Integrated coastal zone management in the Mediterranean

from local to regional, how to stop the loss of biodiversity ?

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Workshop 2

The ICZM coping with Climate Change

1. CLIMATE CHANGE IN THE MEDITERRANEAN

1.1. Nature of the phenomenon

It has now been proved that the climate is changing and IPCC's last report shows that the areas surrounding the Mediterranean are "hotspots". The models associated with IPCC's A1B scenario (see Box 1) suggest that there will be an average rise in annual temperatures of 2.2 to 5.1°C by the end of the century, i.e. much higher than the world's average rise, even if we will not be able to detect this rise with certainty for 15 to 25 years. The rise should be higher inland than on coasts, at sea or on islands, and it should be more notable in summer (2.7 to 6.5°C) than in winter (1.7 to 4.6°C). There will be more heat waves and they will be longer and more intense, with more dry days exceeding 40°C, which will increase the risk of deaths and forest fires.

Forecasts also suggest that annual rainfalls will drop by 4 to 27%, and once again this phenomenon will be more notable in summer than in winter. North Africa will be particularly affected, given that a reduction has already been observed over the last decades in Cyprus, Spain, Greece, Israel, Italy and Turkey. Therefore, droughts should also be more frequent and more intense. All combined these signs of climate change help to exacerbate already acute fresh water problems in the Mediterranean, i.e. increased evaporation, rarefaction of the resource, salinization of coastal aquifers. At the same time, episodes of strong rain my increase rather than decrease.

Finally, it is still difficult to forecast the rise in sea level at regional level, especially in the Mediterranean basin. It could reach 23 to 47 cm by the end of the 21st century according to IPCC, whose 2007 forecasts are considered as optimistic. If this happens, many Mediterranean regions would be susceptible to submergence or erosion, among which we can cite the extreme cases of the archipelago of Kerkennah in Tunisia, Alexandria and the Nile Delta in Egypt, Thessalonica in Greece and even Venice in Italy.

There are still many uncertainties with regard to climate change modelling and these uncertainties are not necessarily decreasing as progress is made in research dedicated to the climate and which IPCC summarizes in its reports. For a given scenario on greenhouse-gas emission, the ranges of uncertainty remain wide, and neither the most optimistic nor the most pessimistic scenarios can be excluded. For example, the IPCC's simulations do not take into account the behaviour of ice caps which could be responsible for about 30% of sea-level rise.

In this document, we have chosen to work with figures provided by IPCC based on scenario A1B which is usually used for popularization and often qualified as "intermediary" even if it corresponds to an economy which is still very energy-intensive – it includes sustained economic growth, a demography stabilized by 2050, energy sources evenly balanced between fossil energy and other energies (nuclear, renewable) and the rapid introduction of new technologies. However, it is not more probable or less probable than another scenario: everything still depends upon demographic, economic, and technological evolutions and the decisions made within the framework of international negotiations on the climate.

Box 1. Some details on figures relating to climate change

1.2. Vulnerability and impacts on Mediterranean coasts

The IPCC defines climate vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity".

Mediterranean societies and their environment are proving to be very vulnerable to current and future climate changes for natural reasons (historically limited water resources for example) and because of development modes – particularly coastal development and intensive development of coastal tourism. Therefore, climate change is an emerging threat which presents two major, constantly interacting challenges: (i) it magnifies the strain on ecosystems that have already been deteriorated by pollution, the destruction of habitats or the over-exploitation of natural resources; (ii) it calls into question development strategies of the past – or the present – in the light of new physical conditions it imposes or suggests.

Climate change impacts are extremely varied, linking the changes themselves (temperatures, rainfall, winds, increases in sea level, etc.) with all socio-economic sectors and natural systems. As for the latter, the potential effects are produced at different levels of biological organisation, from physiological dysfunctions of individuals to modifications of a community and its functioning, via local extirpations or/and the extension of certain species (notably invasive species). All the forecasts concerning the consequences of global warming on biodiversity as a whole are very worrying. Based on a moderate climate change scenario, it is now predicted that 15 to 37% of Mediterranean species will be extinct by 2050 (UNEP-MAP-CAR/ASP, 2008). The impact on fishing resources particularly could be devastating given that most stocks have already been very much reduced by over-fishing.

It would be fastidious to enter into a full review of the potential effects of climate change but the increase in sea level is of prime importance in discussions on integrated coastal zone management and it illustrates the challenges and their interrelations well. Such an increase, which is already perceptible and likely to accelerate, would affect:

- Ecosystems : beaches, dunes, lidos, lagoons and marshes are the unique or favoured habitats of many animal and plant species and would be affected by accelerated erosion. The ecological function of lagoons, for example, is very dependent on their depth and salinity and these are likely to change. Mediterranean wetlands as a whole, which have already been put to a severe test by human development, are very vulnerable to an increase in water levels as the spatial evolution of many of them has been limited by infrastructures, dikes and dwellings.
- Human installations: as development has taken place mainly in coastal zones, loss of constructions or agricultural land to flooding by the sea (temporary flooding) seems a real threat. The gradual receding of the shore line brings installations near the shore closer and closer to the waves.

In its introduction, the ICZM Protocol shows how worried Mediterranean countries are about the "risks threatening coastal zones due to climate change" and expresses "the need to adopt sustainable measures to reduce the negative impact of natural phenomena[1]". It then calls upon the Parties to take "prevention, mitigation and adaptation measures to address the effects (...) of climate change[2]" and "adopt the necessary measures to maintain or restore the natural capacity of the coast to adapt to changes, including those caused by the rise in sea levels[3]".

Therefore, to deal with climate threats, the Protocol underlines the need to both reduce greenhouse gases (prevention), and adapt to the effects that cannot be avoided. This framework document will focus on this second line of action.

2. ADAPTING TO CLIMATE CHANGE

2.1. Definition

The ICZM defines adaptation as an "adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities".

Generally, we can distinguish various types of adaptation, notably:

- anticipatory or reactive adaptation, i.e. before or after the occurrence of the phenomenon that we need to adapt to;
- public or private;
- Autonomous or planned.

2.2. Coping with the rise in sea level

To cope with the rise in sea level, three main types of adaptation are usually presented, over and above non-action: protection, "accommodation" and strategic retreat. Table 1 summarises some of the advantages and drawbacks. On this basis, we can further explore[4] examples of strategies to promote the conservation of coastal ecosystems, then the protection of human installations.

[1] Introduction, paragraph 5.

[2] Article 22.

[3] Article 23.

[4] According to Carreno et al., 2008.

Strategies	Advantages	Drawbacks
Protection Freeze coast line (dikes, rock-armour) or deal with causes of erosion (breakwaters, jetties, re-depositing sand)	Efficiently solves local problems Very socially acceptable	High cost The phenomenon of erosion is simply moved to other sectors Disruption of sedimentological function
« Accommodation » (adjustment in natural or human systems to a new or changing environment) Adapt to the phenomenon by enacting construction regulations (zoning, raising foundations, etc.), and measures to compensate for property or systems destroyed	A gain of space and conservation of natural shore condition Local policy Low cost Compensation and extra cost of protecting shore are avoided	Local measures and not uniform Measures do not meet long-term imperative
Strategic retreat Move the objects threatened further inland	More efficient in the short and long-term No maintenance No impact on sedimentary function	A need for space inland and land where infrastructures and activities can be moved to Difficult to implement in zones where socio-economic interests are important or infrastructures and urbanisation are extensive Not very socially acceptable
Non-action Decide not to take any action	Preserve natural functions	Implementation limited to natural areas where very little is at stake

Table 1. Advantages and drawbacks of different adaptation options to cope with the rise in sea level (according to Carreno et al., 2008)

Strategies for the conservation of coastal ecosystems:

- Allow environments to adapt on their own: do not let infrastructures prevent them from evolving, therefore move some of the existing ones and avoid building new ones by creating un-constructible zones (100-metre strip, 100 years, etc.). Climate change should also be integrated into environmental impact studies and into land-use and town-planning documents.
- Strengthen the ability of coastal habitats and species to adapt on their own: climate threats are exacerbating phenomenon that already exist (fragmentation of ecosystems, pollution, over-exploitation, etc.), it increases the need for more protected areas that are larger, better located, better managed, more interconnected (networks of protected areas, corridors, greenbelts, etc.), and the need to reduce or move sources of occasional pollution (urban and industrial pollution) and diffuse pollution (agricultural).

Strategies for the protection of human installations:

- Plan the strategic retreat: move coastal installations inland to protect them from coastal hazards, i.e. make the coastal zones less artificial. Of course, it may be difficult to get the different players involved to accept this but experience shows that when the stakes are quite low, the process can be understood; to such an extent that many cases have already been noted in the Mediterranean.
- Manage the risk by introducing risk prevention plans, town planning programmes, and by making it illegal to build on strips of 100 or more metres (100 years, 2 metres altitude, etc.).
- Use insurance and compensation mechanisms which are sometimes more effective and less costly than other types of measures. Use the price of insurance and even the impossibility to insuring property for eviction purposes.
- Use strong defences to protect the coast when there is no other alternative (an environment which is highly urbanised, a very active economy which cannot be moved, etc.).

2.3. Adopting new decision-making modes

Implementing adaptation strategies finally requires an in-depth revision of the way decisions are taken on investment and land-use. In short, the most robust solutions should be chosen (whatever the future evolution of the climate in a plausible range) instead of trying to find the best solution(s) for a given climate scenario. Hallegatte (2008) provides four sets of guidelines to taking more robust decisions:

- Institutionalize long-term planning and ensure a regular revision process to take account of the new information available. Adaptation is a continuous learning process.
- Promote "no-regret strategies" i.e. strategies that reduce vulnerability of a system at negative, null or negligible cost (by taking "pessimistic" margins in the design stage of an infrastructure rather than having to conduct further work later, for example).
- Favour strategies that are reversible over irreversible choices: for example, refusing to urbanise has a well known short-term cost, but if new information shows

in the future that the area is safe, urbanisation can be allowed virtually overnight. Allowing urbanisation now, on the other hand, yields short-term benefits, but if the area is found dangerous in the future, the choice will be between retreat and protection, two options which are often extremely costly and not always feasible.

- Avoid focussing on technical adaptation solutions: sometimes institutional or financial tools can be more appropriate (for example insurance schemes for agriculture or the implementation of early warning systems rather than costly coastal protection). The key advantage of these "soft" adaptation options is that they imply much less inertia and irreversibility.

In the end, we see that adapting to climate change has a great deal in common with integrated coastal zone management. We shall now describe the link between these two notions, how they interact and under what conditions they can work in synergy.

3. ICZM AND ADAPTING TO CLIMATE CHANGE

3.1. Shared principles

First of all, we should point out that ICZM and adaptation share the same general sustainable development objective – the sustainability of human activities and their underlying ecosystems. Adaptation aims to "reduce the negative impact[6]" of climate change which could ensure sustainability, while article 5-a of the Protocol indicates that ICZM aims to "facilitate (...) the sustainable development of coastal zones". More precisely, the Protocol explicitly states that one of ICZM's aims is to prevent natural risks. We see this in article 5-e which specifies that ICZM should strive to "prevent and/or reduce the effects of natural hazards and in particular of climate change, which can be induced by natural or human activities". It should also be stressed that "the preservation of the integrity of coastal ecosystems" and thus biodiversity, which is one of the main objectives of ICZM[7], has a major role to play in the field of adaptation. Indeed, efficient coastal ecosystems provide many services which help combat the impacts of climate change (wetlands and availability of water resources, dunes and erosion, etc.).

There are also some obvious overlapping principles: coordination, participation of stakeholders in decision-making processes, discussions between scientists and managers, etc. As stated by the ICZM Protocol and the IPCC respectively, ICZM and adaptation are intended to be continuous, dynamic processes[8] of decision-making and "adjustment[9]", which do not imply reaching a stable, utopian condition: managing a coastal zone is never totally "integrated" and a coastal system can never be totally "adapted". Therefore, the long-term is a crucial aspect of these two approaches which necessarily integrate future demographic, economic, ecological and social changes that coastal regions experience.

3.2. ICZM as a tool for adaptation: the example of the Protocol

These shared objectives – sustainable development in general and prevention of natural risks in particular – and the shared principles have corresponding implementation tools that are partially similar. Thus, several of the Protocol's measures should contribute to adaptation to climate change.

As far as sectoral measures are concerned, there are tools to assess projects that could impact the coastal environment which the Protocol states should be used for two purposes, i.e. "environmental assessment[10]" and "risk assessment[11]". By contributing to the prevention of coastal erosion and the protection of biodiversity, regulations on the extraction of sand and river sediment[12] could also contribute to adaptation to climate change and ICZM implementation. In addition, institutional coordination, which is greatly encouraged by the Protocol[13], would lead to the "reconciliation» of marine and land administrations, based on a scheme of integration. It could bring together the themes of "Biodiversity" and "Climate" and also the competent departments which are often prevented from working together because of the compartmentalisation of Conventions and the resulting administrative divisions. Finally, the Protocol encourages Parties to "develop scientific and technical research[14]" and in general "promote scientific and technical research on integrated coastal zone management[15]". In this way, scientists could help assess coastal regions' vulnerability to climate changes and guide decision-makers towards suitable solutions to land-use issues.

From a more cross-sectoral point of view, policies and schemes on land-use and urban development, i.e. the "rational planning of activities[16]", constitute basic tools in ICZM and in adaptation. The actual idea of integration requires States and local authorities to avoid any "spreading out" of sectoral adaptation measures which are not strategically linked to each other. It is essential that the integrated tools for ICZM implementation ("coastal strategies, plans and programmes"), which are required by article 18 of the Protocol, integrate climate change issues and particularly adaptation solutions. In this context, the level at which such documents are drawn up will be just as important as the competent authority: as the Protocol states, "coastal plans and programmes" should be drawn up at "an appropriate territorial level[17]".

Henceforth, it is essential these documents be applied to homogenous parts of the coast but failing this, the specific characteristics of each part should at least be taken into consideration, especially their vulnerability to climate change. Therefore, it would be inappropriate to apply the same adaptation policies to coastal zones with radically different geomorphic characteristics (coastal topography, susceptibility to erosion, etc.) and economic or social characteristics (a community's dependence on coastal activities, etc.). For example, although it has been proven that a non-constructible

[10] Article 19.
[11] Article 6-i.
[12] Article 9-d(ii).
[13] Article 7
[14] Article 25-1-b.
[6] IPCC definition
[15] Article 25-2.
[16] Article 5-a.
[7] Article 5-d.
[17] Article 18-3.
[8] Article 2-f.
[9] IPCC definition.

strip along coastlines can preserve coastal ecosystems and protect communities from flooding and erosion, its ideal width very much depends on local circumstances. In some cases, the one hundred metres specified in article 8-2 of the Protocol are sufficient. In other cases, using the "one hundred years strip" will be more pertinent, necessitating a study on the probability of coastal erosion and rise in sea level. Moreover, much depends on the types of land-use envisaged (see Figure 1). Therefore, the difficulty lies in coinciding the administrative territory, planning document implementation zone and physical territory with the same characteristics.

Figure 1. Propositions for rational management of coastal areas in a situation where the shore line retreats (according to Cazes-Duvat and Paskoff, 2004[18])

[18] V. Cazes-Duvat, R. Paskoff, 2004. Les littoraux des Mascareignes entre nature et aménagement, L'Harmattan, Paris.

4. FOOD FOR THOUGHT

4.1. Adaptation: can we succeed where we failed in the past?

When exploring the link between integrated coastal zone management and climate change, we should not lose sight of the fact that climate change mainly comes into play by accentuating threats and problems – sometimes opportunities – that already exist. Problems in Mediterranean coastal zones do not stem from the impact of climate change but from the impact of unsustainable development models so far adopted by the societies concerned. The problem of erosion is a good example of this. It is a major challenge for many Mediterranean coastal zones but it is mainly related to:

- coastal installations: sea defence facilities which prevent shore drift and accelerate erosion down shore, walls and rock armour at the top of the beach, destruction of dunes by treading or construction, etc.
- river installations: it is estimated that sediment input from rivers decreased by 90% in the second half of the 20th century because of the construction of dams and the massive extraction of granular material.

However, climate change amplifies existing threats, sometimes in a decisive way by bringing out threshold effects, with ecosystem functions for example. It encourages the "over-sizing" of certain policies so as to have the latitude to cope with a very uncertain future, and above all it raises old questions by calling upon Mediterranean societies to succeed where they have failed in the past decades, i.e. to reconcile economic development with the sustainable management of coastal zones.

4.2. A need for expertise which is contextualised and anchored in the territories

The historical weakness of research on adaptation has meant that experts have tended to communicate mainly about risks and can offer few solutions. Although this approach is important, it is often badly received by the players directly concerned. Moreover, even when describing risks, there is a need for more local modelling and information but these are often given on a global scale or at best a regional scale. For example, figures on impacts or adaptation strategies in terms of GDP points do not indicate "who will lose out and where", which is essential if appropriate public policies which are favourable to "losers" are to be developed. Yet the objectives, interests and reasoning of the different players with regard to climate impacts and adaptation strategies are often divergent. Adaptation should not pretend to ignore these divergences but should recognise them and deal with them using the array of tools available: participation, negotiation, mediation, communication, reaching a consensus but also arbitrating in favour of some interests to the detriment of others. Adaptation and integrated coastal zone management should remain horizons which we strive to reach via continuous, contextualised processes and not via stereotype procedures.

4.3. Is there a synergy between protection of coastal zones, the fight against climate change and adaptation to its impacts?

This document has focussed on the many synergies that exist between ICZM and adaptation to climate change because it is only logical to concentrate first on courses and measures that could produce positive impacts at all levels. However, it is important to note that these synergies have their limits and in some cases it will be necessary to arbitrate and choose priorities:

- Adaptation may involve the implementation of greater coastal defence mechanisms which usually interfere with the natural processes underlying ecosystem services.
- The possible effects of climate change on coasts (rise in sea level, coastal erosion, changes in the way ecosystems function) could exacerbate disputes on the use of areas and resources – these types of disputes are already common in Mediterranean coastal zones. Moreover, unless there is a sound strategic framework based on ICZM, the probable increase in extreme weather conditions (storms, increased rainfall, droughts, etc.) could lead to the adoption of limited, crisis measures which in the end correspond to a "bad adaptation".

- Reducing emissions could also have negative consequences on coastal zones: we are referring to the renewed construction of dams on rivers to produce energy which negatively effect integrated coastal zone management and adaptation. On the other hand, even if this is not the purpose of this document, ICZM can help reduce emissions (transport planning, etc.).
- Finally, we should remember that there are many examples of adaptation measures which have a negative impact in terms of reducing greenhouse gas emissions: desalting plants, air-conditioning, etc.

These points illustrate the need to implement integrated adaptation approaches which include impact studies on the environment and climate. At the same time, climate concerns should be integrated into development processes in general[19], and into coastal strategies, plans and programmes in particular.

[19] This corresponds to the English notion of "mainstreaming".

4.4. Can we depend on climatologists? (Un) certainties and integrated coastal zone management

Hallegatte (2008) considers that climate change represents much more than a change in climatic conditions: for decision-makers it represents increased uncertainties. Climate models are badly adapted to existing decision-making frameworks and the uncertainties they raise are not residual: they are not even starting to lessen and, whatever the case, the future climate greatly depends on future greenhouse gas emissions which depend on decisions that have not yet been taken (see Box 1). The basic uncertainty on climate change will not be dispelled in the coming years: decision-makers should not count on climatologists, economists and other modellers to help them avoid making difficult decisions in uncertain contexts.

Therefore, managers should definitely not suspend all decisions until a perfect – and illusory – knowledge of ideal adaptation measures is found for a given coastal zone. To the contrary, they should learn how to govern in a state of uncertainty and to base their actions on scientific data that is often incomplete. Adaptation strategies should basically be robust to cope with a wide array of possible futures. Thus, climate change resembles a range of futures that are not improbable and for which the current climate scenarios provide an initial estimation, without indicating that such and such a scenario is more or less probable than another.

Finally, it is clear that public and private players involved in coastal issues should improve the way they use information on the climate, i.e. should integrate it more into their policies, development plans, business plans, etc. Nevertheless, the main change that global warming will bring may not be actual weather changes but (i) uncertainties about future climatic conditions – which were marginal in previous centuries and which could be ignored in the decision-making process[20] ; (ii) uncertainties about future policies on the reduction of greenhouse gas emissions and their structuring effect on all economic sectors.

[20] Hallegatte, 2008.

The prospect of climate change is an opportunity (which also brings its constraints) for Mediterranean States to reappraise their medium and long-term strategies for the development and management of coastal zones. This study should be conducted and implemented very soon without losing sight of the fact that:

- For many players, climate change is synonymous with hypothetical problems that could materialise in the next 20 to 30 years while their action is guided by definite problems that they have to deal with now.
- According to most of the models currently available, if average temperatures stabilise at +2°C (the objective expressed by the European Union), major changes in our modes of development should ensue. Therefore, all the forecasts we can make for the medium and long-term should be envisaged in a society that has been profoundly transformed by the pursuit of this objective, or with climate changes that are much more radical than we usually imagine.

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