance of Invasive species (like water hyacinth) endanger native species and reducing ecosystem services. Water hyacinth, for instance, can cause a large proliferation of organic material and decomposition, leading to oxygen deficiency and anaerobic conditions in the water for other living organisms. Not to mention, urbanization and land-use changes have led to the degradation of aquatic ecosystems, deforestation as well as the removal of tree buffer strips which could allow to mitigate extreme events. Furthermore, wind and soil erosion have further intensified land degradation and desertification.

On a more positive note, climate change could present some opportunities for the territory. Concretely, most tourism in Sardinia is concentrated in the summer and especially over 1-2 months (July-August). General warmer conditions could allow longer tourism periods and possibly reduce the tourism demand from peak over shoulder seasons, which would reduce in turn pressure over water and other resources in the summer. Besides, general global warming and a longer crop growing season will allow planting earlier in spring to avoid possible extreme heat conditions and high water demand in the summer during grain filling, to sustain yield productivity.

5.2.2 KCS Scale

The two TransformAr key community systems retained for Oristano are the water system and nature conservation. These systems are considered for their social and economic vitality as well as their climate vulnerability.

I- WATER SYSTEM

In the upstream of wetlands, the habitats along the affluents are severely degraded by climate change impacts, adding to that being surrounded by intensive land use activities (Agriculture, animal husbandry, industry, mining), leading to high nutrient loads.

The phenomena of coastal flooding combined with inland flooding may contribute to the loss of coastal wetlands hydraulic efficiency, to the alteration of river dynamics and the salinization of wetlands and groundwater.

The community and economic activities of the area have a strict link with the water system, in particular fishery and agriculture. In fact, an alteration of the water quality will influence the fish stocks leading to a reduction of fishermen's income. Long drought periods could increase the water demand from wells or, where possible, the request for public water which would increase the costs for farmers. This phenomenon is already driving the farmers to test innovative solution for reducing the use of water or changing the types of cultivation towards less water dependent ones.

II- NATURE CONSERVATION

The complex and diverse ecosystem components that mark the environmental structure of the Gulf of Oristano are particularly vulnerable to sea level rise, to coastal flooding and to coastal erosion impact.

Beaches, river mouths, wetlands, terrestrial biological systems, protected areas are the multiple coastal receptors impacted, in terms of habitat degradation, biodiversity loss and the emergence of alien and invasive species. The climate change impacts on the natural environment are directly related with the capacity to produce ecosystem services, which are the benefits people obtain from ecosystems. These include provisioning, regulating, and cultural services, that directly affect people and supporting services needed to maintain their services. In these terms, the local community, the private companies operating on the area and tourists will be all clearly affected by climate changes impacts.

5.3 Governance Baseline

5.3.1 National Scale

At a territorial scale, different governance instruments overlap due to the presence of protected areas of different degrees, RAMSAR, Natura 2000 sites, landscape and hydrogeological protected areas.

In Italy, the Council Directive 92/43/EEC on the conservation of natural habitats, wild fauna and flora, commonly known as 'Habitats Directive', was transposed into national legislation by Decree of the President of the Republic (DPR) no. 357 of 1997, amended by DPR no. 120 of 2003. According to article 4 of this decree, Regions are responsible for the management of Natura 2000 sites and for the establishment of conservation measures and appropriate statutory, administrative or contractual measures. This decree devolved the approval of management plans for Natura 2000 sites to Regions, but did not make management plans compulsory in Italy.

On the basis of the aforementioned national decrees, Sardinian Regional Government is responsible for the management of its Natura 2000 network, including the establishment of conservation measures and the approval of management plans for Natura 2000 sites.

In Italy, the National Strategy for Adaptation to Climate Change has the general objectives of increasing awareness in the definition of sectoral adaptation strategies and plans and supporting awareness-raising and information on adaptation through communication activities on possible hazards and risks.

5.3.2 Territorial Scale

At a regional level, there are different plans related to hydrological and climate issues. The Regional Strategy for Adaptation to Climate Change (SRACC³⁶) contains Sardinia's future climate scenarios to 2050, illustrates vulnerability and adaptive capacity, defines the implications of climate change in some priority sectors and multi-level governance for the integration of adaptation at the different levels. In this context, it defines the River/Lake/Coast Contract as an important tool to implement adaptation strategies such as the COAST³⁷, signed in February 2021. In the framework above described, the COAST acts as a tool to test and modify the regional climate change strategy, with the main aim of increasing the resilience of the whole area of the Gulf of Oristano and the Sinis Peninsula - through the implementation of interventions to reduce the artificialisation of the territory and the restoration of natural systems - and to raise awareness among the population.

5.4 Response Measures

5.4.1 Knowledge Production

At a territorial scale, there are several ongoing collaborations with research centres/consultants to bridge knowledge gaps and produce knowledge: Firstly with the IMC-CNR of Oristano which is a non-profit NGO Research Foundation that develops scientific research for the study and revaluation of marine and coastal ecosystems, focused on the marine environment, aquatic species and their relationship to the environment. Secondly with Sardinian Engineering Company called Criteria SRL, that operates in the fields of planning, design and environmental assessment with a multidisciplinary group of professionals. Last, but not least, the CMCC Foundation which is developing several projects in the area focused on the ongoing impacts of climate change and also with the water monitoring within the ACQUAOUNT project of the H2020 programme.

³⁶ <https://delibere.regione.sardegna.it/protected/45523/0/def/ref/DBR45368/>

³⁷ <http://www.maristanis.org/index.php/risorse/progetti/contratto-delle-zone-umido-costiere-dell-oristanese.html>

At regional level the main studies and maps are:

- The Hydrological Management Plan (PAI³⁸) which organises the mapping of the areas exposed to landslides, avalanches and floods, classified by level of risk. The plan provides measures to limit land use in order to not increase the risk level and identifies the main protection actions to reduce or to remove the hydrogeological risk.
- Desertification map built using the Environmentally Sensitive Area Index by the Hydro-meteoclimatic Department of the ARPAS (Regional Sardinian Agency). The factors that affect the desertification process are mainly represented by both climate change and anthropogenic activities, which determine negative impacts on the environment. The index is calculated using both qualitative and quantitative data of soil, climate, vegetation and land management using GIS tools.
- Rainfall distribution maps. These maps are part of the climate monitoring assessment conducted every year by the Hydro-meteoclimatic Department of the ARPAS. They represent the cumulative water level maps of the precipitation occurred during the year, and also during the most rainfall season. Maps are available until 2019.

At a local level, MEDSEA³⁹ is working on a local climate risk assessment of the Oristano Gulf considering multiple climate drivers such as Sea Level, Storm surges, Significant Waves and Extreme precipitation with return period of 100 years.

5.4.2 Participatory Governance & Awareness Raising efforts

Two main awareness raising campaigns are developed at the scale of the territory to shed the light on climate impacts and on the importance of climate adaptation:

- The Climathon 2021⁴⁰: The international event is organised by EIT Climate-Kic, an organization supported by the European Union that promotes a 24-hour hackathon challenging cities around the world to find solutions to climate change. The theme of the challenge joined by the signatory municipalities of the Coastal Wetlands Contract was “Nature-based Solutions in Coastal Transition Environments: The Climate Change Adaptation Challenge for Tourism and Agriculture”.
- Participatory process for the institution of a Regional Park: The first phase of the Consultation Process for the creation of a Regional Park in the Gulf of Oristano and to present the effects relating to CC is in place. Nowadays, 12 meetings and a final event to describe the results have been carried out. During the second phase the governance structure and the geographic boundaries will be discussed with the main stakeholders.

5.4.3 Policies & Action Plans

I- WATER SYSTEM

At a regional level, the Management Plan of the Hydrographic District of Sardinia, required by the Water Framework Directive (Directive 2000/60/EC), is the operational tool to plan, implement and monitor measures for the protection, restoration and improvement of surface and groundwater bodies and to facilitate the sustainable use of water resources. The Hydrogeological Management Plan and Sardinia's flood risk management plan aim to guarantee adequate levels of safety during hydrogeological events,

³⁸<https://www.regione.sardegna.it/index.php?xsl=510&s=149037&v=2&c=8376&t=1&tb=8374&st=13&slu=1>

³⁹ <http://www.medseafoundation.org/index.php/it/chisiamosep/rassegna-stampa>

⁴⁰ <https://consorziouno.it/climathon2021/>

protecting human activities, economic assets and the environmental and cultural heritage exposed to potential damage. These plans also permit to regulate activities and interventions towards an adequate hydro-geological organization and to provide actions of river environment and structural requalification.

On a local scale, COAST⁴¹ aims to improve the ecological status of water systems by taking preventive action to reduce the negative effects of human activities (excessive water withdrawal, organic pollution, plastic litter, etc.) on one hand, and to improve water circulation and water quality, on the other. Regarding resilience to climate change, COAST acknowledges that wetlands are very important in helping to reduce the impact of climate change, as they are natural reservoirs that sequester CO₂ and, if properly designed and managed, can also act as natural water retention areas during extreme events. COAST is currently being updated and coordinated with the specific objectives of the Regional Strategy for CC Adaptation.

II- NATURE CONSERVATION

The region of Sardinia, through the management plans of Natura 2000 sites, implements specific habitat and species conservation measures. Moreover, the COAST acts in order to improve the state of conservation of biodiversity and natural capital, reducing habitat fragmentation and safeguarding the existing plant and animal components. It also allows for increasing the conservation status of species and habitats, implementing habitat reconstitution and connectivity enhancement interventions, improving the environmental quality of the buffer zones around the ponds and reducing the anthropic load on coastal areas.

The probable institution of a Regional Park (process in place under the COAST, strategic axis of Governance) is aimed at the better management of Natura 2000 and Ramsar sites through the establishment of a single management entity, solving the problem of uncoordinated management.

5.4.4 Implemented Grey/Green Adaptation Measures

The integrated project for the requalification of the ecological connections and the reduction of habitat fragmentation in the San Giovanni-Marceddi wetland compendium and the Corru S'ittiri pond was financed with ERDF under the 6.5.1 action. The project aims to restore the ecological connections within the water bodies, which are strategic for improving the trophic and mesological conditions of the wetland compendium, priority habitat 1150*, which is locally in a state of degradation and low representativeness (especially the ponds of San Giovanni and Marceddi) with positive effects on the hydraulic functionality of the entire river system at the mouth of the Rio Mogoro and of the transition.

5.5 Key Stakeholders

Table 5.2 List of key local stakeholders in Oristano per type, sector, influence, motivation to take climate action and link with TransformAr.

It is important to note that the “motivation of actor to take climate action” is based on activity of the organisation, considering the public information available. This is a relative characteristic or one that is likely to evolve in time and may not reflect the real motivation of all actors within a particular organism.

⁴¹ <http://www.maristanis.org/index.php/risorse/progetti/contratto-delle-zone-umido-costiere-dell-oristanese.html>



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Municipality of Terralba	Public Body	Governance / management	Decision maker (Mayor) - development of laws/regulations	active	Municipality that will administratively manage the implementation of the NBS project. + Support in the Governance process	Increase the resilience to climate change and improvement in risk management
Municipality of Guspini	Public Body	Governance / management	Decision maker (Mayor) development of laws/regulations	active	Municipality that will involve the implementation of the NBS project. + Support in the Governance process	Increase the resilience to climate change and improvement in risk management
Municipality of Arbus	Public Body	Governance / management	Decision maker (Mayor) development of laws/regulations	active	Municipality that will involve the implementation of the NBS project + Support in the Governance process.	Increase the resilience to climate change and improvement in risk management
Other municipalities involved in the COAST	Public Body	Governance / management	Decision maker (Mayor) development of laws/regulations	active	Support in the Governance process	Increase the resilience to climate change and improvement in risk management
Regional Government	Public Body	Governance / management/ environment	Decision maker / development of laws/regulations	Pro-active	Support in the Governance process and the CC strategies	Increase of the resilience to climate change and the ecosystem integrity
Local Action Group Linas Campidano	Public-private	Sustainable development	Director	supportive	Knowledge in the agriculture sector	No direct added value
Local Action Group Linas Campidano	Public-private	Sustainable development	President	supportive	Knowledge in the agriculture sector	No direct added value



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
LegaCOOP	Private – trade association	Fishing	Regional coordinator	supportive	Knowledge in the fishing sector	Better control of water quality and prevention of risks due to high growth of control parameters (salinity, temperature, etc.) to reduce production losses
FLAG Pescando	Public-private	Fishing	Vice-president	supportive	Knowledge in the fishing sector	Better control of water quality and prevention of risks due to high growth of control parameters (salinity, temperature, etc.) to reduce production losses
Consorzio Bonifica dell'Oristanese	Public	Governance / management	Director	active	Knowledge in maintenance procedure and activities	Coordination between channel management and the physical and chemical conditions of the wetlands
Consorzio Cooperative Riunite della Pesca di Marceddi	Private	Fishing	President	active	Knowledge in the fishing sector (productivity, etc..)	Better control of water quality and prevention of risks due to high growth of control parameters (salinity, temperature, etc.) to reduce production losses
S. Pietro Produzioni Agroalimentari S.r.l.	Private	Agriculture	Director	-	Knowledge of agriculture and water use	Reduction of flood risk with reduction of losses and damage of economic activity



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Cooperativa 3A	Private	Agriculture	Consultant	supportive	Knowledge of agriculture and water use	Reduction of flood risk with reduction of losses and damage of economic activity
COOP. Produttori Arborea	Private	Agriculture	--	supportive	Knowledge of agriculture and water use	Reduction of flood risk with reduction of losses and damage of economic activity
Sa Marigosa Società Consortile a r.l	Private	Agriculture		supportive	Knowledge of agriculture and water use	Reduction of flood risk with reduction of losses and damage of economic activity
Liverani Servizi Smart Geo Survey	Private	Services for Agriculture	Owner	supportive	Knowledge in specific technologies (use of drones in agriculture)	No direct added value
AFNI - Associazione Fotografi Naturalisti Italiani	Private	Environment	Photographer	supportive		No direct added value
LIPU	Private	Environment	Member	supportive	Knowledge in birds and species protection and presence	No direct added value

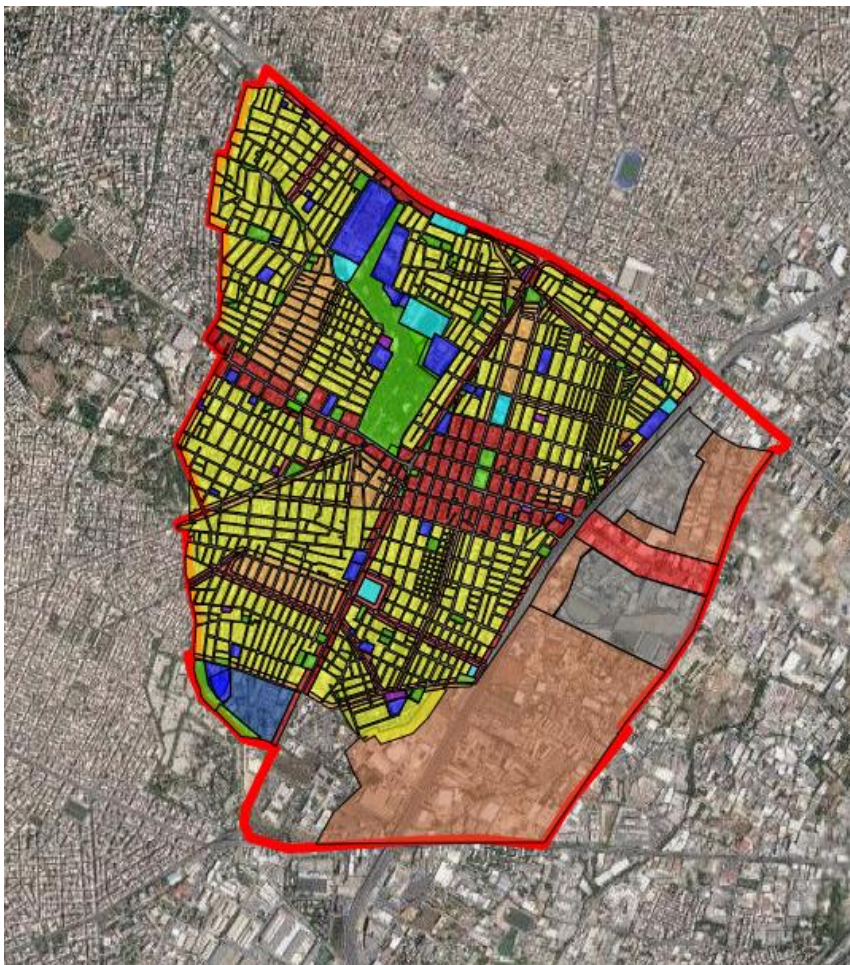
6.0 City of Egaleo Greece

6.1 General Context General Context

6.1.1 Geographical Context

The municipality of Egaleo (37.9924° N, 23.6781° E) is situated at the west region of the urban planning complex of the region of Attica and has been built at both sides of the ancient road «Iera Odos». It is approximately 4km away from Athens and it shares borders with the Municipality of Athens to the East, the Municipalities of Peristeri and Haidari to the North, the Municipalities of Nikea-Agios Rentis and Agia Barbara to the West, and the Municipality of Moschato-Tauros to the South (Zerdes & Karamitsos, 2005). Egaleo is about 9 km away from the sea (with Pireas port being the closest to the municipality).

Figure 6.1 Egaleo's borders



Egaleo is largely regarded as a Municipality with a rich cultural heritage. After the downfall of Asia Minor in 1922 many refugees settled in Egaleo and formed the community of Nees Kudonies. The area was also inhabited by refugees coming from Pontos and Assyria. This neighbourhood continues to thrive to this day and preserves the historical culture of Asia Minor with places such as the Museum of Asian Minor Culture. Furthermore, the Municipality hosts 17 cinemas and the Alexis Minotis Open Theater (Bilinis & Stoyannous, 2017). Another cultural landmark of Egaleo is the Giannis Ritsos Cultural Centre, as well as the archaeological findings of the ancient Iera Odos that are exhibited in Egaleo's Metro station.

Figure 6.2 Museum of Asia Minor Culture



The most significant natural landmark is Baroutadiko Groove which is largest green space in Western Attica, reaching a size of 134 acres (121.608,70sqm). From a technical study conducted by the Municipality, it is found that the most frequent trees that cover the area are Eucalyptus (*Eukalyptus Globulus*), wild Olives (*Olea Europaea subsp. Oleaster*), Pine Trees (*Pinis Halepensis*), Pseudacacia (*Robinia Pseudacacia*) as well as Sophora (*Sophora Japonica*). Other varieties of flora include Ligustrum (*Ligustrum Japonicum*), Oleander (*Nerium Oleander*) and Japanese cheesewood (*Pittosporum Tobira*). Not much is documented about the fauna of the Municipality, other than the fact that the most common animal species are rock doves (*Columba livia*) and cats (*Felis Catus*).

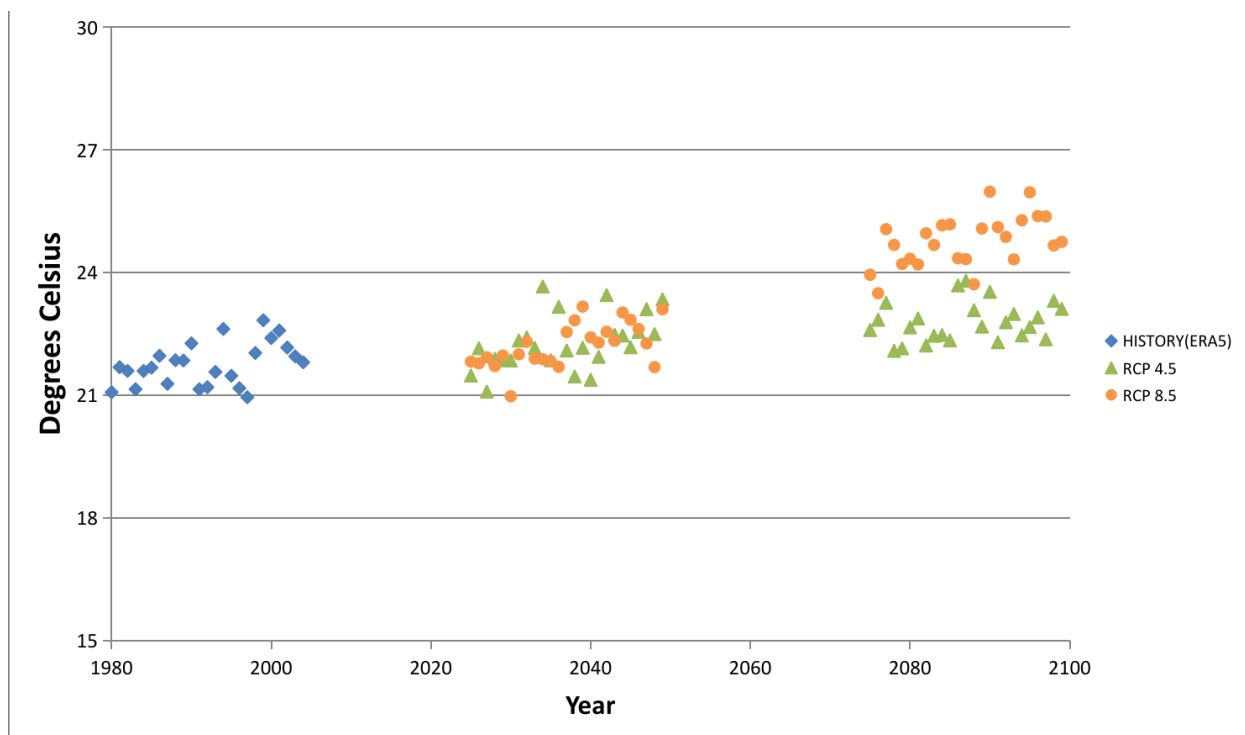
Figure 6.3 Baroutadiko Grove



The region is characterised by a mild Mediterranean Climate, like most of Greece. A technical study conducted by the Municipality showcased that the temperature of air in Egaleo ranges from 8,41°C (January) to 34°C (July). The lowest temperature is about 6.7°C during winter and the highest can reach up to 45°C during summertime.

In the figure below (Figure 6.4), climate projection for the Egaleo Municipality for current weather conditions (HISTORY) and two IPCC scenarios (RCP4.5 and RCP8.5) for two climate variables are presented. The Mean Annual Temperature illustrates higher mean values per year, whereas, the Mean Daily Rain reveals more frequent events of higher amount of rain in 24 hours period. The latter may translate to more frequent flood events in the area of the municipality.

Figure 6.4 Mean Annual Temperature in Celsius, of Egaleo Area for historic period (1980-2004) and two IPCC climate scenarios (RCP4.5 & RCP8.5)



Source: NCSR database.

6.1.2 Demographic Context

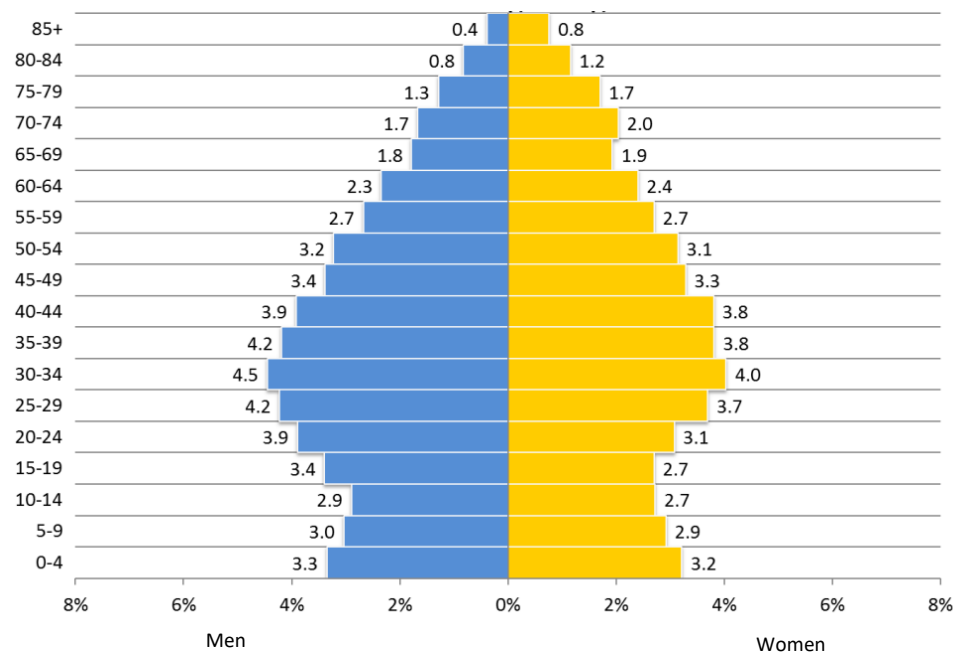
The official number of inhabitants in Egaleo according to the 2011 census is 69.946 (Hellenic Statistical Authority, 2011). However, it is estimated that the city is inhabited by approximately 120.000.

The average population density of Egaleo is 225 inhabitants per hectare, according to the data of the Hellenic Statistical Authority (2011). Research from WWF summarised the evaluation of 900 green spaces by 4,500 citizens, and the Municipality of Egaleo (MOE) gathered a total score of 7.4/10, a score which is among the highest in the Attica Region (Sinanis, 2017). The ever-increasing density can pose serious threat to the ecosystem of Egaleo, as the increased human activity correlates with the upscaling of excessive usage of cars, thus forming higher volumes of traffic within the area and favouring air pollution. This summer critical fire outburst episodes occurred throughout many locations in Greece, leading to the operational suspension of the Baroutadiko Grove during the summer period due to high risk of fire. The dry summer season in Greece poses a great threat to the ecosystem, which is also aggravated with the density of population in Egaleo.

From 1971 and 1981 the population of Egaleo increased by 2.18%, which is due to the arrival of the migrating population of Asia Minor. Later on, the population had decreased by 6.62% between 1981 and 1991, and by 1.16% during the years 1991-2011, which is largely due to the infertility of couples (Spiliou, 2015). The 2011 census showcased a decrease of 1.34% on the total population. This poses challenges and present some opportunities from a climate perspective as, one on hand, the decrease of population growth shows a significant increase in aging population, which amplifies the amount of people that are vulnerable to the extreme weather effects that occur mostly during summer. On the other, the decrease of population signifies that less people would be driving cars and thus the urban environment will be decongested from air pollution.

The demographic Pyramid of West Attika that was developed based on the 2011 census showcases that the largest portion of the population are men and women aged 30 to 34 years old. The lesser portion of the population are people aged 85+, where women largely outnumber men by 50%. This is relevant due to the fact that both elderly and women have higher vulnerability towards climate change. Kids aged 5 to 9 and 10-14 years old make the 11.5% of the total population, where adolescents and young adults from 15 to 19 make the 6.1% subsequently. There are no significant deviations between males and females for the aforementioned age groups. Nonetheless, they make up a significant proportion of the population which is also more prone to the effects of climate change.

Figure 6.5 Demographic Pyramid of Western Attika



Source: Regional Plan for the Adaptation on Climate Change PEPSKA.

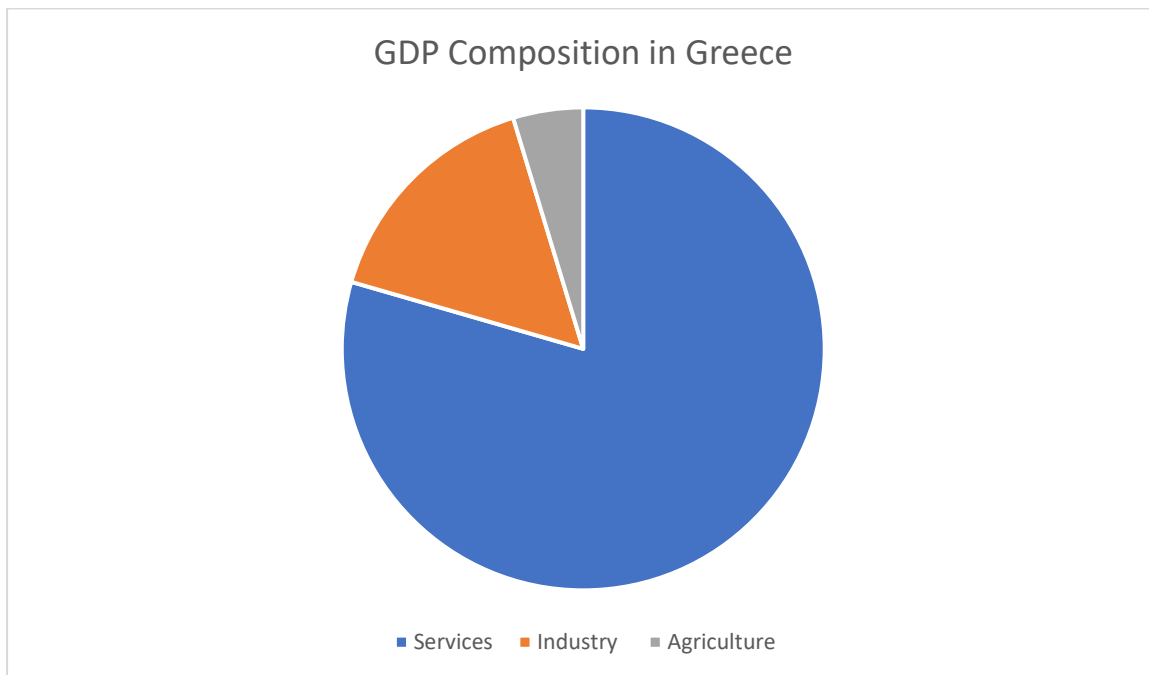
6.1.3 Economic Context

The Municipality of Egaleo is among the municipalities with the highest unemployment rates in Attika. Both the Manpower Employment Organization and the Hellenic Statistical Authority measured the unemployment rates in Western Attika at 13.50% at 2010, while peaking at its highest in 2013 with 36.98%. In 2016, the percentage of unemployment reached 28.04% (Hellenic Statistical Authority, 2011; Manpower Employment Organization, 2016). Specifically, for Egaleo, the unemployment rate is rated at 22.12%, which is considered particularly considerable. For the first semester of 2021, the Manpower

Employment Organization showcases a percentage of 18.8% in unemployment, which is expected to increase. These people are especially vulnerable towards the severe effects of climate change due to their lack of resources to protect themselves against harsh weather effects. The Municipality provides such services (e.g. public closed spaces with heating or air conditioning, water and food, first aid, etc.) but the number of people in need for such services constantly increases.

The graph below (Figure 6.6) showcases the GDP sector composition in Greece for 2020, with Services standing at 69.81%, Industry at 13.91% and Agriculture at 4.12% (Statista, 2021).

Figure 6.6 GDP Composition in Greece



Source; Data Retrieved from Statista, 2021.

As there is no specific data at the scale of Egaleo, it is essential to underline that the main economic sectors of the area come mostly from small-medium businesses. These enterprises mostly offer services that range from clothing trading, car repair workshops, transportation, foods and beverages and electronics trading.

Reflecting on the socioeconomic and environmental conditions that have been occurring within the Municipality of Egaleo (MOE), the Key Community Systems that are threatened by climate change are Health, Infrastructure and Urban Planning. The main providers of economic activity within Egaleo are small and medium sized businesses, which make Egaleo a renowned landmark for trading and shopping within the Attika region. The excessive risk of heatwaves compromises the area’s economic efficiency and possess significant threat to the KCSs.

6.2 Vulnerability & Key Observed and Projected Impacts

6.2.1 Territorial Scale

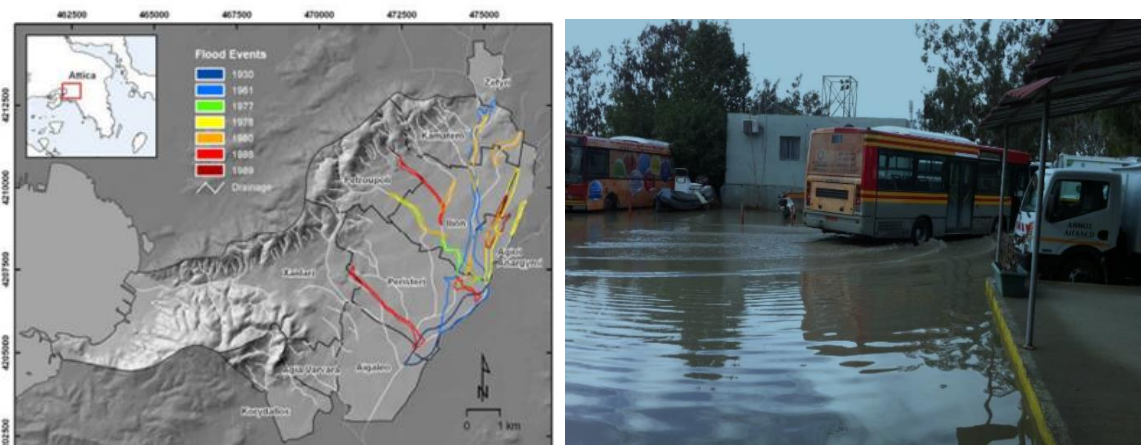
Egaleo, being part of the Western Region of Attika in Greece, belongs to the wider Mediterranean biogeographical region. As thoroughly assessed earlier on, Egaleo is at great risk of drought and wildfires fires of the Baroutadiko Grove. Furthermore, heatwaves also pose a dire danger to elder citizens and to

households that cannot afford adequate cooling, which also stresses the issue of energy demands of cooling.

Among the major natural risks that are threatening Egaleo are fires caused by the severe temperatures and the dryness of the air during summertime. Another potential natural risk for Egaleo is flooding from rain waters, which is due to the insufficient flood risk management systems. Egaleo is located near Kifissos river, which has a high risk of flooding during mid-autumn-winter session, causing massive damage to the area.

There has been a series of wild fires roaming throughout summertime in Greece. Egaleo has not experienced a direct episode of fire in Baroutadiko Grove, although each summer temperatures have been reaching up to 45°C, putting the municipality in an alarming state. The Figures below (Figure 6.7) present an overview of the flooding phenomena and the drainage systems of the Western part of Attica, showcasing the vulnerability of Egaleo.

Figure 6.7 Municipalities of West Attica under examination, drainage network and extent of past flooding phenomena; Flooding in Eleonas area



Source: Diakakis et al., 2011.

Stoyanous and Bilinis (2016) presented the issues that Egaleo is facing, increasing the territory's vulnerability from a climate perspective, including:

- The slow population growth rate, high unemployment rate and the prevalence of vulnerable groups (migrants, offenders). These groups often lack the resources to protect themselves against severe climate effects and the slower economic growth of Egaleo makes it difficult with keeping up with their support.
- Issues related with the infrastructure, mostly the inefficient street planning, the lack of public spaces and parking lots. That leads to surplus people activity in public spaces and increased traffic volume that can cause amplified harm to the environment of the area.
- Direct environmental issues that are caused by the industrial activity in Eleonas and Yula areas.

The increasing temperature in Egaleo during summertime is evidence for its citizens to realise the existence and impact that climate change yields. This could urge them to become more aware about their living habits and start changing their lifestyle to an eco-friendlier one (e.g. start using public transportation more, reduce in-house electricity usage, not litter the streets).



6.2.2 KCS Scale

In the case of Egaleo, Health, Infrastructure and Urban Planning are considered as key community systems. A special attention needs to be paid to these systems as on one hand they can be key to address the issue of climate change, and on the other, they are vulnerable from a climate perspective.

I- HEALTH

When considering Health as a KCS, it regards the relationship between citizens being able to become more responsible towards the green areas in the city, so that the flora can provide CO₂ reduction and significant increase in their quality of life. Diminished sensitization from people, but mostly the severe weather effects that occurred in Greece during the past summer periods, have led to the deterioration of the urban green areas which in turn can cause important implications in the health of citizens living in the urban web.

Public Health maintenance is a thoroughly costly procedure that can invoke discrepancies among people. During high-risk periods like August, the MOE always operates its public infrastructure for citizens that lack adequate cooling at home. The running of this service keeps requiring more funds from the side of the Municipality (operational costs, water and consumables, etc.) and on the long run, it mostly covers a more pivotal problem which is the fact that there are still citizens that cannot provide for adequate cooling during severe summer periods.

II- INFRASTRUCTURE

Many infrastructures in Egaleo, being private or public, are regarded as outdated and not energy efficient, which can lead to their degradation by natural phenomena. The main problem that this causes is not only that these buildings are not environmentally and energy efficient, but also that they do not provide adequate protection against weather effects. The materials used to build them are not heatproof which makes them especially vulnerable in the case of heatwaves, not to mention, a potential fire threat.

Infrastructures that are energy inefficient and are unable to protect their residents bring forth socioeconomic issues. The large unemployment rates in the Municipality indicates that a significant portion of the citizens cannot afford to upgrade their home with better resources to withstand extreme weather effects (air conditioning, heatproof windows, etc.), where energy class A+ upgrades are costlier. This leads again to the overburdening of the Municipality's resources, having to operate public spaces for the support of these citizens. Moreover, being unable to live inside their own homes, people become more restless and worried about their future conditions which can worsen their mental and physical health.

III- URBAN PLANNING

Land usage for the improved mobility and quality of life of citizens has always been the top priority for the MOE. Having to cope with the ever-changing extreme weather effects can pose problems to the urban layout and environment. To be able to cope with extreme heat (and with cold during winter periods), while also making essential infrastructural preparations for the case of fire, a lot of the public squares and green places may have to be repurposed into shelters, due to the fact that there is a critical problem with land usage and there is little to no available space for exploitation remaining in Egaleo.

Altering the urban planning to resist extreme weather effects will overburden the budget of the Municipality and is likely to lead to conflicts between citizens. Efficient use of the limited available land that was reserved for the creation of facilities that would improve the quality of life of citizens (e.g., sports facilities, more green spaces) will instead be used to safeguard citizens from extreme weather. This in turn can invoke conflicts between citizens with adequate household resources and those with not.

6.3 Governance Baseline

6.3.1 National Scale

Greece joined the European Union in 1981 and ever since it complies to its customs, making Parliamentary Republic its status. The country underwent an administrative reorganization in 2011 as foreseen in Kallikratis Plan, which led to the creation of seven Greek decentralised administrations (apokentroménes dioikíseis), the head of each of which is appointed by the central government.

On 22 December 2019, the Ministry of Environment and Energy (former Ministry of Environment, Energy and Climate Change), the Academy of Athens (Biomedical Research Foundation) and the Bank of Greece signed a memorandum of cooperation with the aim to address the impact of climate change at country level through specific adaptation actions. The memorandum adds to the experience of the Bank of Greece and its Climate Change Impacts Study Committee (CCISC) on the economic sector and others. The cooperation concerned, inter alia, drafting the National Adaptation Strategy.

The overarching objective of Greece's adaptation strategy is to strengthen the country's resilience to the impacts of climate change, and to create conditions for well-informed and farsighted decisions that address risks and opportunities resulting from a changing climate. The NAS provides an initial five-year horizon for building the capacity for adaptation and prioritising and implementing an initial set of actions. Due to the significant uncertainty surrounding climate change and its impacts, as well as in light of the latest information and developments, the views on the best way to promote adaptation need to be constantly put in new context, which calls for continuous evaluation, training and specialised analysis. Against this background, the first draft of the NAS provides an opportunity for developing a strategic approach to adaptation to climate change, which sets in motion an ongoing process of revision, updating and realignment.

The key objectives of the NAS are to:

- establish and enhance the (short-term and long-term) decision-making procedure regarding adaptation issues;
- link adaptation with the promotion of a sustainable growth model through the implementation of regional/local action plans;
- promote adaptation actions and policies in all sectors of the Greek economy, with emphasis on the most vulnerable ones;
- create a monitoring, evaluation and update mechanism for adaptation actions and policies; and
- build adaptation capacity and raise public awareness.

Furthermore, since 24/11/2012, the Greek Ministry of Climate and Energy is currently on consultation for a new law regarding the Transition to Climate Neutrality and the Adaptation on Climate Change, with the final conclusions of the consultation to be drawn on the 4th of December 2021⁴².

6.3.2 Territorial Scale

The Western Attika Developmental Association (Anaptiksiakos Sundesmos Ditikis Attikis) is an association created by Municipalities of the Western provinces of Attika region in order to secure more national and European funds through the development of projects. To tackle the ever-present climate perils that exist within the region, the Association delegates and creates funding opportunities for initiatives to address climate change. The Association is being monitored by the Region of Attika, which also offers funding opportunities for its city-members to develop various projects including ones that are related to climate change.

⁴² Source: Government of Climate and Energy Official Webpage

6.4 Response Measures

6.4.1 Knowledge Production

Egaleo has been collaborating with the National Centre for Scientific Research Dimokritos to bring forth innovative solutions for environmental and technical affairs, while also making such knowledge more accessible to the general public. Other collaborating institutions include its two Universities which have collaborated for the creation of projects and training of students, Panteion University of West Attika. Other than that, there is also a memorandum of understanding with IASIS NGO for the creation and submission of projects related to mental health and climate change.

There are no specific maps yet indicating the most vulnerable places that are at risk of heatwaves, due to the complexity of it being an urban city. The MOE aspires to map these places in order to be on alert during periods of high risk, through its involvement in the TransformAr project

6.4.2 Participatory Governance & Awareness Raising efforts

No campaigns were developed to directly address climate change and related issues in Egaleo, with the main issue being the focus on other preeminent issues (social vulnerable groups) coupled with the former lack of know-how and the lack of resources to develop climate awareness campaigns. Egaleo, in the near future, will provide a space in its football court as a social innovation hub, in which there will be promotional and awareness raising activities regarding climate change.

In efforts to increase its climate knowledge and to share expertise with other municipalities, Egaleo is an active member of the Covenant of Mayors for Climate and Energy since 2008⁴³, and is a member of the Network of Healthy Cities aiming to promote public health⁴⁴.

6.4.3 Policies & Action Plans

I. NATIONAL SCALE

A new legislation is in deliberation and will consist of the National Climate Change Adaptation Strategy (NCCAS) for Greece. Among others, the new regulation obligates (1) the Municipalities to create a strategy to diminish the carbon footprint, (2) the new building to take into account the goals of the state for carbon neutrality and (3) the public building to be assessed in terms of vulnerability and risk to climate change and mitigation.

II. REGIONAL SCALE

The regional government of Attica has an ongoing study for assessing the baseline climate preparedness of the territory and providing adaptation priorities on a regional level.

III. LOCAL SCALE

The MOE has compiled studies for assessing the municipality's' infrastructures in terms of GHG emission, vulnerability to climate risks. The results of the studies will be taken into account when providing solutions for climate mitigation and adaptation.

A Sustainable Energy and Climate Action Plan for the Municipality of Egaleo, was approved by no. 159 / 3-11-2021 decision of the Municipal Council. The developed local action plan addresses the importance of climate change mitigation and adaptation. The plan considers 6 categories of action including: 1)

⁴³https://www.covenantofmayors.eu/about/covenant-community/signatories/overview.html?scity_id=11800

⁴⁴ <https://eddyppy.gr/meli/>

Buildings-facilities, 2) Transportation, 3) Administration, 4) Energy, 5) Climate Adaptation/Renovation, 6) Waste management. In the context of climate adaptation, the following actions are proposed:

- Bioclimatic upgrade and renovation of selected squares and parks of the municipality. This measure can help improve the microclimate of the area and reduce energy consumption for cooling in perimeter buildings and greenhouse gas emissions.
- Creation of new green space in selected areas of the municipality, either through the development of parks, or "pocket parks" (smaller parks in size <1 building block).
- Update of the Risk Management Plans of the Municipality, to include climate risks (heat waves, floods, fires) with a focus on refugees (which are likely to be more vulnerable to climate impacts).
- Establishment of air pollution monitoring system, and development of a response plan to be implemented if air pollution exceeded the desired limits.
- Calculating, monitoring and compensating the municipality's carbon footprint.
- Developing new municipal tree planting programs in un-used areas.

6.4.4 Implemented Grey/Green Adaptation Measures

In Egaleo, there have been attempts to mitigate the effects of climate change by starting on a local level. The MOE promotes projects for funding that regard innovative solutions for climate change adaptation and resilience. Furthermore, the Municipality itself takes part in various European funded projects aiming at creating tools, methodologies and technologies to make the municipality mitigate the effects of climate change. The Municipality is also currently undergoing an upgrade of the lighting systems on its streets, upgrading old ones with LED lighting that is more environmentally friendly. Nevertheless, no remarkable projects with a main focus on adaptation have been implemented at a local scale.

To implicate actors and promote projects and ideas focused on sustainable urban mobility, the Municipality of Egaleo, within its participation in the European Mobility Week, offers students and other citizens various awards and prizes. The latter are given in collaboration with local enterprises and businesses.

6.5 Key Stakeholders

Table 6.1 List of key local stakeholders in Egaleo per type, sector, influence, motivation to take climate action and link with TransformAr.

It is important to note that the "motivation of actor to take climate action" is based on activity of the organisation, considering the public information available. This is a relative characteristic or one that is likely to evolve in time and may not reflect the real motivation of all actors within a particular organism.

Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
IASIS NGO	Non-Governmental Organization	Psychosocial support of vulnerable groups, actions for climate change	Development of projects and services to tackle social and environmental perils	Active in climate change and its correlation with mental health	Grant knowledge on projects and funding calls to increase resilience of people towards climate change	Provide support and dissemination for the project's outcomes



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Panteion University	University	Social and Political Sciences	Training of future professionals in various social and political fields	Expressed interested of the students	Provide students that want to learn more about climate change and its social parameters	Making use of its vast network of professionals to support the project
Western Attika Developmental Association	Funding Body	Development of cities	Creation of funding opportunities for cities to flourish	Climate change in Western Attika	Communication and provision of support	Utilizing its network and its knowhow
University of West Attika	University	Technical and Social Sciences	Training of future professionals in various social and technical fields	Expressed interested of the students	Provide students that want to learn more about climate change and its social parameters	Making use of its vast network of professionals to support the project
Commercial Union of Egaleo	KCS	Commerce and Trade	Union of all shop workers in Egaleo	Create more opportunities for eco-friendly working conditions	Awareness promotion to its members	Being closer with workers of Egaleo for climate change
Egaleo Scout's System	Non-Governmental Organization	Youth Work, Environment	One of the largest NGO in Egaleo regarding youth and environment	Engage young people on a larger-scale environmental activity	Awareness promotion and engagement of young people in the project	Access to a pivotal target group for the holistic impact of the project
Museum of Asia Minor Culture	Non-profit, permanent institution	Cultural Heritage	The most significant cultural landmark of the culture of Asia Minor in Egaleo	Invoke cultural and environmental awareness in citizens	Active support in all of the actions of the Municipality for the project	Access to a wider audience for the project
Community Centre of Egaleo	KCS	Vulnerable group support	Provision of allowances in citizens, along with consultation and other relevant psychosocial services	To amplify its support for citizens facing financial problems, enhanced by climate change	Sensitization of a large portion of citizens regarding climate change and its effects	Large outreach to all vulnerable citizens in Egaleo
Social Grocery Store & Pharmacy of Egaleo	KCS	Vulnerable group support	Provision of necessary items for the citizens on the verge of social exclusion and financial deprivation, including medicine	To help reduce the number of vulnerable citizens that need to cope with the socioeconomic effects of climate change	Sensitization of a large portion of citizens regarding climate change and its effects	Large outreach to all vulnerable citizens in Egaleo



Stakeholder Name	Type	Sector/Area	Influence/Role in Society	Motivation of actor to take climate action	Stakeholder's contribution to TransformAr	Added value of TransformAr for this actor
Region of Attika	Government (regional)	Policy making/funding	The governing body of the largest region in Greece	Support the fight against climate change which already is a prime priority on its action	Networking with a significant number of high-ranked stakeholders that can potentially add up to the value of the project	PR and networking with stakeholders and decision makers
Municipality of Farcadona	Government (municipal)	Municipal governance	A Municipality on the southeastern Trikala regional unit, part of Thessaly in Greece, with more than 13.000 total population	Collaborate with the Municipality of Egaleo to create future projects for climate change	Sharing the project's progress and results with its citizens	Awareness promotion and creation of mutual campaigns for climate change
Municipality of Larissa	Government (municipal)	Municipal governance	A Municipality located in the region of Thessaly. Its total population is more than 284,000 citizens	Collaborate with the Municipality of Egaleo to create future projects for climate change	Sharing the project's progress and results with its citizens	Awareness promotion and creation of mutual campaigns for climate change
Hellenic Association of Positive Psychology	Research Association	Rn'D	Provision of training services and research regarding positive psychology	High interest in examining the effects of climate change on humans	Scientific support and engagement in promotion	Bridging social scientists with climate change issues
Youth and Lifelong Learning Foundation	Funding Body	The National Agency of Erasmus+ projects related to youth	Funding Erasmus+ projects regarding youth, with a possible extension to environment	Recognizing action for climate change as a national and European project priority	Linkage with young people and the Erasmus community for climate change awareness	Connection with other organizations and funded projects to expand the outreach of this project
State Scholarship Foundation	Funding Body	The National Agency of Erasmus+ projects related to vocation, education and training	Funding Erasmus+ projects regarding adult learning, with a possible extension to environment	Recognizing action for climate change as a national and European project priority	Linkage with a wide variety of scientific and Rn'D organizations that are interested in climate change action	Connection with other organizations and funded projects to expand the outreach of this project

OBSERVATIONS

This report, seeking to identify the particularities of the selected TransformAr lighthouse demonstrators (LDs), underlines the importance of understanding the context of a given territory as geographic, demographic and economic factors affect (positively or negatively) its capacity to address climate issues. This presents the importance of approaching the topic from a multi-disciplinary perspective.

In some cases, data availability was limited, especially in the case of communities or municipalities whereas at a supra-municipal level or a regional scale, there seem to be more developed maps and climate-related information. As a case in point, there seems to be more knowledge at the scale of Attika, then at the scale of the municipality of Egaleo. Similarly, statistics and economic data are more developed at the scale of Sardinia than at the scale of Oristano. This stresses the importance of developing climate-relevant data at a municipal scale.

In all the examined LDs, the impacts of climate change have already been experienced, are projected to worsen if no adaptation measures are to be implemented, and are exacerbated due to many factors such as existing natural risks, pollution, ageing of population, among others.

Common challenges are experienced across the examined territories, including an ageing population that is more vulnerable from a climate perspective, water-related challenges (e.g., droughts, water stresses, pluvial floods, sea level rise), and increased risks of catastrophic weather-related events such as forest and wildfires (e.g., Municipality of Egaleo, Oristano and Galicia).

Various researchers, projects and initiatives have been developed in the existing LDs to understand the vulnerability of the territory to climate change, and/or to develop adequate response measures. It is remarked that, even though all 6 territories are EU member states, the efforts of the LDs are not all at the same level (i.e. in some LDs the efforts are more advanced than in others). In this context, it is nevertheless important to underline that it is crucial to build on existing efforts and create synergies with concerned actors to accelerate the development and implementation of transformational adaptation solutions.

In total, 40 stakeholders were mapped in Lappeenranta, 14 in West Country region, 16 in Guadeloupe, 6 in Galicia, 18 in Oristano, and 15 in Egaleo. The identification of key stakeholders was done by the demonstrators themselves in collaboration with technical support partners. The results thus show that in the examined LDs, a different number of actors is engaged, of different types. In some cases such as the case of Lappeenranta, there is an important presence of private sector actors, in others, governmental and public bodies have a higher representation, such as the case of Guadeloupe. In Galicia, the scientific community (including universities, knowledge and research institutes) is considered as a key stakeholder. In all of the LDs, different stakeholders seem to have different motivations and reactivity to take climate action, some seemed to be actively engaged and mobilised to adapt the territory to climate others less. This mapping permits to identify the actors that needs to be further implicated and incited to take climate action, and the ones that are likely lead the change.

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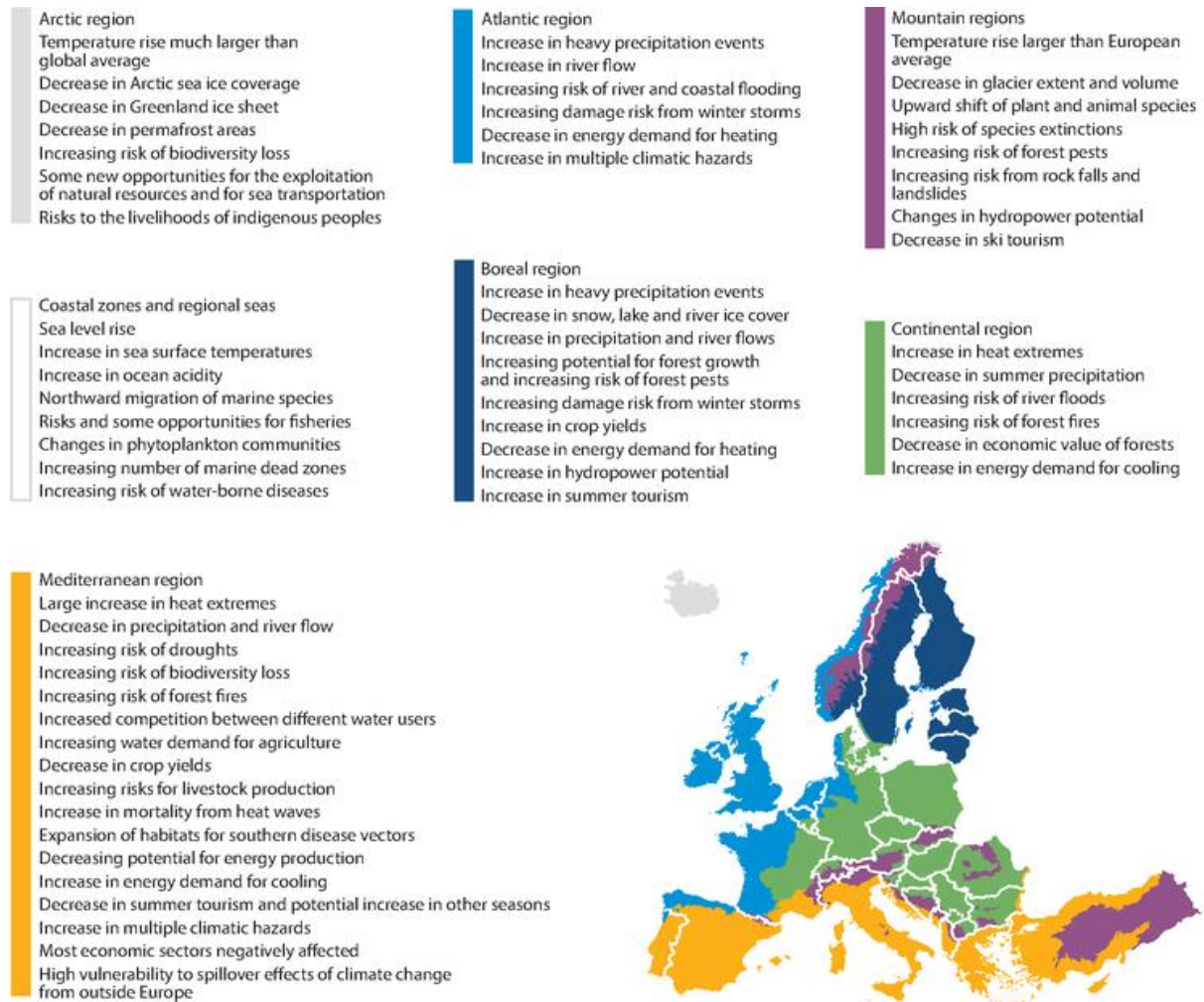
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ANNEX: Support Figure(s) Relevant for all LDs

Figure 7.1 Map of observed and projected climate change and impacts for the main biogeographical regions in Europe



Source: Figure retrieved January 5, 2022 from <https://www.eea.europa.eu/data-and-maps/figures/key-past-and-projected-impacts-and-effects-on-sectors-for-the-main-biogeographic-regions-of-europe-5>



Climate change impacts are here and now. The impacts on people, prosperity and planet are already pervasive but unevenly distributed, as stated in the new EU Blueprint strategy (European Commission-EC, 2019). To reduce climate-related risks, the EC and the IPCC agree that transformational adaptation is essential. The TransformAr project aims to develop and demonstrate products and services to launch and accelerate large-scale and disruptive adaptive process for transformational adaptation in vulnerable regions and communities across Europe.

The 6 TransformAr lighthouse demonstrators face a common challenge: water-related risks and impacts of climate change. Based on existing successful initiatives, the project will develop, test and demonstrate solutions and pathways, integrated in Innovation Packages, in 6 territories.

Transformational pathways, including an integrated risk assessment approach are co-developed by means of 9 Transformational Adaptive Blocks. A set of 22 tested actionable adaptive solutions are tested and demonstrated, ranging from nature-based solutions, innovative technologies, financing, insurance and governance models, awareness and behavioral change solutions.



TransformAr



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