SCENARIOS

ON THE EVOLUTION OF THE GULF OF MORBIHAN DUE TO CLIMATE CHANGE

IMCORE
INNOVATIVE MANAGEMENT FOR EUROPE'S CHANGING COASTAL RESOURCE

Investing in Opportunities
Investing in opportunities

UBO
université de bretagne occidentale

AMURE
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CENTRE DE DROIT ET D'ECONOMIE DE LA MER

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S.I.A.G.M.
Golfe du Morbihan

projet de Parc Naturel Régional Golfe du Morbihan

The IMCORE project

Location of IMCORE project partners

The European research project **IMCORE** (Innovative Management for Europe's changing COastal Resource) **aims to promote a sustainable, innovative, transnational approach to reduce the ecological, social and economic impact of climate change on the coastal resources of North-West Europe.**

Conducted between 2008 and 2011, it involves 17 North-West European institutions (research centres and local authorities). The French IMCORE team is formed by the partnership between the mixed research unit **UMR-Amure** of the University of Western Brittany (UBO) and the **Syndicat Intercommunal d'Aménagement du Golfe du Morbihan** (intercommunal planning union for the gulf of Morbihan, SIAGM).

This summary document presents the results of work conducted with local players in the gulf of Morbihan (workshops, interviews...) which enabled, through locally identified issues, the joint construction of possible area evolution scenarios with regard to the effects of climate change. These scenarios focus exclusively on how the area could evolve in the face of a sea level rise which is identical in all the scenarios.

Why build scenarios?

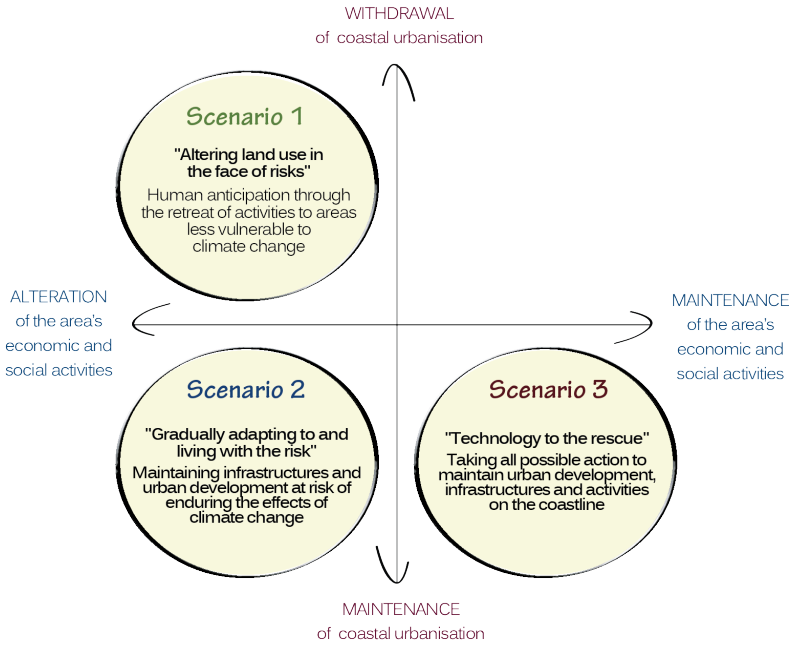
How could the gulf of Morbihan evolve?

Within the context of the IMCORE project, the term «scenario» was considered as an approach which helps to structure, understand and plan for future uncertainties. Scenarios do not predict the future, but rather develop our capacity to consider a range of possible futures. They enable us to explore, create and test possible and desirable future conditions. They facilitate the handling of uncertainties inherent to assumption-based decision-making. By examining the different ways in which the future could develop, scenarios can also be used to compare the potential consequences of these different contexts. They therefore provide a means of considering current political and decision-making processes in light of future potential developments.

Following the initial phase involving the identification of existing local issues in the gulf of Morbihan, local players (local councillors, State services, professional organisations, associations, companies and local authority technicians) found themselves once again heavily involved in the IMCORE project, with a view to contributing to scenario-building. They took part in two workshops in March and May 2010, supervised by members of UBO and SIAGM, to determine **how the area may evolve under the effect of climate change and the potential outcomes of this evolution** (possible futures).

The scenario-building process focused on the theme of «urban planning and infrastructures» due to the long term dimension it implies, and the wide-ranging nature of the sectors it touches upon. Other themes such as biodiversity and maritime activities, although considered in less depth in the scenarios, were nevertheless addressed.

Three scenarios were developed and were then subjected to critical scrutiny by a panel of around sixty people (representatives of all the sectors affected by climate change) to complete them, amend them and make them more realistic. In total, around one hundred participants from the gulf of Morbihan contributed to the scenario-building process. The group workshops and individual interviews also revealed the divergence in opinion between the groups of people consulted, as well as within these groups.



"ALTERING LAND USE IN THE FACE OF RISKS"

Human anticipation through the retreat of activities to areas less vulnerable to climate change

Acute erosion and flooding of exposed coasts lead to a certain number of consequences on the coastal area: certain coastal roads disappear and properties are severely threatened. In this scenario, rather than investing in an unending struggle against the impact of climate change using major technical and technological means, these impacts are taken into account in land planning and adaptation measures are taken. Driven by the negative psychological impact of storms, a population transfer is gradually implemented to ensure the safety of property and populations.

Safety of property and human lives




Transformation of the coastal strip

This scenario does not involve fighting against erosion and marine flooding, which are inevitable (the use of riprap has been proven inappropriate), but rather creating conditions to mitigate their impacts. This may consist for instance in installing alternative protection systems at the foot of dunes or establishing/maintaining buffer zones. State services produce coastal natural risk prevention plans in all the communes affected and define high vulnerability areas in terms of the hazards.

Use of alternative protection systems

Vulnerable unbuilt coastal areas become no build areas

Unbuilt coastal areas considered vulnerable in the long term are definitively classed as no build areas. Public control is exercised over transactions via a preemption right: if these plots constitute agricultural areas of interest, their sale is managed by a public land agency which directs them towards acquisition for agricultural usage. They may for instance be used for fodder production. Such plots may also be of interest to the Conservatoire du Littoral or departments responsible for natural sensitive species, or even communes. In both cases however, this concerns large surface areas. If these solutions are excluded, this land is often purchased by neighbouring landowners who wish to expand.

Although the price of plots newly classed as no build areas has plummeted, house prices at the edge of the high vulnerability area are rising, despite the risks, as they now constitute rare properties in a sought-after situation.

Properties built and infrastructures established in the «black spots» defined in coastal PPRNs (natural risk prevention plans) **are gradually being removed or altered.** When population safety and protection measures prove more costly than expropriation compensation, the State, communes or associations of communes can implement such expropriation, when it is considered to be of public utility.

Scenario 1

Two types of sectors can be distinguished:

- **The most vulnerable sectors,** in particular plots subject to severe erosion, are **left as natural areas**: they therefore act as a buffer zone between the land and sea and, if they are large enough, can help to restore a natural balance (self-sustaining dunes). These areas are open to the public. Access is regulated to prevent damage to the environment (signposting, pedestrian paths, information boards etc.). If these areas are of heritage value, the Conservatoire du Littoral may become involved. Their management can also be delegated to associations or the commune. The deartificialization of these sectors also contributes to the improvement of rainwater management and water purification. However, in previously urbanised areas, the short term re-establishment of suitable conditions for agricultural use is difficult to imagine. On the public maritime domain, beaches can be altered.

- **In other regained areas, less exposed** to erosion yet vulnerable due to heavy chronic storms, **priority is given to professional activities which directly depend on access to the sea for their development (oyster farming, fishing, nautical activities and pleasure boating).**

Installation of activities dependent on the sea in newly available areas with the lowest level of risk

Unlike homes, these infrastructures are less vulnerable to storms and are unoccupied at night, preventing sleeping inhabitants from being trapped by flooding.

Such plots of land and installations are the property of the State, which attributes concessions to professionals or distributes temporary land occupation authorisations. The infrastructures related to these activities, set up in vulnerable areas, should however meet with precise specifications including safety and aesthetic criteria (architectural harmony to avoid marring the appearance of the coastline) and should be removable if possible. The economic revitalisation of the coastal area, based partly on the promotion of traditional activities, provides new appeal for tourism, increasingly focused on the area's lively and authentic character.

Vitality of towns

Seafront shops and restaurants are relocated in towns, helping to revitalise them, while reducing their seasonal variation. Coastal leisure activities are reduced to bathing, recreational shellfish harvesting and nautical activities.

These two types of areas, build and no build zones located in high vulnerability areas, are managed by the State (through the Conservatoire du Littoral), communes or public land agencies. Vulnerable areas are defined by State services.

A certain number of impact adaptation measures should be provided on the coastline:

- Oyster farmers develop their farms in deeper waters, due to foreshore reduction, initially transferring their tables (in particular on foreshores recreated by the transfer of urbanised areas and the removal of protective structures).

- The marking of farm boundaries is reviewed as underwater stakes constitute a risk for nautical activities.

- As for the network of coastal paths, a particular attraction in the gulf of Morbihan, only the sustainable sections are maintained and developed to reduce the impacts of erosion to a minimum (revegetation of path edges). To ensure the continuity of the route, alternative itineraries are developed inland, promoting local heritage (fountains, washhouses, bread ovens...).

- The sectors in which shellfish harvesting is practised is gradually decreasing due to foreshore reduction, which increases local pressure on resources by fishermen, concentrated in increasingly limited areas. This tends to generate conflicts between users.

Conflicts of use on the foreshore

Impacts on the coastal hinterland

transfer of accommodation and activities

Transfer of populations inland

As the clearance of high vulnerability areas requires a high degree of anticipation, **the transfer of populations and activities towards safe areas will also be planned and organised.** This movement can therefore be implemented without damaging the area, provided efforts are made by society.

Control of urban sprawl

- The relocation of residents from vulnerable areas takes into account urban sprawl control and is implemented through land planning instruments (SCOT, PLU, regional nature park charter): through such urban planning documents, isolated housing, which requires large amounts of space (individual houses in the middle of large plots), is limited in favour of denser housing immediately surrounding town centres. Major efforts are made so that such forms of housing (collective residences, terraced housing) may offer a high quality living environment required to prevent conflicts which could emerge from such densification. This draws upon the work of landscape gardeners and architects to offer a high level of social and environmental comfort (many park and garden areas, privacy studies, sports equipment, soundproofing etc.). These developments also fulfil environmental requirements, mainly dictated by the Grenelle II Law (bioclimatic architecture, resource savings, artificialization limits etc.).
- The transfer of inhabitants takes into account residents' status: relocating residents' main home is quite a different issue from relocating second homes. The first are therefore given priority for available housing.
- To promote economic activities which revitalise and support the area, communes offer tied accommodation to working families which experience difficulty in accessing residential accommodation: this concerns oyster farm employees, fishermen, and young farm workers who suffer particularly from this situation, as they must find accommodation close to their workplace.

Creation of tied accommodation

Farmers also offer useful services to the commune by maintaining landscapes and contributing to the living environment (local markets, holiday houses...).

Supply of council housing

- This is completed by a supply of various types of council housing (ranging from studio apartments to 4 bedroom apartments, terraced housing) to promote diversity within communes. The limit on the supply of council housing provided by the Law on Solidarity and Urban Renewal is increased by 20 %.
- Finally, alongside these efforts, a support policy (subsidies) for the restoration of existing housing is established. This policy also provides choice accommodation to tourists in search of traditional homes.

We note that the issue of population transfer takes on a whole different slant if it relates to a sparsely populated area of individual houses, with a majority of secondary homes, as opposed to a very dense urban area (a town) home to many permanent residents and to economic activities. In this case, the entire town must be redesigned upon this transfer, in order to recreate a balanced and coherently structured urban hub on the hinterland.

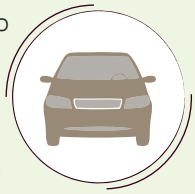
From an agricultural point of view, to compensate for deficient agricultural yields due to climate change (summer droughts, high levels of precipitation in winter complicating work in fields etc.), **useable farmland is made available, putting an end to the retention of land by landowners** who hope to sell if building on these plots becomes authorised. This involves the facilitation of the legal processes of land rental, or an official decision by the commune not to urbanise this land.

Finally, in order to reduce the risks of fire related to summer droughts, communes can demand that landowners maintain fallow land, or call upon professionals to do so at landowners' expense.

Scenario 1

Impacts on transport

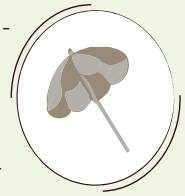
A regional transport authority incorporates climate change issues in its policy so as to adapt to the new conditions and to take part in the global CO_2 reduction effort. It focuses on t**he development of public transport** (bus and tram routes) **and non-motorised transport** (cycling, walking). Furthermore, vehicle sharing schemes are developed by private or public initiatives (bikes, cars or electric boats, etc.). This is coupled with the creation of car share parking bays. Finally, **the maritime public transport network is developed** to facilitate links between the urban hubs within the gulf.



Creation of a regional transport authority

Impacts on tourism

As far as the transfer of tourist accommodation from vulnerable areas to the hinterland is concerned, several possibilities are explored:



- Restoration of existing accommodation
- Development of campsites, with priority given to their installation on land that is of no agricultural interest
- Design of high quality, innovative campsites (eco-campsites, yurts etc.) to accommodate affluent populations instead of new second homes (which would not have been rebuilt in a low density configuration in any case)
- Alternative solutions, based for instance on the rental of empty accommodation, the promotion of house swaps, or even the construction of residences used as student accommodation during term time and transformed into apartments for families of tourists in the summer.

Information campaign on the area's safety

The negative psychological impact of storms may require **an information campaign on the area's safety**, in which emphasis is placed on the rehabilitation of vulnerable areas, helping to promote traditional activities. Tourists base their search for a holiday destination on two elements: image and safety.

To diversify seaside destinations, several strategies may be adopted: local heritage on the hinterland (which goes hand-in-hand with the relocation of accommodation) and natural coastal areas, increasingly present, developed for public use. Finally, activities are offered by sea professionals (oyster farming, fishing etc.) as well as farmers (farm holidays).

Impacts on governance

Major role of the State

The State plays a major role in this scenario: it demands that a coastal natural risk prevention plan be drawn up in each coastal commune, c**ompels local authorities or individuals themselves to order the removal/alteration of infrastructures located in high vulnerability areas, and reinforces the legality control system.** This mainly concerns the application of the Water Framework Directive (WFD n°2000/60 EC) and the French Coastal Law (n°86-2 of 3 January 1986). This application may however be adapted to a certain extent in some specific cases, in particular relating to agriculture: for instance, the use of coastal land as grazing pastures may require the construction of buildings to shelter livestock in the winter. Derogations may therefore be obtained for certain infrastructures (as long as they are well integrated in the landscape and are removable). However, in terms of the construction of protective structures and defence against coastal risks, controls on applications are tightened to improve compliance with legislation.

In conclusion, local managers make decisions within the context of reinforced application of laws on a national scale.

To facilitate the understanding of difficult political decisions made by the State, a major national communication effort is made on the risks: it aims to raise the population's awareness of the vulnerability of certain properties located on the shoreline, as well as the need to change certain behaviours (resource savings: space, water, energy etc.).

This awareness-raising has also occurred on a local scale and illustrates the vulnerability of plots in the gulf using clear, accessible visualisation tools.

Impacts on governance

State services and communes benefit from greater support from civil society (associations, professionals, etc.) to conduct an assessment of the impacts of climate change on the environment.

In order to save space available for urbanisation, intercommunal cooperation is established. This has several advantages:

Intercommunal cooperation

- To coherently organise the transfer of populations and activities from vulnerable coastal areas to communes with land available for urbanisation
- To manage tourist services (activities concentrated on the coast, but increasingly present in the hinterland, and accommodation further inland)
- To jointly absorb the cost of the removal of infrastructures located in very high vulnerability areas
- To share infrastructures so as to reduce their number (retail parks, trading estates, sports equipment and cultural facilities). The transport network should be adapted accordingly (development of a network to serve these infrastructures)

The setting up of this intercommunal cooperation implies the pooling of their general operating grant, professional taxes, land and property taxes, here allocated to the intercommunal group rather than the individual communes.

- A land use plan is drawn up for the whole of the gulf to organise its consistent and integrated development.
- Urban planning documents also systematically include a climate section which plans solidarity actions for the global response to greenhouse gas emissions (construction of passive and positive energy buildings, non-motorised transport etc.).

"GRADUALLY ADAPTING TO AND LIVING WITH THE RISK"

Maintaining infrastructures and urban development at risk of enduring the effects of climate change

This scenario, of which certain aspects are very similar to the current situation, considers the maintenance of infrastructures and urbanised areas on the coast despite the risks generated by climate change. These risks are clearly identified yet society has chosen to live with them: it reacts «on the fly», without anticipation. The area is therefore confronted with new pressures which induce unplanned economic, social and environmental changes.




Flooding risks

Alerted/mobilised by the various storms that hit coastal areas, States services identify vulnerability areas for marine flooding.

- **In unbuilt areas, urbanisation is strongly discouraged,** and is left to the discretion of mayors. If they constitute interesting entities in terms of natural heritage (and if they are put up for sale), such plots may be purchased by the Conservatoire du Littoral.
- **In built up areas, if human safety is seriously endangered, the State offers the choice of leaving homes and buildings in exchange for minimal compensation.** However, it does not force people to leave, as it has experienced failure of this policy in the past. It nevertheless declines all responsibility if the buyout offer is refused. Meanwhile, local and national information campaigns on the risks are set up to give the population a sense of responsibility. Residents are therefore free to decide on their fate with full knowledge of the facts, through information distributed by the State, local authorities, associations and scientists.

Implementation of alert and response systems

Alongside information campaigns, high performance emergency prevention, alert and response systems are introduced, often requiring major investments. The aim is not however to implement major technical means such as a continuous network of walls and protection systems.

No major protective structures

- Communes therefore strive for instance to reduce soil sealing and deterioration of wetlands which act as a buffer zone. They address the issue of water management according to the means they have available for example by creating retention tanks, improving drainage systems and protecting them against flooding.

Scenario 2

- In terms of housing, existing buildings or new builds take prevention and adaptation measures into account: buildings at least one-story high, manual openings in the roof (so that residents can take refuge on the roof), damp-resistant insulation, tiles rather than carpets, etc. Wherever possible, shops and services will be located on the ground floor, while the upper floors will be residential. In order to reduce storm damage, electricity cables are underground, and are protected against corrosion risks due to flooding.

- Temporary buildings are also constructed in areas threatened in the short term, sometimes built on stilts. However, there is no formal planning on the scale of the gulf as no authority has managed or wished to take the reins: initiatives are therefore organised on a communal or intercommunal basis.

No formal planning for the gulf as a whole

Global adaptation measures

Development of non-motorised forms of transport

These actions, which respond to local, isolated needs in coastal areas, are conducted alongside national mitigation and adaptation measures in the continuity of commitments made through the Grenelle Environment Laws. Some of these measures are imposed by legislation, while others are simply encouraged by funding provided by local authorities, the State or Europe (with eco-conditional requirements for its allocation). This applies to both private and public initiatives.

These measures mainly involve efforts in the building sector (bioclimatic architecture, green roofs, low energy buildings, rainwater reservoirs, etc.), **the transport sector** (development of non-motorised and public transport, promotion of local services, etc.) **and the energy sector** (reduced consumption, development of renewable energies, etc.). Meanwhile, services are developed to facing growing demand (tradesmen, companies able to meet environmental standards). **However, these adaptation measures are generally not specific to climate change and coastal areas, but rather are part of the general land use planning strategy.**

Impacts on urbanisation

Land prices evolve according to the vulnerability of plots. Coastal areas outside of high risk areas become increasingly rare and therefore expensive. Properties within the high vulnerability perimeter can only be sold to the State, and are therefore passed down from generation to generation until the family agrees to sell the property to be demolished.

Very costly coastal areas

Once urban infill sites have been exhausted, populations settle in the coastal hinterland, where prices generally end up rising. As farming becomes increasingly restricted due to climate change, the evolution of the international context and the difficulty in finding accommodation for farmers, it gradually declines, unless support is provided by public authorities. Certain local authorities and groups of communes also help to support agriculture, conscious of its benefits and in particular the maintenance of landscapes.

If no public support is provided, the decline of agriculture offers new land for urbanisation. Urban development makes headway and landscapes evolve gradually from maintained countryside into fallow land or urbanised areas.

According to the commune's policies, areas of urbanised plots may or may not be limited, resulting in the construction of isolated individual houses in certain sectors or, on the other hand, densely populated housing estates with small gardens. **Landscape evolution is therefore entirely subject to the judgment of local decision-makers.**

Unlike scenario 1, the clearance of space along the shoreline due to high vulnerability to risks is generally too limited to be able to recreate large natural areas for inhabitants to enjoy. Rather a discontinuous network of plots is obtained, which is difficult both to manage and to develop. Ideally, these plots are transformed into green open spaces to form small parks for residents.

Discontinuous network

Scenario 2

Impacts on the environment

Climate change adaptation measures are generally rather unsuited to the local context and are therefore insufficient to overcome impacts, which are therefore likely to result in environmental degradation. For example, torrential rain and storms (which are liable to occur increasingly frequently) can lead to the saturation of drainage systems, generate large quantities of run-off (in particular on manmade surfaces) and cause soil leaching. This results in a sharp drop in water quality, already affected by summer droughts, concentrating pollutants and promoting eutrophication.

This scenario also sees the development of fallow land due to the prohibition of urbanisation in high risk areas, the dismantling of certain properties along the shoreline and the loss of farmers who have either taken retirement or become discouraged by the difficult working conditions (see above). These farmers hope that construction will become authorised on their agricultural land and generally refuse to rent it in the meantime. Fallow land which develops increases fire risks in the summer and affects the landscape quality. Finally, in certain communes where urbanisation is uncontrolled, urban sprawl degrades landscapes in coastal areas and hinterlands.

Impacts on the economy

In this scenario, climate change has a heavy impact on certain economic activities, in as far as these activities receive no particular support from the local authority or development policy in their favour. This is the case of agriculture, faced with decreased crop yields: it would be difficult to compensate for this decline by an increase in the farming area, as the tendency is rather to urbanise each plot made available. **In some cases, farmers choose to leave farming to maintain public areas or work as environmental officers.**

Oyster farming has to deal with increasingly frequent flooding and storms. This first requires tables to be raised up and farms to be moved out of the affected area, with the possibility of creating oyster farming hamlets on the hinterland. These arrangements generate a lot of additional expense, however **the main problem for this activity is the drop in water quality.**

Decreasing water quality

Like oyster farming, **shellfish harvesting suffers from the reduction of the foreshore and gradually declines. From a technical point of view, nautical activities and vessel fishing are relatively unaffected by the impacts of climate change**: possible adaptations can be implemented (raising wharfs and slipways etc.) Adaptations should be considered to ensure vessel safety in case of storms.

For fishermen, the main challenge lies partly in the decrease in water quality and partly in the alteration of marine ecosystems and therefore of the species present in the environment.

Possibility of developing new activities

This is offset, however, by the fact that **climate change promotes the emergence and development of new activities: oyster spat culture in the gulf, seaweed culture, etc.** Salt production is greatly boosted by summer droughts. These activities may encourage career changes among certain professionals.

Yet **all professionals are confronted with the difficulty of finding accommodation**: along the shoreline, near their workplace, accommodation is very expensive (except in vulnerable areas). Similarly, in the agricultural sector, livestock farmers must live near their farm, which often proves difficult (many farmhouses are sold off to second home owners).

Growing social disparity

Growing social disparity can therefore be observed in the area: the coastline is mainly inhabited by affluent residents who can afford to settle there. These areas are therefore occupied by an ageing population and a growing number of second homes. No official policy on diversity of the population has been considered, other than the percentage of council housing imposed by the laws in force. Furthermore, coastal communes face greater investments than hinterland communes. This is reflected in land and property taxes and further discourages less affluent populations from settling along the coastline.

Scenario 2

Impacts on the economy

The coastline is therefore gradually deserted by active populations with moderate incomes. Professionals who work in the coastal area (maritime activities) or nearby (as part of the residential economy: shops, services to the elderly etc.) are obliged to stay far from their work place and occupy the hinterland. This has repercussions on the problem of transport by causing increased travel.

Impacts on tourism

Despite the sea level rise and the increasing frequency of storms, **seaside and nautical tourism endures**, at least for a local clientele. **Advertising campaigns are however necessary to reassure tourists from further afield, alarmed by the flooding of houses on the seafront or the storms which hit campsites.** These campaigns emphasise the safety aspect.

To mitigate damage to boats caused by storms, dry **ports are developed along the coast or on the hinterland** when no space is available. Such facilities provide a safe haven for motor boats and yachts.

Coastal paths still attract walkers. Certain sections damaged by climate events are only sporadically «patched up», and paths can end up disappearing due to erosion or because of protective structures set up by landowners. Users must therefore use alternative itineraries further inland.

In reality, the real dangers for the maintenance of tourism are, on the one hand, the decrease in water quality (which can affect bathing and shellfish harvesting) and, on the other hand, the decrease in landscape quality in areas where manmade development is poorly managed. The impacts are liable to be greater on tourism, as the gulf loses its image as a «high quality living environment». The results of water sampling are published in the media and beach closure causes uproar.

Tourists may also be sensitive to the disappearance of a certain number of emblematic economic activities which guarantee the authentic and active image of the area, such as oyster farming, agriculture and fishing. However, the fall in the number of tourists may be curbed by **the development of what the hinterland has to offer**, based on local heritage (architecture, religion, culture), megalithism, natural sites and local events. The warm welcome and authenticity of the local population are emphasised; walking, cycling and horse riding are ways of discovering this area which deserves to emerge from the shadows of the shoreline. Furthermore, **this has the advantage of stretching out the tourist season** over a longer period than the summer months.

Finally, we can hope to see a new clientele arriving in the region, previously attracted by more southern areas, yet now put off by the droughts and heat waves that hit the south in the summer season. Furthermore, **it is possible that the gulf, a small, relatively sheltered inland sea**, may see other coastal areas affected by the impacts of climate change before being hit itself, and **may therefore benefit from the arrival of tourists from other more vulnerable coastal regions.**

It is therefore very difficult to predict how tourism will evolve in the gulf, as many factors come into play at different levels.

Impacts on governance

The State is unable to look beyond immediate local issues and invest in the long term in the two-fold challenge of sustainable environmental protection and the preservation of public finances. It cannot stand up to the pressure of economic lobbying to truly satisfy the most common and long term requirements. **Local councillors continue to be the main local decision-makers/developers, on a scale that is not necessarily relevant for action against climate change and its effects.**

Local councillors are the main decision-makers

"TECHNOLOGY TO THE RESCUE"

Taking all possible action to maintain urban development, infrastructures and activities on the coastline

This scenario takes full account of the marine flooding risks generated by climate change and the decision is made to respond to these risks using major technical and technological means. Structures able to mitigate the effects of climate change are constructed so as to maintain urban development, infrastructures and activities on the coastline at all costs.

Response with major technological means




Protection against risks

To protect property and human lives against marine flooding risks, new walls are built, existing walls are restored and heightened if need be, roads and engineering structures are raised up, ports are redesigned and protective structures (riprap, groynes etc.) are built in areas heavily affected by erosion.

The shoreline is therefore protected by a «barrier» composed of a continuous series of protective structures to safeguard the land against coastal flooding and erosion. Sectors thought not to be at risk are also equipped to prevent impacts from being transferred to these areas. Wherever possible, plants are grown over sea walls to reduce their visual impact, promote their maintenance and encourage the development of biodiversity.

So as to restrict flooding and storm surges in the gulf, **hydraulic gates are fitted at the entrance to the gulf**, linking the two peninsulas, accompanied by the creation of a power station drawing upon energy from marine currents.

Fitting of a hydraulic gate at the entrance to the gulf

Impacts on urbanisation

In order **to overcome the lack of available space on the coastline for urbanisation, the maritime area is occupied by building housing,** shops and offices on stilts over the water. **Artificial islands** are also built in the gulf, increasing the accommodation and activities on offer to tourists, who also enjoy the islands' appeal and exoticism. These new areas are also the opportunity to develop accommodation and infrastructures to high environmental standards, with crossings to the mainland by electric boats or yachts. New harbours are built to shelter these boats. Technology is also used to build bridges between the islands.

Creation of artificial islands

On land, automated dry ports are developed and composed of several underground layers of spaces for boats and cars, linked to the sea by a canal. Vertical construction saves a vast amount of space, and the system acts as a refuge for boats in the event of storms.

Scenario 3

Impacts on urbanisation

In urbanised areas, technological progress enables the optimisation of construction methods (high environmental standards, low energy etc.), transport means (electric vehicles) and the improvement of water management techniques (drainage systems, purification systems). **The area's technological dynamism strongly encourages the production of renewable energy** (development of offshore wind turbines, tidal power plants, wave power, etc.).

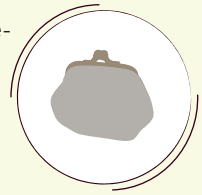
Renewable energy production

As far as land and property prices are concerned, even if properties are in danger, the State does not intervene in sales: the principle of supply and demand governs the market. A heavily threatened property will lose value and will be bought by an owner who can afford to protect it. An increase in land prices is expected in non-vulnerable coastal areas due to their scarcity. In vulnerable areas requiring protection, prices drop due to the high costs implied by the necessary infrastructure work: plots are therefore bought up by developers or individuals who can afford to set up protective structures against erosion and flooding.

Populations forced to leave the coast due to the expense involved move to the hinterland, where land prices also gradually start to climb. Finally, **some islands are privatised**, as the cost of protecting property and inhabitants (based on the number of permanent residents) is too high for the local authorities to handle.

Privatisation of some islands

Impacts on the economy



Certain economic activities benefit from technological progress to develop and adapt to new environmental, social and economic constraints.

To save space and boost production, **agriculture turns towards intensive farming** (factory livestock farming, soilless crop culture). Through technological progress, efficient effluent management, water purification and waste treatment systems are developed. Large crop farms drop sharply, hit partly by droughts and an increase in parasites and partly by heavy urban pressure. Farmland (and sometimes farmhouses) is made available to new residents. The gulf therefore continues to be urbanised. Finally, to deal with drought problems in summer, desalination plants are established and water is channelled to agricultural plots by aqueducts.

Creation of water desalination plants

Offshore shellfish farming

In terms of shellfish farming, new technologies are used to relocate production to pools cut off from the natural environment, or in the open sea, using floating systems. Oyster farms develop above the water (floating farms or farms on stilts). With the rise in water temperature, the production of oyster spat becomes possible. **Oyster farmers are nevertheless confronted with problems of sanitary water quality**, accentuated by the concentration of organisms due to new production techniques. These technical alterations require major investments, and only the most economically viable companies survive.

To maintain shellfish harvesting, which continues to attract tourists as long as the water quality allows it, **action is taken against the gradual disappearance of the foreshore by ensuring continual sediment input.**

Vessel fisheries benefit from the development of harbours to adapt to climate change (raising of wharfs and landing centres, protection of boats against storms by an appropriate port facility etc.).

Impacts on the environment

This scenario is a threat to the area's environmental quality: the construction of protective structures destroys coastal ecosystems, worksites are a source of pollution, closure of the gulf by gates leads to a drop in water quality and an alteration to marine and coastal ecosystems, the entirely walled shoreline is disfigured.

Scenario 3

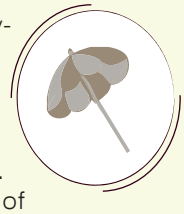
Impacts on the economy

Over and above this aspect, the activity itself is relatively unaffected. The fishermen themselves however may be forced to leave their homes, if they cannot afford to protect them when they are close to the coast, and may encounter difficulties in finding new accommodation near their workplace.

Creation of jobs

The construction of different protective structures leads to an explosion of building trades (civil engineering etc.) and creates many jobs. However, like for fishermen and oyster farmers, the workers are confronted with major difficulties in finding accommodation near the worksites.

Impact on tourism



Tourists feel reassured by the deployment of protective structures which ensure the safety of property and people. However, **the artificialization of the coastline may have a very negative impact on the area's appeal.** The aesthetics and visual integration of structures play a predominant role in the future of tourism. Yet behind protective structures and high sea walls, the sea view is sometimes difficult to preserve for walkers.

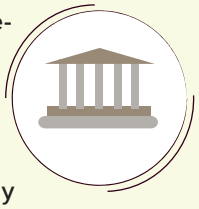
The supply of quality accommodation is developed (hotels built to high environmental standards directly on the seafront, trips in electric boats etc.), **yet takes away from the area's authentic appeal.** Houses on stilts are not traditional yet nevertheless strive to attract a clientele attached to the gulf's character. However, to attract new tourists, professionals bank on the development of a variety of activities, in particular through the creation of watersports centres.

Development of watersports centres

Furthermore, navigation in the gulf, already less demanding than in the open sea, is greatly facilitated by the reduction in currents caused by the closure of the gulf: it is made easily accessible to beginners.

Walkers are liable to find themselves deprived of coastal paths, which become gradually «stuck» between the sea and protective walls around properties. They can nevertheless be established along walls, or replaced by passages on stilts.

Impacts on the governance



The planning of coastline management (and therefore of protective structures) is conducted on a large scale so as to ensure consistent and efficient action.

State withdrawal

This extremely costly scenario is at the expense of the financial withdrawal of the State, which limits its role to investment in technological evolutions. This involves research programmes, tenders or competitions in different fields such as urban planning, energy, infrastructures, or transport.

Local authorities are financial responsible for the cost of infrastructures, until they can no longer afford to fund them and turn to the private sector. Therefore, **most public funding is used to finance protective structures, at the expense of social, cultural and educational aspects. This does not encourage permanent residents to stay.** Private players impose rates higher than communes for the construction/management of infrastructures, and are free to build excessive structures (towers, private runways etc.).

This also implies that **the coastline is more than ever the reserve of a privileged clientele**, able to pay for the construction and maintenance of protective structures. **This results in an ageing coastal population and the phenomenon of second homes, at the expense of local working populations who cannot afford to live in these areas.**

The State also declines responsibility for risk management, as it no longer has the human or financial means to address the growing issue. Coastal residents must therefore take their safety into their own hands and only have their own means to rely on. In some cases, they form associations to pool their resources and skills, or commission private operators to conduct their projects.

Safety ensured by inhabitants

From a legal point of view, this scenario implies either an amendment to the law (Coastal Law and Water Framework Directive for instance) to allow the installation of major protective structures; or the allocation of authorisations for the occupation of the Maritime Public Domain.

Adaptive strategy scenarios

The scenarios obtained describe three possible evolutions in the gulf of Morbihan in the face of climate change. These scenarios are intended as tools and offer many advantages, in particular by facilitating the development of an adaptive strategy for the area by:

- Increasing the availability, accessibility and relevance of knowledge and information
- Helping to organise and interpret our thoughts on the future and to understand how to create the necessary conditions to reach the desired future
- Enabling local actors to let their imagination run wild to conceive possible futures, by encouraging more pro-active attitudes towards adaptation and by increasing the understanding of inter-relations between processes and players operating on different levels
- Involving local players in a participatory approach to coastal zone management and long term decision-making, giving the scenarios greater legitimacy and credibility
- Encouraging dialogue between different groups of players who therefore develop a common frame of reference (knowledge, language)
- Increasing players' capacity to think strategically, to commit, to work towards a consensus, and helping them to identify and develop more robust adaptive strategies
- Facilitating and guiding decision-making within the complex context of climate change, in which the risks are real, yet are accompanied by many uncertainties
- Increasing the chances of success of the subsequent implementation of jointly defined actions.

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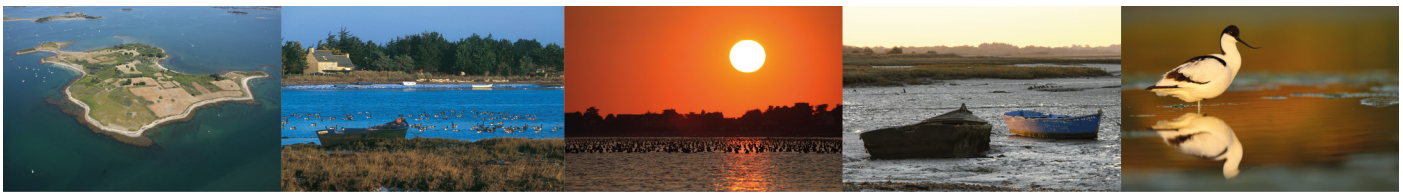

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Produced by : UBO and SIAGM, june 2011
To quote this document : Houin R., Philippe M., Cassé M., Pasco R., Herry J., Bailly D., Boncoeur J., Hay J., Julien S., 2011. Scenarios on the evolution of the gulf of Morbihan due to climate change. Interreg 4B ENO IMCORE project, www.littoral-et-changement-climatique.fr.