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Climate Change Vulnerability: Planning Challenges for Small Islands

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Introduction

What will happen to the small islands under the climate change scenarios currently envisaged? Despite the fact that island societies are small contributors to climate change due to their restricted populations and their production and consumption patterns, 'they will suffer disproportionately from the damaging impacts of climate change' (United Nations Framework Convention on Climate Change (UNFCCC), 2007, p7). This vulnerability is largely the result of insularity or 'islandness' (Baldacchino, 2004, p272), their small size, remoteness and low accessibility, combined with unique and fragile natural and cultural environments. Due to their small size and the subsequent lack of natural resources (Tompkins et al, 2005), economies of scale are unattainable and therefore competitiveness in the world markets very low. At the same time, their economies – just like other peripheral and coastal areas – are usually characterized by mono-activity based on the exploitation of natural resources (e.g. agriculture, fishery, mining and tourism) that are excessively dependent on international trade. The issues related to their remoteness, adaptive capacity and accessibility increase the operational cost for enterprises,

households and governance (administration and infrastructure) as well as for mitigation and adaptation measures. However, with their well-preserved local assets, customs and practices, these small islands have the potential to provide the exemplars of sustainability and endurance in the wake of a changing climate.

In this chapter, we discuss the various characteristics of small islands, especially those features that render them amongst the areas most susceptible to climate change. These vulnerability issues are discussed first within the context of small islands. The specific case of the Aegean Islands in Greece is then set out in detail to demonstrate the urgent need for proactive spatial planning, along with suggestions for further action.

The global situation of small islands

Islands face a number of difficulties within contemporary global and national relations. Their socio-economic and political status is mixed: some form independent states of one or more islands (also termed as Small Island Developing States (SIDS)); others are autonomous or administrative regions; and a

third group comprises the parts of nearby or far away continental states. In all cases, they may appear to have a limited role in the global social, economic, cultural and political arena, as discussed below.

A large body of literature has been developed for the SIDS, which are explicitly identified in Agenda 21 chapter 17 (UN, 1992) as particularly vulnerable areas that have to be managed in an integrated way in order to achieve global sustainability goals. The Barbados Conference in 1994, and subsequently the Mauritius Declaration (2005), followed by the Programme of Action for the Sustainable Development of Small Island Developing States (www.sidsnet.org/) have highlighted the potential significance of climate change impacts. Data collection systems and methods are also developed in order to assess impacts and propose effective policies (Tompkins et al, 2005; Gilman et al, 2006; UNFCCC, 2007). Programmes such as the South Pacific Sea Level and Climate Monitoring project (SPSLCM) and Caribbean Planning for Adaptation to Climate Change (CPACC) have created monitoring and observation networks for Pacific SIDS and Caribbean SIDS, respectively.

As regards the second group of the autonomous or administrative island regions, Chapter 16 of the Intergovernmental Panel on Climate Change (IPCC) Working Group II's Report on 'Impacts, adaptation and vulnerability' (see Mimura et al, 2007) focuses on their vulnerabilities to climate change impacts. Particular focus in the report is on policy implications and adaptive measures to sea-level rise in the 'autonomous small islands predominantly located in the tropical and sub-tropical regions' (Mimura et al, 2007, p690). Major vulnerabilities identified in the report include: sea-level rise and its effects on infrastructure; lower precipitation leading to limited fresh-water resources, as forecast by the IPCC Special Report on Emissions Scenarios (IPCC, 2000); varying degrees of effects on natural systems (flora and fauna) and displacement of species; effects on local agriculture (food security), tourism and human health. The report acknowledges the low adaptive capacity of island systems, discusses

opportunities and constraints from the examples of SIDS, and recommends a number of integrated measures for adaptation and capacity building by means of public engagement and traditional local knowledge.

For small islands, archipelagos and regions that form parts of the EU member states, there have been efforts under way by various think tanks and regional networks (e.g. Islands Commission of the Conference of the Peripheral and Maritime Regions of Europe (CPMR)) to raise policy-level recognition of the specific attributes of small islands that should be taken into account at the national and European scales. Today, climate change is considered as one of the main external factors (along with globalization) in discussion of European islands' policy. However, these discussions primarily relate to consideration of impacts on territorial cohesion and balanced development in the insular regions, rather than specifically focusing on appropriate mitigation and adaptation measures.

In the Mediterranean region, the Mediterranean Action Plan (MAP), sponsored by the United Nations Environmental Programme (UNEP), has put climate change as one of the seven essential issues in its Strategy for Sustainable Development, endorsed by the 21 Contracting Parties in 2005 (MAP, 2005). While sea level rise is viewed as a major threat, the rise of temperature will exacerbate problems such as lack of water, reduction of wetlands area, invasion of new species and migration or extinction of existing ones, desertification and loss of agricultural productivity. These impacts, combined with the growing population pressure from both sides of the Mediterranean Sea, lead to continued degradation of the environment (Benoit and Comeau, 2005). Different policy measures have been proposed, promoting Integrated Coastal Zone Management and efficient use of energy, water and renewable resources, in order to reduce growing environmental pressures. All these measures focus on the issues of high vulnerability of small islands and the low adaptive capacities of their resources.

Vulnerability and adaptive capacity of small islands

As mentioned in Chapter 1, vulnerability is a function of both exposure and sensitivity. Islands are among the most vulnerable places, and hence, have to develop 'mitigation-friendly' adaptive measures to become resilient to the impacts of climate change. Furthermore, as Halsnæs and Laursen (Chapter 7) argue, vulnerability is both a social and a development issue. As regards small islands, this relates to the peripherality and marginality from the mainland areas. In this respect, vulnerability does not remain invariable for all islands: size, morphology and geographical location differentiate the impacts. For example, under all projections of sea-level rise scenarios (Chapter 18), small and low-lying islands could see large parts of their coastlines submerged by sea and lose a significant part of their resources and coastal developments. Islands located in tropical zones are more likely to suffer from frequent and vigorous tropical cyclones and hurricanes, droughts and desertification, threatening human and ecosystem safety and making sustainable development difficult. Tompkins et al

(2005) have provided a number of vulnerability assessment indicators and tools (referring to agriculture, biodiversity, economy, natural resources and public health) along with examples and suggestions for adaptive measures on small islands (see Table 8.3). However, their proposed adaptation strategies give relatively less attention to mitigation, probably on the grounds that not only do greenhouse gas (GHG) emissions from small islands have relatively minor impacts on climate change but that mitigation may also mean cutting energy use in construction and transport, the two sectors that underpin mass tourism.

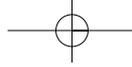
UNEP has recorded some characteristics of the 2000 most important islands of the world (islands.unep.ch). This figure is smaller than the actual number, but since national definitions also vary there is no definitive number of islands and the criteria against which the relative 'importance' is measured (e.g. in Greece UNEP records a total of 36 islands, while the number of inhabited islands in 2001 was 112). Fifty-two per cent of the islands that were recorded by UNEP are found in the Pacific Ocean, where the smaller ones in size are also located (median size of 136.9km²). Average altitude is lower for Arctic

Table 8.1 Altitude classes for islands according to the UNEP islands' data base

	Total N	Total with altitude data		Altitude classes %				
		N	%	< 50m (N = 127; 10.1% of total)	50–100m (N=72; 5.8% of total)	100–500m (N=397; 31.7% of total)	500–1000m (N=358; 28.6 of total)	> 1000m (N=298; 23.8 of total)
Pacific	1038	639	51,0	52,8	37,5	46,1	54,2	56,4
Atlantic	378	225	18,0	22,8	19,4	16,6	15,9	19,8
Indian	218	115	9,2	9,4	18,1	12,1	7,5	5,0
Arctic	170	135	10,8	10,2	16,7	14,9	8,9	6,4
Mediterranean	88	71	5,7	0,8	0,0	5,0	8,9	6,0
Southern Antarctic	79	45	3,6	0,0	0,0	3,3	4,5	5,4
Baltic	21	18	1,4	3,9	8,3	1,8	0,0	0,0
Rest*	8	4	0,3	0,0	0,0	0,3	0,0	1,0
Total	2000	1252	100	100	100	100	100	100

Note: * The category 'Rest' includes 8 islands that are classified from UNEP as being parts of the 'borders' between oceans (Atlantic/Pacific, Atlantic/Arctic, Indian/Pacific and Pacific/Arctic).

Source: islands.unpe.ch, processed by the authors.



most islands. At present, the island societies are ageing (18.8 per cent of population were over 65 in 2001 compared with the national average of 16 per cent), natural growth is negative and immigration trends are positive. Therefore, population stability can be largely attributed to immigration (especially foreign workers and Greek pensioners).

Despite common perceptions, the Aegean economy is based more on tourism and agriculture than on fisheries. Although agriculture has declined in the last decades, it still remains important.¹ However, the decline has significantly affected the overall land use patterns (see Kizos et al, 2007 for a more detailed analysis). Until the 1950s to 1960s, production was principally oriented towards self-sufficiency, with diversification of production and land uses, storage of raw or processed products and distribution to markets lowering risks and ensuring strong connection with markets in the dense communication networks of the area (Horden and Purcell, 2000). These features have generated characteristic landscape elements such as terraces, drystone walls, footpaths, traditional storehouses, windmills and water mills in the Aegean Islands. In general, the islands have limited fertile and flat arable areas as well as resource availability (especially irrigation water).

Organic agriculture (especially for permanent crops such as olives and lately for vegetables) and animal husbandry are increasing. Organic production does not involve less irrigation or lower grazing densities and therefore does not resolve vulnerability issues of water scarcity, soil degradation and erosion. Aquaculture has developed in the last two decades and is now a very dynamic and exporting sector for the whole Greek economy, with the Aegean Islands accounting for about 20 per cent of national activity.

Tourism is the most important activity in the majority of islands, balancing economic decline and population loss after the 1950s in some islands and affecting almost all with development pressures. In some, tourism (including related activities in commerce, restaurants, entertainment and transportation services) represent more than 50 per cent of GDP and employment, as

well as of energy and water consumption. A rich variety of localities, settings, accessibility and tourism development levels form the basis of the regional tourism industry. However, tourism is unequally developed both temporally and spatially (Spilanis and Vayanni, 2004). Tourists (approximately 3.5 million per annum) travel mainly if not exclusively in summer – most of the times with chartered flights (67 per cent in 2001). This increases vulnerability in terms of socio-economic activity with intense seasonal changes in transportation frequency and environmental pressure. Spatially, most of the hotel beds (250,000 in total) are found on a small number of islands: 44 per cent are found on Rhodes and Kos, and more than 65 per cent are found on six islands. The numbers of nights that tourists stay (more than 25 million in total) are even more unequally distributed, with 49 per cent on Rhodes and 23 per cent on Kos.

In addition to tourists, the presence of ‘vacationers’ (i.e. people who own houses in the islands but do not live there all year round) is very important in economic and social terms, but generates some of the most intense land use and landscape changes and environmental pressures (water and energy consumption, waste production). The local economy has benefited greatly from construction and associated activities.

Another key concern in these islands is housing developments. Land tenure and speculations can result in economic and social vulnerability on small islands. Data on new houses built on the Aegean Islands reveal that, with the exception of the Prefecture of Lesvos, the last 20 years have been a period of rapid house construction, at a greater rate than in Athens (Table 8.2). This has been accompanied by constant rise of land and house prices (e.g. prices for houses on Mykonos and Santorini are currently the highest in Greece). It is worth mentioning that local taxes are based on the size of area/land covered by the house rather than the value of the building itself, while construction and value-added taxes (VAT) are collected by the central government. Such tax regime encourages sprawl, and the resulting new constructions threaten landscape character in the



Table 8.2 Number of houses, new houses and their changes for Aegean Islands Prefectures

	Number of houses change %		Number of houses (2001)	New houses change %		New houses (2002)
	1961 to 1981	1981 to 2001		1996 to 2002	2000 to 2002	
Greece	72.5	37	5,476,162	47.9	43.5	128,297
Athens	140.7	26.5	1,529,998	35.1	20	26,177
Aegean Islands	21.5	40.1	330,697	51.3	56.6	8980

Source: Greek National Statistics Service, processed by the authors.

areas, raise land prices and turn all pieces of land into potential building plots. This simultaneously raises concerns about the vulnerable local natural resources and habitats. However, it remains such a powerful driving force that all restrictions to individual building permits largely end up in illegal construction, which is becoming a major problem throughout Greece, but mainly in the coastal zones.

The most important difference between tourists and vacationers arises from the demand for buildings, as vacation development requires more infrastructure and space. This fact puts additional pressure on the resources of the area, particularly fresh-water resources.

The consumption patterns of visitors have a double impact on the islands: a direct one from their own behaviour (high mobility; preference for fast ships and short stays; use of airplane, private car and air-conditioning; consumption of imported food and beverages; use of swimming pools; high water consumption; demand for big houses etc.) and an indirect one as they transform the perceptions, expectations and behaviour of the local population.

Conservation of natural resources on the Aegean Islands is based around the NATURA 2000 network that has been slowly developing since the late 1990s. Many rare and endemic species and specific habitats are found on Aegean Islands in a significant number of sites (15 per cent of the total, 28 sites of roughly 50,000ha with nine more sites in a second catalogue, www.minenv.gr). Although the actual management plans are not realized yet, it is used as a means of pressure for the protection of the environment. Many locals see protection as

barriers to 'development', especially in relation to building permits. So far, only two organised institutionalized efforts have been developed on islands in marine protected areas: one on the Ionian Islands (Zakynthos) for the protection of the sea turtle (*Caretta caretta*) and another on the Aegean Islands (Alonissos) for the protection of the monk seal (*Monachus monachus*). Their implementation was not without problems as the competencies of the Authorities of Natural Parks are not clear enough and financing from central government is not secured. Efforts of individuals and NGOs to protect certain areas have met fierce resistance and limited results. Such efforts often aim to block harmful practices of different public (national and local) and private actors, rather than planning initiatives for the protection or conservation of resources.

Other important environmental issues on the islands include water and waste management. Seasonal tourism demand makes the problems worse; as it is in the summer when water availability is naturally low. In many islands, water has to be delivered by special ships in the summer. In some islands desalination plants have been operating with conventional energy sources. A recent pilot project by the University of the Aegean desalinates sea water on an off-shore (floating) platform using wind power; wind power is also used in a recently constructed installation on Milos Island producing 2000m³ per day.

Energy is another major issue as demand increases annually. Growing tourism and second home activity as well as air-conditioning use are the main reasons for the increase in demand. Electricity is produced in 27 small or medium

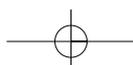
**Table 8.3** Type of climate change phenomena and their expected impacts for the Aegean Islands

Type of climate changes	Impacts
Increase of frequency of extreme events such as heat stress, drought or flood conditions Changes in precipitation and storminess Increased evaporation rates	Diminution of fresh water availability Increase of fires, runoff and soil erosion Increase of energy demand Destruction of man-made capital Changes in habitats and species Changes in agriculture and tourism activities
Sea level rise	Coastal erosion Change in shoreline Loss of beaches Coastal lands inundated Inundation of wetlands Destruction of human settlements, tourism investments and infrastructures Salinization of coastal aquifers and diminution of fresh water
Rise of sea temperature	Increase of sea's acidity Loss of sea-grass beds Changes in marine habitats and species Structural changes in the fisheries and aquaculture sector

Source: Based on Tompkins et al (2005).

size inefficient generation units using fossil fuels, producing power of high cost that is subsidized in order to keep the same price as on the mainland. Few islands are connected to the continental network and some islands have interconnections. The constant rise in demand repeatedly raises the issue of building new units or increasing the production potential of existing ones. Permanent connection via underground cables is facing economic, social and environmental problems. Renewable energy production is for the moment restricted to solar domestic water heating and small wind farms. Talk of solar and wind power developments have been delayed as the national plan for the spatial allocation of the units that will produce renewable energy production is still under discussion. Many locals and most NGOs react against the proposed development of wind farms with huge turbines (150m high) relative to the scale of the islands.

The question of a low carbon development trajectory for the Aegean Islands is still open to debate and tangled up with national energy plans: on the one hand, it seems that the renewable or 'clean' energy sources (solar, wave and wind power) are ideal choices for most of the islands, especially smaller ones, as they can easily be developed in small scale. On the other hand, if islands are not linked with the national network, 'conventional' energy power plants are necessary to complement all types of autonomous systems. The situation in Greece in general does not provide a basis for much optimism, as in recent years the energy supply has been based on imported power during the summer when demand is at peak. Moreover, the power plants planned for near future would still be using the lignite (low grade coal) as fuel.



Climatic vulnerabilities for the Aegean Islands

Three questions emerge: (a) What kind of vulnerabilities have been observed on the Aegean Islands? (b) What impacts are expected as a result of these vulnerabilities? (c) What kind of planning measures have to be implemented?

The main phenomena related to climate change on Aegean Islands (a mixture of slow onset changes and sudden extreme events, as described by Tompkins et al, 2005) and their expected impacts are summarized in Table 8.3. Although these phenomena have not been the subject of specific assessment at the level of Greece or that of the Aegean Islands, we will try to provide some evidence below.

As evidence of climate change, water scarcity is already an important issue as demand is growing and heat stress and droughts are becoming more frequent. In some islands precipitation has decreased as much as 25 per cent in the last ten years compared to the last century's average, while the salinization of local underground aquifers is becoming intense. Also, exotic species of algae and fishes are migrating into the Aegean from warmer seas. These vulnerabilities, along with the impacts identified in Table 8.3, will not only affect the capacity of islands to achieve sustainability and development goals (such as higher GDP, lower unemployment, and population well-being), but also endanger their viability.³ Since in most of the islands the majority of tourism infrastructure and activities are settled in coastal zones it is not hard to envisage situation of islands that will have difficulty pursuing tourism activity if scenarios of sea level rise materialize.⁴

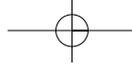
What would the content of mitigation and adaptation strategies be in this context? In terms of general mitigation measures, even if the small islands by themselves may not appear to be able to significantly diminish overall carbon emissions (the economic activity of Aegean Islands is less than 4 per cent of the Greek GDP), they can contribute with their own (limited) forces to achieve this goal, mainly by reducing the intensity of energy consumption per product unit

(e.g. per night spent) and by replacing fossil fuel uses by renewable sources. Although availing the public/private investments in such projects remains a challenge for small islands. The main potential for reducing GHGs lies in:

- changing consumption patterns for both tourists and permanent inhabitants (e.g. countering the increases in travel frequencies, transport activity and energy consumption per km by faster sea vessels);
- increasing energy efficiency of houses, both for tourism and private use. More and more hotels are now investing in reducing energy consumption (e.g. use of low energy lamps, interruption of electricity in a vacant room, interruption of air-conditioning when a window is open, etc.) but there is space for improvement;
- substituting conventional with renewable energy sources (such as wave-action and wind-power, etc.) via local and private initiatives.

There are also general options for the adaptation measures, such as to take action in order to reduce stress on the resources identified in Table 8.3 that are going to be most affected (i.e. fresh water, beaches, habitats and soil). Islands can invest in vulnerability reduction, as this is the main option to reduce the damage caused by environmental hazards. The causes of vulnerability are closely linked to an island's social, economic and geophysical characteristics (Tompkins et al, 2005) and to their development pattern.

The weakness of planning policy at the national level appears to have turned almost every piece of land in the Aegean region into prospective real estate. There is no overall planning or zoning that directs or constrains house building, except for some restrictions on NATURA 2000 sites that meet bitter local resentment. Even agricultural land can be transformed into housing development, as Greek legislation allows development of parcels of cultivated land of at least 0.4ha. Larger fields are divided and sold, bringing large earnings to ex-



farmers. This creates further demand to expand public infrastructure to service scattered development. The national land use plan does not consider putting restrictions on building; on the contrary, it promotes huge condo hotels and golf resorts (Ministry of Environment, Spatial Planning and Public Works, 2008)

At the same time, there are no restrictions to the type of houses that are built, except for some apparent regulations in settlements that are characterized as 'traditional'. Therefore, many of the buildings are far from sustainable: swimming pools are allowed with no restrictions even on islands with water scarcity instead of imposing the construction of cisterns for rainwater collection; there are no strict rules for energy use and new buildings tend to consume more energy than older ones for heating and especially cooling.

Water policy is another example. The overall state of the water resources is not audited or monitored. Even in cases where its quantity is not good, the response is not to attempt to reduce the demand, but to increase its supply. As surface water is lacking, drills reach deeper and deeper aquifers of decreasing quality. The construction of new dams, reservoirs and desalination plants are proposed as the only solution in order to deal with supply limitations. There are no concrete measures to reduce water consumption or to reduce the pressure on the carrying capacity of the islands.

This development approach increases vulnerability of islands in two ways. Firstly, it increases pressure on natural resources through the combination of unsustainable consumption patterns and climate change trends. This threatens, for example, irreversible impacts of water and biodiversity resources. Secondly, it places tourism – the most dynamic and competitive and often the only important activity for many islands – under threat by eroding a significant proportion of its assets (i.e. beaches, landscape, flora and fauna, a part of infrastructure built on shoreline). At the same time, the costs of the inputs that are necessary for tourism production (i.e. water, energy, food, transport, etc.) are rising. There is, therefore, a need for a more sustainable development path.

We maintain that this new sustainable development path has to be based upon two basic principles:

1 Qualitative versus quantitative and low cost production

Islands do not possess the resources necessary to sustain low cost and large-scale production without placing the overall system under stress. The formulation of policies that focus on the expansion of mass tourism and residential houses are unsustainable both locally and globally.

2 Proactive versus reactive policies⁵ in order to minimize risks

The preparation of realistic and applicable adaptation and mitigation strategies require visionary implementation plans based on public engagement (Chapter 23). As Tompkins et al (2005, p52) stress, 'clear trade-offs [...] have to be made between minimising the cost of adapting to climate change, minimising the risk of damages occurring, and ensuring that local voices are heard in the decision making process, so that local views and values can be taken into account'.

The components of a spatial planning framework for the Aegean Islands in terms of mitigation and adaptation measures, that can address these challenges, are likely to be based on the following key areas:

- Increasing the social responsibility of the population and of economic operators. In particular, local populations have to be persuaded to recognize the limitations of the current model and to invest in the opportunities offered by the alternatives.
- Adaptive land and coastal planning, with the use of participative procedures, to protect natural resources and avoid human exposure to high risks (e.g. extreme events).
- Increased environmental efficiency of households and of the public and private sector.
- Formalized marine reserves to protect marine fauna and flora from pollution and



over-use from human induced activities (e.g. aquaculture, fishing, maritime transport, yachting, etc.).

- Valorizing local natural and cultural resources to create high value-added tourism. As mass 3S (Sea, Sun and Sand) tourism efficiency is diminishing, it has to be substituted by other products incorporating sustainability principles (ESPON, 2006).
- The planning, implementation and institutionalization of monitoring schemes that will be used for evaluating current policies and planning for future ones.

Conclusion

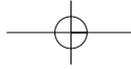
Islands represent a particularly vulnerable type of territory. This chapter demonstrates that vulnerability is as much a function of socio-economic and institutional characteristics as it is of physical features. Place-centred solutions must recognize this vulnerability and seek to reduce it in tandem with mitigation actions. These solutions have to recognize that mitigation will play a relatively small role in the level of adaptation required relative to the size, population and extreme vulnerability of island territories. This is despite the fact that there are important opportunities for island communities to develop low carbon systems as the basis of robust local economies. The Aegean Islands exhibit many of the shared challenges facing insular territories in relation to climate change. The major role that tourism and second homes play in the economy of the islands is a common feature of many islands worldwide. The chapter also establishes that this economic sector itself is very vulnerable to climate change as well as being a major driver of increasing vulnerability. There remain major conflicts between the current development path and the one that would reduce the islands' vulnerability. National leadership in policy and legislation needs to be instrumental in enabling the Aegean Islands to embrace a more sustainable development path. At the same time, the Aegean case also suggests the importance of securing support from local stakeholders in such a path.

Notes

- 1 8.9 per cent and 2.8 per cent of the GDP of the North and South Aegean Regions respectively came from agriculture in 2006, compared to 3.7 per cent for the country; 22 per cent and 8.7 per cent of the active population were employed in agriculture in 2001, compared to 14 per cent for the country.
- 2 The Statistical Office of the European Union (EUROSTAT) has developed a definition, for regional policy use: islands are all areas of size 1km² at least, permanently populated, with at least 50 inhabitants, separated from the continent by a water channel of at least 1km, not connected with the continent by permanent structures (tunnels, bridges) and where no state capitals are located.
- 3 As Aegean Islands are mountainous (even the smaller of them), they do not risk 'disappearing', unlike a lot of small ocean islands.
- 4 Even if studies for Greek islands are not available, this scenario seems to be confirmed in other Mediterranean islands (World Trade Organization (WTO), 2003, pp45-47).
- 5 An integrated policy for islands has to be adopted for European islands, with European, national and local authority involvement, following the subsidiarity principle.

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