LOCAL ADAPTATION PLAN OF THE CITY OF PATRAS

April 2013

Table of Contents

Mayor's foreword 6

Introduction & structure of the plan 7

1 Vision, guiding principles and objectives of the plan 9

1.1 Vision and guiding adaptation principles for the municipality 9
1.2 The aim of the Adaptation Plan 9
1.3 The strategic objectives and targets of the Plan 9
1.4 The potential barriers to adaptation at local level 9

2 Context for adaptation in Patras 10

2.1 General description of the context 10
2.1.1 SOCIO-ECONOMIC CONDITIONS 10
2.2 Existing adaptation policies and measures (potential synergies of sectoral or municipal policies with adaptation policy) 16
2.2.1 AAP 2020 - Adriatic Action Plan 2020 16
2.2.2 RDP – Parks network 16
2.2.3 CCWaterS – Climate Change and Impacts on Water Supply 17
2.2.4 GP Wind - Good practice in reconciling onshore and offshore wind with environmental objectives 17
2.2.5 ENESCOM - European Network of Information Centres promoting Energy Sustainability and CO2 reduction among local COMmunities 17
2.2.6 SURF Nature – A better use of structural funds for natural heritage, biodiversity and nature conservation 18
2.2.7 ISOLABELLA – Sustainable Tourism Indicators for Mediterranean established destinations 18
2.2.8 PLUS - Public Lighting Strategies for Sustainable Urban Spaces 18
2.2.9 WaS4D – Water Saving for Sustainable Development 18
2.2.10 PROFORBIOMED – Promotion of residual forestry biomass in the Mediterranean basin 19
2.2.11 WBB – Wander By Bicycle 19
2.3 Mapping adaptation at local level – who is responsible for what 20

3 Understanding climate change in Patras 21

3.1 Current climate observed trends 21
3.2 Climate change projections 22
3.3 Dealing with uncertainties ..... **Errore. Il segnalibro non è definito.**

4 Assessing vulnerability and the impact of climate change 27

4.1 Vulnerability to climate change 27
4.1.1 Biodiversity 27
4.1.2 Cultural Heritage 27
4.1.3 Desertification 27

4.1.4 Fisheries 28
4.1.5 Health 28
4.1.6 Landslides 29
4.1.7 Tourism 29
4.2 Current and potential impacts resulting from climate change 30
4.2.1 Health 31
4.2.2 Tourism 32
4.2.3 Cultural heritage 34
4.2.4 Desertification 35
4.2.5 Fisheries 36
4.2.6 Landslides 37
4.2.7 Coastal zones 38
4.2.8 Biodiversity and Forests 43
4.2.9 Water availability and quality 49
4.3 Challenges and opportunities of climate change .....**Errore. Il segnalibro non è definito.**
4.4 Identifying priority areas for action 53
5 Adaptation to climate change 55
5.1 Health 55
5.2 Tourism 56
5.3 Cultural heritage 59
5.4 Desertification 59
5.5 Fisheries 60
5.6 Landslides 60
5.7 Coastal zones 61
5.8 Biodiversity and Forests 66
5.9 Management of water resources 70
5.10 Summary of the main adaptation actions of Patras ..**Errore. Il segnalibro non è definito.**
6 Implementing the adaptation plan 79
7 Monitoring and reporting the adaptation plan 80
8 ANNEX I – The stakeholders involvement: key stakeholders and actions performed for the involvement 81
9 ANNEX II – Mainstreaming adaptation into the sectoral policies: key actors, tools and strategies for integrating adaptation 88
9.1 Management of water resources 88
9.2 Nature-Biodiversity 89
9.3 Management of coastal areas 90
9.4 Marine environment 91
9.5 Forests 91
9.6 Desertification and Soil 92

9.7 Agriculture 92
9.8 Tourism 93
9.9 Energy 94
9.10 Health 95
9.11 Urban environment and infrastructure 95
9.12 Land-use planning 96
9.13 Civil protection 101
9.14 Proposals for funding opportunities 101
10 Glossary 103
11 Conclusions 104
12 Bibliography 105

Table of Figures

Figure 1: Annual mean temperature variation predicted by RCMs (°C) 23
Figure 2: Annual minimum temperature variation predicted by RCMs (°C)..... 23
Figure 3: Annual maximum temperature variation predicted by RCMs (°C)..... 24
Figure 4: Annual mean temperature variation predicted by GCMs (°C) 24
Figure 5: Annual cumulated precipitation variation predicted by RCMs (%) 25
Figure 6: Annual cumulated precipitation variation predicted by GCMs (%) 25
Figure 7: Changes in drought periods (in days) 25
Figure 8: Change in three-day cumulative precipitation (in %)..... 26
Figure 9: Change in number of days with T > 35 oC (in days) 26
Figure 10: Comparison of TCI scores in baseline year and in future scenarios (2046-2065 and 2081-2100) 32
Figure 11: DISMED: SDI evaluation in Greece 36
Figure 12: Natura 2000 site No. GR 2320007 of Mountain Panachaikon (source: geodata.gov.gr) 44
Figure 13: The catchment of Glafkos River – with highlight the mountainous part and the coastal aquifer 49
Figure 14: Satellite image of the coastline between Rio and Rodini 65
Figure 15: Catchment basin of rivers Pinios, Piros and Vergas (GR28) 71

Mayor’s foreword

Introduction & structure of the plan

When the City of Patras participated in the project LIFE ACT available of studies were already indicating that a number of environmental threats were deteriorating the environment of Patras. This situation poses a danger for the economic life and future development of the region but also for the quality of life and the integrity of properties and infrastructure.

Foreseen climate change and its impact is expected to further reinforce the threats to the physical and human environment and bring a number of challenges that need to be encountered by measures of both mitigation and adaptation.

During the Local Adaptation Board meetings, three areas were recognized as critical for the wider region of Patras:

- Coastal zones erosion
- Biodiversity
- Water

In the current Local Adaptation Strategy the roadmap and principles for the adaptation of Patras to climate change are explained. Beginning with the political interest and commitment of the local authorities and the formation of the Local Adaptation Board, the climate projections for Patras and the impacts of climate change are analyzed for nine (9) – identified as more important since they fit in the regional and local profile of the city of Patras – categories:

1. Health
2. Tourism
3. Cultural Heritage
4. Desertification
5. Fisheries
6. Landslide
7. Coastal zones
8. Biodiversity
9. Water

To these categories, existing and past EU project initiatives that Patras has participated are linked and explained so that expertise and best practices can be sought for study and implementation.

The most important part of the current Strategy is the Local Adaptation Plan to climate change of municipality of Patras. The Strategy is divided in two parts:

1. The general adaptation strategies and guidelines – national and regional strategies and guidelines and they can be translated in local terms

2. The local adaptation strategies and guidelines for the nine different categories that were identified by the Local Adaptation Board as important for the city of Patras. Local adaptation strategies and guidelines are more thoroughly analyzed for the three areas were recognized as critical for the wider region of Patras during the Local Adaptation Board meetings

1 Vision, guiding principles and objectives of the plan

1.1 Vision and guiding adaptation principles for the municipality

The vision of the Municipality of Patras is to provide a safe environment to its citizens in the face of the current and coming impacts of climate change. The guiding principle of the adaptation strategy is that it must support the sustainable development of the city.

1.2 The aim of the Adaptation Plan

The aim of the Adaptation Plan is that the actions proposed will be addressed in the Policies of the Municipality and an in the City's Operational Programme.

1.3 The strategic objectives and targets of the Plan

The Strategic objectives of the Adaptation Plan are to:

- Raise awareness and understanding of the impacts of climate change in the city of Patras and the importance of adaptation measures amongst decision makers, stakeholders and the local community.
- Integrate adaptation measures in the local agenda.
- Support decisions related to the adaptation to climate change.
- Promote the concept of adaptation in any new developments.

The targets of the Plan are to:

- Identify the most important effects of climate change in the city of Patras.
- Prioritize the actions needed in order for Patras to adapt to climate change.
- Ensure the appropriate response of the Municipality and of the local community during crisis management plans for climate change impacts.
- Strengthen the decision-making processes of Patras towards adaptation to climate change.
- Promote the participation of all local actors in the planning and implementation of adaptation measures.
- Ensure that the design and implementation of new infrastructure takes into account the effects of climate change predicted to occur.

1.4 The potential barriers to adaptation at local level

The main barrier to adaptation in the city of Patras is the financial cost of the adaptation measures. The economic crisis in Greece and the reduced State funding towards the Municipalities hamper the implementation of the adaptation measures.

2 Context for adaptation in Patras

2.1 General description of the context

2.1.1 SOCIO-ECONOMIC CONDITIONS

Between the years 1991 and 2001 there was observed a decline in employment in the primary and secondary sector production mainly in the mountains apartments in the municipality, and deleted a dramatic reduction in employees is up 93.5%. Overall the Municipality of Patras reducing the employed in the secondary sector amounts to 17.3% higher than the reduction in departmental level, while the primary drop to 6.5% is significantly lower than the change in departmental, regional and national level.

The deindustrialization of the county and the upward trends in urbanization census decade led to expansion of employment in the tertiary sector of production, and the Municipality of Patras deleted rise by 23.9%, which follows the overall increase in the county (27%) and superior growth employed in Western Greece and the country.

2.1.1.1 Employment by sector of economic activity

In the Municipality of Patras in 2001 the highest percentage of staff employed in the industry has trade with 16.6%, followed by the manufacturing and education with 10.5% each. In the other classes, the percentage of employees at levels lower than 7%.

Primary Sector

The area of the Municipality of Patras has low agricultural activity. The main agricultural products produced in the study area is a series of quantities produced olives, Cabbage, tomatoes, etc. The majority of the utilized agricultural area of the Municipality of Patras used for tree crops (63.05%) of farmland or 19,191.60 acres, while 19.21% are covered by annual crops. Production volume is low with respect to ranching activity, both at the district level, and the study area, resulting in low participation of livestock in total agricultural income.

Secondary Sector

In the Municipality of Patras operate industries, whose activities have as their object the timber, dairy products, paper, alcohol, concrete, quarries, the Tannery, the keramourgeia. Crafts in Patras Municipality, according to the EV Achaia, amounting to two thousand three hundred and ten nine (2319). Establishing a firm demand VIOPA the Municipality of Patras. Launched with the approval of power G.P.S which envisaged the construction VIOPA in owl. The urban study VIOPA completed have

been completed up procedures of the Management and Implementation of VIOPA which brings the Municipality of Patras, Achaia and the South East Chambers and manufacturing organizations. The Management Authority recently signed (2006) framework agreement with Southeast Achaia basis of which the technical services of the latter will manage the implementation of the necessary infrastructure. The construction of VIOPA done so on favorable terms to relocate there, the crafts area. Besides, the new Development Law 3299/2004 stipulates (Article 5 par.vii) the opportunity to grant business relocation to VIOPA and industrial areas.

Tertiary Sector

The economy of the region, as most of the major urban centers of the country, based mainly in the tertiary sector. The tertiarisation economy of urban centers is a generalized phenomenon and partly due to the development of technologies and networks, a clear improvement of the educational level of the workforce, the rapid development of transport, but also the lack of competitive advantages in the fields of primary and secondary production in urban areas, the existence of problems of land use conflicts in such activities and to improve the functioning of the bureaucratic processes through the spatial concentration of services.

2.1.1.2 Unemployment

Deletes rising unemployment during the reference decade both in primary and at the departmental level. Specifically, the Municipality of Patras rate of change the unemployed population is higher the oldest is the population and the rise of unemployed mature productive population stands at 277.6%, while the increase of unemployed aged 30-44 stands at 103.4%.

Similar increases are by sex, especially the problem of rising unemployment mainly affects the female population, especially the mature productive population. A similar picture exists in the prefecture of Achaia. Also it should be noted that in 2001 there is a decrease of unemployed women over men compared with 1991 in both departmental and municipal level. The prolific juvenile population of the Municipality of Patras and in Achaia, most affected by the phenomenon of unemployment, and a proportionate share of this group in total unemployment is two (2) to three and a half (3.5) times the participation of class 30 -44 years on unemployment in the census years 1991 and 2001. It is worth noting that the percentage share of age group 15-29 years decreased while increasing the participation of both the instrument and the mature productive population.

2.1.2 ENVIRONMENTAL ISSUES

2.1.2.1 Important natural areas

On their tops Panachaiko (maximum elevation 1,924 meters) meets the

visitor bare mountain slopes, forests, cliffs and meadows, springs and streams. The rare flora with endemic species of the Peloponnese and southern Greece gives a great ecological importance in the region. The value and the importance of conditions is expressed by the fact that total area Approximately 121,700 acres in this area has been designated a protection zone and is included in the European ecological network Natura 2000. Furthermore, the area of Patras meet fir forests and woodlands of evergreen and deciduous in Local Apartments Elekistras, Souli and Fate. However, the condition of the landscape presents strong environmental pressures and trends continuing degradation due to overgrazing, illegal hunting, the expansion of the road network and the illegal building cottages.

2.1.2.2 Flora - Fauna – Biodiversity

The Municipality of Patras occupies an area totaling 125,400 acres and divided - according to the census of 1991 (NSS) - a percentage of land use structure in pastures of 32.5%, in forests at 23.76% in cultivated area by 20 , 7%, of the land covered by water at 2%, of the land settlements by 26.7% and in other areas by 2%. As noted, the proportion of Patras municipality has a balance of general land uses extremely rich and balanced, which attaches to Patras particularly ecological and economic comparative advantages.

The combination of important elements of the human environment (archaeological sites and historical monuments) and natural environment (forests, plains and sources of streams and rivers, important species of flora and fauna and important habitat types) and essentially raises the key targets for protection in . The vegetation zones of Panachaiko zonosi13 correspond to a typical Mediterranean conditions. Natural forests are few and small nest in moist valleys, with larger than those around the sources of Glaucus and slopes of Zoumpatas. The whole area is listed or reforested in 1934, by decision of the Ministry of Agriculture for ydronomikous-protective reasons, and subsequent decisions reforestation and land reclamation due to fires in various locations in the area. Giving an overview of the vegetation of the area with emphasis in Panachaiko would say that degradation tendencies namely: deciduous oaks and holm have
degraded to maquis than before and folic (prevalence of resistant species) and only kept their spots in places. The formations and phryganic the garrigue which are the most deprived states of vegetation are also significant extent.

2.1.2.3 Hydrogeologic data

Water balance in the region of Patras include surface and groundwater from the hydrological processes cycle. The high water potential of the region is directly linked to the location of Patras and the provision of Orographic region, favoring high altitudes precipitation. This large amount of precipitation and then feeds the drainage network in

the area of high runoff. The study area is drained by four streams (ravines, bland, begging, Glaucus) leading to the beach P.S.P. The two main rivers, the Glaucus and ravines forming hydrological basins. The sections of streams and Milihou Diakoniaris, crossing the city of Patras is covered.

If you would like to identify the pressures on the water resources of the area and given the fact that there are no delineated 'sensitive' to pollution, we should note that many times the network water or hydro-project collector comes in contact with various contaminants, namely: Agricultural and livestock activities, due to the use of chemical fertilizers and pesticides are a potential hazard and chemical organic pollution of water discharges. In addition, municipal wastewater, as to settlements outside the city, placed in tanks and no settlement has no sewer. In some cases due to saturationof these sewer overflow occurs and runoff to the watercourse
torrents. Also waste of these settlements are deposited in torrents, while local districts in the area are farms that have their waste in open pits, creating in this way risks of pollution of groundwater. Finally, waste disposal, local small cheese dairies and mills without proper treatment will result in additional long-term pressures on environmental quality and pollution of water discharges.

2.1.2.4 Surface water resources

The surface water resources mentioned in runoff occurring during along four main streams in the region mentioned above and several smaller that contribute to them. These streams areform two major surface watersheds, Basin Glafkos Basin ravine. However, all of them are not located within the administrative boundaries of the municipality.

Migrant superficial tumors meteoric water in the basin is Glaucus important, especially after periods of heavy rainfall. Because no such exactly the type of basin exists and transfer of debris torrents materials in the lowland zone. It should be noted that generally the Prefecture of Achaia has characterized the past by now cheimarropliktous the country. The flood runoff streams were a particular problem for the lowland area of the municipality of Patras and necessitated surgery settlement of mountain torrents route, from the 1960's. Recently, after heavy rainfall, increasing flood occurred off the torrent Diakoniaris, which meant that even the loss of human lives. To address the torrent ongoing subcontract arrangement of bed in the urban part of the journey, while strengthening containment dikes in the area Romanos.

2.1.2.5 Ground water resources

The underground water resources listed in underground aquifers formed in rocks of the region from infiltration of meteoric water into the mass. Water as a special case of

groundwater resources listed sources in the area of the municipality, after coming from underground aquifersand especially the karst, but most of them appear on the surface and added to the surface runoff. The underground water resources of the study area as a whole is remarkable, given the geological structure of the area and the large rainfall index that characterizes it.

2.1.2.6 Water abstraction

The surface waters of Glaucus utilized to meet part of the water supply needs of Patras. The main sources of water supply of the city of Patras is the Velvetsiou, Romanos and ydromastefsi the bed of Glaucus. When the amount of water decreases Glaucus in the summer then the water of Patras is primarily hydro-drilling. According to data from the DEYAP, the average daily consumption is estimated at Patras 72.000 m3, which in winter is mostly covered by surface waters of the owl. This consumption increases during the summer period, when estimated at 84.000 m3, with coverage primarily of drilling. These quantities correspond tototal flow fed to the network, including non-invoiced water, ie the quantities corresponding to leaks, theft Errors and water meters.

2.1.2.7 Protection of water resources from pollution

To protect the hydrological and hydrogeological basin Glaucus from uncontrolled disposal of urban waste water of the city of Patras has been constructed and operated sewer and water treatment plant meets all the needs of the municipality. Based on available data, the biological treatment covers about 70% of the sewage system of the city. The biological treatment of Patras covers 60% of the municipality Messatida and 40% of the City Beach. From the above, it is obvious that the problems will continue pollution of surface and groundwater basin owl. The municipality has no Vrachneikon sewer thereby incurring their tanks underground aquifer hydrogeological basin experience.

For the protection of water resources from industrial waste is built and operated her biological Patras Industrial Area, which receives waste from the industrial area and the sewage from the municipalities of Patras, Rio, Beach, and Messatidos Vrachneikon. For the protection of water resources from waste disposal in landfills inappropriate operates the landfill Patras. With the operation of these landfills and wastewater treatment and extension of the sewerage system of the city of Patras and Lepanto protected while and the marine ecosystem of Gulf of Patras from urban and industrial waste, and to eject him eventually surface and groundwater basins Glaukos, experience, Mornos Evinos and many other streams and streams.

2.1.2.8 Fossils

The prefecture of Achaia lacks any significant fossils. With the exception of quarry

aggregates mainly supplied by the extensive views of the limestone, there are minerals in the study area, concentrations or nonmetal elements with economic interest.

2.1.2.9 Major sources of pollution

The human presence and intervention in the area of interest is intense and dominates the low altitudes, especially in the coastal zone, particularly in the urban center of the city of Patras. The area receives locally, but as a whole, environmental pressures from the following main sources of pollution: Extended uncontrolled building with main pressures on soil, groundwater and sea from the uncontrolled disposal of urban waste water absorbent tanks. The movement of vehicles on the roads is the main source of air pollution. Main source pollution from road traffic is the highway Corinth-Patras-Pyrgos, the Rion-Antirion the Highway Antirrio - Ioannina and the coastal highway linking Antirio with Nafpaktos. Pollution from shipping is also observed in the port of Patras is the exhaust and effluents from the operation of the drive motor ships which are an important source of air pollution and water given the high traffic of passenger and cargo ships in the area. The industrial units also exert considerable influence both in the atmosphere with emissions from the production process and emissions from industrial combustion, and soil and water from the uncontrolled disposal of untreated or partially treated industrial waste in water bodies and sea . Pollutants are also produced by central heating and are mainly CO2, CO, SO2 and particulate matter (mostly soot) mainly in the city of Patras. The agricultural sector and agricultural production also significantly burden surface and groundwater and soil through runoff of pesticides and fertilizers. Similarly, livestock and seed oil acts in the same way through waste burdening small farms mainly surface and groundwater.

2.1.2.10 Energy infrastructure

In Patras Municipality of the energy supplied based on the function the power station operating in Kournampella position. Station using the power of the water flowing from the river Glaucus, generates electricity power 3,7 MW. The water used for the production of energy, then the turbine, a portion of the driven refineries DEYAP and another is used in irrigation. In HPP Glaukos operate two units since 1997. The generated power from the Station Glaucus is unable to meet the needs for energy in the municipality. The power of the municipality is basically the premises of Etoloakarnania.

Wind energy

In the Municipality of Patras and specifically in TD Elekistras sited three wind farms, which are located on sites with estimated power 14.450 KW, Tranos Rock with a projected power 5.950 KW and St. Theodore, with projected power 9.350 KW. Station renewable energy source (RES) which is licensed by the Region of Western Greece (RWG) is the wind power plant, 41 wind turbines rated at 34,85 MW. It has the ability to

power a city of 20,000 inhabitants and was completed in about 8 months. Total production is expected to exceed 80 million kilowatt hours per year, while the operation of the park saves about 1.5 million by replacing conventional fuel.

Natural Gas

In the Municipality of Patras and across the county there is gas network. However, the installation of gas in an urban center like Patra and especially with the "crisis" passes the cost of buying oil is of considerable importance for the industrial development of the region.

2.2 Existing adaptation policies and measures (potential synergies of sectoral or municipal policies with adaptation policy)

City of Patras has constantly tried to participate in international projects and initiatives that will permit exchange of know-how and scientific knowledge related to the impacts of climate change, mitigation of and adaptation to climate change, sustainable development and protection of the environment. To this end, the Local Adaptation Board will play a role of integrating outcomes and results from all relevant projects in order to achieve better and far reaching results. A list of projects that Patras has recently participated can depict the width of the readily accessible knowledge and know-how:

2.2.1 AAP 2020 - Adriatic Action Plan 2020

The operation's overall objective is to exchange experiences on policies and instruments, benchmark and standardize methods and administrative procedures, identify and disseminate best practices, and jointly implement improved policies for local sustainable development. This should be achieved through systematically integrating sustainability into public sector policies and raising the awareness of private sector operators on sustainability as an innovation factor. Final results will be formalized in an Adriatic action plan that contains common strategies, objectives, actions and commitments in respect of implementation. The Adriatic action plan will be promoted widely across Adriatic and Ionian cities.

2.2.2 Reseau Des Parks – Parks network

The main objective of the Parks Network is therefore that of ”Creating a new form of dialogue on the common topics of environment management, by establishing a network comprising protected natural areas of Mediterranean with a view to contributing to the identification of mutual strategies to be implemented within the framework of a long-term collaboration. The exchange of knowledge and skills is being focused on the following topics:

- Management of Problematic Species
- Forest Management
- Tourism Management
- Use of EC funding for the development of the territory

2.2.3 CCWaterS – Climate Change and Impacts on Water Supply

In CC-WaterS, SEE governmental bodies, water suppliers and research institutions work together and implement jointly developed solutions, hence to be applied on a regional or local level in SEE. The complementary knowledge of the partners, enhanced by further applicable results of past projects, will provide a strong background. Capitalizing already existing knowledge and data from EU-funded scientific projects and eliminating parallel investigations, CC-WaterS will make information applicable for concrete solutions, develop tools and instruments for public water supply and implement safeguarding measures. An accessory dissemination strategy will ensure that CC-WaterS' durable results are transferred to the relevant users.

2.2.4 GP Wind - Good practice in reconciling onshore and offshore wind with environmental objectives

GP-Wind project had the objectives to:

- Increase the consenting rate for on and offshore wind projects, and reduce the processing period for applications.
- Increase the efficiency of processing applications, thereby reducing process costs.
- Build evidence based support for the design, planning and implementation of projects which are sensitive to environmental and community concerns.
- Assist quicker, more transparent and less costly deployment of wind energy across Europe, contributing to the achievement of 2020 targets for renewable energy generation.
- Secure endorsement of project outputs by participating partner administrations and commitment to adopt relevant good practice.
- Secure endorsement of project outputs by other Member States and commitment to adopt relevant good practice.

2.2.5 ENESCOM - European Network of Information Centres promoting Energy Sustainability and CO2 reduction among local COMmunities

The project will contribute to an enlarged network of energy efficient cities with low carbon footprint, to increased awareness and knowledge among key stakeholders and citizens as regards energy efficiency and RES use, to the transfer of best practices and intelligent energy technologies in Europe and to the development and implementation

of further sustainable energy action plans in 70 local communities. The activities will ultimately generate future energy efficient investments, a decrease in energy consumption and greenhouse gas emissions and more energy-efficient lifestyles and behaviors.

2.2.6 SURF Nature – A better use of structural funds for natural heritage, biodiversity and nature conservation

The overall objective of the project is to improve regional policies and practices for nature conservation and biodiversity by increasing the opportunities for financing these measures from the ERDF, whilst giving them a greater impact.

2.2.7 ISOLABELLA – Sustainable Tourism Indicators for Mediterranean established destinations

The general aim of the project is to strengthen the Governance of minor islands' Public Administration in order to transform them from marginal and peripheral communities of the Mediterranean into a "networking" system, able to promote new development models, instruments and strategies based on a participatory decision-making process in order to manage the territory according to the principles of sustainability.

2.2.8 PLUS - Public Lighting Strategies for Sustainable Urban Spaces

The PLUS project makes a significant contribution to decreasing energy use and rationalizing energy consumption related to public lighting. It will do so by analyzing the existing public lighting strategies of each partner as well as the actions developed thus far, by means of 'deep dive' visits which will each time focus on a specific environmental challenge in the field of lighting. Successes and shortcomings will be identified, and be compared to the other partners' own experience. Each deep dive will lead to an individual set of recommendations, resulting in an improved public lighting Strategy and Action Plan for the participating cities and regions. By focusing on new ways of approaching the field of urban public lighting utilizing technological innovation, the project contributes to energy efficiency, and ultimately sustainability and economic success. Due to the multi-faceted nature of public lighting, lighting strategies in public spaces may only be designed and implemented in an integrated way, also taking into account aspects of e.g. urban lighting pollution, citizens' sense of safety, traffic regulation, social cohesion & city marketing.

2.2.9 WaS4D – Water Saving for Sustainable Development

The attitudes and behaviors that serve to conserve drinking water, scarce water resources, optimize water efficiency, water resources and water demand management

and water line services (e-services) and educational tools are the key project objectives WaS4D.

Specific objectives of the project are:

• Determination of water needed for domestic and other uses - regional and spatial water balance.
• Promotion of locally available resources that are not currently used - recycled water.
• Scientific data implemented in a Geographic Information System and creation of relevant maps for water protection.
• Create a "point of information" for the sustainable management of water in places that are called "Water House" through which promoted the education, training, events and new consulting services to help professionals involved in water management and consumers.

2.2.10 PROFORBIOMED – Promotion of residual forestry biomass in the Mediterranean basin

This project aims to promote renewable energy as an economic and social opportunities in rural areas through energy recovery of forest residues and agricultural biomass. Simultaneously, however, sought the creation of new jobs and the development of industries associated with this industry.

The expected results are:

• Assessment of forest biomass for energy production.
• Transfer of knowledge and adoption of sustainable forest management, including forest biomass production chain and its use as an energy source.
• Improving governance in rural areas and developing clusters and agreements between public and private actors.
• Develop a model public support for sustainable forest management and biomass production.
• Identify funding mechanisms for public and private investment.
• Create new economic opportunities.

2.2.11 WBB – Wander By Bicycle

The project objectives match the objectives pursued by the European and national policies on transport, sustainable development, regional development policies, policies mountain development and tourism development.

Also in compliance with European and national policies of mountain development, arguing that the highlands are an essential element of geography and identity of a nation and the EU, this project seeks to diversify economic activities in mountain areas through the creation economic benefits from the creation of bike paths and related services for their support, as well as the benefits of tourism.

The expected deliverables of WBB are:

• Feasibility study for the construction of a cycling route and adjusting routes to European standards for bicycle
• Adjust paths and mountain tracks to create a cycling route
• Design and implementation of a coordinated system of marking
• Study and market infrastructure to optimize the transport of bicycles at stations than the ascent, the descent and safety due to landslides
• Construction of infrastructure for cyclists as bicycle rental areas and market places for bike storage and parking in each country covered by the network.
• Construction of tourist maps containing all the technical information about the route
• Purchase of GPS equipment to rent for visitors, which contains all the technical information about the trail and general information about the area
• Organisation open days for the environmental awareness of the public, in collaboration with the IAT, APT, CEA and local associations
• Production of promotional material for distribution to travel agencies, thematic exhibitions and publications in trade magazines
• Participation in 2 tourist fairs in the (bag of sports tourism and wellness-October in Montecatini Terme; handbag environmentally sustainable tourism - February in Riva del Garda)
• Establish contracts with commercial premises and infrastructure residence
• Creation of integrated tourist packages connecting Italy and Greece through the creation of bike paths

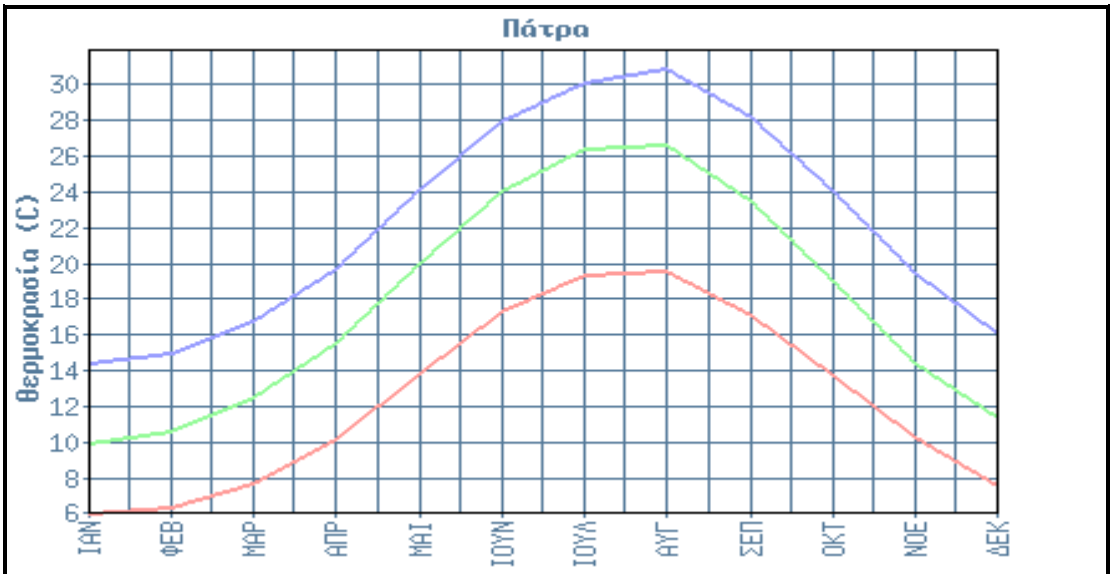
2.3 Mapping adaptation at local level – who is responsible for what

Until the preparation of this document there was no official Adaptation Policy for the City of Patras. Adaptation measures were discussed and implemented under the juridisdiction of the responsible Vice-Mayor based on the City's Operational Programme. The creation of the Adaptation Plan calls for a structure that will be responsible for its implementation and monitoring.

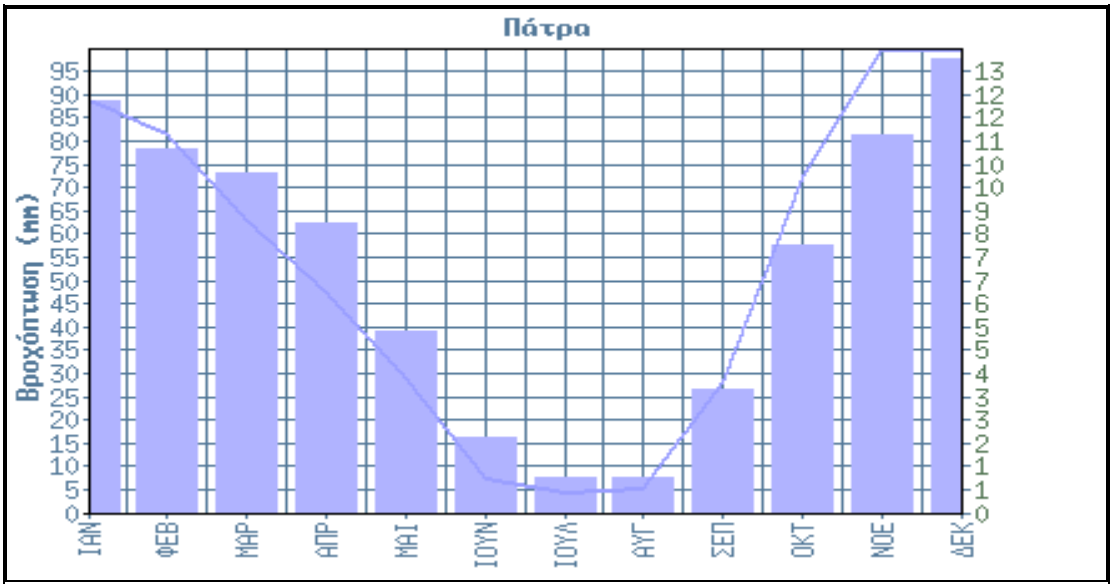
3 Understanding climate change in Patras

3.1 Current climate observed trends

Climate data was gathered for the city of Patras from the Hellenic National Meteorological Service. For the period 1995-1997, the temperature and precipitation variations are given below:



1st semester	Jan	Feb	Mar	Apr	May	June
Minimum monthly temperature	6.1	6.4	7.7	10.2	13.9	17.4
Mean monthly temperature	10.0	10.6	12.5	15.6	20.1	24.1
Maximum monthly temperature	14.5	15.0	16.8	19.7	24.2	28.0
2nd semester	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Minimum monthly temperature	19.4	19.6	17.2	13.8	10.3	7.6
Mean monthly temperature	26.4	26.7	23.5	19.0	14.5	11.4
Maximum monthly temperature	30.1	30.9	28.2	24.1	19.5	16.1



1st Semester	Jan	Feb	Mar	Apr	May	June
Mean monthly precipitation	89.1	81.7	63.3	47.8	28.9	7.5
Total days of rain	12.0	10.6	9.9	8.4	5.3	2.2
2nd Semester	**Jul**	**Aug**	**Sep**	**Okt**	**Nov**	**Dec**
Mean monthly precipitation	4.6	5.2	28.3	72.2	99.9	99.9
Total days of rain	1.0	1.0	3.6	7.8	11.0	13.2

3.2 Climate change projections

The climate of Patras is expected to have an increase in the mean air temperature and a reduction in the annual cumulated precipitation. Both temperature and precipitation projections were calculated using three Regional Climate Models (RCM) and two high-resolution Global Climate Models (GCM). The results for the RCMs were made available only for the "intermediate" emission scenario A1B (720 ppm CO_2); for the GCMs, the results were also made available for the A2 (pessimistic – 850 ppm CO_2) and B1 (optimistic – 550 ppm CO_2) scenarios.

More specifically, the rise of the mean air temperature (until 2100) is estimated to be between 3.5 °C (RM5.1) and 4.0 °C (RACMO2) with a warming more pronounced in summer (between 4.5 °C and 5.1 °C) and less in spring (between 2.4 °C and 3.0 °C).

The warming predicted by the GCMs in the A1B scenario is lower than the prediction by the RCMs (1.4 °C and 2.9 °C for INGV and CNRM models, respectively). In the A2 scenario, the GCMs estimate a warming between 2.0 °C and 3.6 °C, while in the B1 scenario the global CNRM model predicts a warming of 1.9 °C. This means that the

two opposite scenarios (i.e. A2 and B1) introduce an uncertainty in the variation of mean temperature of about 1.0 °C wide. This uncertainty is likely to be wider when more GCMs are considered. With regards to the GCMs projections, the maximum increase for the mean temperature (4.7 °C) is predicted by the CNRM model in the A2 scenario, and the minimum increase for the mean temperature (0.5 °C) is predicted by the INGV model in the A1B scenario.

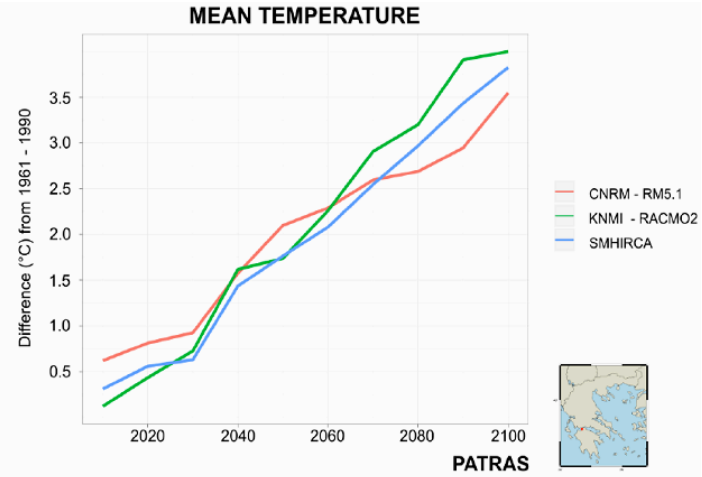


Figure 1: Annual mean temperature variation predicted by RCMs (°C)

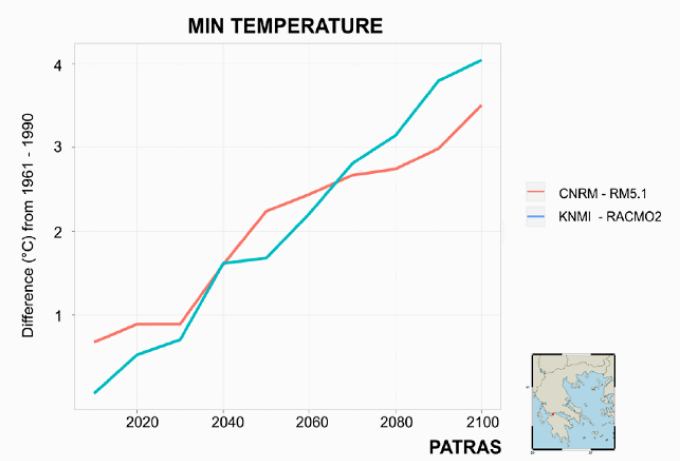


Figure 2: Annual minimum temperature variation predicted by RCMs (°C)

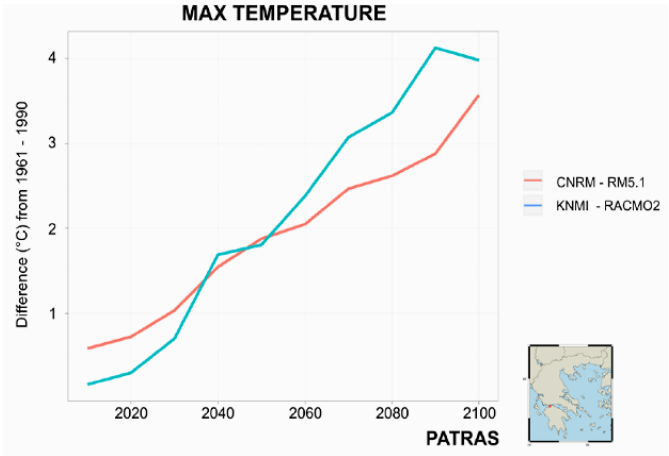


Figure 3: Annual maximum temperature variation predicted by RCMs (°C)

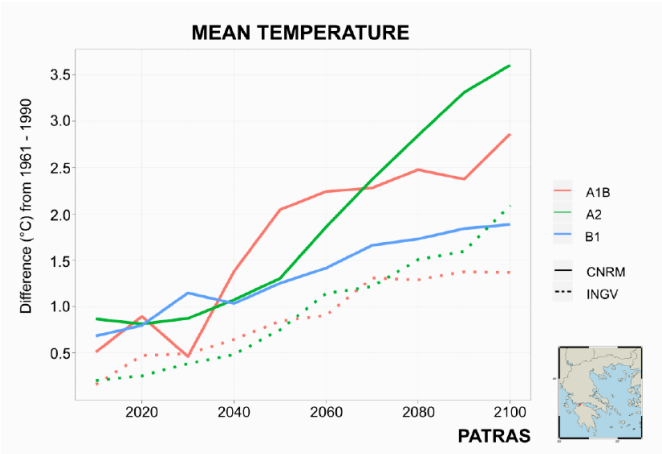


Figure 4: Annual mean temperature variation predicted by GCMs (°C)

The reduction of the annual cumulated precipitation is estimated between -5.5% (RACMO2) and -28.3% (RM5.1) with a stronger reduction during summer (between -22.6% and 44.6%).

Only two models predict an increase of the seasonal precipitation: RACMO2 in autumn (14.3%) and SMHIRCA in winter (8.7%). Moreover, in the A1B scenario CNRM predicts a precipitation reduction of -20.1%, while the INGV model predicts a precipitation reduction of -36.9% for the last ten years of the period. In the A2 scenario, the GCMs predict a drop of the annual precipitation between -34.6% and -56.8%, while in the B1 scenario the global CNRM model predicts a -9.4% reduction.

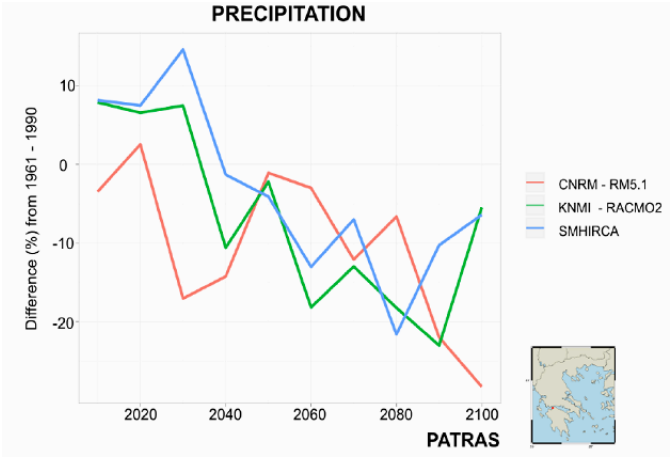


Figure 5: Annual cumulated precipitation variation predicted by RCMs (%)

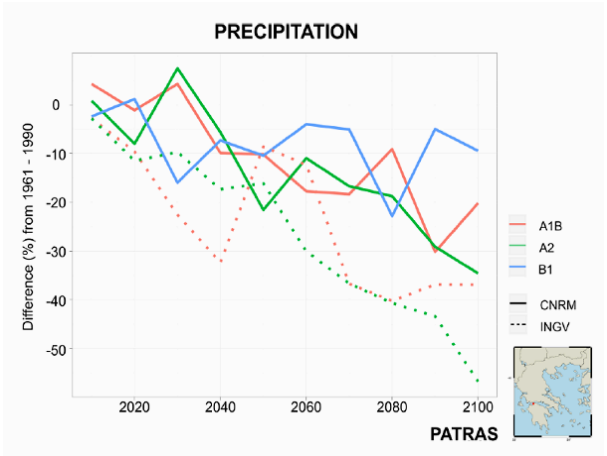


Figure 6: Annual cumulated precipitation variation predicted by GCMs (%)

In addition, a report by the Bank of Greece evaluates the changes in: (i) periods of droughts (row of days with precipitation less than 1mm), (ii) occurrences of flash floods (change in three-day maximum precipitation) and (iii) periods of heat shocks (number of days with temperature more than 35 oC) for the period 2071 – 2100 compared to 1961 – 1990.

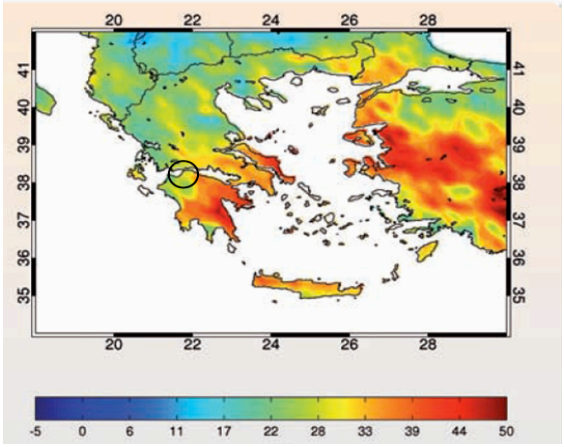


Figure 7: Changes in drought periods (in days)

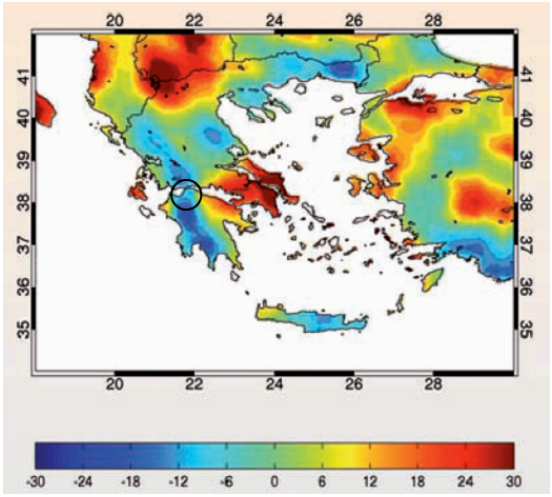


Figure 8: Change in three-day cumulative precipitation (in %)

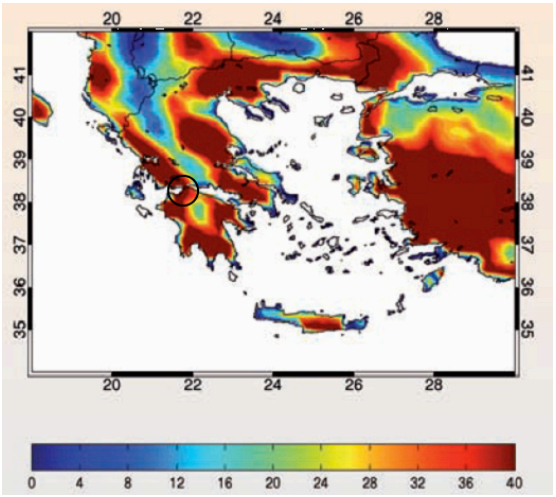


Figure 9: Change in number of days with T > 35 oC (in days)

The projections agree that the wider Patras region will have a warmer climate with more frequent hot days and drought periods as well as slightly less flash floods occurrences.

4 Assessing vulnerability and the impact of climate change

4.1 Vulnerability to climate change

According to the methodology of LIFE ACT project, city of Patras has compiled a number of "Climate change impact assessment and local vulnerability" reports for the following sectors: Biodiversity, Cultural heritage, Desertification, Fisheries, Health, Landslides and Tourism.

4.1.1 Biodiversity

For the mountainous ecosystem of Panachaikon, vulnerability analysis showed that, first, the ecosystem is vulnerable to the expected temperature increase and fall in precipitation that result in the decrease of growth and yield of flora. Second, species distribution is vulnerable to the local climatic conditions and their change is expected to alter the composition of the ecosystem's zones. Third, the ecosystem is highly vulnerable to natural disasters (forest fires and floods/landslides) which are expected to increase in number.

4.1.2 Cultural Heritage

Currently, there is no systematic recording of the vulnerability parameters for the monuments and sites in the city of Patras, mainly due to the large number of institutions that are in charge for the maintenance of public buildings, monuments and sites. Moreover, there is no established frame for the recording of the condition of privately owned buildings are.

4.1.3 Desertification

DISMED project has evaluated the Sensitivity to Desertification Index (SDI) in the Northern Mediterranean, Greece included. The wider Patras region is assessed as having low sensitivity to desertification.

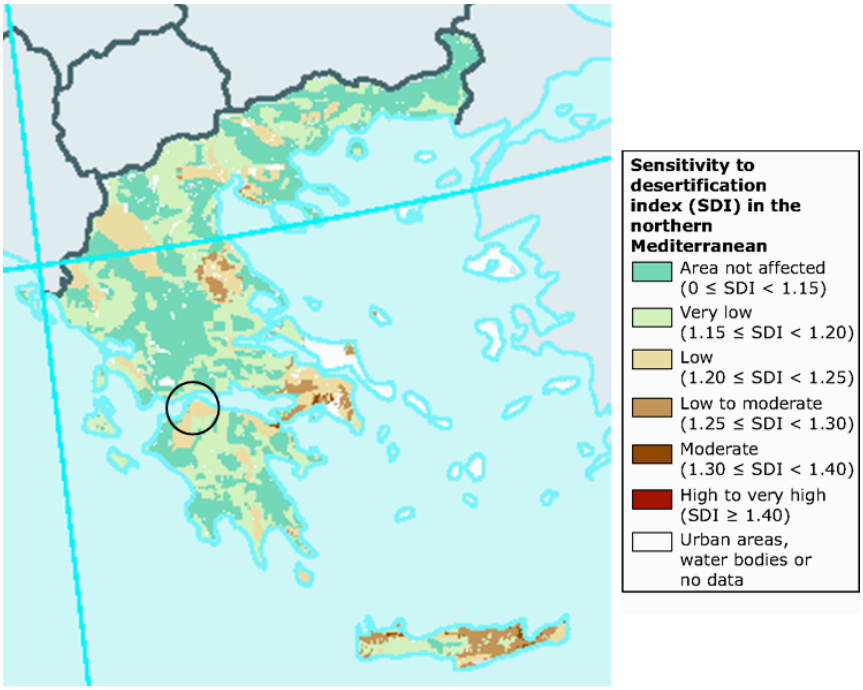


Figure 10: DISMED: SDI evaluation in Greece

4.1.4 Fisheries

In order to examine the correlation between Sea Surface Temperature (SST) and fish production, statistical data from the Hellenic Statistical Authority where analyzed. Extended analysis on monthly time series for the correlation between SST and fish production, it is estimated that for every 1°C increase of SST, fish production decreases (1.1% of total benthic production, 1.3% of mid-pelagic fish). Nevertheless, vulnerability of fisheries and fishing production to climate change could not be adequately linked because fishing productivity of a region is defined mostly from overfishing and less from natural factors.

4.1.5 Health

A detailed analysis of the vulnerability of the city of Patras to the climate change impact with regard to the health of its population was performed in previous actions of LIFE ACT project. The analysis resulted in the following vulnerability ratings for specific impact indicators.

High vulnerability	Medium-High Vulnerability	Medium Vulnerability	Medium-Low Vulnerability	Low Vulnerability
	Increase of the number of Deaths in elderly people			
		Increase of the number of Deaths of children		

High vulnerability	Medium-High Vulnerability	Medium Vulnerability	Medium-Low Vulnerability	Low Vulnerability
	Increase of diseases of the circulatory system for people with chronic health problems			
		Increase of diseases of the respiratory system for people with chronic health problems		
	Increase of diseases of the circulatory system for people with problematic diet or nutrient deficiency, low incomes and difficult access in health services			
	Increase of diseases of the respiratory system for people with problematic diet or nutrient deficiency, low incomes and difficult access in health services			

4.1.6 Landslides

A vulnerability analysis with regard to landslides was not compiled for the city of Patras. Nevertheless, qualitative analysis showed that the combination of increased probability for forest fires and floods will make the mountainous areas around Patras highly vulnerable to landslides in the following decades.

4.1.7 Tourism

Using the LIFE ACT project methodology, a detailed analysis of the vulnerability of the city of Patras to the climate change impact with regard to the tourism sector was performed previously LIFE ACT project. The analysis resulted in the following vulnerability ratings for specific impact indicators.

VULNERABILITY RATINGS				
High vulnerability	Medium-High Vulnerability	Medium Vulnerability	Medium-Low Vulnerability	Low Vulnerability
Impact	Impact	Impact	Impact	Impact
				Change in tourists arrivals pattern
		Resources' shortages		

VULNERABILITY RATINGS				
High vulnerability	**Medium-High Vulnerability**	**Medium Vulnerability**	**Medium-Low Vulnerability**	**Low Vulnerability**
Impact	**Impact**	**Impact**	**Impact**	**Impact**
		Damages in tourism infrastructure		
			Damage in cultural heritage	
		Impacts of extreme weather events		
		Changes in flora, fauna and landscape		
		Changes in agriculture and forestry		
	Health problems			

4.2 Current and potential impacts resulting from climate change

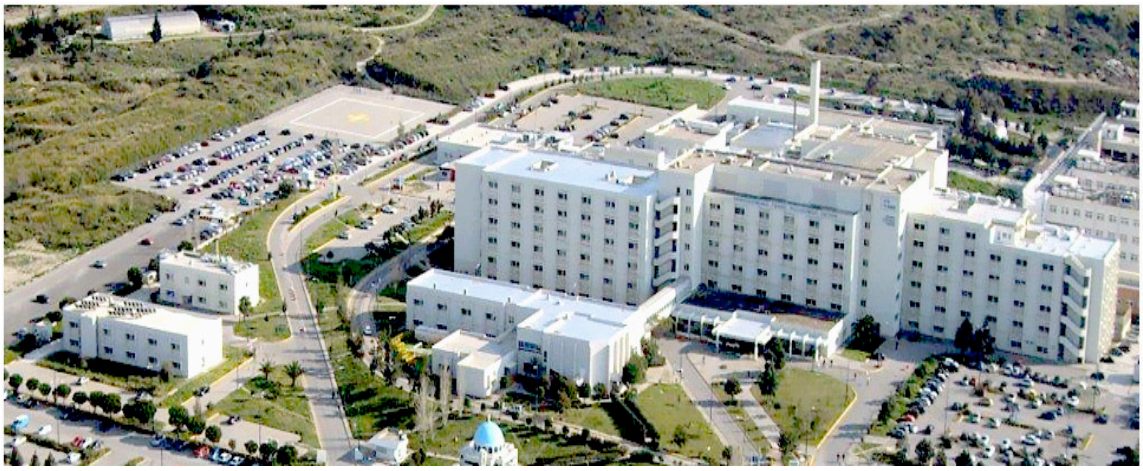
During the ACT project, impact of climate change on nine (9) areas was studied for the region of Patras:

1. Health
2. Tourism
3. Cultural heritage
4. Desertification
5. Fisheries
6. Landslides
7. 7. Coastal Zones
8. Biodiversity and Forests
9. Water availability and quality

Conclusions on these six areas were drawn in order to provide input to the Local Adaptation Board on the actions that should be taken in order for the city of Patras to adapt to the climate change impacts.

4.2.1 Health

A detailed analysis of the vulnerability of the city of Patras to the climate change impact with regard to the health of its population was performed in previous actions of LIFE ACT project.



Picture: The University Hospital of Patras

The analysis resulted in the following vulnerability ratings for specific impact indicators.

High vulnerability	Medium-High Vulnerability	Medium Vulnerability	Medium-Low Vulnerability	Low Vulnerability
	Increase of the number of Deaths in elderly people			
		Increase of the number of Deaths of children		
	Increase of diseases of the circulatory system for people with chronic health problems			
		Increase of diseases of the respiratory system for people with chronic health problems		
	Increase of diseases of the circulatory system for people with problematic diet or nutrient deficiency, low incomes and difficult access in health services			
	Increase of diseases of the respiratory system for people with problematic diet or nutrient deficiency, low incomes and difficult access in health services			

4.2.2 Tourism

As suggested also in the recent EU PESETA project (http://peseta.jrc.ec.europa.eu/), ISPRA used the Tourism Climate Index (TCI) developed by Mieczkowski (1985) in order to assess the potentially occurring climate impact for tourism in Patras. The TCI has been calculated for the year 2000 (baseline) and the periods 2046-2065 and 2081-2100.

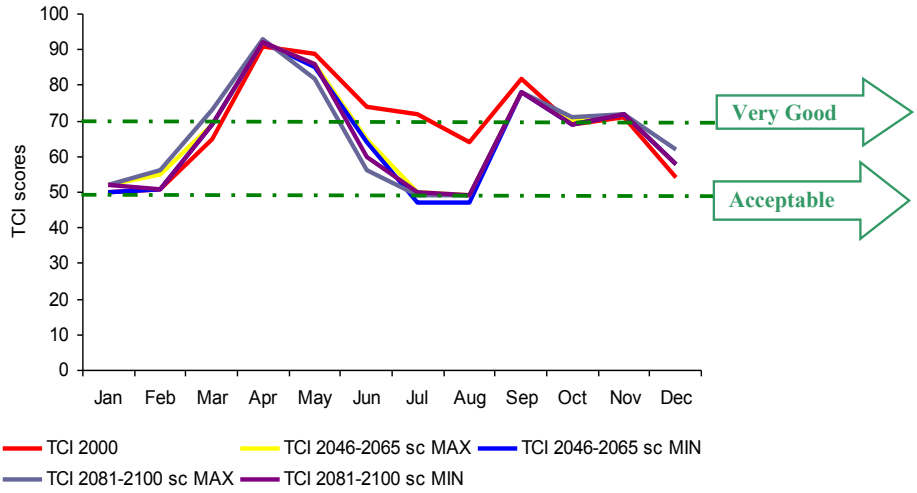


Figure 11: Comparison of TCI scores in baseline year and in future scenarios (2046-2065 and 2081-2100)

Afterwards, the Hamburg Tourism Model (HTM) was used to assess the impact on tourist demand in Patras, being aware of the TCI outputs that put in evidence how tourism might partially depend on temperature change.

Picture: the Tourist port in Patras

A minimum and a maximum scenario have been considered for each emission scenario just taking into account the minimum and maximum value of temperature. As far as A1B scenario is concerned, change in percentage of tourists in Greece and Patras (% variation with - without climate change) at 2100

Minimum scenario

GREECE	**-23,43**
Patras (Achaia)	**-19,77**
Rest of GREECE	**-23,48**

Maximum scenario

GREECE	**-23,43**
Patras (Achaia)	**-11,48**
Rest of GREECE	**-23,61**

As far as B1 scenario is concerned, change in percentage of tourists in Greece and Patras (% variation with - without climate change) at 2100

Maximum value downscaling

GREECE	**-18,12**
Patras (Achaia)	**-12,51**
Rest of GREECE	**-18,21**

Minimum value downscaling

GREECE	**-18,12**
Patras (Achaia)	**-11,36**
Rest of GREECE	**-18,23**

As far as A2 scenario is concerned change in percentage of tourists in Greece and Patras (% variation with - without climate change) at 2100

Minimum scenario

GREECE	**-24,34**
Patras (Achaia)	**-17,51**
Rest of GREECE	**-24,45**

Maximum scenario

GREECE	**-24,34**
Patras (Achaia)	**-6,43**
Rest of GREECE	**-24,62**

As it is evident from each simulation in the different scenarios analyzed, tourists arrivals are intended to decrease in 2100 in all the Greece and this general reduction will be partially allocated to Patras area depending on the differential between the mean temperature of the country and the mean value in Patras. The larger the differential will be (with the mean temperature in Greece higher than the one in Patras), the less the decrease in arrivals will be in Patras with respect to the rest of Greece.

A detailed analysis of the vulnerability of the city of Patras to the climate change impact with regard to the tourism development was performed in previous actions of LIFE ACT project. The analysis resulted in the following vulnerability ratings for specific impact indicators.

High vulnerability	Medium-High Vulnerability	Medium Vulnerability	Medium-Low Vulnerability	Low Vulnerability
				Change in tourists arrivals pattern
		Resources' shortages		
		Damages in tourism infrastructure		
			Damage in cultural heritage	
		Impacts of extreme weather events		
		Changes in flora, fauna and landscape		
		Changes in agriculture and forestry		
	Health problems			

4.2.3 Cultural heritage

According to the ISPRA Assessment of Climate Change Impacts, the damage on a monument is due to the climatic and environmental conditions of the area where the asset is placed (territorial danger). Taking into consideration the climate projections of the project, both the Lipfert formula and the MULTIASSESS dose-response function on the surface recession / loss of material result in a decreased loss of material from the cultural assets due to the decrease of precipitation. Also, loss of material for metals is decreased since, according to the MULTIASSESS dose-response functions, both the increase in the mean air temperature and the reduction in the annual cumulated precipitation result in a decreased rate of material loss. For all cases, concentration of pollutants in the atmosphere has been considered as constant in the period up to 2100.

Installation of a network of air quality stations across Patras can help in the better evaluation of the territorial danger in the future.

Picture: The Ancient Roman Odeon of Patras

Currently, there is no systematic recording of the vulnerability parameters for the monuments and sites in the city of Patras, mainly due to the large number of institutions that are in charge for the maintenance of public buildings, monuments and sites. Moreover, there is no established frame for the recording of the condition of privately owned buildings are (mainly listed buildings).

Following the previous paragraph, a precise calculation of the risk for the cultural heritage of Patras could not be performed. Nevertheless, since the territorial danger is expected to decrease, territorial, individual and local risks are expected to decrease for the forthcoming period.

4.2.4 Desertification

DISMED project has evaluated the Sensitivity to Desertification Index (SDI) in the Northern Mediterranean, Greece included. The wider Patras region is assessed as having low sensitivity to desertification.

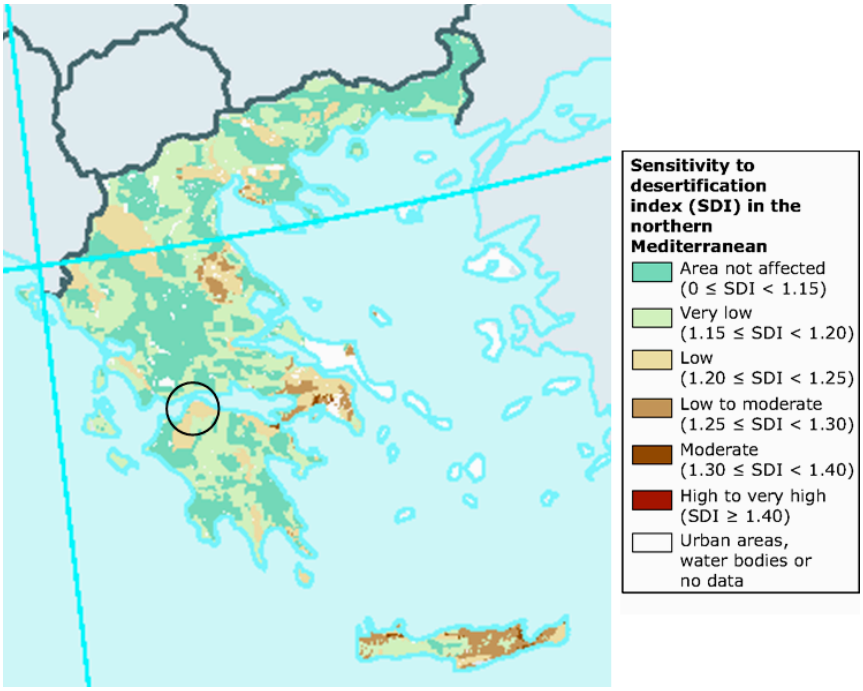


Figure 12: DISMED: SDI evaluation in Greece

Although, climate change projections suggest a hotter and drier climate for Patras in 2100, current situation in the rest of Greece (that is already experiencing this kind of climate conditions) suggests that agriculture activities can be sustained if necessary measures towards sustainability are adopted.

The main challenges against desertification are related to the management of natural resources and landscape in the wider Patras region: prevention of land abandonment, refosteration, actions to mitigate floods and landslides, sustainable development of the city suburbs and surrounding settlements, sustainable agriculture and water management.

4.2.5 Fisheries

Temperature increase of the sea water and the reduction of the atmospheric precipitation could combine with the change on the river flow and results in the ecological distortion of the river outfall in the region of Patras. Another impact of the temperature increase is the acceleration of the growth rate of the poikilotherm living aquatic resources. This impact could not be linked with a potentially increased fishing production because fishing productivity of a region is defined mostly from overfishing and less from natural factors. This theory is also strengthened by the fact that even though the sea temperature, for instance, in the Aegean Sea has risen up to 1,5^{o}C, fishing production has shown reduction. More specifically, it is estimated that for every 1^{o}C temperature increase of the sea water, a reduction of 0,8% is projected. This is mostly due to the fact that the temperature will affect the sea food quality level. Moreover, temperature rise affects fish immigration from food sources and reproduction areas. Another estimated impact of the temperature rise is the change in the sea water

and sea current (surface, internal, upstream, downstream and coastal currents) by affecting eco – production.

Picture: The Fishing dock of the city of Patras

It is commonly known that temperature increase is affecting the sea level and changes biodiversity, fishery structure by means of biological, natural, chemical and hydrological sea characteristics and the fish production economy. The sea level rise affects wetlands and the first stages of fish reproduction and causes several changes in the dish farming methods, the reproduction of fish and minor changes at several stages of fish growth and productivity.

Finally, fish farming, which is rapidly growing, has several consequences in the environment and especially in the coastal areas of the region, decreasing natural fish production and availability of fisheries.

4.2.6 Landslides

According to the all climate change scenarios, Patras is expected to suffer a reduction of precipitation in the coming decades. Furthermore, some scenarios indicate an increased probability in flood and landslide phenomena. These results are a part of several dependencies such as diversification, vegetation, land-use and anthropogenic interference. It is very important for the development on strategies for adaptation. Nevertheless, it is important to notice that Patras and the wider region have lower probability for future flood and landslide phenomena than other areas in Greece.

4.2.7 Coastal zones

Introduction

Coastal Zones change rate is one of the most important parameters on coastal erosion which reflects the total long year term impact and depends on:

- The accuracy on measurements at the coastline
- The level of the timeless change of the coastline
- The number of data
- The time internal accuracy of the data and between measurements
- The period of the data coverage
- The methods used for rate calculation

The movement of the coastline over time usually consists of a piece predictable variation that can be considered as a signal, or trend, and a short piece of change, or "noise". The long-term effects, such as rising sea levels or movement of natural sediments occur over many decades and give more predictable trends. Generally, the short term change occurs during periods from a few days to many years. This shows that both the long and the short term trend are detectable. Some scientific groups working on the coast and the phenomena observed in these long-term trends based on changing coastlines to draw conclusions regarding the management of coastal areas, while others are based on relatively short-term trends.

The coastline changes depend on various physical factors such as the waves, the tides, the change in sea level, the change on the sediment, the geological background of the region, climate, runoff due to rainfall and biological indicators. However, there are also other factors that change the character of the coastline such as construction works in the coastal zone such as harbors, jetties, wharves, breakwaters and dams nearby rivers, etc.

The following table shows the time and spatial change scale for the above mentioned changes:

Table: Physical changes of the coastline in relation with the time-space scale

Scale (time – spatial)	Physical causes
Centuries or thousand years More that 100Km changes	• Sentiment availability • Relative sea level change • Vertical movements at the bottom • Geological surface • Geological scale climate changes
Decades to centuries 10 to 100Km	• Relative sea level change • «Waves of sand" • Local Climate Change

	• Extreme weather events
1 to 10 yr 1 to 5 Km	• Climate change wave • Change in the ramp area wave • Extreme weather events
Hours to 1 year Up to 1Km	• Waves, tides and storms • Seasonal climate changes

Table: Anthropogenic causes of coastline changes in relation to time-space scale

Scale (time – spatial)	Physical causes
Centuries or thousand years More that 100Km changes	• Climate change caused by human activities • Change in runoff of large rivers (dams) • Large coastal structures • Reform of the coastal zone in a large scale • Coastal zone management, a range of technical projects
Decades to centuries 10 to 100Km	• Change in drainage basins (dams etc.) • Coastal engineering works • Reform of the coastal zone • Coastal (non) management • Over-exploitation of natural resources
1 to 10 yr 1 to 5 Km	• Wave Construction zone • Sand Feedback at the coastal areas

Table: Natural causes erosion or sedimentation of the coastline and the relative time scale

Natural Cause	Result	Time Scale
Beach sediments	Erosion / sediment	Centuries to millennia
Sea level rise	Erosion	Centuries to millennia
Sea level rise	Erosion	Months to years
Storm Waves	Erosion	Hours to Days
High tides	Erosion	Hours to months
Short period waves	Erosion	Hours to months
Smooth waves	Sediment	Hours to months
Coastline steam	Erosion / no change / sediment	Hours to millennia
Breakout stream	Erosion	Hours to Days
Groundwater flow	Erosion	Hours to Days
Wave Zone	Erosion	Hours to Days
Wind	Erosion	Hours to Centuries
Sinking, compression	Erosion	Years to Millennia
Tectonic sinking	Erosion / sediment	Minute or Centuries to Millennia

Observations since 1961 show that the oceans absorb more than 80% of the heat added to the climate system. The increase in temperature causes expansion of seawater contributing to rising sea levels.

According to the 4th Assessment Report of the IPCC that presented in 2007, coast are expected to be exposed to increasing risks, including coastal erosion, due to climate change and rising sea levels.

Climate change can be enhanced by the threatening severe weather events (storms, big waves, tsunami) but also affect long-term bio-geophysical effects such as rising sea levels, erosion of the coastline, lack of sediment, the saltwater intrusion into coastal aquifers, and loss of coastal wetlands.

The average rise in global sea level increased at an average of 1.8 (1.3 to 2.3) mm per year from 1961 to 2003. The rate was faster over the period 1993 – 2003, about 3.1 (2.4 - 3.8) mm per year. It is evident that sea level increase rate is higher in the 20th century than the 19th century. The overall increase in the 20th century is estimated at 0,17 (0,12 - 0,22) m.

Impact

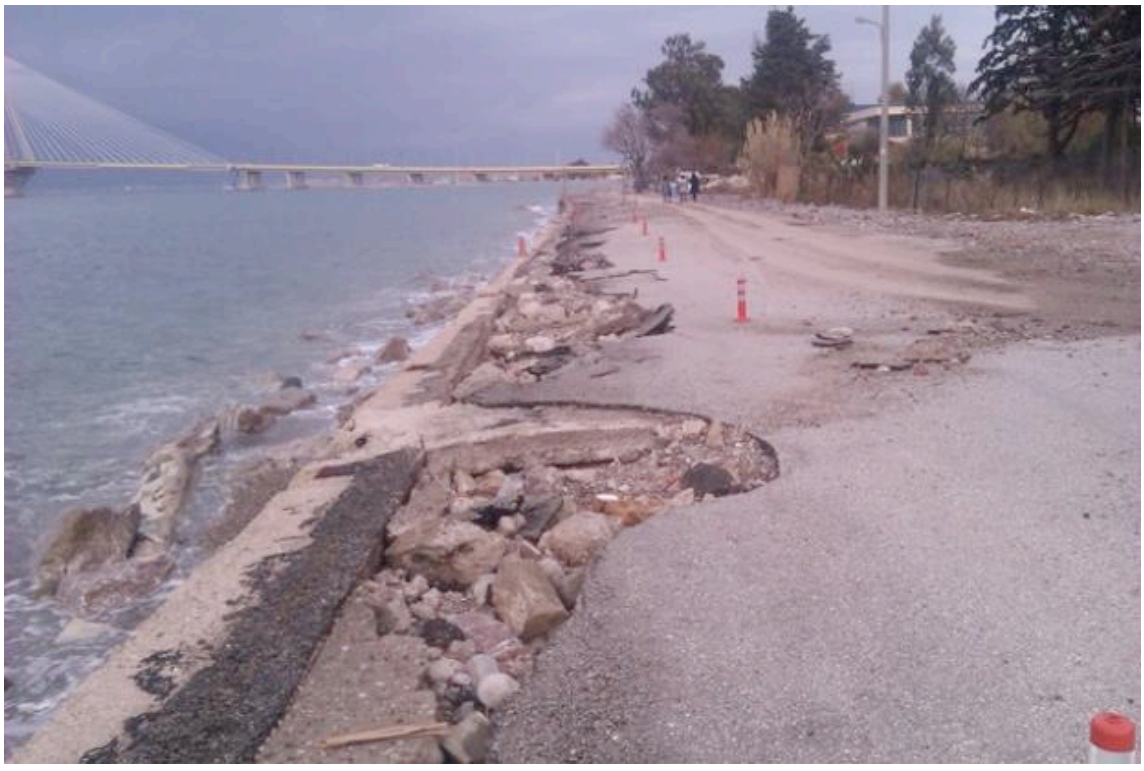
Rio coastline

The coastline of Rio is already facing significant corrosion problems created because of technical projects in the past, namely due to the construction of the New National Road Patras-Corinth and the pier before the hotel Porto Rio. The retaining walls don't actually solve the problem as the minimisation of the coastline doesn't decrease the wave energy causing significant damages to the coastline road. Two major storms in 1999 and 2008, severely damaged parts of the coastal road that made these parts inaccessible to cars. With the expected result of climate change increasing sea levels and extreme weather phenomena, may occur a number of potential impacts include:

- Roads. Throughout the length of the coastal road is vulnerable due to the fact that it was built on debris of the beach and the retaining wall was built from beach material without proper foundation. Already some parts of the coastal network is severely damaged and closed. Without any security measures, the coastal road damages will continue and possibly be expanded to other parts.
- Tourism. The coastline of Rio hosts three (3) major resorts in the area, the Porto Rio Hotel, the Rion Beach Hotel and Achaia Beach Hotel. All three are within a few dozen meters from the sea. Consequently, there is an imminent risk of destruction of tourist infrastructure in conditions of severe weather phenomena or the gradual rise in sea level. A possible destruction of

infrastructure would be a major blow to the tourism economy of the region which anyway has a strong seasonal characteristics showing significant movement, especially during the summer months.

- Private and Public Properties. A significant number of properties (houses and dining centres) located a short distance from the coastline and a small amount of the surface of the sea. Mostly on long-term period, there is a possibility that these areas will face wave energy problems resulting on downgrading the properties.
- Population. Significant number of people living and working close to the coastline. Also significant is the number of people using the area of shoreline for recreation (swimming in the sea, fishing, walking). The impacts of climate change will increase the risk of exposure of this population to severe weather conditions and as a result people are deprived of the possibility of giving the shoreline for recreation.
- Economy Damage to roads and the municipal electric grid caused by the waves create a significant cost to the budget of the municipality. Without adequate adaptation measures such deterioration will continue and likely to become even bigger by increasing the financial cost recovery.



Picture: Coastal erosion in Rio coastline

Coastline Monodendri - Vrachneika - Tsoukaleika

The coastline Monodendri - Vrachneika - Tsoukaleika faces serious problems of erosion, overloaded from illegal poorly designed construction. The risks of a potential sea levels rise are important:

- Roads. Significant parts of the road network of the coastline have been carved into contact with the sea. The protective structures that are placed (vertical wall, boulders) enhance the erosion problem. Due to the fact that wave energy don't decreases gradually but more violent onto the vertical walls, the road receives significant amounts of seawater and has suffered significant damage in some places. In other places, the seaside road is undermined and the danger of collapsing is clear. Rising sea levels and extreme weather events may cast the road assessable.
- Tourism. Near the coast there are rooms and rent areas which meet the needs of the tourist area. The accommodations are based on distance from the sea which is more or less likely to flood and suffer serious damage. In conjunction with the gradual loss of beach, the impact of climate change on tourism in the region is expected to be significant. There is a considerable number of small enterprises (e.g. shops) catering which although not rely solely on tourism will be affected.
- Private and Public Properties. A significant number of properties (houses and dining centres) located a short distance from the shoreline and a small amount of the surface of the sea. With current circumstances in cases of intense weather these properties experiencing water flooding. With further change of the coastline the risk of disasters will increase. This risk also downgrades the property value in the area.
- Population. Significant number of people living and working close to the coastline. Also significant number of people using the area of shoreline for recreation (swimming in the sea, fishing, walking). The impacts of climate change will increase the risk of exposure of this population to severe weather and as a result there will be deprived of the possibility of giving the shoreline for recreation.
- Economy. Damage to roads and the municipal electric grid caused by the waves create a significant cost to the budget of the municipality. Without adequate adaptation measures such deterioration will continue and likely to become even bigger by increasing the financial cost.

Conclusion

The parts of the coastline of the Municipality of Patras examined in this study faced significant corrosion problems which are caused by human interventions during the last 30 years. Climate change together with the severe weather phenomena and bio-geophysical impacts are expected to result in significant additional impact. The Municipality of Patras should take adaptation measures to protect the people, property (municipal and private) and the economy region.

4.2.8 Biodiversity and Forests

Introduction

The 4th Assessment Report of the IPCC, the Millennium Ecosystem Assessment, the UNEP-World Conservation Monitoring Centre and similar authorities concur that climate change is likely to become the greatest threat to global biodiversity in the course of the 21st century. As global mean annual temperature rises towards a critical threshold of 2 degrees Celsius above pre-industrial levels, the structure and function of both terrestrial and marine ecosystems will experience substantial changes, and plant and animal species will be exposed to increasing extinction risks.

Looking at Europe in particular, climate related hazards and water stress will mostly increase, and that regional differences of Europe's natural resources and assets will get magnified. They also considered the effects of climate change on the physiology, phenology and distribution of plant and animal species, and concluded that natural ecosystems and biodiversity will be substantially affected, with many species expected to have difficulties in adapting. Climate change has the potential, over a period of a few decades, to undermine our efforts relating to the conservation and sustainable use of biodiversity.

The area with biodiversity interest in Patras is the Mountain Panachaikon. The study area is located in the north-western part of the Peloponnese. Administratively, the area belongs entirely to the Prefecture of Achaia and falls within the administrative boundaries of the Municipalities of Patras, Erymanthos, and the Community of Leontio. To a large extent the area is a Natura 2000 site with the code name "Mountain Panachaikon" with the code GR 2320007. This area includes a wealth of important environmental elements such as forest areas, rivers streams and wetlands. The area includes a wealth of important environmental elements such as forest areas, rivers streams and wetlands.

The study area includes the mountain of Panachaikon, especially the land included within the Natura 2000 area code GR2320007, Panachaikon Mountain, about 125,000 acres of land and a small external area towards downstream, so the total area is 191,200 acres.

Pasturing is the dominant land use in the area of Panachaikon mountain as take up approximately 118 km^2, a percentage of 56,5% of the total area. This is followed by forest areas of 38 km^2 (percentage of 19,6%) and agricultural land of 33 km^2 (percentage of 17,4%). The settlements, roads etc occupy 0,7 km^2, and 2 km^2 are covered by water.

In general the vegetation of the Panachaikon Mountain is downgraded because of the over pasturing in the highest altitudes and because of the repeated fires in the lower

altitudes. The forests of deciduous oaks and holm have been downgraded to prinones, while some spots are maintained only in small areas. The forests of Aleppo pine that in the past occupied significant areas in the lowlands of Panachaikon today have been downgraded into Mediterranean shrublands because of the repeated fires, with only sporadic appearance of Aleppo pine. Toast ecosystems that are downgraded forms of forest vegetation occupy significant areas in Panachaikon. Fir forests do not form a continuous zone but consist of discontinuous, scattered spots, usually sparse and degraded.

GR 2320007

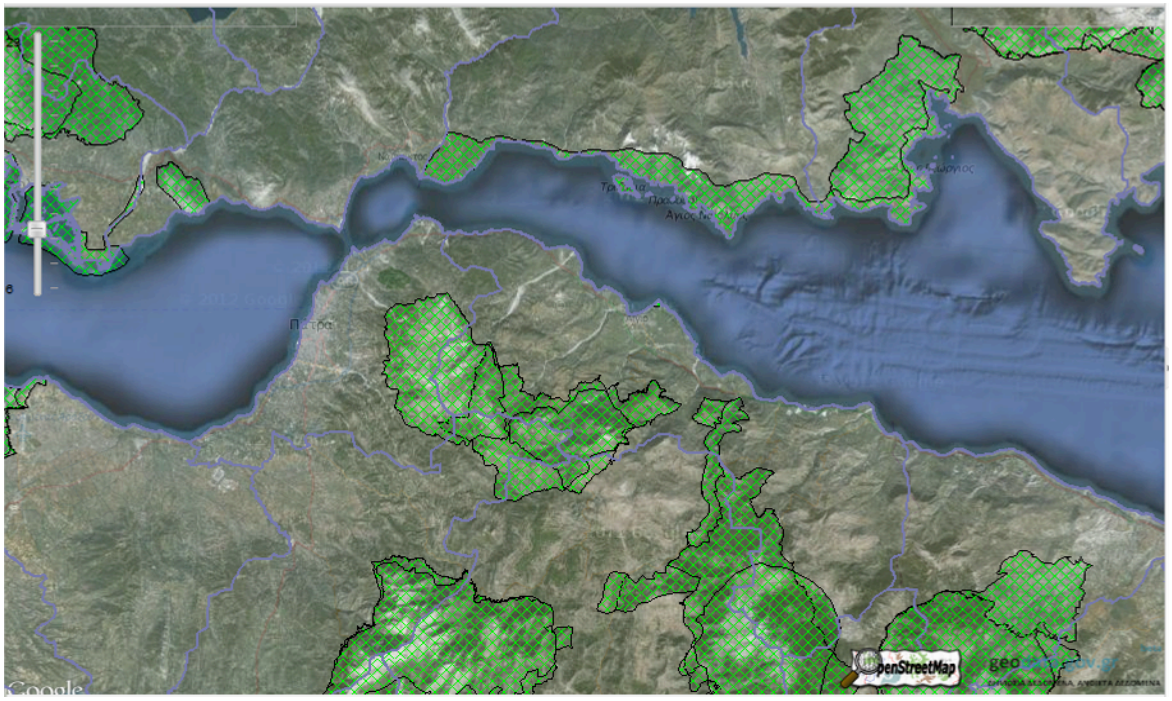


Figure 13: Natura 2000 site No. GR 2320007 of Mountain Panachaikon (source: geodata.gov.gr)

The situation is relatively better in the south and south-east areas where the fir forests are more extensive and continuous and present a better ecological situation. But even in these areas the situation is not the best. In the highest altitudes the fir forests have been degraded towards communities with Juniperus oxycedrus in the steepest slopes and communities with Crataegus heldreichii in the milder slopes.

The degradation of the fir forests has resulted in great spread of steppic prairie that occupies a significant extent in the area. The steppic prairie is in a quite good ecological situation, accommodate a large number of endemic and other interesting species and characterize the high peaks over 1.500 meters. The shaven fields also occupy a relatively large extent on milder slopes and deeper soils of peaks at 1500 meters and above.

Picture: The forest of Thana in Panachaiko Mountain.

The ecotopes that are present in the area are briefly the following:

- Forest Ecotopes
- Abies cephalonica forests
- Communities with Quercus coccifera
- Forests of Quercetum frainetto
- Oak forests
- Aleppo pines
- Black pine forest
- Forests with Platanus orientalis
- Communities with Crataegus heldreichii
- Communities with Juniperus oxycedrus
- Garrigue
- Brushwood
- Communities of steppic meadows
- Communities of subalpine shaved meadows
- Chasmophytic communities of limestone rocks
- Phytocommunities of sarres
- Rush communities
- Galleries with Salix alba
- Reeds with Typha angustifolia
- Eutrophic natural lakes
- Oligotrophic watercourses subalpine regions
- Agricultural crops and abandoned farmland

In Panachaikon Mountain there have been recorded 568 species of flora, known either by bibliography or by recent recordings of a study group, while the actual number of plant species in Panachaikon is possibly higher. A very important number of endemic, rare and protected species is growing in Panachaikon. The species *Dianthus androsaceus*, *Peucedanum achaicum*, *Gymnospermium altaicum* ssp. *odessanum* και *Ophrys argolica* are the rarest and are included in the Red Data Book.

Regarding fauna, there have been recorded 155 species of vertebrates and more specifically 8 species of amphibians, 26 species of reptiles, 96 species of birds and 24 species of mammals. In the rivers of Selinounda, Meganiti, Finika and Volinaio there are the fish species *Leuciscus cephalus* and *Barbus peloponnesius* The number of invertebrates is much higher (very possibly is more than 2000 species), but it is not easy to calculate with accuracy without many years of research. It should be noted that the number of fauna species are very big in relation to the size of the area, fact which underlines the big importance of the natural environment of Panachaikon.

Amongst the 96 bird species that have until today been recorded in Panachaikon it is worth noting the presence of the following species *Gyps fulvus, Aquila chrysaetos, Hieraaetus fasciatus, Pernis apivorus, Circaetus gallicus, Falco peregrinus*. Many more predator bird species pass by Panahaiko during the immigration period. The position of the mountain immediately after the narrowest passage between Peloponnesus and the Greek mainland makes it an important stop during the autumn migration with the presence of the species *Caprimulgus europaeus, Dendrocopos medius, Lullula arborea, Anthus campestis, Eremophila alpestris, Prunella collaris, Lanius collurio, Sylvia ruepelli, Parus lugubris*. From the 96 recorded bird species the 21 are included in Annex I of the Birds Directive. In addition 10 species are included as threatened and rare in the Red Book of Threatened Vertebrates of Greece. Finally a significant number of these 96 species are referenced in International Conventions and other official international catalogues of protected species.

One point that needs also to be mentioned is forest fires, which have contributed to the degradation of forests and forest areas of Panachaikon Mountain, especially at its lower part. It is characteristic that the forests of Pinus halepensis that used to occupy the lower heights in almost all the north side of the mountain, today occupy a very small area in form of spots.

The fires are usually present in lower altitudes, closer to the settlements, mainly in the forests of evergreen broadleaf, because of the favourable conditions, but also during the burning of stubble from the farmers often fires extent to the evergreen broadleaf area. From studies, it has been concluded that fires occur almost exclusively in the zone of evergreen broadleaf, a fact that is true for almost all the Mediterranean basin. On the contrary the occurrence of fires in the higher altitudes in Quercus cocifera, and in the south side of Panachaikon, where the settlements are less developed, is minimum and the burned area is very limited. This can be explained by the climatic

conditions, the type of vegetation and the situation regarding settlement development and land-use.

It must be noted that although in the alpine zone the danger of fire start is minimum, there is serious danger of damage from fires that start in the lower zone and spread uncontrollably. As these ecosystems (*Quercus cocifera* and black pine forests) do not have adaptation mechanisms against fire, the damage that can be caused by fires is enormous, since there is the danger of completion destruction of the forest accompanied by inability to reinstate it. This can lead to a mountain with significant areas without vegetation with uncontrollable consequences for the ecological equilibrium of the wider area of Panachaikon.

Climate change Impact Assessment on Biodiversity and on the Forests of the Natura 2000 area of Panachaikon Mountain.

Temperature

Due to the increase of temperature probably in Achaia and Patras area availability of water is a more important factor influencing forest growth. In the Mediterranean areas and hence in Mt. Panachaikon, where production is limited by low water availability, it is predicted that the growth and yield under climate change will decrease. So heat is often a stress factor. The optimum temperature for photosynthesis rarely exceeds 30^{o}C. At high temperatures photorespiration is stimulated and photosynthesis is inhibited.

Precipitation and related factors

Rising temperatures without an increase in precipitation or with decreasing precipitation can lead to drought, especially in typical Mediterranean Forests of Mt. Panachaikon (*Pinus pinea* and *Abies Cephallonica*) and temperate continental conditions. Drought conditions will reduce forest growth in sensitive species, such as *Platanus orientalis*, and *Salix alba* whereas other species such as *Quercus coccifera*, which is more tolerant of dry conditions. These influences will affect the species composition of forests. High temperatures and dry conditions can negatively influence nutrient availability in soils and lead to enhanced loss in nitrogen via accelerated nitrification. These conditions also lead to aggravated competition of tree seedlings with other vegetation. Changes in cloud cover alter the amount of incoming radiation at a site. These influences are currently not predictable, but may affect how different species compete for resources at a particular site.

Increase of forest fire incidents

According to the projections on climate change, the wider areas will suffer from increased numbers of forest fires. This is mainly due to the temperature rise and

decreased precipitation. As forest fires, have been a serious threat to Panachaikon there of forest fires incidents pose a serious threat to the area.

Picture: forest fire in Panachaiko

Effects on species distribution

Climate change is expected to affect tree species distributions. Bioclimatic envelopes (i.e. conditions, under which species grow well) will shift northwards and higher up in elevation. Competitiveness between species can change due to alterations in temperature, moisture regime, CO_2 and radiation as has been found for *Abies Cephallonica* seedlings. Changes in competitive relationships between species will be important in mixed stands and natural ecosystems and they will influence tree migration in the long term. Conifer forests of Mt. Panachaikon subject to continuing disturbance show a more rapid shift to dominance by other temperate broadleaves. The treeline is expected to move further north and upwards in the mountain regions. In the Mediterranean, socio-economic developments, drought and altered fire regimes may lead to more shrub-dominated landscapes.

Climate change and flooding risk

In the past, there was frequent occurrence of extreme flooding and landslides resulting in the destruction of forest, so in coming years extreme flooding events are expected to occur more frequently as a consequence of climate change.

The number of rain days is predicted to decrease, but the number of days with heavy rain events is predicted to increase. This change is leading to more summer droughts as well as more extreme flooding events during summer. Flooding is more harmful if it occurs during the growing season than if it occurs during the dormant season of plants. Plant responses to flooding during the growing season include injury, inhibition of seed germination, changes in plant anatomy, and promotion of early senescence and mortality. Trees are most vulnerable to the effects of flooding in late spring, just after the first flush of growth.

4.2.9 Water availability and quality

Introduction

Glafkos is the longest and most important river in the former province of Patras. The basin of Glafkos is 108,5 km2, it stems from Panachaikon and is fueled by various sources, poured on the south side of the Patras Gulf. In 1927 in the village Glafkos was built the hydroelectric plant of Glafkos for lighting of Patras. There was also constructed a dam and an artificial lake and belonged to the municipality of Patras. Since 1953 it is being operated by the Public Energy Enterprise. Today in lower Glafkos take place projects are setting its bed, with the construction of reinforced concrete walls and rebuilding the riverside road that crosses it.

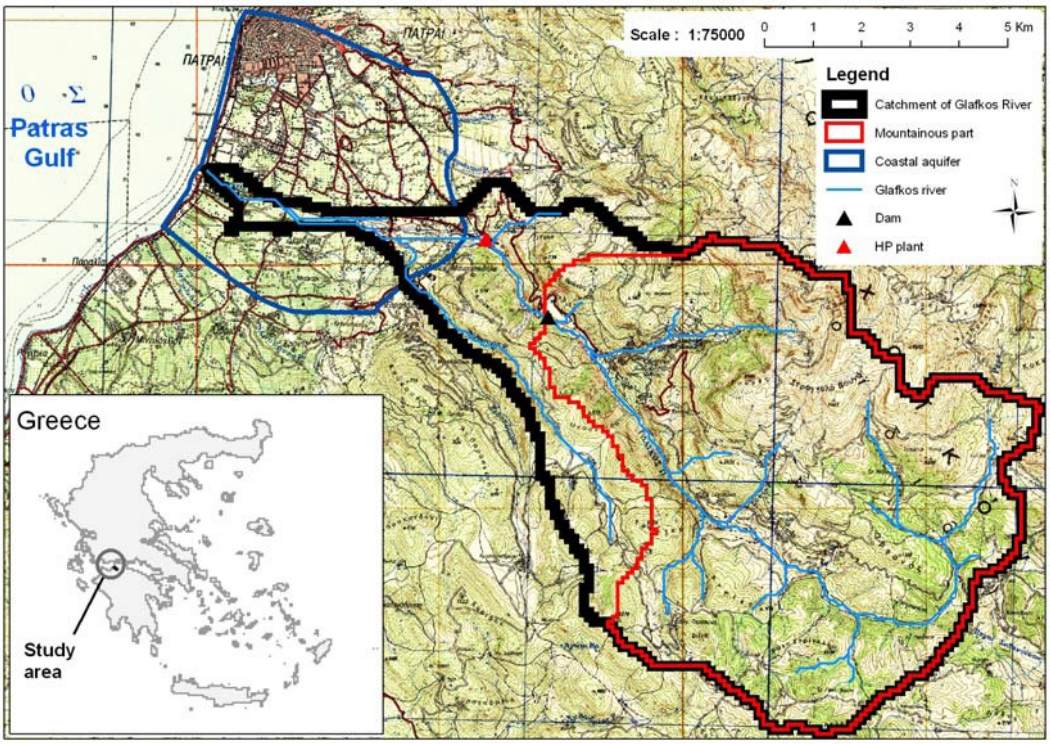


Figure 14: The catchment of Glafkos River – with highlight the mountainous part and the coastal aquifer

Picture: The Hydroelectric dam of river Glafkos

Direct climate impacts on water

University of Patras has investigated the Glafkos catchment with regard to (a) the estimation of probable changes of the water budget components due to climatic changes and (b) the assessment of probable changes in the land use and in the water quality due to climate change.

The changes of the monthly precipitation are not significant whereas the changes of the monthly temperature vary from 0 ^{o}C to 2 ^{o}C. Using a calibrated model the change of the water budget components and particularly the change of the runoff has been estimated. It has been found that this change is not significant.

Due to not significant changes of the water budget components, changes of the land use due to climatic changes and consequently changes of the water quality are not expected. Owing to the fact that changes of the water quality due to climatic changes sum with changes caused by anthropogenic activities we performed a simplified analysis in order to predict the long term development of the water quality due to such activities.

The quality of the surface water can be influenced by the agricultural activities. At present this influence seems to be not significant. Stepping-up of the agricultural activities can increase the pollution originating from them. The quality of the groundwater was investigated using the data available for 9 pumping wells of the

Municipal Enterprise of Water Supply and Sewage of Patras (DEYAP) for the period 1990 – 2002.

The investigated parameters do not show any significant trends and the mean values for the aforementioned period are for the most of the wells below the limits for the drinking water. However, the analyzed data originate from a limited area and are eventually not representative for the whole aquifer. Further, the lag of systematic monitoring for the period after 2002, does not allow evaluating the development of the groundwater quality characteristics in the last years.

Due to the fact that the expected changes of the hydrological conditions in Glafkos catchment due to climate change are small, they can not cause significant changes of the land use in the area of Glafkos aquifer. The quality of the groundwater in the future will be influenced by the anthropogenic activities. A simplified analysis shows that under the influence of the probable pollution loads the overall groundwater quality will be affected after significant periods of time. However, local changes of the groundwater quality are probable at locations, where concentrated inflows of pollutants take place. Local contaminations are particularly important, if they occur in the capture zone of pumping wells. For the protection of pumping wells near the Glafkos River, restrictions concerning the land use are required in a zone parallel to the river bank, whose minimal width is equal to the distance between the pumping wells and the river bank.

Economic evaluation of the impacts of climate change on water reserves

The Committee for the Study of Climate Change of the Bank of Greece has estimated the economic impacts of climate change on water resources in Greece based on climate scenarios - and the corresponding evolution of hydrological parameters - for the period 2010-2100. These scenarios emerged with underscaling scenarios: B1 (2.4 ° C), A1B (3.5 ° C), A2 (4.5 ° C), and B2 (3.1 ° C) corresponding to the IPCC climate zones of the Greek territory.

In this study the economic valuation of climate damage to water supplies in Western Peloponnesus takes the following approach: First, determine the future demand for water per year. The estimate of future water demand depends on permanent water needs of the population and the needs of the tourism sector. To avoid overestimation of the sizes used in each case the minimum expected consumption is used. So the quantity of 200 liters of water per day is considered as the expected average consumption per person in the resident population, while of 300 liters of water every night count for the tourism sector. Considering that these quantities are used in studies of shorter period, along with the assumption that the (expected) increase in the standard of living of the Greeks but also the quality of the supplied national tourism product lead to an increasing quantity of water consumed, we ensure a conservative estimate of the relative sizes.

2001	2050	2100
24,56 hm^3	25,81 hm^3	17,01 hm^3

Table: Actual and predicted demand of water supply in Western Peloponnesus

With the assumption that the price of water is already an underestimation of its full value, it is estimated in value-terms the costs or benefits due to changes in water demand during the periods 2041-2051 and 2091-2100:

Water Supply (€)	
$\mathbf{V_D}$ (2041-2051)	$\mathbf{V_D}$ (2091-2100)
14.486.534,70	-117.344.834,90

Table: Changes in demand of water supply in Western Peloponnesus

The negative sign in the second column refers to the decade 2091-2100 and indicates less demand compared to the base year, thus reduced costs for water supply. Reduced demand relates only to the decline of population. In the next stage, the future annual cost or benefit under the influence of climate change on water quantities offered is estimated, in terms of money:

Western Peloponnesus – Water Supply (€ prices of 2007)	
$\mathbf{V_C}$ (2041-2051)	$\mathbf{V_C}$ (2091-2100)
-76.402.111	-163.564.220

Table: Cost (or benefit) because of the change of water supply reserves due to climate change (scenario A1B)

The table shows that during the A1B scenario the water reserves are decreasing because of climate change.

Western Peloponnesus – Water Supply (€ prices of 2007)	
$\mathbf{V_C}$ (2041-2051)	$\mathbf{V_C}$(2091-2100)
-109.116.543	-272.776.695

Table: Cost (or benefit) because of the change of water supply reserves due to climate change (scenario A2)

The table shows that during the A2 scenario the water reserves are decreasing because of climate change.

Western Pelopponesus – Water Supply (€ prices of 2007)

V_C (2041-2051)	V_C (2091-2100)
-109.959.588	-244.299.007

Table: Cost (or benefit) because of the change of water supply reserves due to climate change (scenario B2)

The table shows the cost from the reduction of water resources due to climate change under scenario B2.

Having calculated the changes in demand and supply of water resources, the final stage is to calculate the net result. *Positive* figures of the estimated parameter V^t reflect total **cost** of the interaction of (reduced) demand and (reduced) supply of water reserves. In contrast, *negative* values of the parameter V^t reflect total *benefit* from the interaction of (reduced) demand and (reduced) supply water reserves. The results are presented in the following table:

	Western Peloponnesus – Water Supply (€ prices of 2007)	
	V^t (2041-2051)	**V^t (2091-2100)**
Scenario A1B	90.888.646	46.219.385
Scenario A2	123.603.078	155.431.860
Scenario B2	124.446.123	126.954.172

Table: Net Cost (or benefit) of water supply reserves due to climate change

The greatest loss is recorded in the climate scenario A2 while the smallest in the climate scenario A1B.

4.3 Identifying priority areas for action

On 12 March 2012 took place the 3rd meeting of the Local Adaptation Board of the city of Patras. In the discussion that took place it came out as a result that the criteria for the selection of the priority areas will be:

- The degree of vulnerability in relation to Patras;
- The available technical knowledge as well as the availability of related studies and data;

Based on these criteria and on the analysis of the impacts above three (3) priority areas were chosen to be the focus of the adaptation plan:

1. Coastal zone
2. Biodiversity and Forests
3. Water availability and quality

For the rest of the areas it was decided that a more qualitative approach would be used.

5 Adaptation to climate change

After the climate change impact was assessed for the city and wider region of Patras, certain proposals that should be translated into specific Local Adaptation Strategies, Plans and Measures by the Local Adaptation Board, in the near future were made.

5.1 Health

Following an analysis in previous actions of LIFE ACT project, the current adaptive capacity of city of Patras was assessed with regard to the six impact indicators related to health sector, namely:

- Increase of the number of Deaths in elderly people
- Increase of the number of Deaths of children
- Increase of diseases of the circulatory system for people with chronic health problems
- Increase of diseases of the respiratory system for people with chronic health problems
- Increase of diseases of the circulatory system for people with problematic diet or nutrient deficiency, low incomes and difficult access in health services
- Increase of diseases of the respiratory system for people with problematic diet or nutrient deficiency, low incomes and difficult access in health services

For all six impact indicators, the adaptive capacity of the city of Patras is determined by the following criteria and factors:

Indicators	Analysis
Factors determining the adaptive capacity	Availability of an early heat wave warning system
Is the system already able to accommodate changes in climate with minimal costs and disruption?	Yes with the need for financial resources
Can the health sector adjust to the projected impact with minimal cost and disruption?	No - will require significant cost and staff intervention
Barriers to the system's ability to accommodate changes in climate	Limited or no financial resources
Existing stress unrelated to climate that limit the system's ability to accommodate changes in climate	Budget cuts and reallocation of personnel related to health centers
Rate of projected climate change compared to the adaptability of the system	Faster than the adaptability of the system
Adaptive capacity	Maybe - Will require some costs and staff intervention

Local Adaptation Board and the city of Patras will work in the direction of mitigating the factors that hinder the adaptive capacity of the city and of promoting the threats to the health system posed from the climate change in order to ensure the necessary budget for the health system adaptation.

5.2 Tourism

Following an analysis in previous actions of LIFE ACT project, the current adaptive capacity of city of Patras was assessed with regard to the eight impact indicators related to tourism sector. For all six impact indicators, the adaptive capacity of the city of Patras is determined by the following criteria and factors:

Impact	Adaptation baseline (underway and planned adaptation actions, etc)	Factors determining the adaptive capacity of the system/ sector	Is the system already able to accommodate changes in climate with minimal costs and disruption?	Can the system/ sector adjust to the projected impact with minimal cost and disruption?	Barriers to the system's ability to accommodate changes in climate	Existing stress unrelated to climate that limit the system's ability to accommodate changes in climate	Rate of projected climate change compared to the adaptability of the system	Adaptive capacity
Change in tourists arrivals pattern	Many offers from foreign tourist offices offer very cheap vacations during the whole year	The touristic industry in Greece has the flexibility to adapt to seasonal changes	Yes	Yes, it's possible by making offers and low budget vacations	Mostly economic barriers	Patra has the ability to develop tourism any season of the year	The same rate of adaptability with the climate change	Yes - No to little costs and staff intervention are necessary
Resources' shortages	National plan on resource shortages	Awareness of tourists and inhabitants	No because Patra already has resource shortages such as water shortages and there is a need for high investments	Need for investments	During the economic crisis there are a lot of barriers such as economic and political	Water shortages in several regions	The rate of the projected climate change is faster that the adaptability of the system	Maybe - Will require some costs and staff intervention
Damages in tourism infrastructure	Emergency plan	Investments required. SMEs in most do not have a plan for restoring damaged facilities on time	No, due to the economic crisis there is no active system	No	Budget cuts due to economic crisis.	No previous damages	The same rate	Yes - But will require some slight costs and staff interventions
Damage in cultural heritage	Emergency Plan	Investment need.	No. there is no active system	No	Economic crisis, budget cuts.	There are no previous damages rather than regular small damages	The same rate	Maybe - Will require some costs and staff intervention
Impacts of extreme weather events	Emergency plan	Level of preparedness of the system for confronting the weather events	Maybe, there is a plan but not sufficient enough for every weather events.	No	Budget cuts and economic crisis result to personnel cuts.	There is a significant number of events occurred due to extreme weather events	Projected climate change is faster than the adaptability rate	Yes - But will require some slight costs and staff interventions

Impact	Adaptation baseline (underway and planned adaptation actions, etc)	Factors determining the adaptive capacity of the system/ sector	Is the system already able to accommodate changes in climate with minimal costs and disruption?	Can the system/ sector adjust to the projected impact with minimal cost and disruption?	Barriers to the system's ability to accommodate changes in climate	Existing stress unrelated to climate that limit the system's ability to accommodate changes in climate	Rate of projected climate change compared to the adaptability of the system	Adaptive capacity
Changes in flora, fauna and landscape	National Plans such as Natura zones, forests, etc.	Ability of the ecosystems to adapt in changes	Maybe	Maybe	Human activities near forests	Urbanisation	Faster than the adaptability of the system	AC3: Maybe - Will require some costs ($$$) and staff intervention
Changes in agriculture and forestry	National plan for agriculture	Human activities, crops resistance to extreme weather conditions	No	No	Biological, economical	Personnel cuts due to poor salaries, overtimes, etc.	Faster that the adaptability of the system	No - Will require significant costs and staff intervention
Health problems	Heat wave awareness events by the authorities	Information and awareness events	Yes	Yes, but will require some costs and personnel	Health	Increased pollution that serves the development of several illnesses	Faster that the adaptability of the system	Maybe - Will require some costs and staff intervention

Local Adaptation Board and the city of Patras will work in the direction of mitigating the factors that hinder the adaptive capacity of the city and of promoting the threats to the tourism sector posed from the climate change in order to ensure the necessary budget for the tourism sector adaptation.

5.3 Cultural heritage

In order to overcome the identified problems and adapt cultural heritage of Patras to the climate change impacts, a number of policies and strategies are recommended:

- The different public and private institutions and stakeholders related to cultural heritage will be invited to cooperate and share information in order to evaluate the vulnerability of the identified buildings, monuments and sites and calculate the risk associated to it
- As evident from all sectors, a better local monitoring of climate, environmental and pollution parameters is needed and will be established in order to calculate more precisely sustainability indicators and corresponding impacts
- Transfer of knowledge, among cities (with similar climate change challenges) as well as from public to private stakeholders within the city will enhance the adaptation potential of the city. The current LIFE-ACT project is part of this strategy for the city of Patras

5.4 Desertification

Greece ratified the United Nations' Framework Convention for Combating Desertification (UNCCD) in 1997 with Law 2468/1997. The National Committee to Combat Desertification (NCCD) was already established in 1996 and prepared a National Action Plan to Combat Desertification (NAPCD) that was adopted in 2001.

The NAPCD also provides for the establishment of several Local Committees for Combating Desertification in Greece, one in each administrative Region of the country. These Regional Committees will result in a restructuring and further invigoration of the implementation of the UNCCD and its monitoring procedures in Greece.

Moreover, the NAPCD addresses the urgent need to reverse an already occurring and visible desertification trend in 35% of the country's land as well as to prevent desertification phenomena and effects in an additional 60% of the country's area. NAPCD also includes a critical analysis and assessment of the factors and processes that control desertification pressures in Greece as well as general and sector-specific measures (agriculture, forests, livestock, wild fauna and water resources) to mitigate them. NAPCD's measures are implemented by several competent Authorities and Services at central (e.g. competent Ministries) and regional levels (e.g. Regions, Prefectures, Local Authorities).

In particular, Local Authorities may refer to the NCCD for scientific guidance and information for implementation of the NAPCD's foreseen measures financed directly from their own budgets.

In the context of UNCCD's implementation, since 2001, five National Action Programmes have been elaborated and submitted to UNCCD, with the latest submitted in 2008.

The 2001 National Action Plan described a number of certain general measures in order to prevent and mitigate desertification. These measures, which involve the whole Greek population and are related to many sectors, are:

- Determination of threatened areas
- Information and awareness of groups involved
- Establishment of agencies responsible for application and monitoring
- Land-Use planning and its implementation
- Allocation of the necessary financial resources
- International co-operation
- Selection of pilot areas
- Restoration of the affected areas
- Research
- Legal and institutional measures

City of Patras, through the work of the Local Adaptation Board, will process and localize the measures described in the National Action Plan in order to compile a local strategy to prevent and mitigate desertification in the rural and semi-rural areas that surround the city of Patras and especially the mountainous landscape of Panachaikon that is mostly threatened.

5.5 Fisheries

It will be important to record and assess all the parameters that define fisheries and the number of jobs that this sector could offer. Through this participation, collaboration and information exchange among relevant parties will also enhance dissemination of relevant strategies. Institutional arrangements and involvement of the national and regional authorities for the improvement of the legislative framework could activate or enhance fisheries by dispersing the fish production commercial capacity and the increase of resource efficiency.

5.6 Landslides

Several measures can be taken but vital data are required for the assessment of the probability and the severity of landslides in the greater area of the city of Patras, such as:

- Geological structure on the region

- Hydrogeological conditions of the region
- Geotechnical parameters
- Soil erosion and assessment of the current situation of landslides.

The Local Adaptation Board should work on the direction of identifying the local degrees of danger and taking proactive measures, using local or regional resources, in the sectors of:

- Surface drainage
- Underground drainage
- Surface slope shaping
- Grouting – chemical grout
- Retaining walls

5.7 Coastal zones

The changing coastline of Achaia

In the region of Achaia, the problem of coastal erosion is becoming more and more intense. The erosion of many areas has been going on for about 30 years, when major projects were built, but during the last decade coastal erosion has gained more publicity as in many areas the phenomenon has reached the last stage and causes damage to estates, coastal roads and infrastructure.

One of the major projects in the region during the 80's was the highway connecting Patras and Athens. Thousands of tons of sediment from the rivers of the region were used to construct bridges, retaining walls, asphalt and to make the necessary polders. Also, the same year began and reconstruction of many coastal areas, such as Aigeira, Akrata, Platanos, Diakopto, Temeni, Longos, Selianitika, Arches, etc, with many constructors getting raw materials from river beds or even the shoreline. Moreover, the construction works within the rivers (e.g. columns, bridges, dams, the settling of basins, etc) have acted and still act synergistically and make erosion worse.

Of course there are other causes which have a local effect and which are:

- Strong sand extraction from beaches and waterways upstream
- The poor design and failures of coastal structures, which lead to a variety of phenomena such as:
    - Refraction
    - Reflection waves (e.g. vertical walls next to the beach)
    - Stop stereo transmission (e.g. fishing ports, harbors, etc)
- Construction of infrastructure near the coast, such as roads (which either destroy or adversely affect the fragile dune system or reduce the length of the active beach)

- Construction of dwellings and hotels within walking distance from the coast (again affecting the balance mechanism of the beach, having reduced the effective width).

Of course the corrosion rate in all areas is not the same but is also influenced by physical factors, such as the morphology of the coast and the coast of filler.

The Rio coastline

The coast of Rio (from Rodini to Proastiou Beach) has a coastline of 16,3 Km. Practically the coast is located between the mouths of two streams, the Selemnou in the east and the west Charadros, which are the main sources of sediment in the region.

Based on aerial photographs and historical data, the main changes recorded in Rio coast between 1971 and 2008, are:

- Until 1971: The coastal zone of Rio to the west of the castle have not been altered except for those on either side of the castle for the approximation of the ferries that service the line of Rio - Antirio. The only operation performed, which continued until the construction of the Rio - Antirio Bridge was the periodic removal of sediment accumulated in the western pier ferry transported by coastal wave power from west to east. For the construction of the New National Road Patras-Corinth large quantities of sediment from all streams of the region were used. This resulted in the steep reduce of the quantity of sediment carried by streams to the coast.
- By 1979: The east pier for the ferries is formed and extended.
- 1986: This is a crucial date for the evolution of the beach. In the summer of 1986 a T-shaped pier is constructed in front of the Porto Rio Hotel, approximately 45m in length. It was a non compact work, in which unforeseen gaps (bridge) let sediments pass so that coastal diet was not disturbed. Very soon, however, because of the intensity of coastal sediment transport from west to east, these gaps were closed and the project has since operated as a compact construction.
- 1986-1997: There is intense siltation in the west side of the Porto Rio pier and coastal erosion in the east side. Erosion is very pronounced in the first 250 m, where the coast retreats very rapidly and affects the coast to 800 m east of the pier. Also, there is an expansion in the westward platforms of the western pier of the ferry that reaches a total length of about 220 m. This item would be irrelevant for the behavior and evolution of the coast of Rio, if not associated with the ongoing dredging and material removal to maintain the useful depth before the platforms.
- 1997-2008: After the fierce appearance of beach erosion problems, the then Community of Rio, in response to the undermining of the coastal road,

proceeded at different times in construction of retaining walls. The result was to strip the beach sediments from what was left due to the reflection of the incident wave in the front wall and entrainment of any material there in front of them. These constructed walls adequately protected the coastal road at some length, but gradually they suffered from extended undercuts and were finally destroyed in some parts

Current state of the coastline

As mentioned in the previous paragraph, after the construction of the pier in front of Porto Rio, the coast of Rio has practically divided into two sections. In the section that spans from Megalou Alexandrou Street to Porto Rio Hotel, strongest erosion problems, undercut coastal structures (walls) and total destruction of parts of the coastal road are observed. Instead, west of Porto Rio Hotel, there is extensive deposition zone and the observed erosion is of low intensity, and close to Achaia Beach Hotel the coast is stabilized.

The Monodendri – Vrachneika – Tsoukaleika coastline

This coastline is a set of coasts, about 5.7 km long, starting with the beach Roiitikon and converge on the western end of the beach of Tsoukaleika, that have similar morphology, almost identical orientation, and thus subject to a similar wave climate.

Overall, in all parts of the integrated coastline area, there are serious problems of coast erosion, with the situation getting worse due to illegal or botched coastal structures, and the apparent lack of central planning of the coastal zone. Thus, there is an imminent danger for the properties, but also for the region's touristic development.

Analysis of the current state with the use of mathematical models

A coast engineering study was performed using mathematical models (computational tool used in MIKE 21 of the Institute of Hydraulics Denmark CHI). According to the analysis of the current situation the following conclusions were reached:

- The area is particularly exposed to the waves coming from North and West direction, particularly not in the eastern (beach Monodendri), in which the incidence of the wave is almost vertical
- In the eastern part of the coast (beach Monodendri) tendencies for bulk corrosion, alternating with small local regions with a tendency for sedimentation are observed
- In Vrachneika beach, there is the tendency for corrosion in the east, and a tendency for sedimentation for approximately 400m in length in the west.
- In the intermediate section between Vrachneika and Tsoukaleika, a strong tendency for corrosion is observed.

- In the central part of the beach Tsoukaleika alternating tendencies for erosion and sedimentation are observed.
- In the western part of the beach Tsoukaleika there is a strong tendency for corrosion.

Adaptation measures

Coastline of Rio

For the Rio coastline the suggested measures are the following:

- The part of the coastline from the Porto Rio until the Rio Beach Hotel, a 430m front is suggested to construct a slope protection wall of the coastal road. This part has suffered the largest scale impacts from the coastline diet due to the Porto Rio harbor. This should protect the road and re-establish the road connection. The slope protection wall will be build by concrete. For the wall protection against the waves, a slope protection from rock falls and natural stone blocks.
- The part from Rio Beach hotel until the Megalou Alexandrou Street, in a from of 300m, the suggestion is to construct a slope protection wall of the coastal road, similar to the above mentioned and additionally the gravel spreading in front of the slope protection wall, in order to create a “artificial beach” for the visitors in the area.
- To support the “artificial beach”, taking into account the steep slope of the bottom of this coast, it is suggested to construct a reef terrace.

Coastline of Monodendri - Vrachneika - Tsoukaleika

- It is suggested to construct 3 works for protecting the region of Rogitica – Monodendri, Hatziina and the region between Vrachneika and Monodendri_(in the middle of the Vrachneika beach), a front with 970m, 750m and 110m length. The scope of this work is to reduce the wave energy nearby the coastline
- Overall, it is suggested to construct 24 freeboard breakwaters and 7 lateral projections. The total budget of these works is estimated at 5.914.300€ and includes excavations in the bottom, strengthening with natural boulders and rock fall protection measures

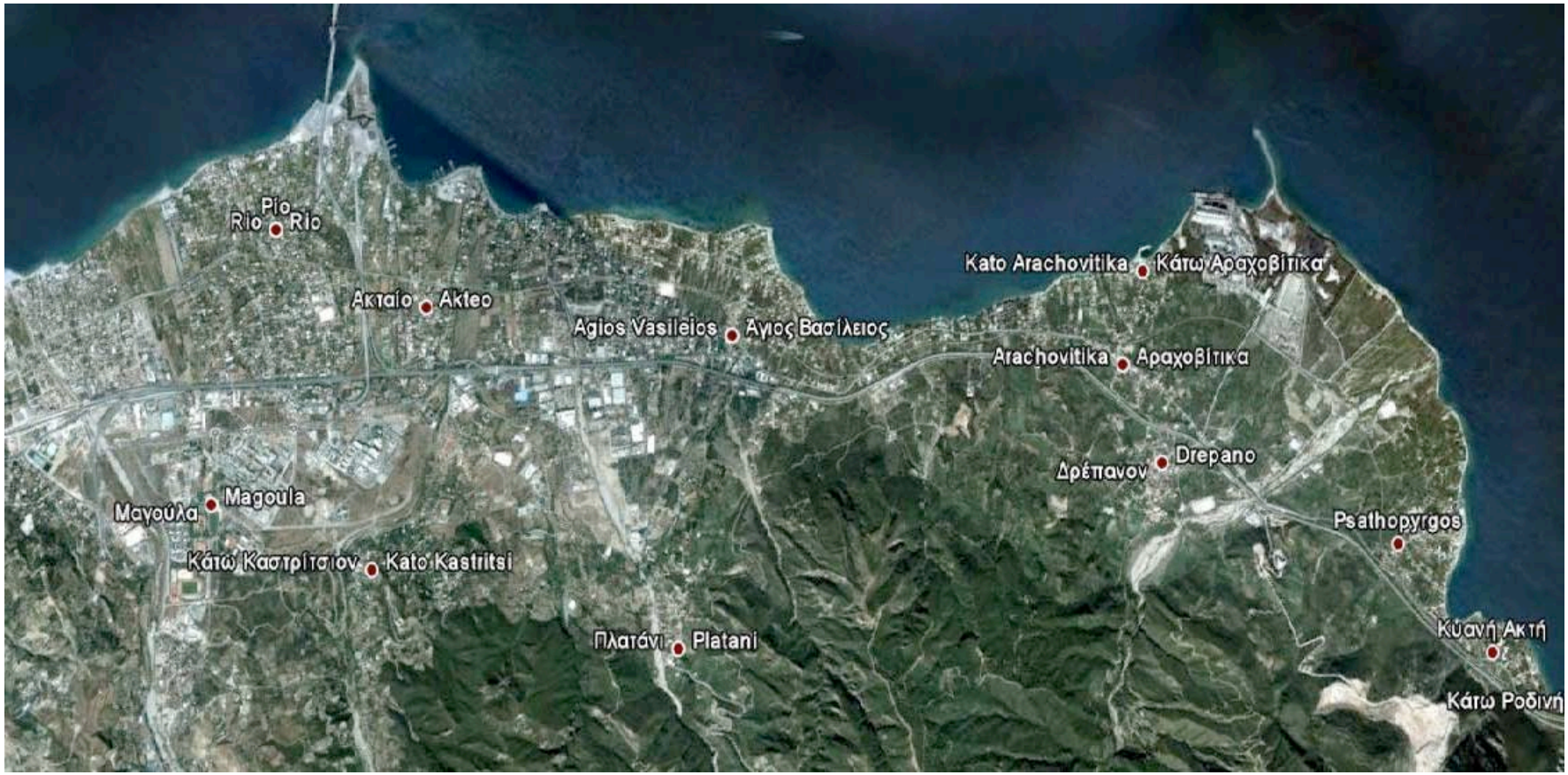


Figure 15: Satellite image of the coastline between Rio and Rodini

5.8 Biodiversity and Forests

As climate change is expected to increase the number of forest fire incid pose a serious threat to the Panachaikon Mountain, specific attention is giv fire prevention and protection.

The plan for fire protection in the area of Mt. Panachaikon has as main o effective protection of the forests and woodlands of Panachaikon, but at the to protect human life and health, infrastructure and properties. The measure been chosen seek to:

1. Improve prevention so as to reduce the number of forest fires in minimize the losses.
2. Enhance effectiveness of extinguishing forest fires.

Specific objectives to be achieved are:

- Increased self-insurance against forest fires by forestry operation pruning, gaping vegetation, additional plantings).
- Comprehensive monitoring of forests and woodlands (fire observat surveillance patrols).
- Better use of staff and resources available for fire protection.
- Easiest access of fire trucks (maintenance and improvement of fores
- Reducing the time between initial attack and suppression of (increase in the number of fire engines and proper dispersion thereof
- Reducing travel time for fire trucks to supply water (greater number c
- Better information and awareness on fire safety issues and the prote natural environment.

Prevention measures

The proposed measures in order to achieve the above-mentioned obje mitigate the impact of forest fires as a consequence of climate changes are

- The manipulation of vegetation
- The development of appropriate infrastructure for fire protection
- The better organization of fire protection

Forest fire prevention measures include the development of all those actic essential to strengthen the self-insurance of forests against forest fires and risk of fires initiation and expansion. At the same time they contribute to t extinguishment of incidents that will inevitably occur.

The measures can be divided in three main axes:

Vegetation Management

- Cleaning and spacing of vegetation, in the protection zones of forests-settlements mixed areas around villages.
- Cleaning works, pruning, logging of vegetation and creation of forest fire protection zones in high risk areas
- Cleaning works, pruning, logging of vegetation and creation of forest fire protection zones in the regions of Aleppo pine forests
- Additional plantings, mainly with broadleaves species in areas where attempts of reforestation have been damages or failed, as well in both sides of existing roads. of past reforestation
- Reforestation with broadleaved species in existing gaps in the forest, especially in the high-risk areas.
- Maintenance works in existing fire protection zones in high risk areas
- Cleaning works along the lines of the existing power distribution network

Improvement of infrastructure

- Maintenance works of major access roads that play a vital role for fire protection zones
- Improvement works on roads or sections of forest road network, especially in high risk areas.
- Planning and opening of new forest roads in high risk areas.
- Placement of notice boards in high traffic roads going through high risk areas and in intersections of basic forest roads.
- Construction of fire observatories, after analysis and evaluation of the visibility of alternative positions.
- Construction of water tanks for fire protection, after analysis and evaluation of the spatial distribution and the characteristics of the existing network of water abstraction.
- Installation of new fire hydrants, after analysis and evaluation of the spatial distribution and the characteristics of the existing network of water abstraction

Raising awareness of the public

- Organization of events on fire protection measures of buildings and infrastructures
- Meetings - information seminars and familiarization of the Fire Department staff on the specific condition and characteristics of the regios

- Meetings - seminars for the training of volunteers on the use of fire prevention and extinguish tools that are available.
- Information meetings of the administrative staff of the Municipalities for the needs of development of evacuation plans
- Development of evacuation plans for each municipality

Enhance the effectiveness of extinguishing forest fires

Measures to improve the efficiency of extinguishing forest fires should have two main objectives:

- Reduce the time for initial attack suppression of a forest fire, which is crucial for the effectiveness of extinguishing a fire.
- Increase the utilization of staff and resources available for fire protection so as to create the right conditions to extinguish a fire with the least possible damage.

The achievement of these goals requires:

- appropriate organization of fire stations
- sufficient and adequately trained staff
- appropriate equipment and resources needed for extinguishing
- modern organization of the telecommunications network detailed action plans

Most of these goals fall in the jurisdiction of the Fire Brigade but the following general measures but can help improve the efficiency of extinguishing fires:

1. Development of a network with constant communication between the stakeholders: i.e., Fire Service, Forest Service, municipalities in the region, volunteer organizations, etc., especially during fire season
2. Dissemination of all available information, including the results of studies, fire risk maps, etc
3. Initiatives implementation of the proposed measures to improve fire protection in the area of all the stakeholders

There are also a number of measures to that can help in the mitigation of the need for fire extinguishing services:

- Increase the number of patrols in the wider Panachaikon area, especially in seasons of high forest fire risk
- Build two new fire lookout stations in the east and north east of Panachaikon mountain
- Improve the training of the volunteers and local patrol teams

- Improve cooperation between the various stakeholders (Fire Service, Forest services, etc) in the area
- Improve communication and early warning equipment that is used in the fire protection and extinguishing operations

Improving awareness and training of the public

One of the most important measures to prevent the problem of forest fires is the development of a conscious ecological behavior and the creation of the need to protect forests and the natural environment to the citizens.

The achievement of this goal is possible in the long term, through appropriate environmental education and information at multiple levels, with the aim to create and activate a friendly behaviour of the citizen towards the forest and the wider environment and will manifest the need to protect forest not only from forest fires and other causes of destruction or degradation.

This can be achieved by constantly informing the citizens on the multiple values and functions of the forest (water, safety, aesthetics, recreation), and the realization of benefits from forests, thus creating the need for their protection.

There are also a number of activities and information activities that can contribute to a behavior that is friendly to the forest:

- ✓ Installation of informational signs and signals at selected points at the entrances and exits of settlements at various intersections, concentrated in places where the public (recreational sites), etc., which would indicate to visitors the risk of fire and the need to preserve forest
- ✓ Promotion of school programs, environmental education and environmental protection, and environmental education especially at school, can contribute decisively to raise awareness of society. In the last decades successfully implemented many programs environmental education in primary and secondary education, while legislation in 1990 that environmental education was recognized as part of the programs of the schools
- ✓ Creation and distributing brochures on specific values of the forest to prevent forest fires and the need to protect, as well as the adverse effects of fire on forest ecosystems, and the appropriate responses of residents in the event of a forest fire as safe escape, participation in the first surgery to deal with fire
- ✓ Events with presentations of disasters of the great fires of 2007 and organizing debates on public awareness in protecting the natural environment and in particular the protection of the forests. Events can be held in cooperation with environmental organizations, mountaineering clubs in the region, etc

- ✓ Information (eg announcement of the news) for the period when the risk of fire is high and therefore requires special attention to activities that lead to increased risk of fires
- ✓ Communication from the news for days not allowed lighting fire near wooded areas, even in rural areas, such as stubble burning, dry grass etc
- ✓ Communication of a fire danger index related to fire in forests and woodlands, while communicating the weather forecast for the periods of very high fire danger index
- ✓ Informing of citizens whose homes or other structures are built near or in forest and woodland, the mixing zone forest-settlements on the measures they should take to protect their property and their lives

5.9 Management of water resources

In order to cope with the challenges that Patra will face with regard to the water management in the coming years, a number of activities that will help in the better water management and policy making have been foreseen.

Leakage control system

The study of Bank of Greece estimated that water loss due to network leakages in a large sample of Municipal Water Enterprises can reach over 60% of the demand. High leakage levels in the water supply network of the city of Patras is one of the most important issues, which must be dealt by the Municipal Enterprise (DEYAP), responsible for the Operation and Maintenance of the Water Supply system.

Till now the approach to leakage control is a passive one, meaning the leak is repaired only when it becomes visible. However DEYAPI is intending to develop a permanent Leakage Control System according to the International Water Association (IWA) methodology. For the implementation of this system a project is in progress, including the following tasks:

- Division of the network into District Metered Areas (DMA), supplied by one or two key mains, on which flow meters are installed. This will make possible to quantify leakages and put priorities in the leakage location and repair.
- Concurrently Pressure Reducing Valves (PRV) will be installed for pressure – dependent demand reduction, in order to reduce leakage and bursts.
- Pressure will be measured at the critical points of the network.

Proper equipment will be installed for measuring, logging and controlling pressures and flows.

It is expected that after the evaluation of the flow and pressure measurements the optimum pressures will be applied at the zones, the leakage levels will be reduced and active detection of leakages will be possible. The project will be financed with NSRF (National Strategic Reference Framework) funds.

Construction of a new water dam for the wider Patras region

A new water dam is planned to be constructed in the Piros and Parapiros rivers of Patras. The project consists of:

- The reservoir earth dam in the location Asteri of Parapeiros River
- The low diversion dam in location Valmadoura of Piros River
- The water pipeline from the dam of Valmadoura, to the Asteri reservoir

Figure 16: Catchment basin of rivers Pinios, Piros and Vergas (GR28)

The aim of these projects is the water supply of the city of Patras, the industrial zone and the coastal settlements and low zones of Achaia prefecture south of the city of Patras.

The average annual rainfall in the catchment basin of river Piros is 1.223,8 mm and in and the basin of the river Parapeiros is 981,8 mm. The Piros river basin in the location Valmadoura is 62 km^2 and the corresponding Parapeiros river basin in location Asteri is 101,1 km^2. The total length of the pipeline transporting water from the dam

Valmadouras to the reservoir dam star is about 10,25 km and consists of steel pipes with internal and external protection.

Information Office for saving water - "Water House"

The Information Office for saving water - "Water House", will be created in Patras, after funding by the project Water Saving for Development - WaS4D (Saving Water for Development). The general objective of the Water House is to promote sustainable water management through information operations, information, education, training, events and new advisory services, addressed to citizens - consumers and professionals involved in water management.

Specifically, the main activities of the Water House will be:

1. Attracting, welcoming, guiding and informing visitors
2. Promote and support sustainable water management in schools
3. Handling of information material
4. Conferences, exhibitions, events
5. Visibility of the Municipality of Patras and neighboring municipalities on water management
6. Planning and organizing volunteer programs

The basic tool for the implementation of awareness on sustainable management and use of water in all social and geographical levels is to make information available to all by improving the transparency of information generated on the state of water and ensure a realistic and objective decision making. Thereby, the "Water House" will ensure behavioral change practices and habits and effectively support the process of policy making.

Alongside, the Water House will contribute to strengthening cooperation at local, national and European level, in order to strengthen the link between research and policy-making processes and decision making.

5.10 Summary of the main adaptation actions of Patras

	Sector	Adaptation action-measure	Projected time-frame	Budget	Source of funding
1.	**Water**	Water House	2013	222.000 €	WaS4D – Water Saving for Development, Interreg Ivc Greece - Italy 2007-2013.
2.	**Water**	Dam Peiros-Parapeiros	2015	130.000.000 €	Ministry of Environment, Energy and Climate Change - EU
3.	**Water**	Public awareness program for i water saving - Distribution of water flow regulators	2013	9.000 €	WaS4D – Water Saving for Development, Interreg Ivc Greece - Italy 2007-2013.
4.	**Biodiversity**	Center of Environmental Information of Panachaiko Natura 2000 area	2013	7.500 €	Sponshorship of Eoliki Panachaiko S.A.
5.	**Biodiversity**	Hire equipment for cleaning grass - branches to prevent fires	2013	61.000 €	Patras Municipality, Civil Protection Dpt.

	Sector	Adaptation action-measure	Projected time-frame	Budget	Source of funding
6.	**Biodiversity**	Environmental awareness program for students to protect biodiversity and forests of Panachaiko	2014	18.000 €	Ministry of Environment, Energy and Climate Change
7.	**Energy**	Energy information center for biomass	2013	20.000 €	PROFORBIOMED – Intelligent Energy Europe
8.	**Coastal Zone (Rion beach)**	-from Porto Rio Hotel by Rio Beach hotel, protective wall inclined to the promenade. - from hotel Rio Beach Street until Alexander the Great, str. a protective wall with a flair for the coastal road to spread gravel to create an "artificial beach".			

	Sector	Adaptation action-measure	Projectedtime-frame	Budget	Source of funding
9.	**Coastal Zone (Coastline Monodendri - Vrachneika - Tsoukalaika)**	Overall, it is proposed to construct 24 breakwaters freeboard and 7 lateral projections.		5.914.300 €	
10.	**Biodiversity**	Plan a forestry fire protection		15.000	
		Study maintenance, improvement and boring forest roads and placement notices		25.000	
		Technical studies fire protection		30.000	
		Silvicultural manipulations of vegetation in areas mixing Hood - Settlements		45.000	
		Informing residents about fire-and building fire protection measures		12.000	

	Sector	Adaptation Actions-measures	Projected time-frame	Budget	Source of funding
11.	**Biodiversity**	Enrichment vegetation - additional plantings - reforestation		45.000	
		Maintenance of existing firebreaks zones in high risk areas		19.500	
		Cleaning vegetation along high voltage transmission lines		N/A	
		Maintenance of existing forest roads		15.000	
		Improvement of existing forest roads		75.000	
		Opening of new forest roads in high risk areas		37.500	
		Placing information signs		15.000	
		Construction of new fire observatories		40.000	
		Construction of new water reservoirs fire protection		100.000	

	Sector	Adaptation action-measure	Projected time-frame	Budget	Source of funding
12.	**Biodiversity**	Silvicultural manipulations vegetation in high risk areas		90.000	
		Silvicultural manipulations vegetation in forests of Aleppo pine		45.000	
		Install new fire hydrants		20.000	
		Update firefighting personnel and volunteers		6.000	
		Update OTA staff and elected evacuation plans for communities		3.000	
		Evacuation plans		N/A	

	Sector	Adaptation action-measure	Projected time-frame	Budget	Source of funding
13.	**Water**	A permanent Leakage Control System according to the International Water Association (IWA) methodology	2013		Municipal Enterprise for Water Supply and Drainage of Patras (DEYAP)
14.	**Tourism**	A network of rural bike routes on Panachaiko mountain area.	2013		Wonder By Bicycle (WBB), Interreg Greece-Italy 2007-2013

6 Implementing the adaptation plan

6.1 The implementation tools and responsibilities

The main tool for the implementation of the Adaptation Plan if the city's Operational Programme. It already includes specific measures that correspond to actions described in the Local Adaptation Plan (see Annex II). Further integration of the Adaptation measures into future city's Operational Programmes needs to be done.

6.2 The financial resources for the implementation phase

The adaptation to climate change is a great challenge which must not be lost by the city of Patras, especially when the scientific community in its great majority has ruled that the costs of inaction will be much greater than the cost of early-preventive action.

The conduct of research, the provision of information to the society and the beginning of implementation of measures should be immediate priority for the city of Patras and therefore should be pursued to ensure adequate resources e.g. means of exploiting European programs (Life, Intelligent Energy etc). In this context it is particularly positive the initiative of the Ministry of Environment, Energy and Climate Change to provide € 6.6m for the necessary national sectoral actions that address the effects of climate change.

The specific amount, however, is only a part of the budget that will be required for drawing up an integrated program to adapt to climate change. Many more resources will be needed for the implementation of the actions that will be contained in -we hope soon drafted- national strategy of the country on climate change.

The use of resources by the Green Fund and the use of every possible financial instrument is a reasonable requirement, always under conditions of full transparency and proper programming. It is also a requirement to take assurance by creditors of the country ("Troika") that the measures to adapt and the expected cost of implementation will not be sacrificed in the interests of budgetary cutbacks.

7 Monitoring and reporting the adaptation plan

7.1 The monitoring and reporting system

A number of key stakeholders are involved in the implementation of the Adaptation Plan. Therefore it is necessary that a Monitoring Team is established in order to follow the implementation of the Action Plan. Since the Local Adaptation Board (LAB) represents a number of key stakeholders it is proposed that this body will be responsible for the monitoring and evaluation of the Adaptation Plan. It also has the advantage that it is an existing Body with some functioning experience. The functioning of the LAB will be coordinated by ADEP S.A. and specifically the Department of Environment & Sustainable Development.

The LAB will report to the Mayor once a year about the implementation of the Adaptation Plan and based on the findings in these reports the Adaptation Plan will be fully reviewed and updated once every three (3) years.

7.2 The key indicators

The key indicators for the Local Adaptation Plan of Patras are:

- The number of adaptation measures already included in the City's Operational Programme that will be put into action, and
- The number of adaptation measures that will be integrated in the next City's Operational Programme.

8 ANNEX I – The stakeholders involvement: key stakeholders and actions performed for the involvement

On December 2011, the 1st Local Adaptation Board meeting took place but after the resignation of several members, a 2nd meeting had to be organized in order to:

- Present the ACT project and the aims of the LAB
- Discuss the Road Map for the adaptation of Patras
- Agree on the Work Plan for the adaptation of Patras

On 12th March 2012 the 2nd meeting of the LAB of the city of Patras took place. In the meeting nine (9) out of the total fifteen (15) members of the LAB were present and discussed the work-plan and road map of the city of Patras for its adaptation to climate change. Mr Konstadakopoulos, ACT Patras Project Coordinator, presented a draft document on the "Road map for the adaptation of Patras to Climate Change". This document:

- Identifies the necessary general principles for drawing-up a coherent and comprehensive strategy for adaptation;
- Identifies the sections on which the adaptation will focus
    - Water resources
    - Nature-Biodiversity
    - Coastal areas
    - Marine environment
    - Forests
    - Desertification and soil
    - Agriculture
    - Tourism
    - Energy
    - Health
    - Urban environment and infrastructure
    - Land-use planning
    - Civil protection;
- Identifies some of the possible funding opportunities for the costly measures that will be decided and adopted in the Local Adaptation Plan (LAP).

It was agreed that Board members will send/ circulate any information relevant to climate change in our area that they are aware of, focusing on other projects that have run in the near past or are currently running in order to have the best possible integration with the information coming from ACT. The contribution of the four (4) University Professors that are members of the Board (Dr. Vantarakis, Dr. Pappas, Dr. Pandis, Dr. Kaleris) is going to be of critical importance as they have access to the latest available data of the scientific community.

At the level of the Municipality of Patras the three (3) Vice-Mayors (Mr. Sigalos, Mr. Georgakopoulos and Mr. Legas) and the two (2) members of the City Council (Mr. Bakalaros and Dr. Vantarakis) that are also members of the LAB will be the ones that will get involved with Climate Change.

Finally in the meeting the work-plan for the following months was presented and adopted by all the present LAB members:

- A report on sectors in the area of Patras which are sensitive to climate change and identification of the necessary actions to adapt – (ADEP S.A. and Project Consultant) – End of March 2012.
- The report is forwarded to Council members and they are given one week to give their comments - suggestions (Council Members) - first week of April 2012.
- Incorporation of comments-proposals (ADEP S.A. and Project Consultant) and their ratification in the 3rd LAB meeting, which will be combined with the working field visit of the ACT project scientific coordinator ISPRA (before Easter 2012).
- Detailed development of the Local Adaptation Plan to Climate Change (ADEP S.A. and Project Consultant) and presentation of the draft in the 4th Council meeting (1st 10 days of May 2012).
- Formulation of comments – proposals on the draft Local Adaptation Plan to Climate Change by the members of the LAB (end of May 2012).
- Completion of the Local Adaptation Plan to Climate Change (ADEP S.A. and Project Consultant) and its ratification by the LAB (until 15 June 2012).
- Sending of proposal from the LAB to the City Council of Patras for the approval/adaptation of the elaborated Local Adaptation Plan to Climate Change for the city of Patras (end of June 2012).

The 15 members of the Local Adaptation Board, their position and contact details are presented in the following table:

	Name	Institution / Position	Telephone	Email
1.	Georgios Sigalos	Vice-Mayor for Environment	6972055744	gsigalos@otenet.gr
2.	Achilleas Georgakopoulos	Vice-Mayor of Administration	6944692496	ahilleasg@hotmail.gr
3.	Christos Legas	Vice-Mayor of Urban Planning	6941605084	info@legas-sa.gr
4.	Christos Bakalaros	Municipal Councilor	2610270271 6974730515	xbaka@tee.gr
5.	Apostolos Vantarakis	Municipal Councilor Assistant Professor of Hygiene, Dpt. of Hygiene, University of Patras	6945336243	avantar@med.upatras.gr

6.	Filippos Gritsonis	President of the Union of Agricultural Cooperatives of Patras.	2610362701	coopatra@otenet.gr
7.	Vasileios Pappas	University of Patras, Professor, Dpt. of Architecture Mechanics	6972323889	vpappas@upatras.gr
8.	Spyros Pandis	Πανεπιστήμιο Πατρών, Καθηγητής, Τμήμα Χημικών Μηχανικών, Τομέας Μηχανικής, Διεργασιών και Περιβάλλοντος	2610969510	spyros@chemeng.upatras.gr
9.	Vasileios Kaleris	University of Patras, Professor at the Dpt. Of Civil Engineers, Laboratory of Mechanics and Hydraulics	2610996517	kaleris@upatras.gr
10.	George Kavadias Sub. Androniki Foi	Technical Chamber of Greece, Dpt. Of Western Achaia	6944943203 6942469500	ote41840@otenet.gr info@foiandriana.gr
11.	Fares Berashat Sub. Zois Spiliopoulos	Region of Western Greece, Head of Environment & Spatial Planning Dpt.	2610613320	fares_besharat@hotmail.com
12.	Sotirios Labropoulos Sub. Bouhelos Christos	Geotechnical Chamber of Greece, Department of Peloponnesus & West Greece	6945896291 6937330203	slampropoulos@yahoo.gr
13.	Ioannis Petratos Sub. Petros Mantas	Chamber of Greece	6943838880 2610994212 2610276767	petratos@enkipis.gr
14.	Dionisios Mammasis Sub. Georgios Kanellis	Ecological Movement of Patras	6947938358 2610621588	info@mamasis.gr
15.	Konstadinos Konstadakopoulos Sub. Eleftherios Alexopoulos	ADEP S.A. Head of Environment & Sustainable Development Dpt.	2610361747 6973289317	konstada@patras.gr lefterisalex@gmail.com

Moreover, city of Patras made a step towards involvement of the municipal services to the climate change adaptation efforts by assigning specific persons to participate in the coordination, monitoring and implementation of the local adaptation strategy:

Overall coordination and monitoring

1. **Municipal Enterprise for Planning & Development of Patras (ADEP S.A.) – Environment & Sustainable Development:** Konstadinos Konstadakopoulos, Eleftherios Alexopoulos, tel. 2610361747

Involved departments of the Municipality

2. Directorate of Financial Management: Spiliopoulou Dimitra, tel. 2610966240
3. Directorate of Annuities: Alivizatos Nikolaos, tel. 2610966250
4. Directorate of Informatics: Goulas Dimitrios, tel. 2610966329
5. Directorate of Town Planning and design applications: Alexopouou Eleni, tel. 2610966260
6. Directorate of Technical services: Stamopoulos Vasilios, tel.2610966270
7. Directorate of waste collection: Agiotatou Mary, tel. 2610.966205
8. Directorate of waste disposal: Chalkou Katerina, tel.2610461153
9. Directorate of Directorate of Environment and green areas: Georgiou Konstadinos, tel. 2160271367
10. Directorate of Maintenance of public spaces and direct labor: Alamolas Antonios, tel. 2610326615
11. Municipal Company of Water Supply and sewage: Kalogeropoulos Konstadinos, tel. 2610366212
12. Social organization of Municipality of Patras: Massaras Theocharis, tel. 2610390963

In the following pages, the Municipal Decision that assigns the five representatives of the Municipality of Patras to the Local Adaptation Board is attached:

Αριθμός 35

7η Συνεδρίαση
(συνέχεια της διακοπείσης
συνεδρίασης στις 8/2/2012)
Δημοτικού Συμβουλίου Πατρέων
της 13ης Φεβρουαρίου 2012

Στην Πάτρα και στην Αίθουσα του Δημοτικού Συμβουλίου, στο **κτίριο «ΛΑΔΟΠΟΥΛΟΥ»**, σήμερα την **13η Φεβρουαρίου 2012**, ημέρα **Δευτέρα** και ώρα **14.30**, μετά από γραπτή πρόσκληση της κας Προέδρου, με **αριθμό 8/3-2-2012**, η οποία εκδόθηκε νομότυπα και δόθηκε σε όλους τους κ.κ. Δημοτικούς Συμβούλους, ήλθαν για τη συνέχιση της συνεδρίασης της 8ης Φεβρουαρίου 2012, η οποία διεκόπη, λόγω του προχωρημένου της ώρας, για την εξέταση των (40) θεμάτων της ημερησίας διατάξεως, τα παρακάτω Μέλη του Σώματος:

1) Σαμούρη-Βαγενά Ακριβή – Πρόεδρος, 2) Σκαρμέας Αλέξιος – Αντιπρόεδρος, 3) Μαριάννα Σταματιάδου-Γραμματεύουσα, 4) Ανδρικοπούλου- Ρούβαλη Μαρία - Αντ/ρχος, 5) Βαφέας Παναγιώτης-Αντ/ρχος, 6) Γεωργακόπουλος Αχιλλέας - Αντ/ρχος, 7) Λέγκας Χρήστος- Αντ/ρχος, 8) Λοτσάρης Βασίλειος-Αντ/ρχος, 9) Μπουρδούλης Κωνσταντίνος-Αντ/ρχος, 10) Σιγαλός Γεώργιος - Αντ/ρχος, 11) Στανίτσας Χαράλαμπος- Αντ/ρχος, 12) Φίλιας Ανδρέας - Αντ/ρχος, 13) Αϊβαλής Δημήτριος, 14) Βανταράκης Απόστολος, 15) Γκίκας Παναγιώτης, 16) Γκόλφης Χρήστος, 17) Γρηγόρης Ηλίας, 18) Δημακόπουλος Φώτιος, 19) Δροσοπούλου–Αραβαντινού Παναγιώτα, 20) Καρκούλιας Χαράλαμπος, 21) Κατσικόπουλος Δημήτριος, 22) Κουρή –Βασιλοπούλου Ήρα –Ειρήνη, 23) Κωστόπουλος Νικόλαος, 24) Μακρής Νικόλαος, 25) Μανέτας Ιωάννης, 26) Μασσαράς Θεοχάρης, 27) Μπακαλάρος Χρήστος, 28) Μπινιέρης Γεώργιος, 29) Παπαγιαβής Παναγιώτης, 30) Παπαντωνοπούλου Αναστασία, 31) Πατούχας Χρήστος, 32) Πολίτης Σπυρίδων, 33) Τσιμπούκης Ιωάννης, 34) Χασμάν Άμπετ και 35) Χριστόπουλος Κωνσταντίνος.

Η κα Μανωλοπούλου-Νικολοπούλου Αναστασία- Γραμματέας, δεν ήρθε από την αρχή της συνεδρίασης, αλλά αργότερα, όπως φαίνεται παρακάτω στα πρακτικά, **χρέη δε Γραμματέως** ανέλαβε η κα Σταματιάδου Μαριάννα.

Οι κ.κ. Γιαλελής Ιωάννης, Καυκάς Γεώργιος, Κορδάς Χρήστος, Πατρώνη Αθηνά και Πελετίδης Κωνσταντίνος, δεν ήρθαν από την αρχή της συνεδρίασης, αλλά αργότερα, όπως φαίνεται παρακάτω στα πρακτικά.

Η κα Καλεντζώτη Ελένη, δεν ήρθε αν και κλήθηκε, απουσιάζουσα δικαιολογημένα.

Οι κ.κ. Αντωνόπουλος Ανδρέας, Κεραμιδάς Ευστάθιος, Μαλλιώρης Σταύρος, Ξυπολιάς Παναγιώτης, Τζανάκος Νικόλαος, Τζουραμάνης Ανδρέας και Χρυσανθακοπούλου Γεωργία, δεν ήρθαν αν και κλήθηκαν.

Επίσης στη συνεδρίαση δεν ήλθε και ο κ. ΙΩΑΝΝΗΣ ΔΗΜΑΡΑΣ - Δήμαρχος Πατρέων, **χρέη δε Δημάρχου** εκτέλεσε ο κ. Μπουρδούλης Κων/νος-Αντ/ρχος.

Αφού έγινε νόμιμη απαρτία, η κα Πρόεδρος κηρύσσει την έναρξη της συνεδρίασης.

.....

Στη συνέχεια, η κα Πρόεδρος εισάγει το αριθ. 9 θέμα της ημερησίας διατάξεως: «Ορισμός εκπροσώπου στο Τοπικό Συμβούλιο, για τη κλιματική προσαρμογή», (σχετικό εισηγητικό έγγραφο του Αντιδημάρχου Περιβάλλοντος και Πρασίνου, Έργων Αυτεπιστασίας, υπεύθυνος για Δ.Ε. Βραχναϊΐκων και Παραλίας κ. Γεωργίου Σιγαλού – Γραφείο Αντιδημαρχίας - με αριθμό 181/23-1-2012 και σχετικό διαβιβαστικό του κ. Δημάρχου – με αριθμό 543/3-2-2012).

.....

.....

Το Σώμα, με τη διευκρίνιση ότι εν τω μεταξύ ήλθε στη συνεδρίαση και η κα Αναστασία Μανωλοπούλου – Νικολοπούλου, Γραμματέας, και αφού άκουσε την κα Πρόεδρο και έλαβε υπόψη του την εισήγηση του Αντιδημάρχου, και αφού ο κ. Παναγιώτης Παπαγιαβής δήλωσε ότι **δίνει λευκή ψήφο,**

ΚΑΤΑ ΠΛΕΙΟΨΗΦΙΑ ΑΠΟΦΑΣΙΖΕΙ:

Ορίζει εκπροσώπους στο Τοπικό Συμβούλιο για την Κλιματική Αλλαγή, τους εξής:

1. **Γεώργιο Σιγαλό** – Αντιδήμαρχο Περιβάλλοντος και Πρασίνου, Έργων Αυτεπιστασίας, υπεύθυνο για Δ.Ε. Βραχναιϊκων και Παραλίας.
2. **Αχιλλέα Γεωργακόπουλο** – Αντιδήμαρχο Διαχείρισης Μηχανικού Εξοπλισμού και Καθαριότητας.
3. **Χρήστο Λέγκα** - Αντιδήμαρχο Πολεοδομικού και Κυκλοφοριακού Σχεδιασμού.
4. **Χρήστο Μπακαλάρο** – Δημοτικό Σύμβουλο
5. **Απόστολο Βανταράκη** – Δημοτικό Σύμβουλο

Διευκρινίζεται ότι:

Το ανωτέρω Τοπικό Συμβούλιο απαρτίζεται και από τους εξής:

1. Ένα (1) εκπρόσωπο της Περιφέρειας Δυτικής Ελλάδας (κατά προτίμηση στέλεχος – υπάλληλο σχετικής ειδικότητας)
2. Τρεις (3) καθηγητές από το Παν/μιο Πατρών (σχετικών ειδικοτήτων).
3. Ένα (1) εκπρόσωπο του ΤΕΕ – Δυτικής Ελλάδας
4. Ένα (1) εκπρόσωπο του ΓΕΩΤΕΕ – Δυτικής Ελλάδας.
5. Ένα (1) εκπρόσωπο του Επιμελητηρίου Αχαΐας,
6. Ένας (1) εκπρόσωπο της ένωσης Αγροτικών Συνεταιρισμών Πατρών.
7. Ένα (1) εκπρόσωπο της ΑΔΕΠ Α.Ε. και
8. Ένα (1) εκπρόσωπο μιας Τοπικής Περιβαλλοντικής ΜΚΟ.

Ο Δήμος Πατρέων δια της Αναπτυξιακής Δημοτικής Επιχείρησης Πατρών Α.Ε. (ΑΔΕΠ Α.Ε.), υλοποιεί το έργο **Adapting Climate in Time - ACT / LIFE+ (Έγκαιρη προσαρμογή στη κλιματική αλλαγή).** Το έργο υποστηρίζει τις Τοπικές Αρχές στη δημιουργία μια Τοπικής Στρατηγικής Προσαρμογής η οποία λαμβάνει υπόψη της, τις περιβαλλοντικές, κοινωνικές και οικονομικές επιπτώσεις της κλιματικής αλλαγής, με στόχο την αύξηση της ανθεκτικότητας της πόλης στην κλιματική αλλαγή.

Βασικό παραδοτέο του ACT / LIFE+ για τη πόλη της Πάτρας είναι η δημιουργία μιας **Τοπικής Στρατηγικής Προσαρμογής στη Κλιματική Αλλαγή**, η οποία θα προκύψει μέσα από την εκπόνηση του Τοπικού Σχεδίου Προσαρμογής στη Κλιματική Αλλαγή (Local Adaptation Action Plan).

Το Τοπικό Σχέδιο Προσαρμογής στη Κλιματική που εκπονείται από την ΑΔΕΠ Α.Ε. , απαιτεί βάσει του έργου **ACT / LIFE+,** να επιβλέπεται από ένα όργανο που θα συσταθεί, το **Τοπικό Συμβούλιο για τη κλιματική**

προσαρμογή (Local Adaptation Board), το οποίο πέρα από την επίβλεψη θα έχει και το ρόλο να δίνει κατευθυντήριες γραμμές για την εκπόνηση του Σχεδίου.

Η συμμετοχή στο Τοπικό Συμβούλιο, για τη κλιματική προσαρμογή, θα συμβάλλει στην αρτιότερη εκπόνηση αυτού του Σχεδίου που θα αποτελέσει σημαντικό εργαλείο για τη περιβαλλοντική πολιτική της πόλης μας.

Η Πρόεδρος **Η Γραμματέας**

ΑΚΡΙΒΗ ΒΑΓΕΝΑ-ΣΑΜΟΥΡΗ **ΑΝΑΣΤΑΣΙΑ ΜΑΝΩΛΟΠΟΥΛΟΥ-ΝΙΚΟΛΟΠΟΥΛΟΥ**

Τα Μέλη

9 ANNEX II – Mainstreaming adaptation into the sectoral policies: key actors, tools and strategies for integrating adaptation

In national level, WWF, General Confederation of Greek Workers, European Centre of Environmental Research and Training and Technical Chamber of Greece collaborated to compile a study that serves as a guideline for the adaptation strategies that should be adopted by Greek regional and local authorities, according to the current legislative framework. Since there is a lack of systematic work on climate change adaptation strategies, national, regional and local stakeholders should try to translate these guidelines in their specific conditions and capabilities.

For the city of Patras, such an opportunity can emerge, apart form the forming of the Local Adaptation Board, from the founding of a City Development Committee that is foreseen in the city's Business Programme. The founding of this Committee is proposed after the "Compilation of a Strategic Plan for the Sustainable Development of the region of Patras". Its main aim will be the facilitation of the local dialogue and collaboration as well of wider cooperation with external stakeholders.

In each of the following adaptation categories, regional and local strategies are added, whether applicable.

9.1 Management of water resources

The sector of water resources is one of the most critical in respect of the adaptation policy, given that climate change already brought significant changes in quality, quantity and hence to the availability of water resources. The formulation of a policy for the adaptation in the field of water should be driven at two levels: firstly, at the level of sustainable management of water resources (Framework Directive on water - 2000/60/EC) and secondly at the level of the treatment and management of risks, which climate change exacerbates (floods, drought - drought).

➜ *Guidelines for the reduction of the impacts and adaptation of water resources to climate change*

Sustainable water management

- Correct and prompt implementation of Directive 2000/60/EC, both as to the monitoring of water, and as regards the preparation of management plans for river basins.

Flooding and Drought

- Prompt and correct application of the Ministerial Decision with number 31822/1542/E103/21.07.2010 with which has been incorporated into national

law the directive 2007/60/EC on the assessment and management of the risks of flooding.

Region of Western Greece has included in the objectives of its Business Programme to investigate in the coming years new methods for better water management and conservation in the residential, industrial, tourism and agricultural sectors.

Municipality of Patras has included in the priorities of its Business Programme (Priority Axis 2, Measure 2.2.5) to:

- Promote the integrated and sustainable management of water resources.

9.2 Nature-Biodiversity

Climate change is likely to make substantial impact on biodiversity and ecosystems, which may affect not only the species which play a key role in ecosystems, but also the services related to these species, on which society largely depends.

The ecosystems play a key role in regulating the climate: for example the wetlands and the oceans store large quantities of carbon. In addition, the ecosystems of coastal wetlands and dunes, which will be affected by sea-level rise, provide for protection by the storms and the erosion of coastal territories.

The fragmentation of habitats is one of the main causes for the loss of biodiversity and climate change is expected to do even more intense this problem.

At the same time, the climate change is expected to cause immigration of species to northern regions or higher altitudes.

The ecosystems are made more vulnerable to climate change and, therefore, their capacity to adapt is reduced.

➜ *General guidelines for the mitigation of the effects and adaptation of biodiversity in climate change*

- Application of all the legal commitments of the country resulting from the national, European and international law with regard to the conservation of biodiversity. Particular emphasis on the implementation of Directives for Wild Birds and the Habitats Directives.
- Emphasis on maintaining and protection of the connections between habitats, as well as the creation of a continuous network of habitats so as to guarantee the habitats of species that are going to be affected the most from climate change.
- Actions related to climate change and included in the national strategy for biodiversity, must be integrated in the first five-year action plan strategy. The

assistance of all the institutions involved is necessary to ensure the effectiveness of measures.

- Direct support of the national system of protected areas, as revised by the Law. 3937/2011.
- The adjustment of the areas of ecological importance should now be taken into account and be assessed in the environmental authorization of projects of all kinds.

Municipality of Patras has included in the priorities of its Business Programme (Priority Axis 2, Measure 2.2.1) to:

- Protect and promote Panachaikon Mountain (in the framework of Natura 2000) after the creation of the respective Management Organization.

9.3 Management of coastal areas

Climate change is expected to lead to a rise of sea-level operating acting as multiplier of already existing environmental pressures.

The environmental problems which are expected to exacerbate with climate change concern the increase in the frequency of the floods, the appearance of soil erosion, the reduction of stocks of drinking water due to the salinization of water and finally the loss of coastal ecosystems.

➜ *General guidelines for the mitigation of the effects and adaptation of coastal areas to climate change:*

- Direct application of the Protocol for the Integrated Coastal Zone Management (ICZM protocol) of the Mediterranean Action Plan.
- Study of multidisciplinary nature, identifying the most vulnerable coastal areas and will be calculating in detail the financial cost of adaptation.
- Direct application of the provisions of national spatial planning in the direction of avoiding the expansion of existing settlements and providing free access to the coasts.
- Protection of areas Natura 2000 and coastal habitats with priority being given to ammophilous and wetland ecosystems.
- Immediate preparation of plans and infrastructure that will face (where necessary) coastal erosion and/or the risk from flooding (e.g. breakwaters).
- Interconnection of policy management of coastal areas with the special land-use planning framework for tourism but also with the national fisheries policy.
- Transfer of responsibilities from the central administration in the regions for more efficient and rapid carrying out of studies, projects and implementation of initiatives with regard to the treatment of risks arising from the rise in sea level.
- Aid for scientific research and knowledge.

9.4 Marine environment

The temperature rise of the sea, in conjunction with the expected reduced rainfall and reduced discharges from land are expected to affect the marine ecosystems and might lead to changes in their structures and functions. The situation of fish resources and fishing activity will be affected directly.

➜ *General guidelines for the mitigation of the effects and adaptation of the marine environment to climate change*

- Effective implementation of legislation and especially of the Framework Directive for the marine strategy, 2008/56/EC and achievement of good environmental situation, namely:
- Effective implementation of legislation and especially of Mediterranean fisheries Regulation EC 1967/2006, specifically as regards mapping and protection of fragile ecosystems (Posidonia sp., Coral formations), establishment of protected areas for fishing in national and international waters.
- The genetic diversity should be safeguarded in the marine environment of Greece and therefore would require an overall planning for the fishing methods and fishing effort, taking into account the results of research that will correlate the climate change and marine ecosystems.

9.5 Forests

The most immediate and rapid impact of climate change in the Mediterranean forests is the increasing frequency and intensity of forest fires, and the appearance of more large-scale fires, with the result the important impact in forest ecosystems. Large-scale fires, in conjunction with the increasing frequency of fires, put susceptible forest ecosystems, such as the various mountain coniferous forests, at serious risk. Forest fires are a milestone in the change of forests and the succession of marginal ecosystems.

However, the forest ecosystems are affected by climate change in many other ways, including the drying of trees and the alterations in reproductive cycles of plants and animals living in forests as well as the immigration of species. Such effects have already been found in many forests of our country and are expected to increase in the future.

The measures and general guidelines below must be taken into account and be implemented as soon as possible, as today the protection of forests in the country is considered to be still in extremely bad level.

➜ *General guidelines for the mitigation of the effects and adaptation of forests in climate change*

- It is indispensable to design adaptation strategies of forest ecosystems to climate change, to prevent major changes (e.g. disappearance patterns, consequences of extreme phenomena) and facilitate the in situ adjustment of forests and the immigration of species, so as to achieve the desired environmental, social and economic conditions. Such strategies should have a preventive approach, to avoid undesirable effects and non-reversible losses and damages on forest ecosystems. The best strategy adjustment should support an increase of diversity at all levels of the forest ecosystem (genus, species, community and landscape), so that it becomes more stable and durable to exogenous factors that tend to upset its balance.

Region of Western Greece has included in the objectives of its Business Programme to prepare a detailed mapping of the region's forests and develop Action Plans for their sustainable management and protection.

9.6 Desertification and Soil

The desertification in Greece is caused by a series of factors which include the agricultural over-exploitation, bad cultivation practices of the land, the depletion of underground aquifers which leads to salting of territories, over-grazing, abandonment of agricultural land, the fires, but also many 'development' interventions which lead to rapid changes in land use.

The impact of these factors in each region depends on the terrain, but mainly on the climatic conditions. Therefore, the expected changes in these circumstances would adversely affect the pace of outbreak of the phenomenon.

➜ *General guidelines for the mitigation of the effects and adaptation of soil to climate change*

- Targeted implementation of the sectoral proposals that have been mentioned above (water management, agriculture, forests, etc.) with targeting of areas with high risk desertification.
- Control and compensation for the impacts which may arise for the soil due to the increased requirements of agriculture in fertilizers and pesticides. Prevention of such tension with putting emphasis on organic farming, or on integrated cultivation practices.

9.7 Agriculture

The agricultural crops are affected by the temperature, the rainfall and generally from precipitation, flooding and more generally, the extreme weather conditions, frost, humidity of the soil and air, etc. The foreseen climate change will bring about changes

in the yields, in the management of livestock and the geographical orientation of production. The growing likelihood of extreme natural phenomena is expected to increase the risk of damage production of certain species.

➜ *General guidelines for the mitigation of the effects and adaptation of agriculture to climate change*

- Direct mapping of water needs of the different crops at regional level.
- Provision of an integrated proposal for the restructuring and/or total change of crops at the regional level, according to the needs for water and the capability of adapting to the new climatic data.

Region of Western Greece has included in the objectives of its Business Programme to:

- Protect farming lands and upgrade the irrigation systems in order to protect and sustainably manage water resources of the region
- Promote the development of environmental friendly agriculture
- Promote the notion of “Integrated Interventions” that will enhance agricultural production, while, in parallel, protect natural resources, soil and the environment

9.8 Tourism

According to the IPCC the tourist period may be lengthened in the spring and autumn and consequently to ease the flow of people who choose Greece as a tourist destination.

In any event, much will depend on the possibility of the State, the local authorities and the local societies to adapt in time on the emerging climate change, by moving toward proper management of natural resources, in appropriate 'green' interventions in infrastructure (saving energy, recycling water) and proper planning of the needs of the tourism sector in the near future.

➜ *General guidelines for the mitigation of the effects and adaptation of tourism to climate change*

- Revision of the existing spatial planning for tourism in the direction of more environmentally-friendly policies with recognition of the carrying capacity of coastal and island regions.
- Direct and compulsory application of systems of environmental standards (ECO labeling) for the tourist facilities.
- Creation of incentives for reducing the carbon footprint and energy consumption of tourist units.
- Interconnection of tourism policy with the integrated coastal zone management.

- Change in the pattern of attracting tourists only during the summer months. Lengthening of the tourism period throughout the year with the emergence of destinations of alternative tourism.
- Decentralization of responsibilities from the central administration in local authorities for immediate intervention in cases where irregularities take place but also for the drawing up local projects of tourism development.

Region of Western Greece has included in the objectives of its Business Programme to:

- Control the tourism development in the coastal areas of the region
- Develop alternative tourism products that include the environmental dimension with a focus on the mountainous areas of the region

Municipality of Patras has included in the priorities of its Business Programme to:

- (Priority Axis 5, Measure 5.3.1): Compile and implement a study to enhance the attractiveness of the city of Patras as a tourism destination.
- (Priority Axis 5, Measure 5.3.5): Promotion of special and alternative forms of tourism.

9.9 Energy

If we want to avoid the worst effects of climate change, the world energy sector should almost eliminate emissions by 2050. Indeed, on the basis of existing technologies, the use of clean renewable energy sources can cover virtually all global energy needs by 2050.

➜ *General guidelines for the mitigation of the effects and adaptation of the energy sector to climate change*

- Direct promotion of RES, to cover the objectives of the EU (20% RES in final energy consumption by 2020, 95-100% by 2050) with a proper planning so as to avoid affecting considerably the natural environment and biodiversity.
- Management of forest and agricultural residues (biomass) for electricity production, as a means of reduction of emissions, but also of reducing the risk of spread of fires in the forest-rural sector.

Municipality of Patras has included in the priorities of its Business Programme (Priority Axis 2, Measure 2.2.6) to:

- Implement measures and actions that will promote (i)Energy efficiency and (ii)RES technologies in municipal energy consumptions.

9.10 Health

The overheating of the planet, according the WHO, would cause serious threats to health, such as storms, floods, drought and fires, with consequences for the limitation of water supplies, food availability and to the provision of health services. The expected increase in the days with heat-waves, in conjunction with the atmospheric pollution and the reduction of rainfall in most urban areas could lead to appearance of more cardiac incidents, allergies, asthma, etc. The improvement of conditions in cities and the measures for the protection of vulnerable populations should be placed as top priorities.

➜ *General guidelines for the mitigation of the effects and adjustment of the health sector in climate change*

- Preparation of a program for the reduction of air pollution in urban areas which will include inter alia :emphasis on the promotion of means of mass transport, reduction of cars in the center of cities and incentives for the replacement of cars exclusively with “clean” cars of small cylinder capacity and low consumption
- Creation of a plan for improving conditions in urban areas, which will include inter alia the creation of green areas, the protection of non-built areas particularly in the center, the use of cold colors and the creation of green roofs, strengthening of the Regulation of energy efficiency for the energy performance of buildings.
- Monitoring the development of diseases and any new infectious diseases.
- Measures for the limitation of the phenomenon of urban island, with emphasis on reducing the use air conditioning.

9.11 Urban environment and infrastructure

The urban environment and infrastructure are indissolubly linked with the protection of life and health of citizens, and provide the background to the development of human activities. Climate change is expected to have an impact on the urban environment and infrastructure and for this reason should be included in the context of the adaptation to climate change.

Infrastructure exposed to weather conditions and hence to climate change includes the buildings, the networks (road, rail, water, sanitation, telecommunications, and energy), the airports, ports, and the flood-relief works.

➜ *General guidelines for the mitigation of the effects and adaptation of the urban environment to climate change*

- Strict monitoring for compliance with planning rules
- Maintenance and improvement of drainage systems

- Organization of warning system for citizens for protection from extreme weather conditions, high temperatures, high levels of pollution, etc.

Municipality of Patras has included in the priorities of its Business Programme to:

- (Priority Axis 3, Measure 3.4.1): Rehabilitation and development of the former camping area in Agyia Swamp.
- (Priority Axis 3, Measures 3.4.2 & 3.4.3): Restructuring, upgrade and increase in area of green spaces in the city of Patras.
- (Priority Axis 4, Measure 4.1.1): Development of an Integrated Transportation Policy.
- (Priority Axis 4, Measures 4.1.2 & 4.1.5): Study for the development of tramway and cycling routes networks.
- (Priority Axis 4, Measure 4.1.7): Construction of new pedestrian zones.

9.12 Land-use planning

Land-use planning is required to take seriously under consideration the parameter of the impact of climate change, based on the main assumption that the climate in the country will be quite different (hotter and drier) over the next decades.

Primer consideration seems to be the following: how, based on the principle of prevention, the territorial development decisions will be less influenced by the possible upcoming effects of climate change.

➜ *General guidelines which incorporate the concept of adaptation*

- During the process of drawing up the spatial planning it is necessary to evaluate the future climatic risks (e.g. in the coastal zones, or in areas susceptible to flooding) and to interconnect systematically the concept of sustainable spatial development with the expected physical changes in the area (e.g. greater drought in some areas, vulnerability of other regions to natural disasters).

Municipality of Patras has included in the priorities of its Business Programme to:

- (Priority Axis 1, Measure 1.4.2): Claim the area between Diakoniaris and Milichos in order to rehabilitate it and develop it with a focus on quality of life, protection of the environment and city development.
- (Priority Axis 2, Measure 2.2.3): Rehabilitate Special Areas of Protection as they are defined and described in the city's General City Plan.
- (Priority Axis 3, Measure 3.2.1): Studies and Measures regarding the rehabilitation of the coastal zone of city of Patras.
- (Priority Axis 3, Measure 3.2.2): Measures and Public Works or urban regeneration in areas that have a certain degree of urban, social, financial and environmental degeneration.

Table of Actions and Responsible Organisation (1/3)

Relevant Sector	Key Actions / measures	Responsible Organisation - Department	Projected Start - End Date	Estimated cost
Water Resources	Investigate in the coming years new methods for better water management and conservation in the residential, industrial, tourism and agricultural sectors	Region of Western Greece Business Programme		N/A
	Promote the integrated and sustainable management of water resources	Municipality of Patras Priority Axis 2, Measure 2.2.5	2008-2010	478.100€
Nature-Biodiversity	Protect and promote Panachaikon Mountain (in the framework of Natura 2000) after the creation of the respective Management Organization	Municipality of Patras Priority Axis 2, Measure 2.2.1	2008-2010	470.000€
Forests	Detailed mapping of the region's forests and develop Action Plans for their sustainable management and protection.	Region of Western Greece Business Programme	2008-2010	N/A
Agriculture	Promote the development of environmental friendly agriculture	Region of Western Greece Business Programme	2008-2010	N/A
	Protect farming lands and upgrade the irrigation systems in order to protect and sustainably manage water resources of the region	Region of Western Greece Business Programme	2008-2010	N/A
	Promote the notion of "Integrated Interventions" that will enhance agricultural production, while, in parallel, protect natural resources, soil and the environment	Region of Western Greece Business Programme	2008-2010	N/A

Table of Actions and Responsible Organisation (2/3)

Relevant Sector	Key Actions / measures	Responsible Organisation - Department	Projected Start - End Date	Estimated cost
Urban environment and infrastructure	Rehabilitation and development of the former camping area in Agyia Swamp	Municipality of Patras Priority Axis 3, Measure 3.4.1	2008-2010	15.000.000€
	Restructuring, upgrade and increase in area of green spaces in the city of Patras	Municipality of Patras Priority Axis 3, Measures 3.4.2 & 3.4.3	2008-2010	1.644.000€
	Development of an Integrated Transportation Policy	Municipality of Patras Priority Axis 4, Measure 4.1.1	2008-2010	23.768.495€
	Study for the development of tramway and cycling routes networks	Municipality of Patras Priority Axis 4, Measures 4.1.2 & 4.1.5	2008-2010	2.000.000€
	Construction of new pedestrian zones	Municipality of Patras Priority Axis 4, Measure 4.1.7	2008-2010	1.954.650€

Table of Actions and Responsible Organisation (3/3)

Relevant Sector	Key Actions / measures	Responsible Organisation - Department	Projected Start - End Date	Estimated cost
Land-use planning	Claim the area between Diakoniaris and Milichos in order to rehabilitate it and develop it with a focus on quality of life, protection of the environment and city development	Municipality of Patras Priority Axis 1, Measure 1.4.2	2008-2010	N/A
	Rehabilitate Special Areas of Protection as they are defined and described in the city's General City Plan	Municipality of Patras Priority Axis 2, Measure 2.2.3	2008-2010	5.390.000€
	Studies and Measures regarding the rehabilitation of the coastal zone of city of Patras	Municipality of Patras Priority Axis 3, Measure 3.2.1	2008-2010	2.200.000€
	Measures and Public Works or urban regeneration in areas that have a certain degree of urban, social, financial and environmental degeneration	Municipality of Patras Priority Axis 3, Measure 3.2.2	2008-2010	13.492.500€
Civil protection	Implement works for the prevention of flooding in selected areas (e.g. Diakoniaris stream)	Municipality of Patras Priority Axis 2, Measure 2.2.4	2008-2010	1.000.000€
	Design and implement a Local Plan of confronting natural disasters (Local Emergency Operation Plan) regarding both natural and human induced disasters	Municipality of Patras Priority Axis 2, Measure 2.3.1	2008-2010	800.000€

9.13 Civil protection

Climate change with the negative effects will affect directly the fields of interest of civil protection. In particular the appearance of more frequent and increased extreme weather conditions require the existence of projects dealing with natural disasters. Also, the gradual emergence of environmental change because of climate change requires the drawing-up of long-term strategies for dealing with them. Another feature of our area concerns the more frequent appearance of forest fires because of climate change.

➜ *General guidelines which incorporating the concept of adjusting*

- Restructuring of the General Secretariat of Civil Protection in the direction of prevention, early response and restoration of natural disasters from climate change.
- Initiatives for policy protection by local actors with the participation of organized civil society, with information and awareness campaigns for citizens, as well as voluntary actions (e.g. Preventive protection of forests).

Municipality of Patras has included in the priorities of its Business Programme to:

- (Priority Axis 2, Measure 2.2.4): Implement works for the prevention of flooding in selected areas (e.g. Diakoniaris stream).
- (Priority Axis 2, Measure 2.3.1): Design and implement a Local Plan of confronting natural disasters (Local Emergency Operation Plan) regarding both natural and human induced disasters.

9.14 Proposals for funding opportunities

The adaptation to climate change is a great challenge which must not be lost by the city of Patras, especially when the scientific community in its great majority has ruled that the costs of inaction will be much greater than the cost of early-preventive action.

The conduct of research, the provision of information to the society and the beginning of implementation of measures should be immediate priority for the city of Patras and therefore should be pursued to ensure adequate resources e.g. means of exploiting European programs (Life, Intelligent Energy etc). In this context it is particularly positive the initiative of the Ministry of Environment, Energy and Climate Change to provide € 6.6m for the necessary national sectoral actions that address the effects of climate change.

The specific amount, however, is only a part of the budget that will be required for drawing up an integrated program to adapt to climate change. Many more resources will be needed for the implementation of the actions that will be contained in -we hope soon drafted- national strategy of the country on climate change.

The use of resources by the Green Fund and the use of every possible financial instrument is a reasonable requirement, always under conditions of full transparency and proper programming. It is also a requirement to take assurance by creditors of the country ("Troika") that the measures to adapt and the expected cost of implementation will not be sacrificed in the interests of budgetary cutbacks.

10 Glossary

CLIMATE CHANGE MITIGATION

Anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases.

CLIMATE CHANGE ADAPTATION

Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

IMPACT

Measure of the tangible and intangible effects (consequences) of one thing's or entity's action or influence upon another.

VULNERABILITY

Degree to which people, property, resources, systems, and cultural, economic, environmental and social activity is susceptible to harm, degradation, or destruction on being exposed to a hostile agent or factor.

11 Conclusions

City of Patras has participated in the project LIFE ACT after a number of studies indicating that climate change will bring a number of environmental threats for the wider region of Patras. This situation poses a danger for the economic life and future development of the region but also for the quality of life and the integrity of properties and infrastructure.

Following the project's activities, a number of reports to assess the state-of-art, expected impacts and priority areas of action were prepared and a Local Adaptation Board was created to consult the city on the best climate change mitigation and adaptation policies.

Climate projections show that the climate of Patras is expected to have an increase in the mean air temperature and a reduction in the annual cumulated precipitation. This will have a negative impact in all environmental and economic sectors of the city, unless an Adaptation Strategy and respective sectoral Plans are compiled and implemented in the following years.

The city of Patras prepares and adopts this Local Adaptation Plan with the vision to provide to its citizens a safe environment in which sustainable development will take place. The aim is to integrate the adaptation measures at the appropriate levels of the local policy.

The most important barrier for the implementation of the Local Adaptation Plan is the economic cost of the measures proposed. Appropriate funding opportunities need to be assessed.

It is proposed that the Local Adaptation Board that was established during the ACT Project will be responsible for the implementation and monitoring of the Local Adaptation Plan under the coordination of the Department of Environment & Sustainable Development of the Municipal Enterprise for Planning and Development of Patras.

12 Bibliography

Bank of Greece, 2011, “Environmental, Financial and Social Impacts of Climate Change in Greece”, Athens, Greece

Bank of Greece – Committee for the Study of Climate Change Impacts (2011), “Economic evaluation of the climate change impacts on water reserves)”, Athens, Greece

Technical Chamber of Greece – Working Group of TCG of Western Greece, Report on the coastal zone erosion, Patras, Greece

Municipality of Patras – Thisseas Programme, 2010, “Study of a plan for forest fire protection of the Panachaikon Mountain (Natura 2000 area)”, Patras, Greece

Municipality of Patras, 2008, “Business programme of the Municipality of Patras, 2008 – 2010”, Patras, Greece

LIFE ACT project (LIFE08 ENV/IT/000436), 2010, “Baseline climate scenario – Climate trends and projections”, Rome, Italy

LIFE ACT project (LIFE08 ENV/IT/000436), 2011, “Climate change impact assessment and local vulnerability – Biodiversity and Forests of the Natura 2000 area of Panachaikon mountain”, Patras, Greece

LIFE ACT project (LIFE08 ENV/IT/000436), 2011, “Climate change impact assessment and local vulnerability – Cultural heritage”, Patras, Greece

LIFE ACT project (LIFE08 ENV/IT/000436), 2011, “Climate change impact assessment and local vulnerability – Desertification”, Patras, Greece

LIFE ACT project (LIFE08 ENV/IT/000436), 2011, “Climate change impact assessment and local vulnerability – Fisheries”, Patras, Greece

LIFE ACT project (LIFE08 ENV/IT/000436), 2011, “Climate change impact assessment and local vulnerability – Health/ Tourism”, Patras, Greece

LIFE ACT project (LIFE08 ENV/IT/000436), 2011, “Climate change impact assessment and local vulnerability – Landslides”, Patras, Greece

LIFE ACT project (LIFE08 ENV/IT/000436), 2011, “Climate change impact assessment on water availability and quality in Patras area”, Patras, Greece

Region of Western Greece, “Study addressing the coastal erosion in Western Achaia”, Patras, Greece

Region of Western Greece, 2011, “Three-year business programme of the Region of Western Greece”, Patras, Greece

WWF et al., 2011, ”Road map for the adaptation of Greece to the climate change”, Athens, Greece

Ziogas, A.I. (Hydraulic Engineering Laboratory, Department of Civil Engineering, University of Patras), 2006, “Water budget of the Glafkos aquifer and capture zones of the water supply wells – Master thesis”, Patras, Greece