Climate Change Adaptation

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There is the need for a legal instrument that would first and foremost establish the executive powers of a new entity with overarching responsibilities and powers over all the authorities that have sectoral responsibilities for climate change. Such a legal instrument should also identify these sectoral authorities and their responsibilities, preferably within an Annex which could be amended and adjusted in a flexible manner. This instrument should be managed by a new unit on climate change within MRA and it should ensure integration without causing fragmentation between the sectors. At the same time, retaining the sectoral input would ensure that there is no duplication of roles, that the institutions are specialised within their own field and that the overarching institution does not becomes a bottle neck. In other words, different competent authorities responsible for the different sectoral policies and obligations should remain, but these must be answerable to an institution that has executive powers to ensure compliance and to coordinate long and short term planning with respect to climate change targets and impacts.

By way of recommendation therefore, a legal instrument of this sort should seek to intervene as little as possible in the daily running of the sectoral policies and only apply its powers in situations of emergency when non compliance by the different sectors stalls the fulfilment of Malta's obligations. Its main role should be to ensure implementation of a National Strategy on Mitigation and Adaptation.

This legal instrument would not duplicate the role of public institutions that are already regulators for various sectors on climate change. It would however empower the new entity to take enforcement measures against the said institutions if they fail to do so. It would also ensure the implementation and enforcement of existing legislation that regulates the various sectors in order to rationalize their sustainable use and provide for conservation measures. This would benefit both the implementation of mitigation and adaptation measures.

An entity entrusted with the overall responsibility for climate change law and policy must be legally empowered to ensure the implementation of national adaptation programmes. It must also coordinate the various sectors to carry out the necessary research to adopt and implement mitigation and adaptation measures. It must necessarily be supported by a parallel capacity building process in the various entities that run the day-to- day implementation functions.

On an administrative level, without necessarily being included in a legal instrument, memoranda of understanding and stakeholder dialogue are indispensable tools to ensure cooperation. This will facilitate reaching mitigation and adaptation targets within the stipulated time frames. The mainstreaming of climate change impacts in national policies ensures the adoption of mitigation and adaptation measures and guarantees synergy and linkages amongst various public plans and programmes. Response to climate change should take place at a strategic level to assess beforehand the socio-economic impacts of any mitigation and adaptation measures adopted as a consequence prior to mainstreaming into national policy making.

The existing Regulations on the Strategic Environment Assessment already include climate change impacts as one of the issues that needs to be taken into consideration in an SEA. Furthermore, for all those situations where an SEA is not required, Maltese authorities should

promote pro-active adaptation measures such as, for example, in development planning, rather than take reactive adaptation measures.

The new climate change legal instrument must ensure effective monitoring and stakeholder engagement, particularly the involvement of NGOS and Local Councils which increases public awareness on climate change issues. The new law should also take into consideration national security issues relating to climate change when formulating mitigation and adaptation strategies.

The new law should also target the development of a research programme for climate change, including access to funding programmes. It is vital that Investment in research and development in all sectors should not remain on a voluntary basis. It will provide local industry with the necessary technology and it will generate specialised local expertise in a rapidly growing sector that is assuming a tremendous economic potential. Procrastination is detrimental on two main fronts. First because Malta will miss out in securing a place in this niche-market and second because we will keep relying upon foreign technology and expertise.

Since Malta can rely on and pool from the scientific and technical advice of the European Environmental agency, it is best to concentrate on investing in scientific and technical research that addresses the local scenario. This should be earmarked as a priority for EU funded projects and care should be taken not to duplicate research conducted by EU agencies to which Malta has access, but rather to build upon it and apply it at the local level. It is also essential to include as a legal obligation the publication to civil society of information acquired as a result of research conducted at the EU level or carried out locally.

It must be ensured that all sectors surmount the constraints due to the lack of a sound knowledge base on local ecosystem dynamics. Filling such a gap would serve to build local scientific evidence that would identify to what extent marine, terrestrial and aquatic flora and fauna groups are vulnerable to the impacts of climate change. Emphasis should be placed on minor and already vulnerable groups. All sectors should be legally bound to maintain a Geographic Information System to integrate data related to climate change, and any other data required apart from spatial information.

Adopting and implementing the recommendations suggested by the National Sustainable Development Strategy for Malta would greatly enhance the implementation of adaptation measures relating to climate change, both on a cross-sectoral and sectoral level. At present it is envisaged that the government is currently preparing a new Bill on sustainable development, in the meantime the applicable provisions of the EPA by virtue of which the sustainable development strategy was published should continue to apply.

Malta should also endeavour to promote more regional cooperation in the Mediterranean under the Barcelona Convention framework and Euro Med, to identify the adaptation needs of the Mediterranean littoral to the impacts of climate change. Authorities should initiate immediately, even at the regional Mediterranean level, studies to assess vulnerability due to climate change, how new opportunities may be tapped, how to meet with the negative consequences of climate change in the sector, how to ensure that local operators adapt to the shift in tourism trends as a result of climate change.

There is the need of systematic and sustained awareness building programmes to educate all. This will intensify awareness and promote a change in behavioural patterns to improve adaptation to climate change. Increasing awareness of climate change impacts within the government, industry, and community sectors will support cultural change transitions that are required for the adoption of more climate change friendly technologies, designs, and operations by public and private operators.

The new climate change law should also obligate the various sectors to formulate contingency plans. This serves to:

address the negative impacts envisaged as a result of climate change particularly upon vulnerable groups.

assess socio-economic implications, with increased insurance covers for risks resulting from the likely impacts of climate change.

identify financial guarantees and incentives amongst the various stakeholders in all sectors.

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CAP	Common Agricultural Policy
CCA	Climate Change Committee for Adaptation
CCD	Climate Change Division
CDM	Clean Development Mechanism
CGIAR	Consultative Group on International Agricultural Research
CoGAP	Code of Good Agricultural Practices
EAFRD	European Agricultural Fund for Rural Development
ECDS	European Centre for Disease Prevention and Control
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environment Protection Act
EU	European Union
GAEC	Good Agricultural and Environmental Conditions
GCCA	Global Climate Change Alliance
GEF	Global Environment Facility
GHG	Greenhouse Gas
GVA	Gross Value Added
Ha	Hectares
ICZM	Integrated Coastal Zone Management
IDCU	Infectious Disease Prevention and Control Unit
INSPIRE	Infrastructure for Spatial Information in the European Community
IPCC	Intergovernmental Panel on Climate Change
LPIS	Land Parcel Information System
MEPA	Malta Environment and Planning Agency
MRA	Malta Resources Authority
MRRA	Ministry for Resources and Rural Affairs
NGOs	Non-governmental Organisations
ODZ	Outside Development Zone
OECD	Organisation for Economic Co-operation and Development
PO	Producers Organisation
R&D	Research and Development
RO	Reverse Osmosis
SAC	Special Area of Conservation
SCAR	Standing Committee for Agricultural Research
SEA	Strategic Environment Assessment
SMEs	Small and Medium Enterprises

SPA	Special Protection Area
SRES	Special Report on Emissions Scenarios
TOR	Terms of Reference
UAA	Utilised Agricultural Area
UNDP	United Nations Development Programme
UNECE	United Nations Economic Convention for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UoM	University of Malta
WHO	World Health Organisation
WMO	World Meteorological Organisation
WSC	Water Services Corporation

01.1 Terms of Reference

The Climate Change Committee for Adaptation (CCCA) was appointed by the Minister for Resources and Rural Affairs (MRRA) in August 2008 and was constituted of:

Mr David Spiteri Gingell (Chair);
Mr Martin Seychell;
Dr George Attard;
Dr Simone Borg;
Ing Marco Cremona;
Prof Charles Sammut;
Ing Mark Muscat;
Ing George Camilleri;
Dr Robert Debono.

The Terms of Reference assigned to the CCCA were the following:

1. to identify the strategic climate impacts likely to affect Malta with particular reference, though not limited, to the following:

   - Health and Socio-Economic Policy;

   - Water and Flooding;

   - Biodiversity and Agriculture.

2. to review the national and international legal and policy ambience with regards to adaptation to Climate Change and to ensure that the strategy recommended to Government is consistent with the direction of the European Union (EU), the United Nations Framework Convention on Climate Change (UNFCCC), and the developments related to the Post-Kyoto Protocol amongst others;

3. to propose abatement measures that Malta is to adopt with regards to adaptation to Climate Change and to prioritise the implementation of such measures;

4. to review the institutional and administrative framework required to support the implementation of the Strategy and to propose recommendations in this regard;

5. to undertake a macro-economic, and where possible a micro-economic assessment, of the economic consequences of the implementation of proposed abatement measures as against a 'policy of no action';

6. to recommend in what circumstances emergency plans should be formed for high probability, and high consequence risks;

7. to review and make recommendations on the potential for insurance and other financial products to complement adaptation measures while also functioning as risk-sharing instruments;

8. to recommend how Malta should capitalise on the opportunities presented by climate change.

01.2 Methodology

01.2.1 Projected Climate Behaviour

The CCCA based this report on the basis of the scientific projections on climate change in the Maltese Islands modeled by the University of Malta (UoM), the MRRA and the United Nations Development Program in the report titled 'Second National Communication of Malta to the United Nations Framework Convention on Climate Change.[1]'

The main findings of the report are the following:

01.2.1.1 Temperature

The overall trend in air temperature over the period 1923-2005 indicates an increase at the rate of 0.71°C every 100 years. This is comparable to the global average temperature increase of almost 0.8°C above that prevailed during pre-industrial times.

The post-1970 period has a clearly exacerbated rate of warming at around 1.5°C over 30 years, especially over the last two decades of the twentieth century, when the temperature anomaly with respect to the climatological mean temperature over the period 1961- 1990 was around twice the anomaly on a global average.

The overall rate of warming is by far strongest in the summer period at around 1.5°C every 100 years. The warming trend can also be traced from the incidence and magnitude of extreme temperature events.

Yearly recorded maximum temperatures have gone up by about 3°C over 100 years, while minimum temperatures have, overall, tended towards lower temperatures, although the absolute lowest temperatures occurred before 1980 and the coldest days in recent years have not gone below 2°C. Events of extreme high temperature are on the increase and tend to be more intense, although the assessment is biased by the anomalous period in the late 1990s.

01.2.1.2 Precipitation

Despite the small extent of the territory, rainfall patterns show a relatively high spatial and temporal variability over the Maltese Islands; even the wettest months can be very dry in particular years. However, there is no definite trend in the observed precipitation.

Over the last 85 years there has been no significant change in rainfall during winter and summer, whereas there has been a decrease of 0.14 mm per year during spring and an increase of 0.8 mm per year during autumn.

During the rainy season, the increasing number of days with thunderstorms (an upward trend of 7 days over 55 years) implies that convective type rainfall is on the increase. This type of rainfall is of short duration and often quite intense. This is corroborated by the positive trend in the daily maximum rainfall between 1923 and 2000, notwithstanding the fact that over a full year the absolute number of days with rainfall in the range 1-50 mm is decreasing.

01.2.1.3 Wind

Further considerations from other meteorological parameters point to a very consistent drop of about 1 knot in wind intensity in the last 40 years. In the period 1996-2005, the drop, most evident during winter, was around 3.5% with respect to the overall mean over the full period since 1946.

[1] Ministry for Resources and Rural Affairs, *Second Communication of Malta to the UNFCCC*, 2010, hereinafter SNC.

01.2.1.4 Atmospheric Pressure and other Meteorological Parameters

An overall positive trend in atmospheric pressure implies reduced frontal activity on a yearly basis and more frequent anti-cyclonic situations, which often enhance subsidence, thereby restricting convection, cloud formation, and, hence, rainfall.

This is corroborated by the recorded decrease in the mean annual cloud cover over the Maltese Islands, amounting to -0.34 oktas in 45 years. The number of daily sunshine hours declined by -0.6 hours over 77 years and is mainly attributed to changes in atmospheric composition, which are predominantly due to the higher atmospheric loading by suspended particles.

01.2.1.5 Sea Level

According to the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES)[2], sea level rise on a global scale by the end of the 21st century is expected to be in the range of 0.18-0.59 m above the reference level corresponding to the decade 1980-1999.

On the basis of satellite observations, the rate of global sea level rise in the last 15 years has been 3.1 mm per year, which is almost double the rate of sea level rise in the last century. This leads to an expected future sea level rise that may actually exceed the IPCC limit.

Sea level changes depend on several factors which are characterised by strong geographical differences, and critically dictated by internal climatic influences and external signals like the North Atlantic Oscillation. This is especially true for the Mediterranean basin. After an overall decline in the basin sea level of 2-3 cm in the period 1960-1990, sea level in the eastern Mediterranean started to rise again after 1993 at a very rapid rate, of around 10 times the global rate.

On the other hand, negative trends are observed in the northern Ionian Sea, as well as including the area near the Maltese Islands. In Malta, sea level measurements conducted by the Physical Oceanography Unit show that, in spite of alternating intermediate trends, the sea level has on average actually declined over the last 15 years.

This is believed to be linked to transient effects which warrant sustained monitoring of sea level changes on the local scale. This situation does not guarantee against a future menace of sea level rise and it is prudent to adopt a precautionary approach. Projections on the basis of the sea level trend over the more recent four years (2002-2006), during which the sea level experienced an average rise of 0.45 ± 0.15 cm per year, are necessary.

01.2.1.6 Sea Temperature

From measurements at Delimara, sea surface temperature of the coastal waters has been steadily increasing at an average rate of 0.05°C per year over the last 40 years.

This rise is most evident during summer and is comparable to Mediterranean averages, which are well above the global average of 0.01°C per year.

01.2.2 Undertaking of Work

In the preparation of this report, the CCCA organised itself in six streams to prepare this report. The streams upon which the CCCA focused its work are the following:

- establishing of a legal framework for climate change and adaptation;
- sustainability and adaptation;
- water and adaptation;

[2] Intergovernmental Panel on Climate Change, *Special Report on Emissions Scenario*, 2000, retrieved from http://grida.no/publications/other/ipcc_sr/?src=/climate/ipcc/emission/, hereinafter IPPC's SRES.

- agriculture and adaptation;

- human health and adaptation;

- tourism and adaptation.

Each of these streams was led by a member or members of the CCCA. The 'owner' of each stream prepared a report, which was discussed by the CCCA. This overall report is built around these individual reports.

01.2.3 Positioning of Recommendations

The initial intention of the CCCA was to present recommendations for each area studied on the basis of worst- and best-case scenarios respectively.

However, the difficulty in obtaining data and the limitations in modeling tools rendered this an unattainable objective.

In the absence of such analytical assessment and modeling the CCCA concluded that the recommendations it will put forward will be on the basis of a 'no pain' basis.

The CCCA defines 'no pain' recommendations to mean action that Malta must take to secure the sustainability of its environment and the surrounding environment. These are decisions that Malta must face irrespective of whether climate change actually results. 'No pain', therefore, means action that comes at a cost to the polity as well as society at large, yet which cost would still yield a positive contribution and would not be born in vain in the event that projected climate changes do not materialise.

Targeted adaptation measures require investment. The CCCA concludes that for Malta to be in a position to decide on such measures, horizontal and vertical detailed research is required.

01.3 Limitations of the Report

The CCCA was not in position to meet all of the terms of reference set for it. This was the result of two limitations, namely:

(i) the CCCA were not full-time members and hence their input was constrained by the time that they could contribute to this initiative;

(ii) no data is available on practically all matters that relate to climate change and adaptation. This renders work on matters relating to climate change and adaptation difficult, at best, to carry out.

The CCCA recommends that future work on this important policy domain should be supported by full-time expertise and resources assigned by the newly set up Climate Change Division within the Malta Resources Authority (MRA).

01.4 Acknowledgments

The CCCA would like to thank all those persons and entities that assisted it with the work leading to the preparation of this report. The CCCA specifically thanks Mr Ray Debono Roberts for his contribution to the Chapter on Tourism and Adaptation.

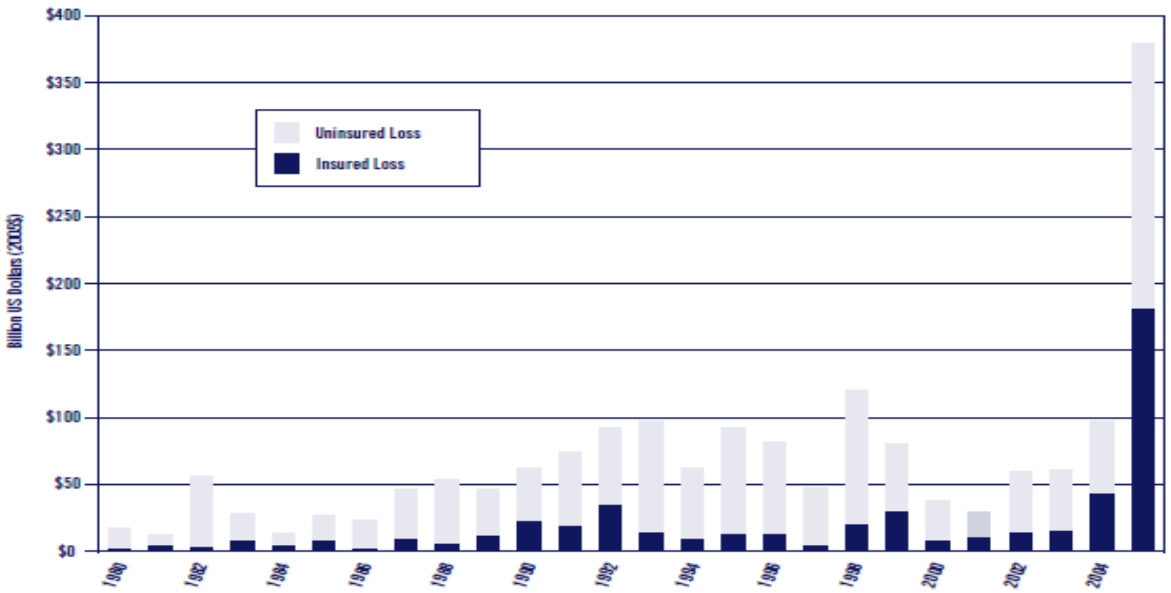
Errors as may be present in this report are the responsibility of the CCCA.

Among the many issues confronting governments in respect of adaptation to climate change, two are especially daunting. The first is equity and its relation to cost. Difficult questions of fairness suffuse the climate change debate but are particularly stark in the case of adaptation, in that those most vulnerable to climate change are the ones least responsible for it. Stronger international adaptation effort, whatever form it might take, and whether understood as assistance or as compensation, will be possible, let alone effective, only insofar as affluent countries are prepared to commit resources. This is a question not of policy design but, rather, of negotiation and political will. The second issue is that reliable information and relevant experience are in short supply. Relative to mitigation, the adaptation challenge is much less well understood and this deficiency extends both to the understanding of adaptation needs as well as to the identification of adequate solutions.

On the global scale, exposure to climate-related risks has risen dramatically in recent decades. With both population and income growth, and with the expansion of human settlements into high-hazard zones, the number of people and the level of wealth exposed have steadily grown. Insurance industry figures show rising losses from extreme weather events over the past quarter-century; even before the record losses in 2005 resulting from Hurricane Katrina.

From 1984 to 2003, losses as a percentage of national income were three times higher in low and lower-middle income countries, which account for 80 percent of the world's population, than in higher-income countries. Increasingly, these rising losses threaten the very process of development. High-risk countries must frequently borrow for disaster reconstruction, raising their indebtedness without necessarily contributing to economic growth or poverty reduction. In extreme cases, single events can cause significant economic setbacks. In Honduras, for example, where the economy had been growing at 4 to 5 percent a year, GDP fell the year following Hurricane Mitch (1998). Figure 1 below shows the loses from global weather catastrophes for the period 1980 to 2005.

Figure 1: Loses from Global Weather Catastrophes: 1980 - 2005



Source: Burton, I., Diringer, E., Smith, J., Adaptation to Climate Change: International Policy Issues, Pew Centre on Global Climate Change, (2006).

In some respects, the added challenge posed by climate change is one of degree. The policies and practical strategies already employed to adapt to natural climate variability; for example, dams to control flooding, coastal defenses against cyclones, and irrigation projects to endure drought, will continue to be employed. Adaptation to climate change will, however, require that the said policies and strategies are employed on a larger scale, in different locations, and at greater cost.

Notwithstanding the above, adaptation to climate change, however, is different in two important respects. Firstly, climate change results from human activity rather than from pure forces of nature. Thus, the question of who pays for adaptation is more complicated and contentious. This question is especially relevant when considering future adaptation efforts at regional and international level.

A second critical difference is that in a world subject to climate change, the historic climate records that have guided past adaptation are less reliable. Cropping patterns, engineering works, and other forms of adaptation have been designed with the expectation that general climatic conditions, as well as the frequency and magnitude of extreme events, will be largely consistent with those observed in the past. A 'normal' or stable climate, however, can no longer be assumed. The challenge is not of successfully managing a transition from one equilibrium climate to another, but rather, of adapting to a far more uncertain climatic future.

The UNFCCC estimates of adaptation cost are broadly in line with preceding studies published by the World Bank, Oxfam, the United Nations Development Programme (UNDP), and in the Stern report. These have recently been summarised by the Organisation for Economic Co-operation Development (OECD) and are shown in Figure 2. Since these studies appear to support each other, the conclusion has sometimes been made that there exists a comforting convergence of evidence. This conclusion would however be misleading because: (i) none of these are substantive studies, (ii) they are not independent studies but borrow heavily from each other, and (iii) they have not been tested by peer review in the scientific or economics literature.

Figure 2: Estimates of Adaptation Costs in Developing Countries for 2010-2015

Source	US$ billion p.a.	Comments
World Bank (2006)	9-41	Cost of climate-proofing FDI, GDI and ODA flows
Stern (2006)	4-37	Update, with slight modification of World Bank (2006)
Oxfam (2007)	>50	Based on World Bank, plus extrapolation of costs from NAPAs and NGO projects
UNDP (2007)	86-109	World Bank, plus costing of PRS targets, better disaster response

Source: Parry, M., Arnell, N., Berry, P., Dodman., Fankhauser, S., Hope, C., Kovts, S., Nicholls., Satterthwaite, D., Tiffin, R., Wheeler, T., Assessing the Costs of Adaptation to Climate Change: A Review of the UNFCCC and other Recent Estimates, Grantham Institute for Climate Change, Imperial College, London, 2009.

In 2007, the UNFCCC commissioned six studies which provided estimates of the cost of adaptation for the year 2030, usually assuming a climate scenario similar to the IPCC's SRES[3] A1B (A balanced emphasis on all energy sources) and B1 (Based on a world more integrated and more ecologically friendly).

In summary the UNFCCC studies cover:

- **Agriculture, forestry and fisheries:** The agriculture estimate consists of three distinct cost items: extra capital investment at farm level, the need for better extension services at country level and the cost of additional global research; as for example on new cultivars;

- **Water supply:** The water estimate considers the effect of additional water demand and changes on the supply side. Investment decisions are made in anticipation of 2050 water needs;

[3] IPPC's SRES, *supra.*

- **Human health:** The health estimates consider the extra prevention costs that will be incurred to deal with malnutrition, malaria, and diarrhoea. The health impacts are based on the Global Burden of Disease study[4];

- **Coastal zones:** Coastal protection costs are based on the DIVA model, which considers a limited set of adaptation options that are applied globally. Uniquely, the coastal estimate considers both adaptation costs and residual damages. For long-life defence infrastructure, investments are made in anticipation of sea-level rise in 2080;

- **Infrastructure:** The infrastructure estimate adopts the World Bank methodology, using insurance data to determine the share of climate-sensitive investment, and applying a percentage increase on current infrastructural investment to suggest additional costs for climate-proofing new infrastructure;

- **Ecosystems:** An indication of adaptation costs for ecosystems was based on the costs that would be incurred as a consequence of increasing protected areas to at least 10% of the land area of each nation or ecosystem. It was, however, not possible to split this into baseline costs of meeting current deficits and incremental adaptation.

The UNFCCC report concluded that total funding need for adaptation by 2030 could amount to US$49 – US$171 billion per annum globally, of which US$27 – US$66 billion would accrue to developing countries. By far the largest cost item is infrastructure investment, which for the upper-bound estimate accounts for three-quarters of total costs. Costs are over and above what would have to be invested in the baseline to renew the capital stock and accommodate income and population growth. It is to be noted that the total excludes the estimate for ecosystem adaptation.

Figure 3: UNFCCC Estimate of Additional Annual Investment Need and Financial Flow Needed by 2030 to Cover Costs of Adaptation to Climate Change (US$ billion in present day values)

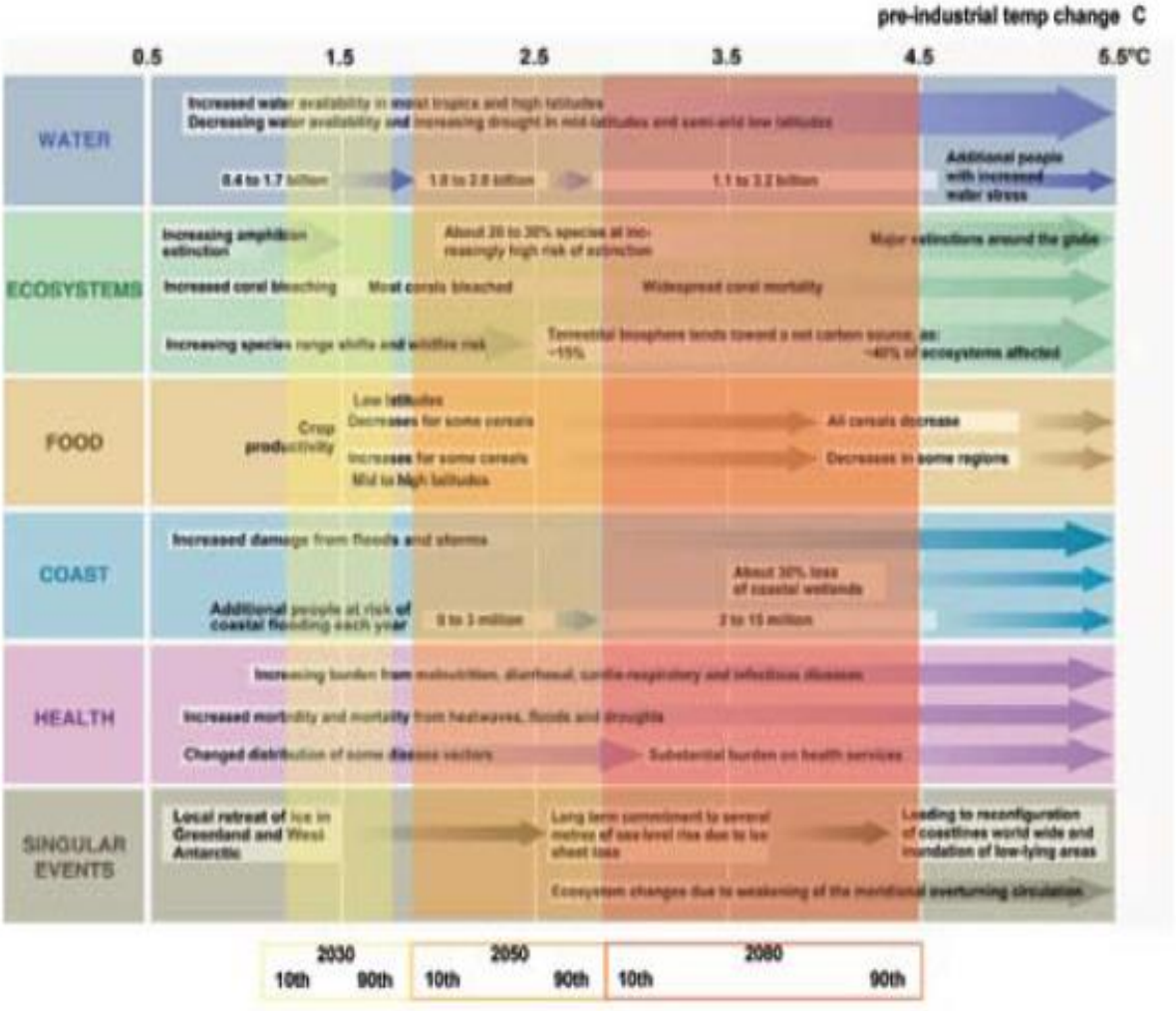
Sector	Global cost	Developed countries	Developing countries
Agriculture	14	7	7
Water	11	2	9
Human health	5	Not estimated	5
Coastal zones	11	7	4
Infrastructure	8 – 130	6 – 88	2 – 41
Total	**49 – 171**	**22 – 105**	**27 – 66**

Source: Parry, M., Arnell, N., Berry, P., Dodman., Fankhauser, S., Hope, C., Kovts, S., Nicholls., Satterthwaite, D., Tiffin, R., Wheeler, T., Assessing the Costs of Adaptation to Climate Change: A Review of the UNFCCC and other Recent Estimates, Grantham Institute for Climate Change, Imperial College, London, 2009.

The Fourth Assessment Report of the IPCC[5] gives a summary of some impacts likely to occur under varying amounts of global warming. Mapping onto this is the expected warming range for 2030 which indicates the potential impacts that adaptation will need to address.

[4] World Health Organisation, *The Global Burden of Disease: 2004 Update*, 2008.
[5] Intergovernmental Panel on Climate Change, *Fourth Assessment Report: Climate Change*, 2007, hereinafter IPPC Report.

Figure 4: Projected Damages Without Adaptation



Source: Parry, Lowe, and Hanson, (2009)

Note: The shaded columns show the 10 and 90 percentile uncertainty range for the scenarios assumed in the UNFCCC estimation of funding needs for adaptation. For most sectors the A1B scenario was taken. For water and coastal protection the scenarios were 2050 and 2080 respectively, on the assumption that adaptation in 2030 will need to anticipate future warming due to the long-term nature of investment needs in those sectors. Scenario data from a simple Earth system model

One aspect which clearly emerges from the figure is the substantial damages that could be expected if adaptation is not fully successful in avoiding them.

A report titled 'The Economic Vulnerability and Potential for Adaptation of the Maltese Islands to Climate Change' concludes that, prima facie, over the past five years, vulnerability to climate change from the production side in Malta appears to have been diminishing. This is due to the fact that there has been a reduction in the relative economic importance of climate-sensitive activities such as agriculture and construction. The manufacturing sector is also in decline with the only growth being registered in pharmaceuticals, which is comparitively not vulnerable to climate change. The importance of the services sector to the Maltese economy is strongly on the increase, but the more climate-sensitive tourism sector is relatively declining[6].

Furthermore, the report concludes that, prima facie, consumption activities are tending to shift towards areas with an increased vulnerability to climate change. Moreover, the persistence of fiscal and external deficits in the Maltese economy may imply that it may in the future be difficult to mobilise

[6] Cordina, G., *'The Economic Vulnerability and Potential for Adaptation of the Maltese Islands to Climate Change'*, Report Update, Malta's Second Communication to the United Nations on Climate change, 2009, 14.

saving resources to effect investment in climate change adaptation and mitigation activities, especially if these do not provide any immediate and tangible financial rate of return[7].

On the other hand, the widespread provision of health and education services by the public sector at zero or low cost may facilitate national efforts aimed at climate change adaptation. This would nevertheless require further investment in health services to ensure preparedness in the face of climate change impacts. As pointed out in the report, a further economic challenge relates to the extent to which health and other public services can in the medium term continue to be provided free of charge. This especially in view of the increasing pressures which may potentially be exercised on these services, not least through climate change effects[8].

The report adds that the long-term development path envisaged for Malta features a mixed outlook in terms of the country's overall vulnerability to climate change. While on one hand, the country plans to develop in sectors which may feature heightened vulnerability to climate change, including tourism, education, and health, on the other hand, development is also expected through the expansion of sectors which are not as sensitive to climate change issues, including high value added manufacturing, financial services and information and communications technology[9].

The report assesses the vulnerability of the production sector as shown in **Figure 5** below:

Figure 5: Qualitative Assessment of Climate Change Vulnerability of Production Activities

	Current		Future	
	Economic weight (%)	Sector Vulnerability*	Economic weight (%)	Sector Vulnerability*
Agriculture and fishing	2.5	2.4	2.0	2.3
Industry	20.9	1.6	17.5	2.4
Distribution	11.5	2.3	9.0	2.3
Transport & Communication	10.0	2.5	10.0	2.7
Financial	4.5	1.4	10.0	1.4
Private Services	31.7	1.4	34.0	1.3
Public Sector (incl. Utilities)	18.9	2.2	17.5	2.7
Overall Production Vulnerability	100.0	1.8	100.0	2.0

* Index of Sector Vulnerability:
0 = None
1 = Negligible
2 = Moderate
3 = Strong

Source: Cordina, G., (2009),The Economic Vulnerability and Potential for Adaptation of the Maltese Islands to Climate Change

The report also assesses the vulnerabiity of the expenditure sector as shown in **Figure 6** below.

[7] Ibid, 17.
[8] Ibid, 18.
[9] Ibid,19.

Figure 6: Qualitative Assessment of Climate Change Vulnerability of Expenditure

Table 10: A Qualitative Assessment of Climate Change Vulnerability of Expenditure Activities

	Current		Future	
	Economic weight (%)	Sector Vulnerability*	Economic weight (%)	Sector Vulnerability*
Private Consumption	33.9	1.7	35.0	2.3
Public Consumption	11.1	1.5	7.0	1.5
Investment	11.0	2.0	10.0	2.0
Tourism Exports	10.0	3.0	9.0	3.0
Other Exports	34.1	1.5	39.0	1.5
Overall Expenditure Vulnerability	100.0	1.8	100.0	2.1

* Index of Expenditure Vulnerability:
0 = None
1 = Negligible
2 = Moderate
3 = Strong

Source: Cordina, G., (2009),The Economic Vulnerability and Potential for Adaptation of the Maltese Islands to Climate Change

The economic impact assessment concludes that Malta should primarily concentrate on adaptation rather than mitigation. An attempt to determine the financial impact of adaptation on Malta is difficult to achieve due to the fact that information and modeling tools that would allow us to carry out a financial impact assessment are only now being rooted in Malta.

Moreover, it is pertinent to note that the UNFCCC itself acknowledges that in the modeling that it carried out, it was difficult to determine the proportion of expected damage that would be avoided by the proposed UNFCCC investment abatement measures. This is so, due to the fact that most modeled impacts are projected to increase non-linearly with climate change, and adaptation costs similarly with impacts.

It is fair to assume that while it will probably be inexpensive to avoid some impacts, prohibitively expensive to avoid others; while some impacts will not be avoided even if funds were unlimited. This is a result of the fact that the technologies that would help to avoid these impacts are, at least to date, not available. This is the case; for example, of technologies that would help avoiding or appeasing ocean acidification.

The CCCA believes that the strategic issue that arises from this consideration is to the degree adaptation measures should be directed to. Assuming a worst case scenario and recommending that full adaptation measures are adopted is not considered to be an appropriate option. As shown in this Report, there is still far too much uncertainty in the science of climate change and how its impacts will evolve, to lead the CCCA to propose such an intensive, and expensive, approach to adaptation.

This, however, does not mean that Malta should stand still and not do anything in this regard. As shown in this study there are a number of sectors that today are, and will, continue to be vulnerable tomorrow, even if the best case scenario with regards to climate change had to result.

Thus, as discussed throughout this study, the CCCA is of the considered opinion that Malta's efforts towards introducing adaptation measures for climate change should be directed to these vulnerable areas.

Recommendation 01

The Climate Change Committee for Adaptation is of the considered opinion that whilst the uncertainty of the science of climate changes negates that Malta should adopt an adaptation approach based on a worst case scenario, Malta should address its efforts towards those sectors that today are, and will, continue to be vulnerable tomorrow, even if the best case scenario with regards to climate change had to result.

Adapting to climate change will not only require responding to the physical effects of global warming, but will also require adapting the way we conceptualise, measure, manage, and finance risks. Climate change is creating new risks, altering the risks we already face, and also, importantly, impacting the interdependencies between these risks.

Researchers and policymakers, as shown above, have sought estimates on the aggregate costs of climate change to use in considering various mitigation options, as well as estimates of regional or local climate change damages in order to improve planning.

This gives rise to two fundamental issues. Firstly, how are the measures directed to mitigate against adaptation risks to be financed and secondly what role will private insurance, if at all, play in providing coverage for such risks?

In this regard, research seems to show that two instruments are emerging in the face of the international climate change challenge. These are the setting up of:

- International response funds: Donor countries and supra-national institutions commit to regular contributions to a multilateral fund to assist countries suffering extreme and/or long-term climate impacts.

- Insurance 'backstop': Donor countries support the introduction or expansion of insurance-type instruments in vulnerable countries by committing funds to subsidise premiums or to reinsure governments or primary insurers[10].

02.1 Financing Measures Directed to Mitigate Against Adaptation Risks

Events such as the 2004 Asian tsunami, have in recent years, drawn record levels of post-disaster assistance from donor countries. However, these humanitarian flows remain largely ad hoc, dependent on a new round of pledging following each new event.

While an extensive architecture on financing for climate change mitigation and adaptation has started to develop at the global level, the earmarked funds fall far short of the requirements. The main dedicated sources of financing for mitigation at the global level include the Clean Development Mechanism (CDM) and various dedicated funds managed by the Global Environment Facility (GEF) and the World Bank. In 2007, the value of primary CDM transactions was US$7.4 billion, which is estimated to have leveraged US$36 billion of flows to developing countries.

The GEF has about US$250 million per annum in grants available for mitigation during 2006–2010. The Adaptation Fund (financed through a 2% levy on revenue generated by the CDM and through voluntary contributions), is a key fund dedicated for adaptation to climate change and is estimated to be US$80 million to US$1 billion per annum by 2012[11].

Other adaptation funds include the UNFCCC Special Funds (about US$270 million) and a portion of the GEF Trust Fund (US$50 million until 2010). The Global Facility for Disaster Risk Reduction, with US$48 million during 2007–2008, is another source of financing for adaptation.

Dedicated funds that support both mitigation and adaptation include the World Bank's Climate Investment Funds (about $6 billion) and the European Commission's Global Climate Change Alliance (GCCA). In addition to these dedicated funds, most global multilateral development institutions and several bilateral agencies have started to emphasise climate change mitigation and adaptation in their regular operations, which is making available more funds for relevant activities.

[10] Burton, I., Diringer, E., Smith, J., Adaptation to Climate Change: International Policy Issues, Pew Centre on Global Climate Change, 2006, 16, hereinafter Burton, Diringer and Smith.
[11] Sharan, D., Financing Climate Change Mitigation and Adaptation – Role of Regional Financing Arrangements, Asian Development Bank, 2008, 1.

Similarly, many other international organisations such as the Consultative Group on International Agricultural Research (CGIAR), the World Health Organisation (WHO), the UNDP, and the World Meteorological Organisation (WMO) have, or are, developing programs mainly to finance climate change adaptation in the areas pertinent to their activities[12].

This approach could be taken further within the climate arena through a new instrument, supported by long-term funding commitments, to provide relief from climate impacts. Such a fund could narrowly target impacts directly attributable to climate change. As early as 1991, Vanuatu, on behalf of the Alliance of Small Island States, proposed the setting up of an International Insurance Pool to compensate low-lying countries for damages resulting from sea-level rise[13].

Within the specific context of Malta, the CCCA is of the considered opinion that whilst the Government should follow international as well as EU developments in this regard it should leverage the commitment in the Emissions Trading Scheme Directive for the application of revenues generated from the auctioning of allowances including revenue generated from the aviation sector for the financing of adaptation measures.

Recommendation 02

The Climate Change Committee for Adaptation recommends that that whilst the Government should follow international as well as EU developments in this regard it should leverage the commitment in the Emissions Trading Scheme Directive for the application of revenues generated from the auctioning of allowances including revenue generated from the aviation sector for the financing of adaptation measures.

02.2 Risk, Insurability and Adaptation

The costs of particular extreme events, and how they may be altered by climate change, will impact the insurance model. The exercises, described earlier, in estimating aggregate losses, whether for global changes in mean temperature or for individual extreme events, will be underestimates if they ignore interactions between impacts.

Hurricane Katrina demonstrated quite vividly many of the dependencies created by extreme events, and that neglecting them can lead to underestimates of losses. Hurricane Katrina was an event, like the 1906 fire and earthquake in San Francisco, where the secondary consequences caused more damage than the original event. With an extreme hurricane or earthquake, other losses become correlated with the event, inflating damages[14].

For example, drawing once again in what happened in the case of Hurricane Katrina, models of potential losses assumed that the pumps in New Orleans would keep flooding in the city to a minimum. However, the extreme nature of Katrina led not only to an evacuation of people, including pump managers, but also to a power outage which reduced pumping capacity and which lead to much more extensive flood damage in the city than was expected.

The insurance industry traditionally bases its view of risk on historical records and harazards and loss occurances. As shown earlier in this Chapter, the last two decades have seen a rise in the economic costs of disasters, and, of particular concern to the insurance industry, in insured losses.

Undoubtedly, there is an increasing concern about what impact this will have on the insurability of natural disasters. If risk is increasing over time, such that insurers do not believe they can accurately estimate expected losses, a key condition of insurability is violated. Further, if the premiums necessary for insurers to cover a disaster in a climatically changed world are greater than homeowners and businesses are willing or able to pay, the private insurance market will collapse.

[12] Ibid.
[13] Burton, Diringer, and, Smith, *supra.*
[14] Kousky, C., and Cooke, R., M., Climate Change and Risk Management, Challenges for Insurance, Adaptatyion and Loss Estimation, Discussion Paper, 2009, 4.

In the case of Katrina, some lines of insurance such as cargo, inland marine and recreational watercraft, floating casinos, onshore energy, automobile, health, and life insurance, which had not been heavily hit in previous catastrophes but which saw many claims after Katrina,clearly demonstrated the tail dependence across these lines of business. What happened in the case of Katrina demonstrates that when tail dependencies are not considered, the exposure of an insurance company can be underestimated.

It is feared that the traditional methods of calculating risk exposure may significantly underestimate risk with regards to climate change adaptation. As with any realisation that exposure is greater than previously thought, insurance companies have three response options. They can: (i) reduce exposure, (ii) increase the amount of capital they are holding in reserve, or (iii) purchase protection from reinsurers or the financial markets. Any of these options will drive up insurance prices. If prices rise higher than those who are insured are willing to pay, then the private (re)insurance market may break down[15].

When catastrophic losses are possible, private insurance may be unable to effectively operate. This is particularly true in instances of high uncertainty such as in the case of climate change, where risks are difficult to account properly, and the estimates of the costs of single events, or of aggregate damages from climate change, could significantly underestimate potential losses. In these cases, the question then arises of how society should manage this risk and how the costs of a disaster should be distributed[16].

One option is conditional indemnity. If indeed correlation is found to concentrate at high damage levels, it may well be that conditionalising on small to modest damage levels could define markets in which diversification is viable. That is, in theory, a cap could be identified under which tail dependence is at a minimum and private markets could function[17].

A possible role for government in this scenario could be of covering losses above the cap. Instead of simply assuming the losses, the government could offer potentially subsidised excess-of-loss reinsurance for the higher levels of loss.

Backstopping insurance could also take the form of catastrophe bonds, in which investors funding a reinsurance pool receive above-market returns if no losses occur but risk their full investment should there be a major disaster.

Catastrophe bonds, therefore, could be potentially designed to cover tail dependent risks. For instance, in April 2007, Swiss Re structured a catastrophe bond covering flood risk in the UK that is triggered if there is flooding in at least four of fifty reference locations[18]. A further example is the Turkish Catastrophe Insurance Pool, a national earthquake insurance programme backed by a standby line of credit from the World Bank. This is the first instance of an international financial institution absorbing a developing country's risk.

Mexico plans to issue catastrophe bonds on the private market to reinsure its national catastrophe relief fund. Donor governments, alone or with private investors, could use the same mechanism to back climate relief in vulnerable countries.

The CCCA is conscious that any way forward in identifying suitable mechanisms and instruments that will ensure that the insurance market remains sustainable in the event of increasing unpredictability of climate change impact on various sectors in Malta requires major discussion amongst all the stakeholders. In this regard the CCCA recommends that the Government, through the Malta Financial Services Authority, should take the lead in stewarding such discussion towards an acceptable risk-coverage model.

[15] Ibid.
[16] Ibid.
[17] Ibid.
[18] Ibid.

Recommendation 03

The Climate Change Committee for Adaptation recommends that given that recent climate disasters have shown that traditional methods of calculating risk exposure may significantly underestimate risk, the Government, through the Malta Financial Services Authority, should take the lead in stewarding discussion amongst stakeholders to identify suitable mechanisms and instruments that will ensure that the insurance market remains sustainable in the event of increasing unpredictability of climate change impacts on various sectors in Malta.

03.1 Introduction: Objective and Background

The UNFCCC, the Kyoto Protocol and the related EU *acquis communautaire* require Malta to take adaptation measures against the effects of climate change. These legal obligations are very general in scope. There is, in fact, no set of specific legal obligations for adaptation to climate change, as one finds in the case of mitigation. Although it is expected that in the coming years such international norms and particularly EU rules will eventually emerge and come into force, adaptation measures will always be more nationally-oriented, given that Member States (MS) have different vulnerabilities that require different adaptation measures to climate change.

Most Member States have formulated their national strategy on adaptation and concomitantly they have concluded that an adequate legal framework needs to be adopted formulated to support and secure the implementation of the strategy. This report is intended to identify a basic legal framework for Malta's strategy on adaptation, and this exercise should, therefore, be seen only as a first step in this direction, As more scientific evidence relating to the impacts of climate change becomes available, to remain effective the legal framework would need to be further fine-tuned or even revised to remain effective.

Any legal measures which aim to support the formulation of the adaptation strategy should mainly target the link between vulnerability and adaptation, since the degree of adaptation required is *directly related to the extent of vulnerability or risks* Malta is exposed to as a result of climate change.

Certain vulnerable resources like water and natural habitats are already well regulated, so existing legislation already contributes to providing adequate legal obligations to secure adaptation at least with respect to certain impacts of climate change. The report will, thus, seek to identify any relevant legal instruments that may already prepare Malta for adaptation to climate change, whilst highlighting the constraints and gaps of a regulatory and institutional nature that exist to ensure better implementation and compliance.

Addressing existing gaps and constraints in the legal framework is indicative of good governance, which itself depends upon optimum coordination between the various sectors that constitute society. Gaps and constraints in the legal framework need to be identified to eliminate those factors that are preventing and obstructing the implementation of adaptation measures to climate change and to assess logistical and practical difficulties that may also hinder compliance.

This report is based mainly on Malta's First[19] and *Second National Communication [20] to the UNFCCC*, which identify various gaps and constraints that hamper public and private entities from adopting adaptation measures related to climate change in Malta. The Second National Communication has, for the very first time, identified various vulnerability and adaptation issues in individual sectors; such as health, water resources, migration and demographic changes, biodiversity, conservation, waste management, the built environment, telecommunications and transport. These reports on individual sectors supplement an earlier report on Technology Needs for Adaptation to Climate Change[21]. Furthermore, this Report takes into consideration the recommendations of the National Climate Change Strategy on Mitigation[22], which addresses existing gaps and constraints that may also apply with respect to adaptation measures.

An adequate legal framework on adaptation, must address gaps and constraints from both a horizontal and a sectoral policy perspective. This report attempts to assess the legal requirements for adaptation of the individual sectors, primarily from a holistic perspective. The horizontal policy aspect

[19] Ministry for the Resources and the Environment, *First Communication of Malta to the UNFCCC*, 2004.
[20] SNC, *supra.*
[21] Xuereb R, Mallia A and Cutajar J, *Report drafted to record the findings of Working Group VI – Vulnerability and Adaptability as part of Malta's Second National Communication to the UNFCCC*, 2005.
[22] Government of Malta, *National Strategy for Policy and Abatement Measures Relating to the Reduction of Greenhouse Gas Emissions*, 2009, hereinafter National Mitigation Strategy.

is subdivided under the following main headings:

- institutional (which includes also the regulatory aspect);
- methodological, research and data;
- capacity-building.

It needs to be stressed that gaps and constraints are interrelated. For instance, gaps in the administrative set-up and the legal framework influence both scientific and technical capacity-building and vice versa. Furthermore, addressing these gaps and constraints may facilitate both mitigation and adaptation measures. Research and data collection, for example, are essential elements and common requirements to fill in gaps and overcome constraints in all the various sectors, serving both mitigation and adaptation. It must also be stressed that any adaptation measures should not, unless there is no further option, run counter to mitigation measures.

Recommendation 04

The Climate Change Committee for Adaptation recommends that the design of adaptation measures should not, unless there is no further option, run counter to mitigation policy measures.

This must be a *decisive* consideration for policymakers when choosing from a range of adaptation options that may be available. It is essential to keep in mind that any adaptation options, which increase greenhouse gas emissions (GHG), would prejudice the attainment of mitigation targets not only from a legal but also from a financial and a temporal perspective.

The sectoral aspect of the required legal framework, would be dealt with according to major sectors that have been earmarked by the strategy as requiring priority because they are the most vulnerable. The CCCA underlines that the sectoral assessment presented in this report cannot be considered as exhaustive. Recommendations made, also aspire at integrating environmental concerns into socio-economic policymaking and at facilitating participation by civil society and non-governmental organisations (NGOs), enabling them to play a more active role in decision making, education and awareness-building on the subject.

03.2 Institutional Requirements in a Legal Framework Addressing Adaptation to Climate Change

Climate change is specifically identified as a distinct policy responsibility in the portfolio of the MRRA. A unit within the Environment Protection Directorate of the Malta Environment and Planning Authority (MEPA), monitors and regulates the implementation of Malta's obligations under the UNFCCC and the Kyoto Protocol.

Following the presentation by Government of the *'National Strategy for Policy and Abatement Measures Relating to the Reduction of Greenhouse Gas Emissions'*[23], for debate at the House of Representatives in September 2009, the decision was taken to consolidate all government functions that relate to climate change into a Climate Change Division (CCD) within the MRA – which is also the regulator responsible for energy and water management.

It is pertinent to underline, that to date, the MRA Act does not refer to climate change, whilst the existing Environment Protection Act (EPA)[24] does. The new Environment and Planning Development Bill, will repeal and replace the latter Act. This new Bill incorporates the provisions that retain the flexibility existing under the current EPA which allows the Minister to appoint different competent authorities for specific issues that may fall within the scope of the Act.

[23] Ibid.
[24] Environment Protection Act, 2001, Chapter 435 of the Laws of Malta, Act XX, as amended.

Given the cross-sectoral nature of adaptation measures to climate change, it could be used to stipulate legal obligations whereby different competent authorities assume legal responsibility to ensure implementation and compliance of adaptation measures in various sectors.

Currently, there is this regulatory gap exists due to the absence of an entity that has over-arching legal responsibility for mainstreaming climate change and for ensuring compliance with adaptation obligations on a cross-sectoral level. The division responsible for climate change, within the MRA, should, therefore, be empowered by law to act as a centralised authority that may intervene to regulate and secure compliance when other public authorities fail to do so, or when they do not provide data and information in this respect.

Recommendation 05

The Climate Change Committee for Adaptation recommends that the Government should consider that the Climate Change Division within the MRA, should be empowered by law to act as *the* centralised authority for Climate Change, so that it may intervene to regulate and secure compliance when enterprises and public authorities fail to do so, or when they do not provide data and information in this respect.

To a certain extent, a sectoral approach to climate change adaptation is indispensible because of the magnitude of the phenomenon. Such an approach would facilitate the mainstreaming of adaptation in *all* policy sectors. In the absence of a policy ambience where the CCD is not provided with the executive power to implement climate change legislation, policies, and strategies from a cross-sectoral perspective the situation will, undoubtedly, remain fragmented. It follows that, in such a policy scenario, there would be no guarantee that all sectors would meet the strategic benchmarks or would have the capacity to secure compliance with legal obligations.

The CCCA is, therefore, of the considered opinion that the legal framework should also provide for the holistic approach empowering one competent authority, currently identified by the Government as being the CCD within MRA, with the ultimate responsibility for:

- advising government in the formulation of national policy measures to mitigate and adapt to climate change;

- monitoring and securing compliance across all sectors;

- assessing the environmental and socio economic impacts of adaptation measures that are considered for adoption;

- ensuring that the burden of adaptation measures is shared in an adequate and equitable manner.

The underpinning role of the CCD should be to coordinate and oversee the mainstreaming of both mitigation and adaptation issues in existing policies, rather than creating new policies in parallel, since implementation of both mitigation and adaptation should ideally, from a logistical point of view, be carried out through existing sectoral policies.

Recommendation 06

The Climate Change Committee for Adaptation recommends that the underpinning role of the Climate Change Division should be to coordinate and oversee mainstreaming of both mitigation and adaptation issues in existing policies, rather than creating new policies in parallel, since implementation of both mitigation and adaptation should ideally, from a logistical point of view, be carried out through existing sectoral policies.

The aforementioned National Climate Change Mitigation Strategy[25] had strongly emphasised that this important role of coordinating and overseeing climate change policy, for both mitigation and adaptation, can only be carried out if the newly setup entity for Climate Change is provided with the appropriate organisational capacity to meet its mandate.

Finally, an appropriate legal framework meant to support an adaptation strategy to climate change should endow the same competent authority with the legal authority and responsibility to:

(i) adopt national positions relating to climate change adaptation (and mitigation) to ensure an integrated approach;

(ii) provide systematic observation of the effects of climate change on a national level and the development of data archives related thereto;

(iii) assess the best options available when taking national adaptation measures;

(iv) provide a steady flow of information to civil society relating to mitigation measures that may be adopted and how they are being implemented.

Recommendation 07

The Climate Change Committee for Adaptation recommends that an appropriate legal framework directed to support an adaptation strategy to climate change should seek to endow the same competent authority with the legal authority and responsibility to:

(i) adopt national positions relating to climate change adaptation (and mitigation) to ensure an integrated approach;

(ii) provide systematic observation of the effects of climate change on a national level and the development of data archives related thereto;

(iii) assess the best options available when taking national adaptation measures;

(iv) provide a steady flow of information to civil society relating to mitigation measures that may be adopted and how they are being implemented.

03.3 A Legal Framework which Addresses Methodological Requirements

03.3.1 Synergy and Horizontal Strategic Planning

There is a critical need for an overall high-level ownership of the strategy relating to Malta's adaptation to climate change which should lead to *the quantified assessment of the consequences of doing nothing.*

Joint-up institutional measures must be introduced to overcome constraints caused by fragmentation, which may lead sectoral policies, plans and programmes to adopt conflicting adaptation and mitigation measures. Joint-up measures between the different sectors, reduce the risk of maladaptation to climate change or the adoption of conflicting adaptation measures, that prevent natural and human systems in Malta from adjusting and responding to climate change by moderating harm. Additionally, when deciding upon adaption measures, there must be appropriate forward planning to address socio-economic repercussions resulting from the impacts of climate change so as to facilitate burden-sharing and to tap any new opportunities.

The responsibility for this overarching role in advising government so as to better guarantee that *all* the best options are considered when choosing which adaptation measures Malta should adopt, to meet its obligations under the UNFCCC and the Kyoto Protocol, should rest with the newly set up

[25] National Mitigation Strategy, *supra*.

CCD. This is even more relevant when negotiating and taking on commitments in this respect within the EU fora.

The Strategic Environment Assessment Regulations[26], which transpose Directive 2001/42/EC[27]on the assessment of the effects of certain plans and programmes on the environment should help to facilitate the implementation of this methodology as a legal obligation.

The SEA Regulations identify those plans and programmes that are liable to have significant effects on the environment including those leading to climate change and which, therefore, require a SEA. The Regulations ensure that this assessment is carried out at the very beginning of the plan/programme, which is referred to as the strategic phase. The SEA compliments the existing Environment Impact Assessment (EIA) process for projects introduced by the so-called Environment Impact Assessment Directive[28] as transposed in national legislation by means of the EIA Regulations[29]. The EIA introduced a system within the Member States for prior assessment of the possible effects of public and private projects on the environment.

The SEA Regulations introduced a system of environmental assessment at the strategic phase, but *only* in the case of public plans and programmes, which fall within their scope. The Regulations apply only to plans and programmes[30] and any amendments made to them. In order to be subject to an SEA, the public plans/programmes must fulfil a number of conditions. They must:

- be prepared and/or adopted by a competent authority or prepared by a competent authority for adoption by means of a legislative procedure;

- be required by legislative, regulatory, or administrative provisions;

- have significant effects on the environment;

- propose future developments that may require an EIA in one or more of the following sectors: town and country planning or land use, transport, energy, waste management, water management, industry, telecommunications, agriculture, forestry, fisheries, and/or tourism, or they require an assessment under the Habitats Directive[31].

Only those plans and programmes that have started after 21 July 2004 are subject to the Regulations. For a plan or programme to be subject to an SEA, it must fulfil all of the above-mentioned conditions. A plan/programme will be exempt from an SEA if the sole purpose of the plan / programme is to serve national defence or civil emergency or refer to financial and budget plans such as the national budget estimates, even if it fulfils the abovementioned conditions.

If there is no significant environmental effect because only a small area is being affected or only a minor modification in the plan/programme is taking place, the competent authority, which is the SEA Audit Team with MEPA's Environment Assessment Team as its operative arm, is responsible for deciding whether an SEA is required[32]. It is to be noted that the new MEPA Bill envisages changes in the institutional set up regarding the authorities responsible for monitoring the implementation of the SEA Regulations. This institutional change however does not affect the substance of the legal instruments requiring SEAs.

[26] LN 327/2008, the SEA (Amendment) Regulations, 2008, amends Article 21 of LN 418/2005, SEA Regulations, (2005), by fine tuning the requirements that the Competent Authority can impose upon the proponent of the plan or programme undergoing an SEA. The amendments specify in detail the information the proponent must give in the second revision of the environmental report of the said plan or programme.
[27] Directive 2001/42/EC of the European Parliament and the Council on the effect of certain plans and project on the environment,Official Journal, L197, 21.7.2001, 30-37.
[28] Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment,, Official Journal L 175 of 5.7.1985, 40-48.
[29] LN 114/2007 which repealed LN 204/2001.
[30] Including those financed by the European Community.
[31] . *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* ,Official Journal L 206 , 22.07.1992, 7 -50, hereinafter Habitats Directive.
[32] Borg S and Farrugia L, Kluwer Encyclopaedia of Laws, Environmental law Monograph for Malta, 35.

Recommendation 08

The Climate Change Committee for Adaptation recommends that the responsibility for the over-arching role in advising government so as to better guarantee that *all* the best options are considered when choosing, which adaptation measures Malta should adopt, to meet its obligations under the UNFCCC and the Kyoto Protocol, should rest with the newly set-up Climate Change Division – and that in this regard, the Strategic Environment Assessment Regulations should be amended to include a screening assessment for climate change.

03.3.2 Awareness Building, Public Participation, and Information

Adaptation to climate change necessitates civilian participation and stake holder dialogue. The legal framework to guarantee this right is already in place. The Aarhus Convention[33], the Decision approving the Convention on behalf of the European Community[34], and the Directives implementing the Convention[35], render it obligatory for the competent authority to facilitate public participation in environmental decision making, particularly but not limited to, when SEAs and EIAs are being drawn up and to provide access to environmental information to any individual or NGO that asks for it without the latter having to prove a direct interest.

There are only few exceptions when the information may be legally withheld and at any rate, the competent authority is duty bound to provide extracts of information insofar as these would not prejudice those exemptions.

Public participation sessions on a national and trans-boundary level are provided for under both the EIA[36] and the SEA Regulations. The SEA Regulations stipulate that results of consultations must be '*taken into account*'. It leaves it up to the competent authority to devise the manner by which this should be done but, in order to avoid duplication of assessment, it reiterates the need to integrate the process with assessments required under other laws. The process proposed under LN 418/2005 aims to integrate, streamline, and expedite these processes as much as possible.

LN 116/2005[37], the Freedom of Access to Information on the Environment, Regulations, 2005, transposes Directive 2003/4/EC[38]. This piece of legislation provides an important legal obligation upon public authorities that is essential for a sound legal framework addressing adaptation to climate change.

The objective of LN 116/2005 is to guarantee the right of access to environmental information held by or for public authorities and to set out the basic terms and conditions of and practical arrangements for its exercise. It ensures that environmental information is progressively made available and disseminated to the public in order to achieve the widest possible systematic availability and dissemination to the public of environmental information.

LN 116/2005 also aims to further the goal of contributing to a greater awareness of environmental

[33] The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, adopted on the 25 June 1998 in Aarhus, Denmark.
[34] Council Decision 2005/370/EC of 17 February 2005 on the conclusion, on behalf of the European Community, of the Convention on access to information, public participation in decision-making and access to justice in environmental matters, Official Journal of the 17.5.2005.
[35] Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC , Official Journal of the 14 February 2003 and Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment, Official Journal of the 25.6.2003.
[36] LN 74/2006, Plans and Programmes Public Participation Regulations.

[37] LN 116/2005 was published on the 19 April 2005 and brought into force by LN 139/2005, Notice of Coming into Force, on the 17 May 2005. It prescribes the nature of the environmental information that may be requested, how it is to be disseminated, the conditions when it may be withheld, the fees to be charged, and the timeframes when it is to be provided. Hereinafter referred to as Access to Info Regulations.
[38] Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EC, L41/26 EEC, Official Journal of the 14 February 2003.

matters, including climate change issues, to promote a free exchange of views, and more effective participation by the public in environmental decision-making. It provides for MEPA, as the competent authority, to ensure that public authorities holding environmental information must make it available to anyone who requests it.

Whilst these existing regulations provide an important legal tool to ensure transparency even in meeting with climate change adaptation requirements, they do not provide MEPA with the authority to seek redress against any public authority, which refuses to provide the information so requested, even when the latter is obliged to do so under the LN 116/2005. MEPA therefore cannot take any action against such public authorities which do not comply with the Regulations. Consequently, compliance or rather the lack of it, is not subject to enforcement.

Recommendation 09

The Climate Change Committee for Adaptation recommends that the Climate Change Division should optimise all legal instruments available to it so as to secure the broadest extent possible of awareness building, public participation and information on matters relating to adaptation measures.

03.4 A Legal Framework Addressing Technical Gaps and Constraints

Financial constraints hamper local research in promoting technological response strategies and tools for adaptation measures. There is also a considerable gap in the compilation of scientific data on a national level that would otherwise provide a valuable contribution to the adoption of appropriate methodologies that could be used for adaptation.

This situation impinges negatively upon public authorities when they need to identify the best options for adaptation measures that have the least negative impact on a socio-economic and environmental level. Malta is also probably losing out when it comes to tapping opportunities, which may not necessarily be 'mainstream' funding/technical resources.

Legal instruments may be introduced, which provide national funding programmes and/or financial incentives in individual sectors to address these constraints. Tapping into existing EU structural funds or LIFE programmes may provide a useful temporary solution to start addressing this urgent need.

A legal instrument, which would mimic the EU LIFE programme on a national level may be introduced even as subsidiary legislation. Adapted to the local scenario it could in a simpler and more straightforward manner than the EU funding programmes, identify who may be the beneficiaries, which are the benchmarks and provide a transparent funding regime for research in climate change. This would be the best option to ascertain continuity, innovation and investment.

The introduction of such instruments would propel the academic establishment and UoM to undertake a more active role in research and education on climate change. There is, also considerable scope for joint initiatives with industry aimed at identifying ideas that could be translated into concrete products, services and technologies, particularly those that seek to exploit Malta's potential as an example of best practice on sustainable technologies for small islands.

Similarly, one should seek to work closely with the construction industry to identify technologies, materials, and approaches that could help Malta achieve its adaptation objectives and create new niches for the industry, assisted by legislative measures and incentives.

The Malta Council for Science and Technology should seek to work closely with the recently established European Institute of Innovation and Technology which aims to set up a Knowledge and Innovation Community on climate change and adaptation.

Recommendation 10

The Climate Change Committee for Adaptation recommends that the Government should introduce a legal instrument, designed on the principles of the EU LIFE programme, directed to boost local research in promoting technological response strategies and tools for adaptation measures.

03.5 A Legal Framework Addressing Reporting on Progress

As argued above, it is important to establish which current or planned policies or other actions, irrespective of subject area, could help or hinder the attainment of Malta's adaptation objectives, once established. Such a system would also help reduce the overall cost of adaptation by streamlining initiatives, strengthening synergy, and minimising conflicts.

It follows that it is of strategic importance that all players, stakeholders, and decision makers are fully aware of, and up to date with ongoing and planned initiatives, their progress, and the current status as regards achievement of adaptation objectives.

Whilst access to and availability of relevant regional data has improved through Malta's membership in the European Environmental Agency (EEA), this does not substitute the collection and compilation of local data in a coordinated manner and the need for well-trained human resources to compile and interpret it. Thus, Malta should establish the appropriate benchmarks to monitor progress at a national level as well as to benchmark such progress with the EU and other Member States initiatives in this regard.

Above all, it is important that Malta possesses enough information and experience on adaptation in order to be a valued partner to the European Commission, the EEA and other EU bodies, so as to ensure that all ongoing work on adaptation at EU level also takes into account all issues of major relevance to Malta and that eventual policies adopted at EU level are relevant enough to assist the Maltese adaptation effort. This can only be achieved if all locally available information is readily available and kept up to date.

Yet gaps exist in the local capacity–building requirements to ensure better monitoring, implementation and compliance, gaps which negatively affect Malta's ability to take the action needed in this regard.

This information should not be retained within the government domain but, rather, should be readily available to all citizens so as to ensure the greatest possible ownership and consensus on Malta's adaptation policy. Moreover, access to information promotes compliance and public participation facilitating ownership of adaptation issues.

Information on initiatives and plans should supplement data which has already been gathered on the state of the Maltese environment, as compiled in the National Communications to the UNFCCC[39] and the Environment Report published by MEPA[40].

Yet, here, too, gaps are evident and should be addressed.

National legislation is not the best instrument to address the need to fill in capacity-building gaps since recruitment and training is essentially a policy decision. More than anything else, legal instruments, imposing a vast array of obligations, highlight the urgent need to have adequate qualitative and quantitative human resources to ensure compliance and implementation both at the regulatory and the operational level.

[39] SNC, *supra*.
[40] MEPA, *The Environment Report*, 2008, hereinafter MEPA Report

Recommendation 11

The Climate Change Committee for Adaptation recommends that a legislative instrument to be introduced, which enshrines the importance of sustained and regular adequate qualitative and quantitative public benchmarking and reporting as well as to seek to ensure compliance and secure implementation both at the regulatory and the operational level. This legislative instrument should also provide the appropriate organisational resources to ensure that these important obligations can be met.

03.6 Gaps and Constraints related to Adaptation Measures in Various Sectors

There are different types of adaptation measures for the various sectors, namely, anticipatory and reactive adaptation, autonomous, and planned adaptation[41]. Adaptation involves both the public and the private sector. It is to be stressed, however, that it is counterproductive to aim at a comprehensive legal framework for adaptation measures from the outset. Identifying adaptation measures and the required methodologies to implement them is a learning curve process. Preparedness, however, is essential and it must be tailor-made to suit the local sectoral scenario since the subjective character of adequate adaptation measures causes them to differ one from another.

03.6.1 The Regulatory Framework.

Gaps in the regulatory framework in the various sectors cannot be assessed at face value. It is improbable that legal instruments would establish obligations to take adaptation measures much in advance. Legal instruments must impose specific obligations upon natural and legal persons. So gaps in the regulatory framework with respect to adaptation are identifiable only as reactive adaptation measures or, at best, as preventive and precautionary measures when sufficient information exists.

An efficient regulatory framework dealing with sectoral adaptation measures depends upon the provision of information that specifies who needs to adapt to what, by when, and to what extent. At any rate, as discussed above, the mainstreaming of adaptation to climate change across all sectors should be the rationale behind any legal instrument that would seek to address this gap.

To recapitulate, the present regulatory framework exhibits, a major gap in being unable to provide even for reactive adaptation or planned adaptation because there is no legal instrument, whether horizontal or sectoral, which bestows enabling powers upon a Minister to regulate such a situation as the need arises.

The provisions of the EPA allow the Minister responsible for the Environment to publish regulations to provide for environmental emergencies but this is inadequate for the purpose of establishing adaptation measures to climate change since they are not the same as environmental emergencies. On the contrary, they need to *prevent* such emergencies.

This is true, even on a sectoral level. Unless there is proper mainstreaming and ownership across the board, any new legal instruments would be futile. In many cases it is a proper regulatory / procedural framework that is necessary. Legal instruments targeting various entities to ensure that they are implementing adaptation measures must be operated within the context of a National Strategy on Adaptation and the diverse entities must be legally answerable to a national agency with cross-sectoral decision-making powers on climate change.

[41] Smit B, Burton I, Klein RJT and Wandel,J,,*An Anatomy of Adaptation to Climate Change and Variability, 2000,* 223-251.

Recommendation 12

The Climate Change Committee for Adaptation recommends that a regulatory framework for adaptation measures to climate change should be designed with the goal of preventing environmental emergencies.

03.6.2 The Administrative Framework

The sectoral legal framework should primarily aim at the formulation and adoption of anticipatory adaptation measures, which may include increasing the robustness of infrastructure and investments, enhancing flexibility of vulnerable managed systems and operations, allowing flexibility for adaptation of vulnerable natural systems, reversing trends that increase vulnerability, and improving awareness building and preparedness at all levels. The existing fragmented administrative set up does not facilitate reactive measures which are the type of adaptation measures that are best suited to apply to natural ecosystems when confronted with climate change.

An appropriate legal framework for adaptation must identify criteria for assessment when selecting key technologies that should facilitate sectoral adaptation to climate change. It must also address gaps related to the transfer of and access to environment technologies.

This would facilitate adaptation to climate change by establishing obligations for research and systematic observation systems relevant to the various sectors. Only in this manner can Malta develop specialised local climate change impact scenarios and provide ongoing technical programmes and projects relevant to adaptation to climate change that are also sector specific.

Once the legal framework addresses this gap, it would be easier to motivate the private sector to adopt adaptation measures or to pursue research in investment opportunities relating to climate change. Consequently, specific laws can be published, which impose adaptation obligations upon operators in the various sectors after carrying out a stakeholders dialogue that is sustained by a research based list of possible options.

Such an approach would offer win-win opportunities for both government and the private sector. It would synergise national adaptation needs with the promotion of job opportunities and training as well as cushion negative socio-economic implications and vulnerability as a resulting from climate change.

Recommendation 13

The Climate Change Committee for Adaptation recommends that a regulatory framework for adaptation measures to climate change should seek to identify criteria for assessment when selecting key technologies that facilitate sectoral adaptation to climate change; address gaps related to the transfer of and access to environment technologies; and establish obligations for research and systematic observation systems relevant to the various sectors.

03.6.3 Water Management

There are three major steps that need to be taken to adapt this sector to climate change. These are:

- the formulation of a water policy which mainstreams climate change mitigation and adaptation obligations;

- compliance with and implementation of Water Framework Directive and other related legislation;

- an assessment of the relationship between climate change/water resources/food security/hygiene (mainly dealt with in the section of this report dealing with health and regulated in part by L.N.17/2009[42]).

There is no doubt that the need for a water policy, which is indispensible even for the implementation of a sound legal framework, is critical. The Maltese legal framework on water management is vast, mainly due to Malta's membership in the EU.

The 2004 Water Policy Framework Regulations[43] transpose the Water Framework Directive, which is the most relevant law that applies for this sector's adaptation to climate change. It establishes '*a framework of action'* for the protection of '*inland surface waters*, *transitional waters*, *coastal waters* and *ground water*.' These Regulations attempt to adopt a holistic approach with respect to the whole field of water management.

The Regulations address emissions and discharges that affect water, whether via point or diffuse sources, irrespective of where they originate. The competent authorities involved, which are the MRA and MEPA, are legally bound, to prevent the deterioration of the status of all the bodies of water[44] and to implement the measures necessary to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to reduce progressively pollution.

The relevance of these Regulations for adaptation to climate change are particularly related to groundwater management, given the already precarious status of this resource and the impact that climate change is likely to cause on precipitation. This situation renders groundwater resources both more vulnerable and more valuable. Additionally, these regulations also regulate coastal water management, which is also a sector that is closely related to climate change adaptation due both to these areas as a habitat and as a zone of intense economic activity.

Indirectly, the regulation of coastal zone management is also a vital issue for adaptation to sea level rise, although this aspect falls more under the infrastructure sector. The regulation of rain water catchment would also be dealt with under the infrastructure sector.

(i) Groundwater Management

The implementation and enforcement of the Water Policy Framework Regulations will constitute one of the fundamental cornerstones for the better regulation of water resources.

These Regulations define the MRA as the competent authority, insofar as inland water[45] and ground water are concerned. It is therefore, the MRA's responsibility to take the necessary measures and ensure that the environmental objectives established under these Regulations for groundwater, are met.

A waiver is permitted when '*failure to achieve good groundwater status*[46] *. . . or to prevent deterioration in the status of a body of . . . groundwater if this is the result of new modifications or alterations to the level of bodies of ground water*.'[47] However, even for this exception to apply, a number of conditions must subsist.[48]

Furthermore, under these Regulations the MRA shall, when making operational the programme of measures for groundwater specified in the water catchment plans, take the *necessary measures*[49] to protect, enhance, and restore all bodies of groundwater. In so doing, the MRA '*shall implement the measures necessary to reverse any significant and sustained upward trend in the concentration of*

[42] Quality of Water Intended for Human Consumption Regulations, 2009.
[43] LN 194/2004, Environment Protection Act, 2001 (Act No XX of 2001), Water Policy Framework Regulations, 2004, hereinafter WPFR.
[44] According to the type of water resources falling under their responsibility.
[45] The exception is inland waters found in nature reserves listed in the Schedule to LN 143/93.
[46] A good ground water status is defined in the regulations as 'the status achieved by a groundwater body when both its quantitative status and its chemical status are at least good', WPFR, *supra*, Art. 2,
[47] Ibid., Article 4(7)(a).
[48] Ibid., Article 4 (7) (a), sub-paras (i)–(iv).
[49] Ibid., Article 4(1)(b)(ii).

any pollutant derived from anthropogenic activities so as to reduce pollution of ground water progressively.'[50]

In fact, the MRA as the competent authority, shall ensure that, for each water catchment district, it will undertake: an analysis of its characteristics; a review of the impact of human activity on the status of groundwater found within the said district; and an economic analysis of water use.

The said analyses and reviews had to be carried out in accordance to the technical specifications set out in Annexes II and III and had to be completed by the end of November 2004. The analyses and reviews[51] shall be reviewed and, if necessary, updated by the end of November 2013 and every six years thereafter. The MRA may also aim to achieve less stringent environmental objectives for bodies of ground water than those listed above, when it is found by virtue of the analysis carried out for that particular water catchment district, that because of the affects of human activity[52] or their natural condition, '*the achievement of these* (environmental) *objectives'*, for the purpose of a good groundwater status, *would not be feasible or would be disproportionately expensive*.'[53]

Nevertheless, the MRA must ensure that when adopting these less stringent environment objectives, the following conditions must be met[54], namely, that the environmental and socio-economic needs served by such human activities cannot be achieved by other means, which are '*significantly better environmental options not entailing disproportionate costs'*. Furthermore, the MRA must ensure that groundwater undergoes the least possible changes to a good groundwater status, given impacts that could not '*reasonably'* have been avoided, due to the nature of the human activity or pollution.

The MRA must also ensure that the status of the body of groundwater is not further deteriorated. Lastly, the MRA must list the less stringent environmental objectives in the water catchment management plan,[55] together with the reasons for adopting these less stringent environmental objectives. These objectives must be reviewed every six years.

As per these regulations, the MRA's monitoring of the ground water status shall cover its chemical and quantitative status. As a blanket provision, the regulations lay down that the MRA, in applying all these obligations, has to ensure that the application does not '*permanently exclude or compromise the achievement of the objectives of these Regulations in other bodies of water within the same water catchment district and that it is consistent with the implementation of other environmental regulations*.' It is also incumbent upon the MRA to coordinate '*all programmes of measures for the whole of the catchment district*.'[56]

It is also the duty of the MRA as the competent authority, to ensure that bodies of groundwater that are identified are afforded the necessary protection to avoid deterioration in their quality, so as to reduce the level of purification treatment required in the production of drinking water. In so doing, the MRA may establish safeguard zones for these bodies of groundwater.[57] The planned steps, which the authority intends to take in this regard, are to be reported in the water catchment management plans.

The Competent Authority must ensure that a water catchment plan, which includes details listed in Annex VII to these Regulations, is produced for each water catchment district and that these are to be published by end of November 2009. These plans may be supplemented by more detailed programmes and management plans. These management plans, as with the programmes of measures above mentioned, shall be reviewed and updated by the end of November 2015 and every six years thereafter.

In order to achieve the environmental objectives aforementioned, the MRA must establish a *programme of measures*, for each water catchment district. In so doing, the MRA is to take into consideration the analysis of the characteristics of the water catchment district, the review of the

[50] Ibid., Article 4(1)(b)(iii).
[51] Ibid., Sub-regulation (1).
[52] Ibid., Art. 5(1).
[53] Ibid., Article 4(5).
[54] Ibid., Article 4(5)(a)–(d).
[55] Ibid., Art. 12.
[56] Ibid.,Article 3(3). One of the very first functions of the competent authority is to identify groundwater, which does not follow a particular water catchment, and assign it to the nearest or most appropriate water catchment district.
[57] Ibid.

environmental impact of human activity, and the economic analysis of water use, as mentioned above.

Each programme shall include a number of *basic measures* besides other *supplementary measures,* where necessary. *Basic measures* are the minimum requirements with which to comply. One of the basic measures is the establishment of controls including a requirement for prior authorisation of the artificial recharge or augmentation of groundwater bodies. The water used may be derived from any groundwater body, provided that the use of the source does not compromise the achievement of the environmental objectives established for the source or the recharged or augmented body of groundwater. These controls shall be reviewed periodically and updated, where necessary.

Another measure relates to point-source discharges that are liable to cause pollution, which must be subject to prior regulation, such as a prohibition on the entry of pollutants into water, or to prior authorisation or registration, based on general binding rules, laying down emission controls for the pollutants concerned. These controls shall be periodically reviewed and, where necessary, updated.

For any other significant adverse impacts on the status of water identified under the analysis carried out in accordance with these Regulations, a prohibition of direct discharges of pollutants into groundwater must be also made, provided that the competent authority may authorize re-injection into the same aquifer of water used for geothermal purposes.[58] Another basic measure requires the prevention of significant losses of pollutants from technical installations and of the impact of pollution incidents in the case of accidents, which could not reasonably have been foreseen, as well as all appropriate measures to reduce the risk to aquatic ecosystems.

Supplementary measures are those measures, designed and implemented in addition to the basic measures, with the aim of achieving the environmental objectives established under these Regulations. Part B of Annex VI contains a non-exclusive list of such measures. The competent authority may also adopt further supplementary measures in order to provide for additional protection or improvement of the water covered by these Regulations, including the implementation of the relevant international agreements.

These programmes of measures had to be established by the end of November 2009 and shall come in operation in November 2010. They shall be reviewed and *if necessary updated by the end of November 2015 and every six years thereafter*. New measures which are introduced shall be made operational within three years of their establishment.

When it becomes apparent through monitoring and other data, that environment objectives set under these Regulations will not be met for a particular body of ground water, it is the MRA's duty as the competent authority to investigate the causes for such a failure and to examine and review relevant permits and monitoring programmes. Currently the link http://www.mra.org.mt/wfd_introduction.shtml provides for public consultation regarding the implementation of the Water Policy Framework Regulations.

There are other Regulations protecting groundwater from mismanagement and pollution namely:

- L.N.108/2009 Protection of Groundwater against Pollution and Deterioration Regulations, 2009;

[58] It may also authorize specifying conditions for: (i) injection of water containing substances resulting from the operations for exploration and extraction of hydrocarbons or mining activities and injection of water for technical reasons into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which for natural reasons are permanently unsuitable for other purposes. Such injections shall not contain substances other than those resulting from the above operations; (ii) re-injection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works; (iii) injection of natural gas or liquefied petroleum gas (LPG) for storage purposes into geological formations which for natural reasons are permanently unsuitable for other purposes; (iv) injection of natural gas or liquefied petroleum gas (LPG) for storage purposes into other geological formations where there is an overriding need for security of gas supply, and where the injection is such as to prevent any present or future danger of deterioration in the quality of any receiving groundwater; (v) Construction, civil engineering and building works and similar activities on or in the ground which come into contact with groundwater. For these purposes, the competent authority may determine that such activities are to be treated as having been authorised provided that they are conducted in accordance with general binding rules developed by the same in respect of such activities; and (vi) discharges of small quantities of substances for scientific purposes for characterisation, protection, or redemption of water bodies limited to the amount strictly necessary for the purposes concerned., provided such discharges do not compromise the achievement of the environmental objectives established for that body of groundwater.

- L.N. 204/2009 Notification of Groundwater Sources (Amendment) Regulations, 2009;

- L.N. 126/2008 Prevention and Remedying of Environmental Damage Regulations, 2008;

- L.N. 233/2004 Protection of Waters against Pollution caused by Nitrates from Agricultural Sources (Amendment) Regulations, 2004.

(ii) Coastal Zone Management

As explained above, this discussion on the legal framework addressing coastal zone waters should mainly be seen as a legal instrument that sustains adaptation measures for marine and coastal biodiversity considered to be amongst the most vulnerable to climate change. It also provides an important set of legal parameters aimed at ensuring a good qualitative status for these waters.

The Water Policy Framework Regulations define MEPA as the *Competent Authority*, insofar as *coastal waters are concerned*. It is, therefore MEPA's responsibility to *'take the necessary measures'* and ensure that the environmental objectives established under these Regulations for coastal water management are met. MEPA is legally bound to implement the measures necessary to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to reduce the progressive pollution of coastal waters.

The analysis and reviews shall be made and, if necessary, updated by the end of November 2013 and every six years thereafter. MEPA must also ensure that the status of the coastal waters does not deteriorate further.

MEPA's monitoring of the coastal waters' status shall cover its chemical and quantitative status. In so doing, MEPA may establish safeguard zones for coastal waters. Management plans, as with the programmes of measures above-mentioned, shall be reviewed and updated by the end of November 2015 and every six years thereafter. Each programme shall include a number of *basic measures* and where necessary also *supplementary measures*. When it becomes apparent, through monitoring and other data, that environment objectives set under these Regulations will not be met, it is the MEPA, which is obligated to investigate the causes for such a failure and to examine and review relevant permits and monitoring programmes.

Of particular relevance for climate change adaptation is the fact that these Regulations, however, specify that the competent authority may waiver, without being in breach of its obligations under the Regulations, the abovementioned legal responsibilities if certain situations arise. This is the case when there is temporary deterioration in the status of bodies of water if this is the result of circumstances of natural causes or force majeure, which are exceptional or could not have reasonably been foreseen, in particular in the case of extreme floods and prolonged droughts, or where the deterioration is the result of circumstance due to accidents which could not reasonably have been foreseen. A waiver in such circumstances, which become more likely as a result of climate change effects can be made when certain conditions specified in the Regulations have been met.[59]

03.6.4 Infrastructure, Land Use and the Built Environment

This sector is perhaps the one where, for the purpose of developing legal instruments, the demarcation line between adaptation and mitigation measures becomes rather blurred. For instance, adapting to climate change requires cooler buildings as temperatures are likely to rise, good insulation, and water catchment reserves due to possible flash floods and freak storms. These measures need to be incorporated at the design phase and, whilst they are a mitigation measure in that they reduce fossil fuel emissions, they also enable the infrastructure and the built environment to adapt to climate change.

There already exists a legal framework that to, some extent, regulates the adaptation of this sector to climate change.

[59] Ibid., Art. 4(6).

(i) Development Planning and the Built Environment

Mainstreaming of climate change adaptation measures is a policy decision that must be addressed as soon as possible in the revision of the structure plan and the local plans. It is after such a mainstreaming exercise has taken place that any specific legal requirements for the building industry as a means to adapt to climate change will emerge.

The most obvious legal requirements are likely to address the enforcement of already existing rules and practices, namely, rain water catchment and appropriate sewage drainage. All building permits require that buildings have a water cistern proportionate in volume to the roof area. This is an ancient practice.

The 1939, Irrigation Ordinance had made an important distinction between '*surface water*' and '*underground* water'. This Ordinance defined '*surface water',* as '*water derived from the roofs of buildings or the surface to roads or lands and stored in underground cisterns'* and '*underground water*', as the '*water that is filtered through the soil and the underlying strata or flowed through natural fissures into the water table'*[60]. This Ordinance, therefore, distinguished between cisterns and wells.

This distinction which has served to subject water abstraction from cisterns and wells to different legal obligations, precisely because whilst the use of '*surface waters*' from cistern was being encouraged, the use of groundwater from wells was being subjected to regulation by the government to safeguard the resource from depletion. Unfortunately this practice was not regularly enforced, though as illustrated in **Chapter 05**, steps have been taken by the Government in the recent months to rectify this situation.

Any adaptation measures that need to be implemented are likely to be closely related to mitigation measures such as energy conservation in buildings. Consequently, an adaptation measure would involve the revision of civil property rights to ensure that any measures adopted do not impinge on neighbouring properties and vice versa. One such as for example, would be the right to enjoy access to solar energy, which is currently not addressed under national law.

Recommendation 14

The Climate Change Committee for Adaptation recommends that the mainstreaming of climate change adaptation measures should be addressed as soon as possible in the revision of the structure plan and the local plans.

(ii) General Land Use

Legal instruments required for this sector to adapt to climate change must address vast socio-economic implications, including issues such as property value and insurance. This is evident from one of the major pieces of legislation that regulate this sector's adaptation to climate change, namely, the Floods Directive 2007/60/EC[61], on the assessment and management of flood risks.

This Directive entered into force on the 26 November 2007. As a result, Malta is required to assess if all water courses and coast lines are at risk from flooding, to map the flood extent, identify the assets and humans at risk in these areas, and to take adequate and coordinated measures to reduce this flood risk. This Directive also reinforces the rights of the public to access this information and to have a say in the planning process.

Malta must carry out a preliminary assessment by 2011 so as to identify the 'river basins' and associated coastal areas at risk of flooding. For such zones, Malta would then need to draw up flood

[60] Ordinance XII of 1938 as subsequently amended.

[61] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks Text with EEA relevance, Official Journal L 288 , 06/11/2007 P. 0027 - 0034

risk maps by 2013 and establish flood risk management plans focused on prevention, protection, and preparedness by 2015.

This exercise must be carried out in coordination with the requirements of the Water Framework Directive, particularly in the drawing up of the flood risk management plans and river basin management plans and in the public participation procedures involved in the preparation of these plans. Moreover, all assessments, maps, and plans prepared shall be made available to the public. Climate change is one of the issues that are taken into consideration under this Directive[62].

Mainstreaming climate change into relevant development planning policies also depends upon an essential exercise that involves the implementation of the, so-called, INSPIRE Directive[63]. This Directive calls for the introduction of a new legal instrument on climate change that should address the compilation of data and observation systems and should lead to improvement in data modeling including emission scenarios and climate change impacts scenarios at a local scale, as well as to the improvement of monitoring systems.

All sectors should be legally bound to maintain a Geographic Information System to integrate data related to climate change, and any other data required apart from spatial information. This is already an obligation under the EU INSPIRE Directive, which ensures that the spatial data infrastructures of the Member States are compatible and usable in a Community and trans-boundary context. This Directive requires that common Implementing Rules[64] are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting.

Recommendation 15

The Climate Change Committee for Adaptation recommends that emphasis should be placed on minor and already vulnerable groups and that all sectors should be legally bound to maintain a Geographic Information System to integrate data related to climate change, as well as any other data required apart from spatial information.

Other essential legal instruments for integrating adaptation measures into land use development already exist namely, the SEA Regulations that has been discussed above and the Environment Impact Assessment Regulations. Adaptation measures should be included in the existing legal process that regulates land use, namely the LN 114/2007 Environment Impact Assessment (EIA) Regulations[65].

These latter Regulations distinguish between a full EIA and a limited EIA.[66] The former provides for an environmental impact statement (EIS), whilst the latter for an environmental planning statement.[67] Both these statements are the subject of different developments which are listed in Schedule 1A to the Regulations.[68] The Director of Environment Protection however may still require the carrying out of an EIA even if the project in question does not fall under Schedule 1A where s/he is of the opinion that significant impacts are likely to occur.[69] Conversely, the said Director may exempt an applicant for development permission for carrying out a limited EIA where this will not add any new information which is already available to the Authority and the project description statement has considered environmental issues in a sufficient manner.[70] The Regulations, therefore, have the required flexibility

[62]For more details on this aspect of adaptation to climate change vide http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents&vm=detailed&sb=Title
[63] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), Official Journal 25.4.2007.
[64] These Implementing Regulations are adopted as Commission Decisions or Regulations, and are binding in their entirety. The Commission is assisted in the process of adopting such rules by a regulatory committee composed of representatives of the Member States and chaired by a representative of the Commission (this is known as the Comitology procedure).
[65] LN 114/2007. The Regulations came into force on 20 April under Article 60 of the DPA and Articles 9 and 10 of the Environment Protection Act, 2001
[66] Ibid., Article 3 (4) and (5).
[67] Ibid., Article 3 (5).
[68] Ibid, Category I of Sch. 1A consists of the projects which lead to an EIS while Category II of the said Schedule consists of the projects which lead to an environment planning statement.
[69] Ibid.,Article 3 (6) and (7).
[70] Ibid. Article 3 (8).

to require developers to take into consideration adaptation measures for climate change.

In addition, MEPA may still refuse a development permission application which requires an EIA, even if no such EIA is held, where the Authority is of the view that the development: is clearly against any approved development plan or planning policy; where the effects are clearly unacceptable; and if the project description statement indicates that the development will have unacceptable environmental impacts[71]. Furthermore, the applicant may, of his or her accord, submit an environmental scoping statement to the Director of Environment Protection together with the project description statement.[72] The environmental scoping statement consists of the identification of key issues, significant actions, alternatives, and impacts to be considered in an EIA.[73] Adaptation to climate change could be included as one of these key issues.

Once the project description statement is submitted, the Director of Environment Protection screens the proposal, that is, s/he decides whether or not a proposal should be subject to an EIA.[74] Part III of the Regulations deals with the full EIA requiring an EIS. Prior to drawing up the terms of reference (TOR) for the EIS, the Director of Environment Protection has to carry out an appraisal of all foreseeable or expected environmental impacts[75].

An EIS consists of a description of the proposed development project[76], a description of the existing environment[77], an assessment of effects of the development[78], an identification of mitigation measures where adverse effects are identified[79], and the drawing up of a scheme of project monitoring requirements during both the construction and operational phases[80].

Although climate change adaptation measures may be required to feature under these headings, the Director of Environmental Planning may modify the TOR of the EIS, even while the EIS is in progress[81], so as to ask the applicant to include them even if the latter has not done so already. The Regulations then require the consultants to submit a draft EIS[82]. The contents of the EIS are spelt out in the law[83].

A public consultation stage follows on the draft EIS consisting of in the submission of a draft EIS to the Director of Environmental Protection, government departments, and other government entities, and to the Director of Planning for feedback[84]. A public hearing is also held[85]. The draft EIS will be opened to the public and the competent local council will also receive a copy of the draft. After taking into consideration all the above submissions, the consultants will review the draft EIS and draw up a final EIS which is presented to the Authority[86]. The application will then have to be amended by the applicant to conform to the recommendations made in the final report[87].

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[71] Ibid., Article 4 (2). The Regulations require an application for development permission to contain a project description statement – that is, a description of the site and the proposed development in sufficient detail to identify the likely effects on the environment and their acceptability under specific policies contained in the development plans and in planning policies

[72] Ibid., Article 5.

[73] Ibid., Article 6.

[74] Ibid., Article 7. Should the said Director be of the opinion that an EIA is needed, s/he will write to the applicant to inform him or her accordingly. The applicant has thirty days from notification of the Director's letter to inform the latter that s/he accepts the Director's views. Otherwise, if the applicant does not write back to the Director of Environmental Planning the application is to be refused by the Authority on the basis that no EIA was carried out when this was required

[75] Ibid., Article 10. The competent local council and relevant government departments are also invited to provide information which they wish to include in the TOR of the EIS. An advertisement has to be placed by the said Director in a local newspaper, at the expense of the applicant inviting the general public to come up with its views as to what should go into the TOR. Finally, the Director in question can also convene a public hearing at applicant's expense prior to setting out the TOR in case of projects of major significance because of their scale, location, hazardous properties, or other reasons. The Director will then meet the applicant and his or her representatives to discuss the TOR. Once the Director draws up the final version of the TOR, these are communicated to the applicant, his or her architect, or consultants. The TOR will also be accessible to members of the public.

[76] Ibid. Article 14.

[77] Ibid., Article 15.

[78] Ibid., Article 16.

[79] Ibid., Article 17.

[80] Ibid., Article 18.

[81] Ibid. Article 19.

[82] Ibid., Article 20.

[83] Ibid.,.

[84] Ibid., Article 21.

[85] Ibid., Article 25.

[86] Ibid., Article 26.

[87] Ibid., Article 26 (4).

Part IV of the Regulations deals with a limited EIA requiring an environmental planning statement. Essentially, the procedure is the same as that followed in the EIA with the difference that being a reduced procedure, no public hearing is held and that the environmental planning statement is more limited in nature than an EIS[88].

Part V deals with trans-boundary effects of a development project and sets out the procedures to be followed when a project is likely to have a transboundary impact.

03.6.5 Natural and Managed Ecosystems

Biodiversity, whether in its natural state or as part of ecosystems managed by humans, will inevitably suffer from negative impacts as a result of climate change. Success in taking adaptation measures for managed ecosystems will involve better management by the farming and fishing communities, who must also take preventive measures to counter the impact of alien species and disease on the species they harvest.

Soil and water management must also feature in adaptation options for this sector. The EU Commission has adopted a three-pronged approach to address soil conservation. It has prepared a Thematic Strategy for Soil Protection which identifies action needed to ensure a high level of soil protection. The Proposal for a Framework Directive sets out common principles for protecting soils across the EU. Within this common framework, Malta will be in a position to protect soil and use it in a sustainable way.

The Impact Assessment[89] contains an analysis of the economic, social and environmental impacts of the different options that were considered in the preparatory phase of the strategy and of the measures finally retained by the Commission. It is envisaged, therefore, that new legislation to this effect will be adopted, via which Malta can regulate the sustainable management of soil.

As a Party to the Desertification Convention[90], Malta is already obligated to take certain conservation measures with respect to soils against the negative impacts of climate change.

There are, moreover, various veterinary laws, plant health laws and agriculture related laws that may serve to assist this sector to adapt to climate change. As agriculture is one of the sectors that is likely to register severe impacts as a result of this phenomenon, a revision of applicable EU laws in the light of the need to take adaptation measures is probably already on the Commission's agenda.

Malta can take the initiative itself, however, and start to examine the relevant legal framework that regulates the agriculture sector to identify, which are the most adequate legal instruments that can be used to prepare this sector for adaptation and, if considered necessary, supplement it with new laws. It goes without saying that a cost benefit exercise needs to be carried out to assess socio-economic repercussions upon this vulnerable sector.

The Plant Quarantine Act[91] is a valuable legal instrument to adopt legal obligations that would prevent the introduction into Malta of plant pests and diseases, introduced as a result of climate change, as well as of controlling and checking their spread. The Act also provides for other matters incidental and ancillary thereto.

Its main aim, however, pertains to the protection of the agro-industry rather than the environment. Consequently, although it does control the introduction of alien species, it does so incidentally, because its primary purpose is the control of plant pests and diseases. Hence this Act does not constitute an appropriate legal framework to safeguard Malta's biological diversity in its entirety. Furthermore, the new Act also adopts EU internal market measures, since the terms 'import' and 'export' do not include the introduction of a thing into Malta or the taking out of a thing from Malta, from or to respectively a Member State of the EU. In this case, the principle of free movement has to be

[88] Ibid., Article 33.
[89] SEC (2006) 1165 and SEC(2006) 620.
[90] United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, adopted in Paris on 19 June 1984.
[91] The Plant Quarantine Act, 2001,Chapter 433 of the Laws of Malta, Act XVIII, as amended.

respected and all border checks have to be abolished.

The administration and implementation of these Regulations fall under the authority of the director responsible for the department of plant health. This department is duty bound to inspect growing plants, areas under cultivation, and plants and plant products in storage or locally in transit, in order to report the existence, outbreak, and spread of plant pests and to control such plant pests. The department is also responsible for consignments of plant materials moving in international traffic, and for issuing phytosanitary certificates or plant passports. This department is obliged to periodically update and disseminate lists of plant material, plant pests, and beneficial organisms, the importation of which is prohibited or restricted into Malta, and they must also disseminate information within Malta about pests of plant and plant products and how to prevent and control them.

Research and surveys in the field of plant protection and the administration and enforcement of these provisions also falls under the responsibility of this department. Under the Plant Quarantine Act, there also exists provision for the set up of a Plant Protection Board, which shall regularly review the state of plant quarantine in Malta on the formulation of policies in this regard, and advise the Minister on any matters with which this Act is concerned.

The functional part is the part dealing with imports and exports. In fact, no person shall import into Malta any plant material, plant pest, beneficial organism, soil, or packaging material except in accordance with this Act. Also, any person, intending to export a consignment of plants or plant products to another country, shall submit the consignment to the Plant Health Service for pre-export examination.

Any importation of any plant material, plant pest, and so forth, has to be accompanied by the required permits and certificates which shall be examined by an inspector at the designated point of entry. Furthermore, any person in Malta who receives any plant material, plant pest, and so forth, from outside Malta, shall immediately notify an inspector and carry out the inspector's instructions regarding its destruction, disposal, or treatment to the satisfaction of the inspector.

If these provisions are not respected, the police have the power to seize such products, and they will follow the inspector's instructions on their treatment or destruction or their disposal. Moreover, the issuance of a permit for importation may be prohibited or restricted by the director after consultation with the Board. Also, the Minister for Agriculture may, acting on the advice of the Board, make regulations establishing rules for the marketing of vegetative propagating and planting material, He/She may, by such regulations, establish the conditions for the grant of permits for the importation and transport of any plant material, plant pest, or other organisms for the purposes of scientific research or otherwise, subject to such terms and conditions as may be established in or referred to in the regulations to safeguard public health, agriculture, and/or the environment. This enabling clause would serve also for the taking of adaptation measures.

Apart from regulating the importation and exportation of such products, the director is also responsible for the containment and eradication of plant pests. In fact, if the director is satisfied that a notifiable plant pest is present at any place, he will notify the landowner of such place and others in the vicinity to take whatever measures on their land in order to eradicate, contain, or restrict the spreading of the notifiable plant pest.

If such owner cannot comply with any term of a notice, the director may authorise the Plant Health Service to enter upon the land or premises in question and to take whatever measures as may be appropriate to carry out the requirements of the notice. Where any plant material or other thing is destroyed or harmed by any measure taken to eradicate, contain, or limit the spread of a notifiable plan pest, the Minister may compensate the owner of the plant material or item destroyed or harmed from monies voted for that purpose by the House of Representatives.

The application of the Habitats Regulations would serve to promote a balance of interests between managed and natural ecosystems whilst providing a sound conservation legal framework for biodiversity in general. LN 311/2006, entitled *Flora, Fauna and Natural Habitats Protection Regulations, 2006,* was published on 7 December 2006. These Regulations are divided into twelve parts, with twelve schedules attached. These schedules basically offer a comprehensive legal

framework, which, if implemented well, could provide the best conservation measures that would greatly enhance adaptation in this sector.

Part II of the Regulations deals with ecological networks. Under the said Regulations the competent authority shall set up a coherent ecological network of protected areas under the title of the National Ecological Network, outlining criteria for their selection. The competent authority shall also contribute to the setting up of a coherent European ecological network of special areas of conservation, established under the title of Natura 2000. Part III deals with protected sites. The Competent Authority shall, from time to time, propose a list of sites indicating with respect to each site, which natural habitat types in Schedule I to the regulations and which species in Schedules II and III to the Regulations that are native to Malta, are hosted by the sites in question. These have to be declared according to the basis of the criteria set out in Schedule IV (Stage 1) to the same Regulations and relevant scientific information, with the aim of designating that site as a Special Area of Conservation (SAC)as soon as possible.

Furthermore, the competent authority is also to furthermore distinguish between those special areas of conservation which, in its opinion, are of national or of international importance. Once a site is designated as a SAC or a Special Protection Area (SPA), the competent authority is to publish details of such site or sites in the Gazette or in a local newspaper. Guidelines are also to be issued by the competent authorities for the management and conservation of protected sites, as well as for the conservation measures and management agreement required for the protected sites. Part IV deals with the protection of species. Species of flora, in all stages of their biological cycle, listed in Schedules V(b) and VI(b) attached to the Regulations, shall not be deliberately picked, collected, cut, uprooted, destroyed or damaged in any way.

With regard to fauna, no person can pursue, take or attempt to take, deliberately capture or kill or attempt to kill, deliberately destroy, keep, transport, by any method sell, buy, exchange, offer for sale or for exchange, import or export any specimen of species listed in the Schedules V(a) and VI(a) to these Regulations, except for those taken legally before the regulations came into force, and unless he is in possession of a prior official permit from the competent authority or director as appropriate. Furthermore, no person shall deliberately disturb any species listed in Schedules V(a) and VI(a) to these Regulations, particularly during periods of breeding, rearing, hibernation and migration, The fauna species, in all stages of life, listed in Schedules V(a) and VI(a) are protected against the destruction and deterioration of their breeding sites or resting places. Furthermore, the deliberate destruction or taking of eggs from the wild is also prohibited.

All endemic species are protected, except for those endemic species listed in Schedule X to the regulations. However, the competent authority or the director, as appropriate, can issue a prior official permit for the exploitation of endemic species or specimens of species not listed in Schedule X to the regulations. The competent authority, if it deems it necessary, can take any measures to ensure that the taking in the wild of specimen of species of wild fauna and flora listed in Schedules VII and VIII as well as their exploitation is compatible with their being maintained at a favourable conservation status.

Such measures may also include, in particular, the temporary or local prohibition of the taking of specimen in the wild and the exploitation of certain populations; the regulation of the periods and, or methods of taking specimen; the application, when specimen are taken, of hunting and fishing rules which take account of the conservation of such populations; the establishment of a system of licenses for taking specimen or of quotas; the regulation of the purchase, sale, offering for sale, keeping for sale or transport for sale of specimen; the breeding in captivity of animal species as well as artificial propagation of plant species, under strictly controlled conditions, with a view to reducing the taking of specimen of the wild; any other measure deemed necessary and an assessment of the effect of the measures adopted.

Part V regards the introduction and re-introduction of species. This part outlines measures, which can be taken by the competent authority with regards to the control of alien species, and the re-introduction of species.

Part VI concerns the capture and killings methods, more specifically, the prohibited use of means of capture and killing and modes of transport. Part VII, 'Conservation and Sustainable Use,' outlines the obligations of the competent authority to develop a national strategy and other relevant policies and

plans, action plans and related programmes aimed at the conservation and sustainable use of biodiversity; the integration of the conservation and sustainable use of biodiversity into relevant sectoral or cross-sectoral plans, programmes and policies; and the promotion and the integration of conservation policies and sustainable use of biodiversity in plans, programmes and policies prepared by other Authorities. It also provides for *in situ* and *ex situ* conservation measures.

Part VIII deals with access to genetic resources and conservation measures, in accordance with the United Nations Convention on Biological Diversity, opened for signature at Rio de Janeiro, on the fifth day of June 1992. Part IX addresses the surveillance and monitoring obligations of the Competent Authority, such as the setting up of a national inventories aimed for the conservation and sustainable use of biodiversity, and as far as practically possible, to have these inventories digitised and made freely available to the public, subject to the provisions of the Freedom of Access to Information on the Environment Regulations, 2005[92]. Part X deals with communications and research, communication education and public awareness, research and scientific cooperation, and the establishment of a clearing-house mechanism.

Part XI deals with permits and penalties and treats the issue of permits, derogations, applications, and other supplementary provisions, the keeping of a register for such permits, and confidentiality. It also outlines the offences and penalties with regards to the various infringements regarding the different schedules.

The twelve different schedules of the flora and fauna protection regulations are the following:

- Schedule I – Natural habitat types whose conservation requires the designation of Special Areas of Conservation;

- Schedule II – Animal and plant species of Community interest whose conservation requires the designation of special areas of conservation;

- Schedule III – Animal and plant species of National interest whose conservation requires the designation of special areas of conservation;

- Schedule IV – Criteria for selecting sites eligible for identification as sites of national importance or of international importance and designated as special areas of conservation;

- Schedule V – Animal and plant species of community interest in need of strict protection;

- Schedule VI – Animal and plant species of national interest and in need of protection;

- Schedule VII – Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures;

- Schedule VIII – Animal and plant species of national interest whose taking in the wild and exploitation may be subject to management measures;

- Schedule IX – Identification and monitoring;

- Schedule X – Endemic species not covered by regulation;

- Schedule XI – Animal species of community interest whose capture and killing and transport are regulated;

- Schedule XII – Prohibited methods and means of capture and killing and modes of transport.

The conservation of fisheries is also well regulated by means of the Fisheries Conservation and Management Act[93] which defines fishing as *'the catching or taking of fish that occur or have grown naturally in the sea, and any other activity which can reasonably be expected to result in the catching*

[92] Access to Info Regulations, *supra.*
[93] Fisheries Conservation and Management Act, 2001, Chapter 425 of the Laws of Malta, Act II, as amended.

or taking of fish or the farming of fish, together with any operation at sea in support of or in preparation of any one of the above-mentioned activities.[94] '

The Minister responsible for fisheries has the power to make Regulations, for the better carrying into effect of the purposes of this Act and amongst other things, for the conservation, management, and protection of fish resources, the establishment and management of marine areas for the preservation of fish stocks, for the control of the exploitation of coral and sponge resources; the protection of turtles, dolphins, and other aquatic animals; the landing of fish and its utilisation in the manufacture of by-products; and to regulate the sale of fish. Therefore, even this sector therefore has an existing legal framework that could be used to satisfy the taking of adaptation measures for the fisheries sector.

03.6.6 Health Issues and Civil Protection

The existing legal framework on civil protection and health needs to be screened for the purpose of adaptation. Existing legislation on food safety, occupational health and safety, vulnerable groups, and public health in general, can incorporate legal measures that would render adaptation measures obligatory. Contingency plans for adaptation would also identify legal obligations that would then be incorporated in legal instruments that address various situations that may arise as a result of climate change and which affect public health and civil protection in general.

[94] Ibid., Article 2.

04.1 Introduction

It is generally accepted that, despite all efforts of mitigation, some degree of climate change is now inevitable. Indeed, it is abundantly clear that climate change is already happening to a marked extent. In its White Paper on Adaptation to Climate Change[95], the European Commission recognises that the Mediterranean Basin is one of the most vulnerable regions in Europe, with small islands being particularly so.

This is borne out by the facts. Mean annual air temperature in Malta has risen by 0.23 °C per decade over the past 50 years. The effects of this rise translate to increased drought, desertification and increased soil erosion, as well as increasing pressure on water resources and biodiversity. In turn, these direct effects may trigger further indirect effects, including impacts on health, agricultural productivity and tourism.

The pressure on water resources is expected to be particularly severe. A decrease of between 10 and 40 percent in mean annual precipitation is expected in Southern Europe by 2100. Despite cyclical patterns, Malta's precipitation data indicates a decrease of 7.9 mm per decade between 1958 and 2008. In view of the need to reduce CO^2 emissions as well as the economic implications, resorting to conventional desalination technology is no longer a straightforward option. The other main fresh water resource, groundwater, is also under considerable pressure from both quality and a quantity perspectives and is in no position to make up for the shortfall.

Another expected result of climate change will be increased variability in precipitation patterns as well as an increased frequency of extreme events, including droughts and flooding. Over the last decade, Malta has experienced two of the most severe droughts since 1960, in 2000-2001 and 2001-2002. This impact alone will require an adequate response, particularly in the areas of spatial planning and civil protection. Moreover, increased contingency will need to be made by both Government and the private sector for the economic damages that such events will inevitably cause. This will translate into a direct economic cost.

Most of Malta's economic activity and infrastructure is either situated in coastal areas or heavily projected towards them. These areas may be increasingly prone to sea level rise and erosion, also necessitating adequate planning and policy responses.

While the exact scenario that will unfold during the coming decades remains uncertain, overall, based on UN benchmarks, Malta is expected to be moderately impacted by climate change when compared to the overall global situation, with the main impacts being drought, deterioration of fresh water resources, increased risk and intensity of flooding, soil and coastal erosion, desertification, changes in sea level and progressive loss of biodiversity and resilience of natural ecosystems.

The high probability of some or all of these changes occurring makes it prudent to assume that measures need to be taken now in order to prepare for these impacts. *As in the case of mitigation, the costs of inaction or delayed action may far outweigh the costs of action, from both an economic and a social perspective*.

Recommendation 16

The Climate Change Committee for Adaptation is of the considered opinion that changes in, amongst others, temperature, precipitation, and drought in Malta over the past 50 years make it prudent to assume the measures for climate change adaptation that are planned and embarked upon today should far outweigh the costs of inaction from both an economic and social perspective.

[95] White paper - Adapting to climate change: towards a European framework for action (COM(2009)147 final), hereinafter White Paper on Adaptation.

Apart from the environmental and economic dimensions, the social aspect of climate change should not be underestimated. The impacts of climate change will be disproportionately distributed, with the most vulnerable sectors of society, including the elderly, the disabled and low income households expected to be most negatively affected.

The primary reason for this is that these disadvantaged sectors of society will be least able to respond to the effects of climate change and will therefore suffer more. Typically, these households also typically spend more of their income on basic needs, such as energy, food and housing. These are all items that will inevitably take the brunt of the cost increases that will be triggered by climate change and the measures necessary to mitigate it. These sectors are also more likely to be earning their livelihood from activities that are vulnerable to climate change, such as agriculture and tourism. More affluent groups are also more likely to have easy access to information that could help them adapt.

It, therefore, becomes imperative to consider adaptation to climate change as yet another example of the importance of sustainable development, based on more sustainable patterns of consumption and production.

Adaptation actions must complement measures already being taken or planned to be taken in the area of mitigation. Many measures, such as those aimed at improving the energy efficiency of households and businesses, or at reducing the need to produce fresh water through energy intensive processes, have a crucial role to play in both mitigation and adaptation efforts.

Other adaptation actions may also be justified by other policies. For example, reducing the water intensity of both agriculture and tourism will translate into greater productivity for these sectors, given the increased cost over time of producing water of the required quality. Indeed, first preference should be given to these 'no regret' options, that is to say, options that would deliver tangible results independently of climate change considerations and which measures would still need to be undertaken to secure sustainable development in Malta.

Recommendation 17

The Climate Change Committee for Adaptation recommends that adaptation measures to be undertaken should, primarily, be those that constitute 'no regret' options, that is to say, actions that Malta still needs to undertake as, for example, the reduction of water intensity use, in order to secure sustainable development in Malta.

It is clear that adaptation is already taking place in some areas, through a number of actions and reactions at Government, private sector and consumer level. For example, the overall trend in water consumption is one of decline, largely because of increased awareness as well as more realistic pricing.

Coupled with greater pressure on the Water Services Corporation (WSC) to improve efficiency and decrease losses and uncharged consumption, water production from the WSC decreased by 6 percent between 2004 and 2008.

What is required, however, is a more strategic approach towards adaptation, as well as a sustained effort to ensure that all policies and actions are in line with this overarching objective. The risk of actions taken without such a strategic framework is that, inevitably, some actions may run counter to others or even cancel out each other's effects, leading to delayed or unachieved results, as well as higher costs.

The CCCA is, therefore, of the considered opinion that it is of paramount importance, as discussed in the previous Chapter, that a governance framework is established immediately so as to ensure that all policies and actions are 'climate proofed' and that climate change is fully taken into account in the conception, drafting and implementation of all sectoral policies.

The current economic crisis offers an opportunity to re-launch the concept of sustainable development and reopen the debate on the balance that needs to be struck between short-term gain and long-term interests. This is central to the climate change debate, given that the plan that needs to be put into effect will need to have a far longer horizon than other policies and plans. This, in turn, raises the issue of how to achieve continuity between successive administrations and ensuring that all concerned remain focused on the ultimate objective, while at the same time addressing changing economic, social and political variables. Perhaps to a greater degree than mitigation, adaptation to climate change requires a national and bipartisan approach, if only because of the timeframes involved and the degree of social consensus that will be required to ensure continued commitment to the objectives.

Recommendation 18

The Climate Change Committee for Adaptation is of the considered opinion that the concept of sustainable development is re-launched and the debate on this generation's use of natural resources and the natural resources that we will pass on to future generations, are re-launched, given that these considerations are both central to the climate change debate, with a view to obtaining national consensus and a bipartisan agreement.

Through the 2009 White Paper[96], the EU has established a framework aimed at reducing the EU's vulnerability to climate change. This will be supplemented at some stage by legislative proposals aimed at ensuring implementation of the principles established in the White Paper. Nevertheless, it is widely recognised that, while the EU has a crucial role to play, particularly in setting common objectives, ensuring synergy with other Community policies in the dissemination of best practices, and ensuring financial support for adaptation policies, the majority of actions will need to be taken at local, regional and national level, mainly because of the diversity of effects expected as well as the local knowledge that is needed to find the best solutions.

Fundamental to a sustainable approach to climate change, is the shift to a low carbon economy based on the promotion of energy efficiency, shifting patterns of consumption towards 'green' products as well as ruthlessly eradicating perverse incentives and subsidies that push society in the opposite direction.

Adaptation to climate change should not be seen exclusively, or perhaps even mainly, as a cost, but rather as an opportunity to improve competitiveness through increased resource efficiency and exploitation of new niches and sectors that the new low carbon economy will inevitably open up. With its well educated workforce, size and position, Malta is well placed to seize these opportunities in areas as diverse as sustainable tourism, energy efficient construction practices, and water and waste recycling.

What is, however, required is a sound policy direction as well as creating the right economic and legislative instruments to point and push society in the right direction. As a small island Member State of the EU, Malta also has a potential attraction for developers of new technologies relevant to adaptation, ranging from an R&D, production, deployment and demonstrative aspect. Malta should seek to make itself and its advantages better known to developers of these technologies and products, also in order to ensure that it is quick to take up front-runner approaches and keeps itself on the leading edge, rather than on the periphery, of Europe.

04.2 Vulnerability and Resilience

In the formulation of any national policy on adaptation, the emphasis must be on sustainability, both in the use of resources as well as in adopting a more long-term view in sectoral policy making. strategies must, in turn, recognise the concept of vulnerability and aim to promote resilience. Of fundamental importance in this context is the need to adopt a more long-term vision for management

[96] Ibid.

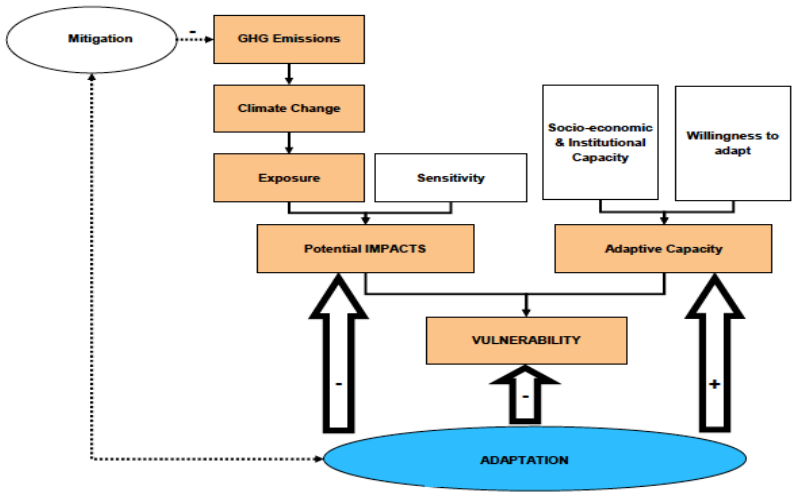
of key environmental resources, as well as, wherever possible, reducing other pressures that could create additional stress on ecological, economic, and social systems, thus hindering adaptation.

Vulnerability, as defined by the Intergovernmental Panel on Climate Change[97], is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. The EEA[98] defines vulnerability as 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 (see Figure 1).

It should also be recognised that not all sectors can adapt to climate change with the same ease. Adaptation policy should therefore aim primarily to first identify those sectors facing the greatest difficulties and then take appropriate measures to address these as a priority. This approach is equally true for the environmental, economic, and social spheres. It is in this context, that adaptation to climate change and sustainability are particularly interlinked. In short, adaptation should not be seen as just an environmental issue.

The concept of resilience can be defined as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change[99]. Adaptation strategy is basically finding the best ways to promote resilience and also address other pressures that, while not necessarily related to climate change, may be happening simultaneously and negatively affecting resilience.

Figure 7: Conceptual diagram for climate change impacts, vulnerability and adaptation



Source: Isoard, Grothmann and Zebisch (2008)

Given the still high degree of uncertainty of the changes that will be triggered by climate change, particularly at the regional or local scale, it is necessary to consider various scenarios when planning an adaptation strategy. The 2008 EEA/JRC/WHO report[100] identified 3 basic types of uncertainty:

Incomplete knowledge: Responses in systems with high levels of complexity such as biological, social or economic systems are very difficult to assess. Climate impacts can either be increased by other, non-climatic factors, or compensated for by adaptation of the system, or internally compensated for until a critical level of resilience is exceeded.

Insufficient observed trends: Observed data and trends for many of the impact indicators often lack the appropriate spatial and temporal scale to provide the adequate level of information to properly

[97] IPPC Report, *supra.*
[98] European Environmental Agency, Joint Research Centre and World Health Organisation, *Joint Report: Impacts of Europe's Changing Climate – Indicator-based Assessment,* 2008, hereinafter Joint Report.
[99] IPPC Report, *supra.*
[100] Joint Report, *supra.*

develop and assess adaptation strategies;

Socio-economic developments: The most important sources of uncertainty are human behaviour, evolution of political systems, demographic, technological, and socio-economic developments. To address this issue requires using a set of global emission scenarios, such as the ones presented in the last IPCC reports, and making use of consistent regional socio-economic and climate change and impact projections as soon as they become available.

Notwithstanding this uncertainty, it would be a mistake to delay adaptation action pending more robust information as, in many cases, the effects are already evident and underway. This is particularly true as regards the state of natural ecosystems, the resilience of which is crucial.

One should, however, recognise the risk that, in the absence of more precise predictions, certain measures may turn out to be counter-productive, lead to 'mal-adaptation' or be expensive but meaningless diversions. The emphasis should, therefore, be to prioritise 'no regret' measures, that would be justifiable under any scenario, and leave for a later stage more adventurous, and potentially harmful, measures until further data and better models allow for more robust predictions and analysis of effects.

The overall cost of adaptation can also be contained by seeking to exploit the natural tendency of environmental, economic, and social systems to adapt to changing stimuli in an autonomous manner. The aim of adaptation is, therefore, not to conserve the present state of these systems, as this will turn out to be impossible, but rather to preserve the functionality of the systems, while recognising that a degree of change is not only unavoidable, but also healthy.

Wherever possible, active intervention should take place to accelerate these changes so they can deliver their benefits earlier. This might mean working with farmers to diversify production away from water intensive crops rather than subsidise water extraction, or promoting the continued cultivation of water intensive crops.

Adaptation might also mean legislating to create a market that would enable the insurance sector to better cover emerging risks from extreme events, rather than simply make contingency for expensive after-the-fact relief for homes and businesses affected by these events. Similarly, one should work with the construction industry and homeowners through incentives and legislation, to produce buildings with lower energy demand in response to rising energy prices rather than subsidising these prices except where strictly necessary for social reasons.

The impact assessment[101] carried out by the European Commission on its White Paper on adaptation to climate change[102] has analysed the capacity of various sectors to adapt and has arrived at the following main conclusions:

- the agricultural sector has a long record of adapting to climate variability. Adaptation measures will be mainly implemented at the farm level through short-term production decisions including adjustments in planting dates, crop mixes, or in the intensity of input use such as fertilizer or water abstraction. However, these decisions will be largely influenced by the economic environment including market conditions and public policies;

- the fisheries and aquaculture industries need to develop their adaptive capacity even further in order to cope with new conditions. The demand for aquaculture may increase as a result of decreasing available fishing resources;

- as regards energy, the southern European region will need to undertake more and more costly investments in electricity production. Throughout Europe there will be a need for increased investments in the distribution system to deal with disruptions due to extreme events and changing demand and supply localisation;

- in the infrastructures and buildings sector, adaptation will require a strong degree of innovation

[101] Commission staff working document accompanying the White paper - Adapting to climate change : towards a European framework for action , (SEC (2009) 387).
[102] White Paper on Adaptation, *supra*.

in materials and design, bio-climatic buildings, climate proofing, reduction of energy consumption, integrated approach to spatial planning and location of infrastructure;

- for tourism and industry, adaptation will require changes in period of operation, relocation of activities, and the development of a less climate-dependent supply chain. Insurance will have a great role to play in particular for Small and Medium Enterprises (SMEs). Adaptation will largely be autonomous, private and local, although public action may be needed to facilitate the reconversion of regions and economic activities impacted by climate change in order, to promote solutions favourable to both climate adaptation and to competitiveness, or to provide appropriate support for SMEs in managing climate risks properly.

- regarding health, much adaptation can be achieved in the context of pursuing wider development objectives, for example, through improved health and education services.

- regarding nature conservation measures, in order to maintain diversity in and increase connectivity between nature conservation sites are necessary.

04.3 Major Areas where Adaptation is Required

04.3.1 Agriculture

The impact of climate change on agriculture will be both direct and substantial, given the direct dependence of the sector on climate. The sector will need to be prepared for scarcity of water, increased risk of extreme events, as well as reduced productivity for certain crops, some of which may be key cash crops.

Coupled with the expected loss of resilience of natural ecosystems, one should also assume a greater incidence of phytosanitary issues related to alien species and increased incidence of plant and animal diseases.

Considering that agricultural land accounts for around 50% of Malta's land territory, greater emphasis should be placed on safeguarding biodiversity in all rural areas and not just in protected enclaves. This would imply promoting agricultural practices that work with nature rather than against it and focusing agricultural production on quality rather than quantity. There is substantial potential for synergy with quality tourism in this respect.

This area is discussed in **Chapter 06**.

04.3.2 Fisheries and Aquaculture

The impact of climate change on aquaculture and fisheries stocks also needs to be evaluated in greater detail. In particular, the expected increased influx of alien species, and the effects of increasing sea temperature, and possible shifts in currents and nutrient flows may substantially impact species of key economic importance.

As the recent tuna controversy has demonstrated, an increasingly unfavourable ecological status for certain flagship species may result in increased political pressure for legislative action aimed at reducing taking of wild stock.

Malta, therefore, needs to redouble its efforts to diversify its aquaculture and fisheries sectors in order not to be dependent on endangered species and also increasing substantially its investment in research aimed at reducing dependence on wild stock, both through private investment by the sector itself as well as through possible take-up of EU funds.

04.3.3 Coastal Areas

As already mentioned, coastal areas are of prime importance in the Maltese economy. They are also areas where much of the key infrastructure is located. Given the typically long lifetime of such

installations, as well as the difficulty faced by a small island state in deploying alternative sites to replace aging infrastructure, the degree to which critical infrastructure will be affected by climate change, in particular coastal erosion, needs to be determined over a sufficiently long timeframe.

This is particularly true for essential infrastructure such as, energy generation, sewage treatment plants and desalination plants. The extent to which increasing sea temperature and heat waves could also affect the cooling process of thermal power plants and, therefore, their efficiency, should also be determined.

Similarly, it is also important to have accurate projections of how household and commercial demand for cooling, arising from increasing summer peaks and more frequent extreme weather events, will impact electricity distribution. This is particularly relevant in the case of an aging population that is more susceptible to the health impacts of rising temperatures.

04.3.4 Ecosystems

A key objective in an adaptation strategy should be that of preserving and strengthening the resilience of ecosystems and wherever possible reducing other pressures that could reduce their capacity to adapt to and counter the effects of climate change. It should also be realistically assumed that, even with the best of efforts, climate change will result in certain changes in natural ecosystems and that, as these adapt, certain habitats and species may do well at the expense of others.

Indeed, such changes may be a desirable outcome in that they may help counter certain effects of climate change. However, the rate at which climate change is occurring, as well as the myriad of other pressures on ecosystems, mean that habitats are not able to progressively adapt and that what we are witnessing in many cases is a degradation of habitats that offers fertile ground for the insertion of opportunistic species. These species, many of which may be alien species, may, in turn, exacerbate an already precarious situation, leading to ecological imbalance and a substantial decrease in diversity within the ecosystem.

One factor that is yet to be fully or adequately understood is the extent to which natural ecosystems service human needs, regulate the climate and mitigate its impacts, as well as protect essential resources such as water and soil.

Similarly, providing green spaces in urban areas would help make these areas more liveable and provide respite for the population during extreme events, while also helping reduce the impact from pollution that could potentially intensify an already precarious health situation during an extreme event such as a heat wave.

04.4 Role of Technology

One must be very cautious about technological fixes. Experience in other countries has exposed numerous costly examples of 'mal-adaptation' that try to work against nature rather than through it.

For example, Malta cannot continue to rely exclusively on active cooling to counter the effects of poor building design. Rather, designs should be improved, if necessary by force of law and economic dis/incentives, to maximise passive cooling.

Recommendation 19

The Climate Change Committee for Adaptation is of the considered opinion that Malta cannot continue to rely exclusively on active cooling to counter the effects of poor building design and that designs should be improved, if necessary by force of law and economic dis/incentives, to maximise passive cooling.

On the same lines, the Floor Area Ratio policy for high-rise buildings has ended up increasing the sense of 'crowding' in urban areas and creating canyon effects without delivering the green spaces that could have helped address these issues.

Another instance in this regard would be the better clustering of industries could render feasible networks for the supply of industrial grade or second-class water. However, given the high cost and time needed to deploy technological fixes, first consideration should always be given to economic measures aimed at avoiding waste of resources in the first place.

The importance of this concept is clearly demonstrated by estimates from the Directorate General for Environment[103] that desalination could, in the worst case scenario, account, over, the next three decades, for 43% of the total energy consumption of Greece, 20% of that Spain and 16% in the case of Cyprus and Bulgaria. Yet, under more optimistic scenarios, these figures could be reduced by half.

04.5 Promoting Resilience through Biodiversity

To date, the promotion of biodiversity has largely focused on protecting enclaves of high scientific interest, mainly through the scheduling of sites of scientific importance, as well as, more recently, the introduction of the Natura 2000 network established under the EU Habitats Directive [104]and the Birds Directives[105].

While this approach should be further strengthened and continue to form a fundamental pillar of Malta's biodiversity policy, with further extension where necessary as, for example, to include the marine environment, it must also be supplemented by the concept of Green Infrastructure.

Green Infrastructure is defined as the interconnected network of natural areas, including some agricultural land, parks, marine areas and native plant communities that naturally regulate storm flows, temperatures, flooding, as well as maintain the quality of environmental compartments such as air, water, and soil.

Recommendation 20

The Climate Change Committee for Adaptation is of the considered opinion that whilst the current approach of protecting sites of scientific importance should be strengthened and continue to form a fundamental pillar of Malta's biodiversity policy, with further extension where necessary as, for example to include the marine environment, it must also be supplemented by the concept of Green Infrastructure.

Malta must, therefore, pay greater attention to the issue of connectivity between protected areas so that these areas are not merely reduced to the last remaining enclaves of a diminishing biodiversity, but rather converted into hotspots that could propagate and positively influence surrounding areas, thus benefiting human activity and the ecological health of these surrounding areas. This will imply revisiting our agricultural and tourism policies in order to strengthen synergies and address potential conflicts before damage becomes irreversible.

The European Commission is expected to launch a proposal on Green Infrastructure in 2011. This will address issues such as the connectivity of ecosystems and is expected to be particularly important in the Maltese context, given the high population density and the pressure of urbanisation on natural and agricultural areas.

A sustainable Green Infrastructure policy must also aim at strengthening the capacity of soils to support ecosystems, water storage and agricultural production, as well as conserving water in natural

[103]Available at http://ec.europa.eu/environment/water/quantity/scarcity_en.htm
[104] Habitats Directive, *supra.*
[105] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, Official Journal, 26.1.2010.

systems in order to reduce the risk of flooding and provide an alternative supply of fresh water for farmers and natural systems.

For this aim to be achieved, Malta should consider supporting an EU Soil Directive that is risk-based, proportionate and sufficiently flexible to address national and local circumstances. Malta should also revisit its development consent system in order to remove any unnecessary bureaucratic obstacles that may be hindering the maintenance of natural valley systems.

Recommendation 21

The Climate Change Committee for Adaptation is of the considered opinion that Malta should consider supporting an EU Soil Directive that is risk-based, proportionate, and sufficiently flexible to address national and local circumstances.

The resilience of natural ecosystems is directly related to biodiversity, or the richness and variety in ecosystems. It is well established that the more species in a particular habitat, the greater the probability that certain species in that ecosystem will possess some characteristic that would help them adapt to changing circumstances. Thus, ecosystems rich in biodiversity have a greater chance of adapting, and surviving, than those in a poor state.

In turn, it is often the case that systems with a low degree of biodiversity are in that state because of multiple unsustainable pressures and will be correspondingly less able to cope with the increased stress of climate change. The net effect of the progressive loss of habitats and ecosystems will be the loss of the ecosystem services they provide. This, in turn, will be the negative driver that impacts sectors that are key beneficiaries of ecosystem services, whether these services are disease control, soil conservation, or pollination.

The threat posed by climate change to biodiversity is not insignificant. The EEA has estimated that a 1 °C warming in the Alps is predicted to result in a 40 percent loss of local endemic plants, while a 5 °C warming would result in a 97 percent loss[106]. Like the Alps, the Mediterranean islands are a hotspot of biodiversity and endemic species, and the effects of climate change are expected to be similarly severe.

The conservation of biodiversity and, wherever possible, restoring habitats to a favourable conservation status should therefore be one of the pillars of an adaptation strategy. Unfortunately, as in the rest of Europe, the current situation is not a positive one.

Recommendation 22

The Climate Change Committee for Adaptation is of the considered opinion that the conservation of biodiversity and, wherever possible, restoring habitats to a favourable conservation status should therefore be one of the pillars of an adaptation strategy.

The 2008 Environment Report published by MEPA[107] states that 64% of habitats and 44% of species have an inadequate or bad conservation status. There is a growing threat from alien and invasive species, for which no specific legal framework exists at either national or European level, although this is likely to be addressed by the EC in the near future. The Report also confirms that, although significant steps have been taken, including the designation of protected areas that now cover almost 20% of Malta's land area, biodiversity in the Maltese Islands is now largely confined to these protected enclaves which are themselves not immune from threats of development, as well as from poorly managed agricultural, tourism and leisure activities.

[106] European Environment Agency, *The European Environment Report – State and Outlook*, 2005, 67.
[107] MEPA Report, *supra*.

In common with the rest of the EU, the majority of land in the Maltese Islands is dedicated to agriculture. There is very little data on the state of biodiversity in these areas, which account for 51% of the Maltese land area.

The 'Health Check for Europe's Protected Nature'[108], published by the European Commission in 2010, states that habitats depending on conventional agricultural practices show a far worse conservation status than other types of habitats, with only 7% of habitats is to be found in agricultural areas being in a good conservation status as opposed to 21% of other habitats. It is evident that the main loss of species and habitats is in those associated with conventional agriculture and there is good reason to expect that this is at least partially true for Malta as well.

The take-up of more sustainable methods of agricultural production, such as organic farming, that would promote resilience, remains very low in Malta, with only 0.19% of total agricultural land and 0.21% of Utilised Agricultural Area (UAA), being dedicated to organic production.

This is the lowest percentage in the EU-27. Active measures need to be taken to address the obstacles hindering organic farming, such as lack of support and training for farmers, improving synergies with tourism, and stimulating demand for high quality local produce. Malta should also continue to insist on a thorough reform of the EU Common Agricultural Policy (CAP), so as to shift resources away from production towards activities providing environmental benefits. Malta also needs to increase the proportion of EU agricultural, structural and cohesion funds allocated to biodiversity related projects or projects that could benefit biodiversity.

Recommendation 23

The Climate Change Committee for Adaptation is of the considered opinion that Malta should also continue to insist on a thorough reform of the EU Common Agricultural Policy, so as to shift resources away from production towards activities providing environmental benefits.

Apart from unsustainable practices in agriculture and related threats such as lowering of soil quality through salinisation, erosion, and desertification, that are partially due to climate change but also due to poor management of this essential resource, the EC has identified land use and urban sprawl as the other main threat to natural ecosystems that could act as a significant buffer to climate change.

There is increased pressure, particularly on lower quality agricultural land, from infrastructural development, such as road networks, leading to increased fragmentation of natural areas and loss of connectivity. Another factor is urban sprawl as population shifts from traditional urban areas to more fringe areas. Although Malta has a low rate of urban sprawl, the poor quality of design and sense of overcrowding in some of the urban areas is creating an incentive, particularly for the more affluent sectors of society, to move into Outside Development Zone (ODZ) areas in order to regain a lost sense of tranquillity and space.

This pressure is highly selective and targets areas of scenic and natural beauty, which is often of high value for biodiversity. This process has been facilitated by loopholes in certain policies and the fact that MEPA has not been able to update its policies fast enough to address this growing threat, often camouflaged as seemingly innocuous developments such as stables, farmhouses and agri-tourism.

The main drivers that are behind the pressure on the countryside are similar throughout Europe and may be summarised as follows:

- the favourable price of land in the countryside compared to that in urban areas;
- the cost of private transport as compared to public transport, making living in relatively remote areas even more feasible;
- the social aspirations of more affluent social strata to move out from what are seen as

[108] European Commission, (2010), Retrieved from http://ec.europa.eu/environment/nature/info/pubs/docs/brochures/healthcheck. pdf

increasingly crowded and suffocating urban areas.

These threats to natural areas and countryside, and hence to a primary resource for adaptation, need to be addressed through a number of measures, but primarily through:

- fiscal (dis)incentives that would aim to encourage people to move towards the urban areas rather than away from them;

- a strict 'no tolerance' ODZ policy, in particular for any new residential development or any increase in scale of existing residential development in these areas;

- improving the quality of design, and life, in urban areas, both by providing quality green (and not just) open areas as well as providing quality amenities and facilities required by young families and the elderly in particular. This should be a key element in any upcoming review of the Structure Plan and Local Plans

Recommendation 24

The Climate Change Committee for Adaptation is of the considered opinion that threats to natural areas and the countryside need to be addressed through a number of measures, but primarily through:

- **fiscal (dis)incentives that would aim to encourage people to move towards the urban areas rather than away from them;**

- **a strict 'no tolerance' ODZ policy, in particular for any new residential development or any increase in scale of existing residential development in these areas;**

- **improving the quality of design, and life, in urban areas, both by providing quality green (and not just) open areas as well as providing quality amenities and facilities required by young families and the elderly in particular.**

Given the increasing pressures that climate change will place on urban populations and their quality of life, the need to preserve open countryside, beaches, and areas of natural beauty in order to provide a respite and recreational areas for these populations becomes critical and also assumes a highly significant social dimension in the case of a densely populated country such as Malta.

Deficiencies in the spatial planning regime that have permitted encroachment into these areas in the past should be identified and eliminated. MEPA should also improve its capacity to react rapidly to new threats. In this respect, the stated intention of Government to remove the possibility of sanctioning illegal developments in ODZ areas is a major step forward and should be followed up by effective enforcement action. MEPA should also find the best way to utilise new legal tools, such as the EU's Directive on Prevention and Remediation of Environmental Damage[109], commonly known as the Liability Directive, in order to ensure effective remedial measures in the case of illegal developments or activities that have damaged important natural areas.

A major threat to the health of natural systems that will be accentuated by climate change is that posed by alien and invasive species. The MEPA 2008 Environment Report acknowledges that *'Alien species are therefore, a serious threat to Malta's biodiversity, requiring the formulation of action plans to eradicate them and to prevent further introduction*'[110].

Malta should adopt a national strategy and appropriate contingency plans to deal with this threat, which could also have significant health and economic implications, as well as push for a comprehensive EU and international framework that would, inter alia, recognise the increased

[109] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage, *OJ L 143, 30.4.2004, p. 56–75.*
[110] MEPA report, *supra*, 47

magnitude of the risk posed by growing and freer international trade in plants and animals and their products.

Above all, Malta needs to beef up its border customs, veterinary and phytosanitary controls with third countries to deal with this growing threat. Legislation should also be put into place to deal with the growing trade in exotic pets, some of which, particularly insects and reptiles, have the potential to propagate and assume an invasive status.

Recommendation 25

The Climate Change Committee for Adaptation is of the considered opinion that Malta should adopt a national strategy and appropriate contingency plans to deal with this threat posed by alien and invasive species, which could also have significant health and economic implications and beef up its border customs, veterinary and phytosanitary controls with third countries. Malta should also push for a comprehensive EU and international framework that would, inter alia, recognise the increased magnitude of the risk posed by growing and freer international trade in plants and animals and their products.

04.6 Water

Water and adaption is discussed as a separate issue in Chapter 05.

04.7 Soil and Land Use

As a direct result of its high population density, Malta has one of the highest percentages of urbanised land in Europe, with 22% of its land territory classified as urban[111]. This situation poses significant challenges in the context of climate change.

It must be recognised that there is a direct relationship between land use and climate change, in that land use patterns both affect and modulate the effects of climate change, while climate change will, in turn, itself lead to changing patterns of land use, particularly if the quality of life in urban areas declines.

A particular concern is that large areas of urban space mean that large tracts of territory are in fact sealed, leading to a reduced capacity for water retention and accentuation of flooding. In Malta, this sealing effect has been amplified by the progressive loss of cool, green spaces and gardens in many urban areas in favour of intensive development.

While this intensive development in urban areas has greatly reduced the rate of urban sprawl, it has come at a cost, namely, a decrease in the quality of life and in the sense of tranquillity and freshness in many areas. The discomfort caused by continuous construction activity and redevelopment in many areas is accentuated by longer periods of heat and lack of precipitation that are expected to increase further with climate change.

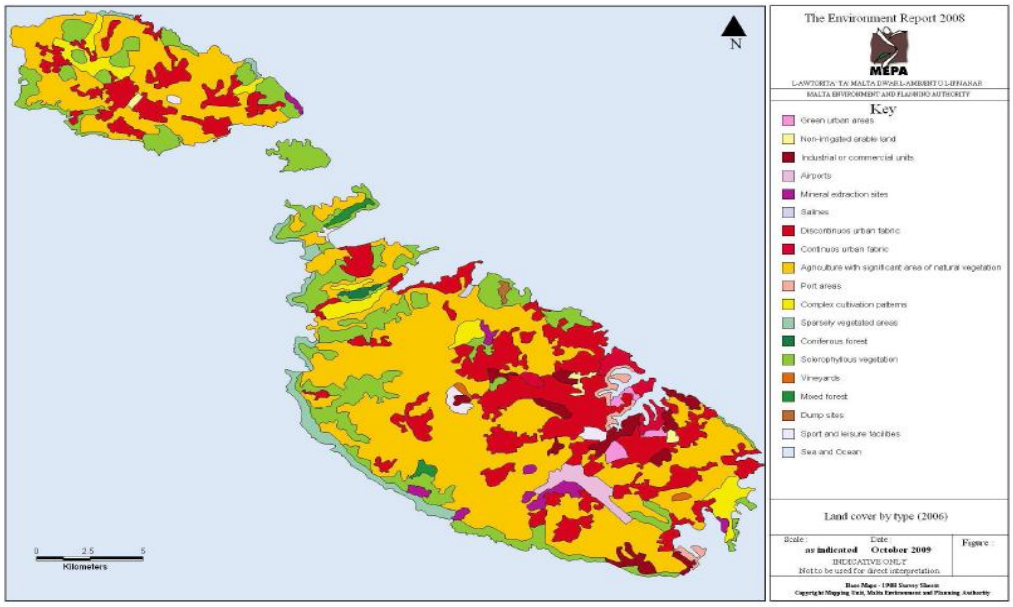
The effects of certain planning and land use policies will negatively impact adaptation. Besides the increasing sense of 'crowding' in many urban areas, the tendency to build smaller units, mainly apartments, which now account for 90% of all planning permits granted by MEPA, results in large sectors of the population living in conditions which will accentuate the effects of climate change.

The larger number of families without access to roofs, gardens, or back yards will find living in a progressively hotter climate more difficult. This may eventually translate into a social problem, as the ability to improve one's situation will depend on the financial status of the individual or family concerned. It is important to put a brake on certain kinds of development that are particularly negative, such as the ubiquitous penthouses that are depriving many residents of roof access and

[111] MEPA report, *supra*.

solar rights, as well as the use of semi-basements as habitations, which is an obvious social problem in the making.

Figure 8: Land Use in Malta



Source: MEPA

Even in areas which are not urban, there is evidence that the quality of soils is decreasing. The European Thematic Strategy for Soil Protection[112] identified 8 main threats to soil at European level, many of which will be amplified or accelerated by climate change:

- erosion;
- decline in organic matter;
- soil contamination;
- soil sealing;
- soil compaction;
- decline in soil biodiversity;
- salinisation;
- floods and landslides.

MEPA's 2008 Environment Report has identified that soil erosion, decline in organic matter, soil contamination and salinisation, soil sealing and land abandonment are all significant threats to Maltese soils.

While Malta has in place a well established legal regime for the protection of agricultural soils, there is no comprehensive instrument for the conservation and protection of soil as a resource, or specifically for non-agricultural soils, including potentially contaminated soils.

[112]Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee of the Regions, Thematic Strategy for Soil Protection, COM (2006) 231 final.

Malta should reassess its policies in this area, act to put into place a comprehensive framework, strengthen capacity to manage this resource, as well as consider supporting the proposed Soil Framework Directive[113], currently blocked in the EU Council, provided this Directive is redrafted to provide greater flexibility for Member States in addressing local priorities and situations, reduce administrative burden and adopt a risk-based approach. In the absence of European legislation, Malta should move ahead and enact national legislation to protect soil.

Along with water, soil is a primary resource, and the lack of a regulatory framework to address this is an obvious deficiency that will hinder Malta's adaptation capacity.

Specific parameters give rise to particular concern. The level of organic matter in Maltese soils is typically low, with many areas being just above the 2% level considered the minimum necessary to avoid irreversible decline. While levels of organic matter are higher in some of the major agricultural areas, the overall low levels place severe constraints on agricultural production that will be increasingly hard pressed to adapt to climate change. Decreased organic matter in soils could lead to a diminished capacity to absorb and retain water, although this effect is also dependent on the physical texture of soils.

At present, the limited information available on Maltese soils and the threats facing them make adaptation in this area very difficult. Given the obvious synergies with other environmental compartments, biodiversity, and land use, it is recommended that the administrative capacity for this purpose be built up within MEPA.

There is still a lack of information about possible contaminated sites, including former military installations, shooting ranges, existing and former fuel storage sites, former landfills and industrial areas. The potential contamination in these sites could affect ground water and neighbouring soils, including agricultural areas, as well as limit the possible future uses of these sites. The proposed EU Directive on Soil provides a framework that, if improved, could be a useful tool to identify these sites and prioritise for remediation.

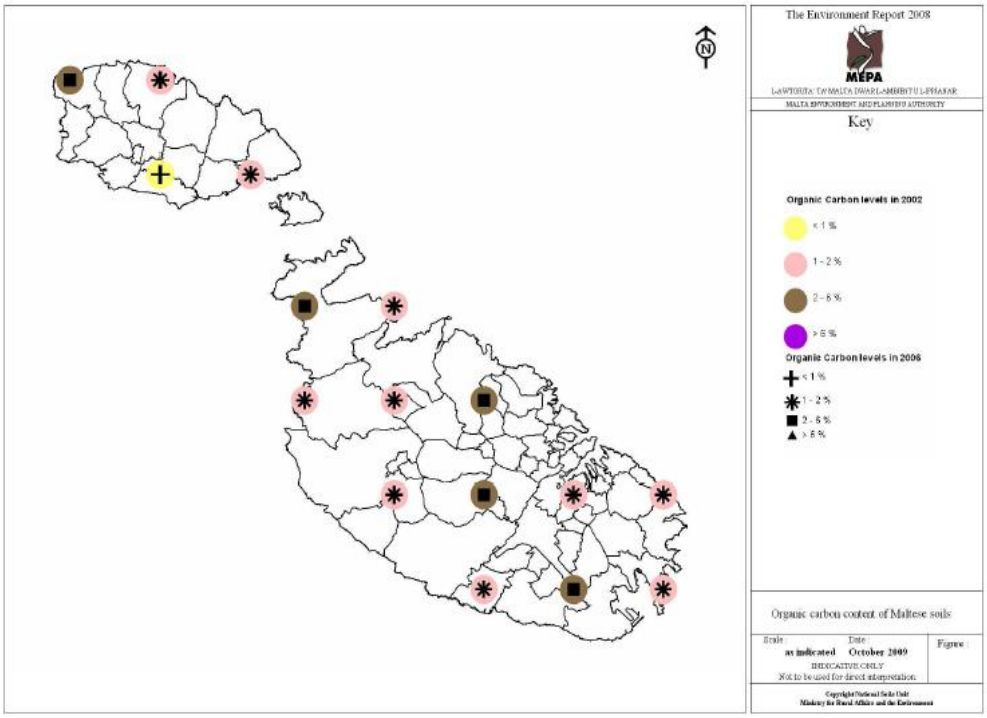
A major threat to soil quality that is directly related to climate change, among other factors, is rising salinity. This threat is more acute in small islands and, in Malta's case, is exacerbated by a high rate of abstraction from natural aquifers, the replenishment of which will be reduced by climate change. Irrigation using progressively more saline ground water results in a gradual increase in soil salinity, with an associated decrease in productivity.

Between 2002 and 2006, average soil conductivity (indicating salinity in soil) increased by 30 percent, from 581 micro Siemen per centimetre (µS/cm) to 756µS/cm at the sites monitored. Highest values were recorded in coastal areas where salt from sea spray is deposited, such as in Mgarr in the north of Malta, where, in 2006, there was a concentration of 1,580µS/cm[114]. Many of these areas are important agricultural areas, and loss of productivity could be especially significant. In the light of this problem, the economic feasibility of utilising the effluent from sewage treatment plants as second class water for irrigation should be revisited, while taking full account of the potential economic and ecological losses that could result from irrigation with progressively more saline ground water.

[113] Proposal for a Directive of the European Parliament and of the Council establishing a framework for the protection of soil and amending Directive 2004/35/EC (COM/ (2006)232 final).

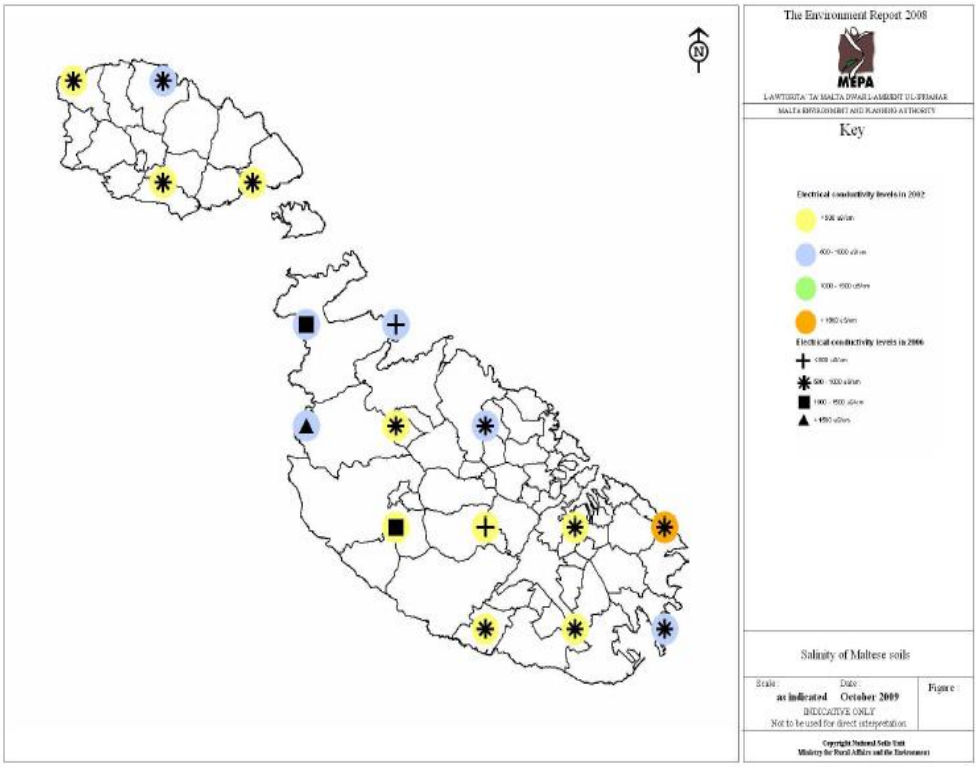
[114] MEPA Report, *supra*, 29.

Figure 9: Organic matter content in Maltese soils



Source: National Soils Unit, MRAE, 2006

Figure 10: Soil Salinity Levels in Malta



The sector immediately impacted by adverse soil quality will be agriculture. Measures need to be put into place to reduce or avoid the loss of soil organic matter by adapting existing cultivation practices (for example, by ploughing in crop residues, and using "green manuring") and supporting the use of

soil improvers, while avoiding measures that further increase the already high levels of nitrates in ground water. Irrigation techniques should be further optimised, not only to reduce water usage, but also reduce the associated input of chlorides into the soil.

04.8 Impact on the Marine Environment

The impacts of climate change will not be limited to terrestrial systems. Indeed, it is the marine environment that may face the most drastic and far-reaching effects of all. Climate change has the potential to affect currents and nutrient flows, leading to imbalance in vital ecosystems. Coupled with ongoing pressures such as overfishing and pollution, the effects could be catastrophic.

The potential extent of these climate-driven changes are not yet fully understood. The IPCC report[115] identified the need to improve understanding and modelling of climate changes related to the hydrological cycle and of the water-related impacts of climate change (especially with respect to water quality, aquatic ecosystems and groundwater) including their socio-economic dimensions as well as the need to develop better tools to facilitate integrated appraisals of adaptation and mitigation options across multiple water-dependent sectors.

The EU Maritime Policy and its environmental pillar, the Marine Strategy Framework Directive[116], incorporate adaptation to climate change and effective implementation of these instruments should be a key objective for Malta. The fact that Malta is a maritime state with significant economic potential in its marine dimension, is an added incentive for fully utilising the opportunities that successful management of a maritime economy and marine resources can bring about, once the pressures on those resources are properly understood and managed.

Key to this management will be the development of a comprehensive framework for Marine Spatial Planning as well as Integrated Coastal Zone Management (ICZM). The emphasis placed on these aspects, as well as the very pertinent link between coastal and marine issues made in the recently announced MEPA Reform are both very positive steps and implementation should be initiated without delay. Implementation of ICZM can be assisted by the opportunities offered especially through the EU's Cohesion Policy, Fisheries Fund and as part of the EU's Research Framework Programme.

[115] IPCC Report, *supra*.

[116] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy, *Official Journal L 164 , 25/06/2008 P. 19 -40.*

05.1 Introduction

Malta is densely populated but poorly endowed with freshwater resources. Meeting a high and rapidly increasing demand for water while protecting and conserving the resource base and the environment is a major challenge[117].

Malta has no surface waters that can be exploited economically, and groundwater resources are subject to increasing competition. The investment, since the eighties, in the desalination infrastructure has ensured reliability of supply.

Agriculture water users continue to be more dependent on the vagaries of the climate and access to water resources for irrigation. The main source of water is groundwater pumped from private boreholes and conveyed to fields via pipe networks and water tankers. Although farmers are relatively more conscious of the importance of water conservation than urban water users, increased agricultural water use and excessive groundwater abstraction by others has affected the sustainability and viability of the aquifer systems[118].

Groundwater degradation which is linked to agriculture takes two distinct forms. First, there is the increasing salinity of the Lower Coralline sea level aquifers systems as a result of vertical and horizontal intrusion. Secondly, there is nitrate contamination of practically all the aquifer systems as a result of intensive livestock production, high levels of fertiliser use, and leakages in the sewage collection system – particularly in the heavily urbanised areas[119].

Approximately 80% of Malta's groundwater resources are abstracted from sea-level fractured limestone aquifers. Continued unregulated over abstraction of groundwater carries the severe risk of destroying the aquifers' capacity to store freshwater. Over abstraction is slowly reducing the volume of the freshwater in the freshwater lenses floating on the underlying denser saltwater. Deep boreholes and high levels of localised abstraction carry the risk of disrupting and broadening the interface between freshwater and seawater and, thereby, further reducing the capacity of the lenses to store freshwater.[120]

As stated above, desalination has been the primary reason for Malta's water supply reliability performance record. Yet, even though the efficiency of Reverse Osmosis production has improved drastically during recent years as a result of technological innovation. the supply of potable – that is drinking water – by means of RO is energy intensive as well as capital intensive.

Moreover, since desalination is dependent on electricity generation, it carries a substantial carbon footprint. Malta has no hydrocarbon reserves and is, so far, dependent completely on the purchase of fossil fuels at international market prices. Thus, the dependence on desalination carries both environmental and economic consequences at national level.

Furthermore, RO plants are susceptible to catastrophic offshore disasters. The Maltese islands lie amidst one of the busiest shipping lanes and any accidental oil spill could cripple some, or most, of the national facilities for a relatively long time with very serious consequences on potable water production.

While desalination has undoubtedly played an indispensable role in securing reliability of supply, a less positive consequence, however, of desalination plants is that they have resulted in a 'water' culture that takes only limited interest in conservation or efficient use of water resources. Particular evidence of this is the limited use of rainwater harvesting and reuse at a local/domestic level[121].

[117] Food and Agriculture Organisation of the United Nations , *Malta Water Resources Review*, 2006, 1.
[118] Ibid.
[119] Ibid.
[120] Ibid.
[121] Ibid.

Moreover, the development patterns and urbanisation in various parts of Malta's main catchment basins and the subsequent sealing of surfaces around low-lying areas have led not only to an increase in the occurrence of floods but also a reduction in infiltration as arable land has increasingly made way for development. Indeed, despite experiencing a construction boom in the 1990s, it is likely that cisterns in old houses have made way for garages and basements. This, notwithstanding the existence of a law that stipulates the need for building a cistern for the collection and re-use of rainwater when constructing houses.

Moreover, despite the urban development in Malta in these last years of economic boom, a similar development in an adequate storm water management system remained wanting. This was partly the result of the main road network being used as the main watercourse during storms.

The above presents a short portrayal of the challenges Malta faces in the provision and distribution of water resources under existing conditions. It is pertinent to underline that the Government has been responding to these challenges and continues to do so.

The success of the desalination infrastructure was the result of planning by successive administrations to remove Malta's dependency on natural ground water and the vagaries of climate for the provision and supply of its water resources.

The National Flood Relief Project (NFRP) for which Government is seeking financing under the European Regional Development Fund/Cohesion Fund is directed to address the aforementioned inadequacies in the storm water management system. The NRFP aims to target flooding and arising damages – the 2003 September floods are estimated to have resulted in damages of €30m to residents, business community, and economic activities as well as for infrastructure, water and electricity networks, and the sewage system.

The NFRP seeks to address this problem through the construction of a network of underground tunnels, canals, and bridges, capable of draining the floods caused by a rainfall having a return period of 5 years in four different catchments, namely; the Birkirkara-Msida; Gzira; Qormi-Marsa; and Marsascala basins.

Recently, the government enacted legislation for the notification of all private groundwater sources (Legal Notice 274 of 2008). Legislation is also enacted requiring the registration and licensing of private operators in the water sector (Legal Notice 249 of 2009) and the metering of private boreholes (Legal Notice 241 of 2010) respectively.

Also only recently the MRRA issued a report titled 'A Proposal for a Water Policy for the Maltese Islands – Sustainable Management of Water Resources', which looks at a range of policy measures that cover sustainable groundwater use, water demand management, and optimisation and use of non conventional water resources, rain harvesting, amongst others.

The key objectives of the Water Policy are the:

- supply of good water quality to meet the needs of the population;
- sustainable use and management of the nation's water resources;
- protection of the water resources and the aquatic environment from pollution;
- fair and transparent regulation of the water industry;
- mitigating against the effects of floods;
- and adaptation to climate change.

A programme has also been embarked upon in the past years to rehabilitate natural valleys and to change them to their natural state and includes their rehabilitation for use for rain water catchment.

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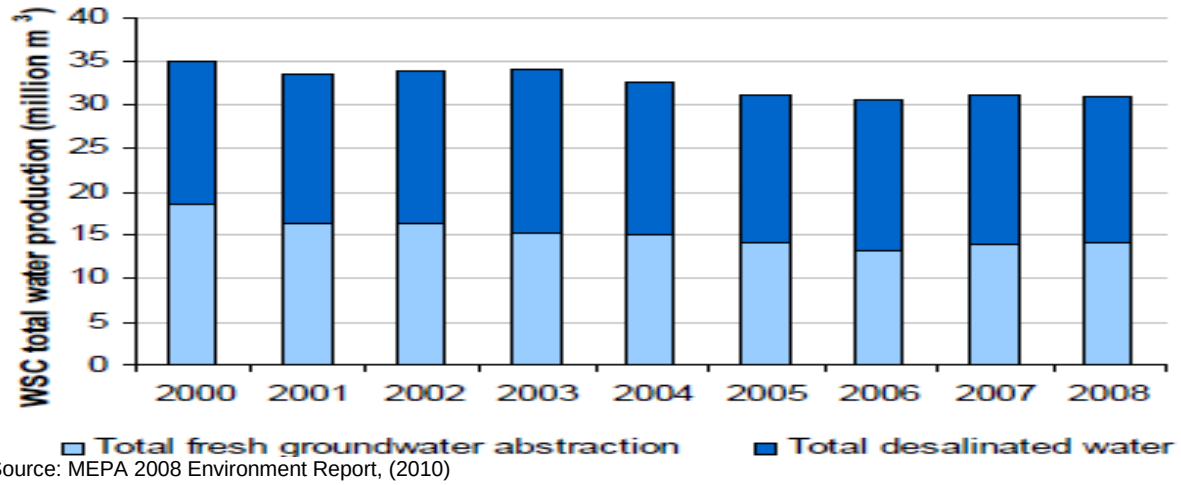
05.2 The State of Play

The total amount of water produced by the Water Services Corporation (WSC) decreased by six percent between 2004 and 2008, falling from 32.78 million m^3 to 30.95 million m^3 during this period. There has been a parallel decrease in groundwater abstraction since 2004, with the volume abstracted decreasing from 14.89 to 14.08 million m^3 between 2004 and 2008. However, a slight increase (of 0.8 percent) was registered between 2007 and 2008. Although as mentioned above, desalination alleviates the problem of groundwater over-abstraction, it involves high levels of energy consumption: in 2007 water production utilised five percent of the total electricity produced. The amount of desalinated water produced was higher than groundwater abstracted in 2008, with desalinated water making up 55 percent of the freshwater supply for the year under review. Water produced from desalination in 2008 decreased when compared to the previous years, but has since 2001 represented the source that produced most water.[122]

Chart 01: Total Fresh Water Produced by Water Services Corporation 2000 – 2008



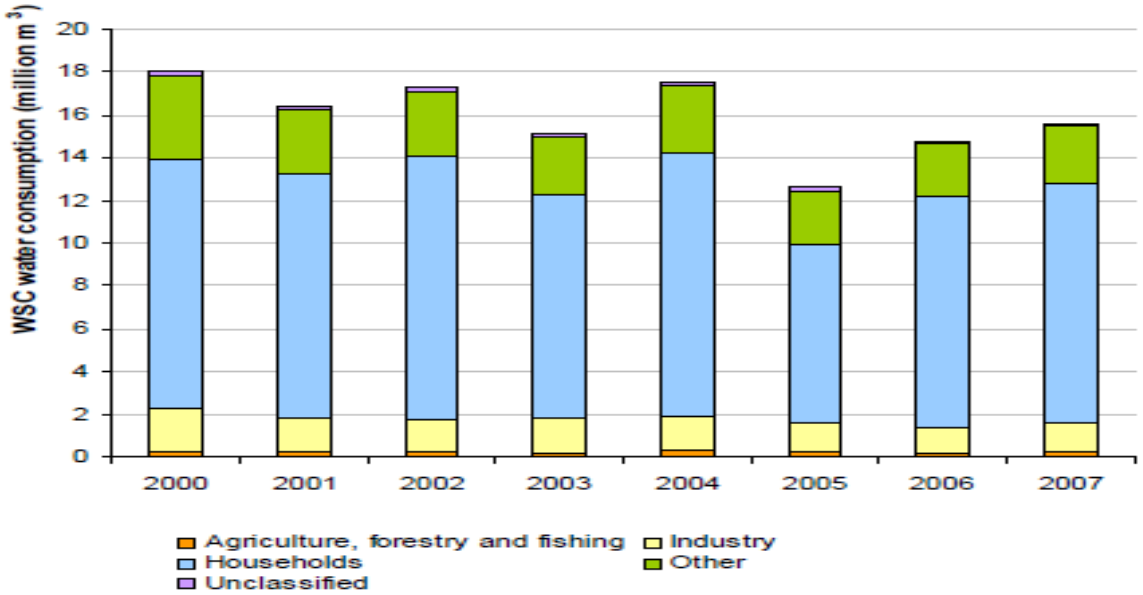
Source: MEPA 2008 Environment Report, (2010)

Recent pricing policies helped in reducing per capita consumption; rising blocks tariffs reward water saving whilst penalising wastage. But one must also give credit to the heavy investment made in recent years in infrastructural improvement, which consequently improved the operational efficiency of the public distribution network. System demand dropped from a €50 million m^3 in 1995 to around €30 million m^3 in 2009 as a result of these improvements, reflecting a drastic reduction of water lossess from the network – discussed below.

The three major consumers of WSC water are households, agriculture and industry, as figures for annual WSC billed consumption indicate. In 2007 the major consumer of WSC billed water was the domestic sector, using 72 percent of total billed water, with the sectors of agriculture, fisheries and forestry using the least (two percent). The overall decreasing trend may be due to several reasons: an increase in unaccounted-for-water, increasing reliance on abstraction from private boreholes, and enhanced end-user efficiency as a result of the increase in prices following the introduction of the fuel surcharge after 2004[123].

[122] Malta Environment and Planning Authority, Sub-Report 5, Fresh Waters, The 2008 Environment Report, Malta Environment and Planning Authority, March 2010, 5.
[123] Ibid

Chart 02: Billed WSC Water Consumption by Sector: 2000 – 2007



Source: MEPA Environment Report, (2010)

The difference between WSC water production (30.97 million m3 in 2007) and billed water consumption (15.57 million m3 in 2007) is made up of unaccounted-for-water (consumed but not billed), and real losses, which are related to leakages. Between 2004 and 2007 apparent water losses increased by 42 percent, while real losses (leakages) declined by 34 percent[124].

Table 01: Apparent and Real Water Losses

	2002	2003	2004	2005	2006	2007
Apparent Losses (m^3)	6,365,784	8,025,146	6,805,109	11,327,265	10,156,235	9,660,651
Real losses (m^3)	10,392,089	11,019,597	8,471,127	7,111,705	5,605,544	5,589,572

Source: MEPA Environment Report, (2010)

The 2008 Malta Environment Report states that 'one of the principal pressures on Malta's groundwater resources is over abstraction, which is of particular concern due to the risk of the resource and the proximity of groundwater bodies to the sea'[125].

In this context the said report compares abstraction rates with current estimates of renewable water resources. The renewable natural water resources that are economically exploited in Malta include groundwater and rainwater harvesting, with the latter being used for agricultural and domestic purposes. The Malta Environment Report adds that groundwater bodies in the Maltese Islands are principally replenished through rainwater infiltration, and to a lesser extent from leaks from the public water distribution system:

> 'Unfortunately, some 50 percent of water recharged into the aquifer systems is lost naturally through subsurface discharge to the sea. Malta's recharge water volume available for extraction is estimated at an average of 23 million m^3 per annum. WSC groundwater abstraction in 2008 amounted to 14 million m^3. However, when private abstraction, which is estimated to account for 20 million m3 per annum is considered, it is evident that there is net over-abstraction. This indicates that there is over-exploitation of the groundwater resource, which increases the risk of sea-water intrusion. Since sea-water intrusion is already impacting the ability of Malta's groundwater resources to meet the needs of the population in terms of water quality, legal measures need to be

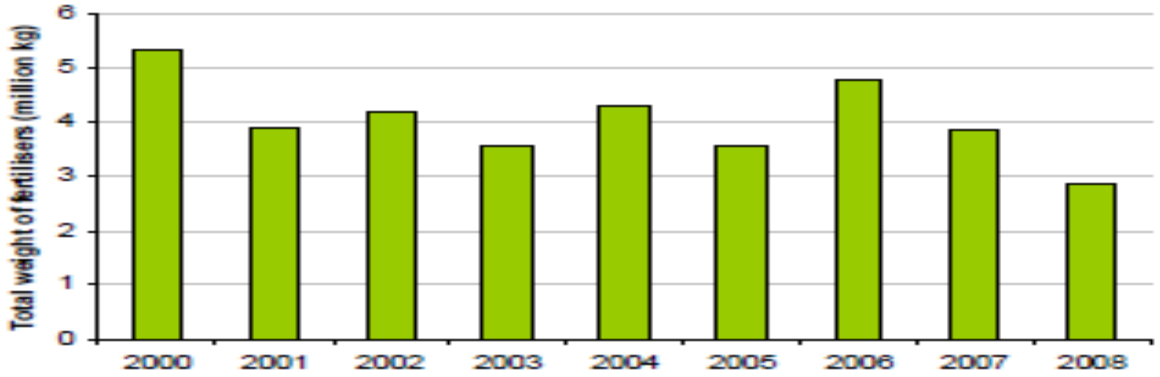
[124] Ibid, 7.
[125] Ibid, 8.

taken to address the situation. The difficulty in quantifying the extent of private groundwater abstraction also poses challenges for the integrated management of Malta's groundwater resource.[126]'

The qualitative status of the water resources is under threat primarily through nitrate pollution. Livestock farming in the Maltese Islands has evolved from a barnyard practice to intensive animal breeding, and consequently, as the amount of livestock increased, the amount of waste generated from this practice has also grown. Indeed pig, cattle, and poultry farms give rise to large concentrations of nitrogenous wastes and other substances, which can migrate towards fresh water bodies unless appropriate precautionary measures are taken. Cattle manure is the most 'inert' form of livestock waste; poultry manure is comparatively high in nitrogen; pig manure is liquid, more odorous and has higher quantities of polluting substances such as certain heavy metals. Pig manure also has a higher potential to transmit disease to the human population[127].

Intensive agricultural activities also have a strong impact on the quality of fresh water resources since they typically involve widespread use of fertilisers and pesticides. The trend in fertilizer importation indicates an overall decrease since 2000. Various factors may be responsible for changes in amounts of imported fertilisers: importation patterns, farmers' expectations, and cash flow, together with climatic conditions in relation to timeliness of operation. Moreover, greenhouse and irrigated-area products, which are the major users of fertilisers, are dependent on, and hence their fertiliser use fluctuates with, market prices[128].

Chart 03: Imports of Artificial Fertilisers



Source: MEPA Environment Report, (2010)

As a result of over-abstraction of the aquifers and localised sea-water intrusion, groundwater in Malta also has high levels of chloride. Increasing levels of salinisation in the aquifers could result in the eradication of agriculture in Malta, unless an alternative source of water is made available. It is a known fact that some arable and livestock farmers have already invested in small RO units to remove the salinity from their groundwater sources and make the water suitable for irrigation/production. However, these additional costs of production are unsustainable to the economic activity of the agricultural sector in the long term. The only existing source of alternative water (other than the rainwater harvesting systems mentioned above) is the 1983 Sant Antnin Sewage Treatment plant. This treatment plant has the capacity to deliver 17,000 m^3 of second-class water for agriculture a day will be decommissioned and replaced by the new Malta South sewage treatment plant.

If groundwater continues to deteriorate, potable and agricultural water supplies would ultimately have to be sourced almost entirely from desalinated water, which will result in an increase in the cost of water and would render the provision and distribution of water supply prohibitive. The reduction in the amount of groundwater available arising as a direct result of climate change may also lead to an increase in the use of desalinated water unless a sustainable balance is found which optimises the use of water in an efficient way. There is no doubt that would create a difficult state of play for Malta.

[126] Ibid, 9.
[127] Ibid, 10.
[128] Ibid, 11.

Whilst this Report recommends a number of policy measures for Government's consideration in relation to water and adaptation as well as with regards to communication and education, the fact remains that the measure that has the highest elasticity impact on behaviour in the immediate and short term is 'price'. The CCCA is recognisant of the fact that Malta has recently removed subsidies as well as increased prices in the cost of water - with both actions triggering negative reactions from various stakeholders within the polity.

Be that as it may, the abuse and misuse of water resources by those who are indifferent to the importance of water as a strategic public good and who exploit it for their own benefit at the expense of the rest of society are short changing the community at large.

The CCCA is not of the opinion that a general polluter's pay fine is introduced on water abuse and misuse across the board - thereby penalising, unfairly, those within the community who live up to their public responsibilities as well as those who abuse of the regulatory environment - thus spreading the impact of such a sanction across the whole of society.

In this regard, the CCCA recommends that the Government should introduce a compliance polluter's pay fine regime that targets the abuse and mis-use of water resources across domestic, industrial, livestock and agricultural users et al on the basis of pre-defined benchmarks of what constitutes 'good' use.

The introduction of such a compliance regime can be introduced incrementally, initially as a psychological prop to a communication and education campaign that over a period of time becomes a de facto sanction. Thus, for example, in the first year the 'sanction' would not actually involve the actual charging of a financial polluter's pay fine but rather a 'dummy' fine that would show a household, entrepreneur et al the extent by which they exceed the benchmark and what the financial value of the polluter's pay fine would be if this has to be applied. This should be supported by simple but effective designed communication and information in order to provide a defaulter with the appropriate education to change his or her behaviour.

Should in the subsequent year, the person default yet again, then he or she is finalised a 'n'% of the penalty with a full penalty to be charged by, say the third or fourth year.

A phased approach as discussed above or any other combination that may be considered with allow households, farmers and entrepreneurs to adjust and change behaviour and norms as a climate change adaptation culture is inculcated whilst at the same time nudging behavioural change if this is not attained through the application of sanctions by means of a targeted polluter's pay fine.

Recommendation 26

The Climate Change Committee on Adaptation recommends that the Government should introduce in a phased manner a polluter's fine compliance regime targeting those who abuse or mis-use water resources to allow and persuade people, farmers and entrepreneurs to adjust and change behaviour and norms as a climate change adaptation culture is inculcated whilst at the same time nudging behavioural change if this is not attained through the application of sanctions by means of a targeted polluter's pay fine.

Although ROs use sea water wells as opposed to abstracting water directly from the sea, a major oil spill or a power outage of more than 48 hours will result in an emergency situation, with Malta having no source of fresh water. Fresh water will have to be imported on very short notice from neighbouring countries – at a high cost to the nation.

Whilst it is recognised that the MRA has embarked on a programme to install meters on boreholes and thereafter carry out a one year monitoring process on the basis of which policy direction will be set, this report recommends that the process of over-extraction through the misuse and abuse of boreholes is reduced as soon as possible. This is of critical importance as a loss of this natural resource could have implications on economic, environmental and social activities in Malta.

Recommendation 27

Whilst the Committee on Climate Change for Adaptation recognises that the Malta Resources Authority has embarked on a programme to install meters on boreholes and thereafter carry out a one year monitoring process on the basis of which policy direction will be set, this Report recommends that the process of over-extraction through the misuse and abuse of boreholes is reduced at the earliest possible given that the loss of this natural resource could have implications on economic, environmental and social activities in Malta..

The EU Water Framework Directive obliges Malta to restore its aquifers to 'good status' by 2015. However, the Water Catchment Plan for the Maltese Islands[129] clearly states that this target will not be attained, and that Malta will be asking for an extension to 2027.

Whilst this Report is recognisant of the fact that a number of EU Member States will be similarly requesting an extension, which the afore mentioned Directive permits, given the criticality and importance of ground water as a sustainable and strategic resource, the CCCA is of the considered opinion that the Government and stakeholders involved should continue to mobilise the necessary and appropriate financial and human resources to allow Malta to meet the EU Water Framework Directive obligations prior to the 2027 target date to the extent that this is possible.

Recommendation 28

Given the strategic importance of ground water as a sustainable and strategic resource, the Committee on Climate Change for Adaptation recommends that the Government and stakeholders involved should continue to mobilise the necessary and appropriate financial and human resources to allow Malta to meet the EU Water Framework Directive obligations prior to the 2027 target date to the extent that this is possible.

05.3 Potential impacts of climate change on Malta's water resources

Section 01.2 of this Report presented the potential climate change impacts on Malta. The Supplementary Paper to the Second Communication of Malta to the UNCCCF titled 'Vulnerability and Adaptation – Water Resources' confirms these trends which include[130]:

- a potential rise in annual average temperature in the range 0.53 – 1.32 ^{o}C by 2030. This is expected to result in less cold winters and warmer summers;

- a potential change in annual mean precipitation projected to be around -5.5% per ^{o}C global mean warming which can be translated into a drop from the current observed value of 568mm/yr to 552mm/yr by 2030 and to 507mm/yr by 2100;

- a potential increase in evaporation rates leading to a higher incidence of drought periods. Winds are projected to be slightly weaker during autumn and winter and slightly stronger during spring and summer thereby contributing to higher evaporation rates leading to a higher incidence of drought periods; - cloud cover is expected to decrease by about 3% over current annual values resulting in more cloudless skies during winter and autumn;

[129] March 2010, can be consulted on http://www.mra.org.mt/Downloads/Consultations/MT_Water_Catchment_Management_Plan.pdf

[130] Gatt, K, 2009. Water Resources. In Micallef, A and Sammut, C V Ed. *The Second National Communication of Malta to the United Nations Framework Convention on Climate Change*. Ministry for Resources and Rural Affairs, Government of Malta. Ch 6 (In print)

- a potential increase in sea level rise. In respect of sea level, contrary to expectations Maltese waters have experienced a fall at an average rate of 0.5+ 0.15 cm/yr. However one needs to maintain a precautionary approach, projections should be made on the 2002-2006 period during which sea level rise averaged 0.45 + 0.15cm/yr, whilst still maintaining appropriate levels of observation in order to determine any changes in trends and the resulting projections into the future that might result therefrom.

Thus, climate change could result in higher ambient temperature which could increase water demand in all sectors: agricultural, domestic, tourism, industry etc. Lower annual rainfalls will potentially decrease the amount of water that will be available for natural groundwater recharge, as will the prevalance of more frequent high-intensity storms.

Adaptation of water management to climate change implies balancing water demands and resources in an uncertain and changing situation. Scenarios and models handle this uncertainty by providing information on possible futures.

This report considers a hypothetical scenario where climate change, as a result of the above temperature, precipitation, wind, and sea level changes, will drive water demand by 7% above current levels over the next 20 years, while the sustainable yield of the aquifers will drop by 20% during this time because of reduced infiltration.

Such a scenario would trigger a state of play characterised by increasing demand and diminishing supplies, which means that either alternative supplies of water need to be sought, or demand harnessed in an agressive manner through water conservation practices.

In this hypothetical scenario, it will be expected that:

- the sustainable yield of the aquifers will fall below 23 million m^3 per year;
- a business-as-usual scenario for the agricultural water demand would result in an increase to 22.5 million m^3 per year;
- real domestic water demand will remain at current levels, that is 12 million m^3 a year, unless supplementary measures, such as re-introduction in rainwater cisterns and greywater systems, to reduce demand are implemented on a national scale. If such measres are introduced, reductions in WSC production of around 7 million m^3 per year are possible;
- municipal water production will stabilise at 24-25 million m^3 a year, to meet a real water demand of around 19 million m^3 per year. This estimate however assumes that leakages in the network are lowered to 15% of production and unaccounted water is reduced to 10% of production. The nation-wide implementation of supplementary measures mentioned above would lower WSC production to around 18 million m^3 a year;
- sustainable aquifer yield is assumed to be split on a 50/50 basis between WSC and agriculture (and private extraction), this would mean that RO production will stablise at current levels, that is around 16 million m^3 a year.[131] Non-agricultural private extraction will be set at 1 million m^3 a year;
- the deficit in water for agricultural will be approximately 14 million m^3 a year, that is the difference between forcasted water demand and the groundwater allocation. This will have to be met through a combination of treated effluent re-use and rainwater harvesting.

05.4 Recommendations

A proper adaptation strategy is one which takes climate change considerations into account, to the extent feasible, in social, economic and environmental policies, practices and actions by all stakeholders. Adaptation will be required to reduce the costs and disruptions, alter behavioural

[131] It is technically possible today to produce potable water from treated sewage effluent. With further improvemnents in the technology, it may well be the case that it will be more cost-effective to produce potable water from sewage than desalination. This eventuality will result in a lower dependency on RO and provides added strategic security of supply

patterns and give an additional context to decision making to acknowledge those causes derived from climate change, particularly from extreme weather events like storms, floods, and heat waves.

There are many adaptation measures that could be implemented to reduce the impact of climate change on Malta's water resources. A comprehensive approach needs to be adopted to address water issues. Policy measures will have to be based on integrated resource management principles focusing primarily on demand management and maximisation of efficiency rather than supply augmentation.

In terms of policy measures for adaptation, the Committee recommends that the Government should consider the introduction of the following adaptation measures in the immediate term.

The Committee is of the considered opinion that metering of all groundwater abstraction sources should be in place by 2011. Given the strategic importance of water, both in terms of its scarceness, and the need to secure the re-generation of the water tables, the Committee recommends that the Government should by 2015 establish pricing mechanisms for private groundwater extraction with a target to reduce the current level of extraction from 21.5 million m^3/year to 16 million m^3/year.: Government should ensure that in doing so, all social, economic and environmental considerations will be assessed beforehand.

Recommendation 29

The Committee on Climate Change for Adaptation recommends that the metering of all groundwater abstraction sources should be in place by not later than 2011. Moreover, given the strategic importance of water, both in terms of its scarceness and the need to secure the re-generation of the water tables the Government should by not later than 2015 establish pricing mechanisms for private groundwater extraction based on social, economic and environmental considerations in order to target a reduced level of extraction from the current 21.5 million m^3/year to 16 million m^3/year.

The MRRA in 2010, under the EU Measure 121 titled 'Modernisation of Agricultural Holdings' launched a scheme to provide farmers with financial assistance to help them construct reservoirs. The financial assistance was to a maximum of 50% of the total cost of construction. In all some €3m were meted out under the said scheme. It is pertinent to underline that the volume of reservoirs constructed as a result of this scheme amounted to 47,000m^3. The CCCA recommends that the MRRA should continue with the implementation of this scheme.

Recommendation 30

The Committee on Climate Change for Adaptation recommends that the Government continues to implement fiscal incentivise schemes directed at the farming and livestock breeding sector to construct or rehabilitate existing reservoirs to capture rainwater for re-use for irrigation and other appropriate uses.

The above shows that specifically tailored fiscal incentive schemes to encourage different sectors to use water more efficiently and to capture and re-use water resources where necessary in order to maximise water use and re-use efficiency can be successfully introduced.

The CCCA recommends that whilst the Government should continue to seek opportunities to introduce fiscal incentives through EU financing instruments it, nevertheless recommends, that it establish, through local financing, fiscal incentive schemes directed at:

01. The introduction of appropriate economic instruments directed at the farming and livestock sectors to encourage them to use water more efficiently. Incentives should also be provided to encourage the agricultural sector to use the best-available irrigation technologies.

Recommendation 31

The Committee on Climate Change for Adaptation recommends that the government introduces appropriate economic instruments financed through local funds directed at the farming and livestock breeding sector to encourage them to use water more efficiently as well as to use the best-available irrigation technologies.

02. The introduction of an incentive scheme directed towards commercial and industrial entities to assist them to build cisterns, wells, and other water catchment measures; to re-use captured water; and to recycle used water for non-potable purposes.

Recommendation 32

The Committee on Climate Change for Adaptation recommends that the Government introduces an incentive scheme financed through local funds directed at commercial and industrial entities to assist them to build reservoirs and other water catchment measures; to re-use captured water; and to recycle grey water for non-potable purposes as well as to introduce efficient water use technologies.

03. The introduction of an incentive scheme directed towards domestic households that have a cistern and water catchment infrastructure but require the appropriate plumbing to direct captured water for re-use.

Recommendation 33

The Committee on Climate Change for Adaptation recommends that the Government introduces an incentive scheme financed through local funds directed towards domestic households that have a cistern and water catchment infrastructure but require the appropriate plumbing to direct captured water for re-use as well as to re-use grey water.

04. The Energy Saving Lighting scheme launched by Government in 2009 for households is replicated by a similar scheme directed at providing the free supply of technologies such as water low-use tap, that could reduce the use of water by households.

Recommendation 34

The Committee on Climate Change and Adaptation recommends that the Energy Saving Lighting scheme launched by Government in 2009 for households is replicated by a similar scheme directed at providing the free supply of technologies such as water low-use taps that could reduce the use of water by the household sectors.

The above incentive measures implemented should, however, be complemented by the following obligatory measures.

01. The aforementioned National Climate Change Mitigation Strategy had argued that:

> *'A cornerstone of good town planning in Malta introduced as early as the building of Valletta was the application of well technology in order to capture water at source. Whilst the building of wells has been a sound practice applied by town planners and architects up to the 1960s, for inexplicable reasons this practice has practically vanished in recent building and major development projects.*
>
> *The reasons for why this happened cannot be ascertained – though one suspect that town planners and architects are inclined to use subterranean grounds for basements and garages. Whatever the reasons, in a country that suffers from*

chronic water supply shortages, produces desalinated water at a great expense, and is facing major difficulties with its water table due to illegal yet sustained water extraction, the failure to regulate and enforce a legal requirement on Malta's statute books that demands that buildings must have rainwater capture reservoirs or wells is a travesty.[132]'

The then Climate Change Committee had proposed that *'in a country that suffers from chronic water supply shortages, and which produces desalinated water at a great expense, and which is facing major difficulties with its water table due to illegal, yet sustained water extraction the current practice not to invoke legal provisions that mandate that buildings must have rainwater capture reservoirs or wells should be repealed and the legislation should be enforced …*[133]'

The CCCA supports these recommendations and reinforces the need for its immediate implementation.

Recommendation 35

The Climate Change Committee for Adaptation reinforces the recommendation by the Climate Change Committee on Mitigation Measures that 'the current practice not to invoke legal provisions that mandate that buildings must have rainwater capture reservoirs or wells should be repealed and the legislation should be enforced' and moreover, reiterates the need for its immediate implementation.

02. Legal instruments should be introduced to ban the use of groundwater for landscaping purposes. Such an instrument should include financial penalties to discourage misuse of such a valuable and scarce resource. Facilities should be introduced so that water for landscaping is purchased from the Sewage Treatment Plants. Moreover, a tough financial penalty regime in this regard would act as an incentive to entities or domestic households to invest in on-site water catchment infrastructure as well as water re-use facilities.

Recommendation 36

The Climate Change Committee for Adaptation recommends that the Government should introduce legal instruments to ban groundwater use for landscaping and introduce a tough financial penalty regime to discourage misuse of a scarce and valuable resource.

If the above fiscal schemes and legislative instruments are introduced in the forthcoming year and if they are supported by intensive communication, education, and marketing it is conservatively estimated that the demand for ground water use would be reduced by 2 million m^3/year by 2015. This will allow for the reduction in WSC groundwater extraction to 9.25 million m^3/ year (down from the current 12.7 million m^3 a year.

The introduction of these schemes and legislative instruments, or other variants thereof, should be directed to meet the following targets:

- replace groundwater demand by 2 million m^3/year by 2020;
- replace groundwater demand by 3 million m^3/year from 2021 to 2030.

Recommendation 37

The Committee on Climate Change and Adaptation recommends that through the introduction of schemes for the re-use of captured water and the use of grey water should seek to achieve

[132] Mitigation Strategy, *supra*, 131.
[133] Ibid.,132..

the following targets:

- **replace groundwater demand by 2 million m^3/year by 2020;**
- **replace groundwater demand by 3 million m^3/year from 2021 to 2030.**

Apart from the introduction of fiscal incentives and legal instruments with regards to the use of a natural resource the CCCA proposes that the Government should embrace, in the immediate term, the following investment:

01. To the earliest extent possible the Government should provide the necessary facilities to render treated sewage effluent available for agricultural and landscape uses.

02. Treated Sewage Effluent (TSE) could, particularly given our short distances, easily be transported by a bowser vehicle distribution network from the three sewage treatment plants. Studies such as the ones being taken in Gozo should be further undertaken to determine the infrastructural requirements for the distribution of treated sewage effluent.

Recommendation 38

The Climate Change Committee for Adaptation recommends that the Government should continue with further studies such as those underway in Gozo to determine infrastructural requirements such as the use of a bowser vehicle network for the distribution of treated sewage treatment effluent.

03. Moreover, consideration should be given to the re-instatement of the San Antnin network and its link to Ta' Barkat. The South East Area has a very high potential for the re-use of TSE.

Recommendation 39

The Climate Change Committee for Adaptation recommends that the Government should consider the re-instatement of the San Antnin network and its link to Ta' Barkat given that the South East Area has a very high potential for the re-use of Treated Sewage Effluent.

04. Incentives should be introduced to encourage the agricultural, industrial, commercial and domestic sectors to use TSE with pre-defined guidelines as opposed to using groundwater.

Recommendation 40

The Climate Change Committee for Adaptation recommends that the Government should introduce appropriate incentives to encourage the agricultural industrial, commercial, and domestic sectors to use sewage treatment effluent within pre-defined guidelines as opposed to using groundwater.

The introduction of **Recommendations 39 and 40** above should be directed to meet the following targets:

- provide 5 million m^3/year by 2015 as a replacement of groundwater used for agriculture, commercial, and industrial need;
- provide 10 million m^3/year from 2016 to 2020 as a replacement of groundwater used for agriculture, commercial, and industrial need;
- provide 15 million m^3/year from 2021 to 2030 as a replacement of groundwater used for agriculture, commercial, and industrial need.

Recommendation 41

The Committee on Climate Change and Adaptation recommends that through the introduction of facilities for the distribution and supply of quality treated effluent, the government should seek to achieve the following targets:

- **provide 5 million m^3/year by 2015 as a replacement of groundwater used for agriculture, commercial, and industrial need;**
- **provide 10 million m^3/year from 2016 to 2020 as a replacement of groundwater used for agriculture, commercial, and industrial need;**
- **provide 15 million m^3/year from 2021 to 2030 as a replacement of groundwater used for agriculture, commercial and industrial need.**

05. A key initiative with regards to water capture is the importance of increasing the current efforts directed to maintain and retain the valley systems in a healthy state, both physically and ecologically. Such action would not only help in the control of flooding following flash storms, but will also act as a natural reservoir which will allow the captured water to sink into the aquifer.

The CCCA, therefore recommends, that a maintenance and preservation plan for all valley systems in Malta and Gozo is designed and implemented at the earliest possible. .

Recommendation 42

The Climate Change Committee for Adaptation recommends that a maintenance and preservation plan for all valley systems in Malta and Gozo is designed and implemented at the earliest possible, given that such action would not only greatly help control flooding but will also act as a natural reservoir, which will allow the captured water to sink into the aquifer.

The current approach of regulating maintenance works in valleys as development is unnecessarily bureaucratic and should be replaced by a system of approved maintenance plans that could be put into effect on a regular basis.
Such plans would also assist effective budgeting. Government also needs to ensure that sufficient financial and human resources are made available to implement these maintenance plans on an ongoing basis.

Recommendation 43

The Climate Change Committee for Adaptation is of the considered opinion that the current approach of regulating maintenance works in valleys as development is unnecessarily bureaucratic and should be replaced by a system of approved maintenance plans that could be put into effect on a regular basis.

Over the years there has been an increase in flooding and a reduction in infiltration as arable land has increasingly made way for development. A part of the existing storm-water infrastructure built in the 1980s and earlier years has fallen in disarray given that there is no maintenance programme for the upkeep of these structures.

The existing storm water infrastructure is identified to be inadequate to drain runoff and prevent disruption to economic activity and to the accessibility of roads even from nominal rainstorms. In areas that are particularly prone to flooding, and with rainfall intensities below the 1 in 5 year return periods, the existing infrastructure is also inadequate to safeguard against damage to property and prolonged disruption and inaccessibility to commercial and residential areas.

Historically, urban centres have grown along watercourses that have become increasingly laden with runoff, while adjacent rural areas have been turned into impervious areas. Meanwhile stormwater has never been approached as a network or in a comprehensive fashion across a watershed; and has instead been constructed in piecemeal fashion, without an overall plan or study of the hydraulics of the respective basin.

A short high intensity storm would swiftly exceed the present infrastructure capacity and would cause water levels to rise rapidly in streets disrupting economic activity and transport in urban and residential areas.

The level of protection against flash storms provided by the present infrastructure is uncertain and the risks to life and property and of disruption is high.

The Government, as mentioned earlier, has designed a National Flood Relief Project (NFRP). The NFRP is directed towards a number of infrastructure investments. Project scheme I targets three basins: (i) Birkirkara – Msida Basin; (ii) Gzira Basin; and (iii) Wied il-Kbir / Wied is Sewda Basin. Project Scheme II is targeted towards the Marsascala Basin.

The technical solutions proposed by the NFRP are design to drain and convey the runoff waters produced by flash rain storms, solving the flooding problems up to the 5 years event rain, and to substantially reduce damages to property, risks to inhabitants and economic activities that are associated with storm events with the 1 in 10 and 1 in 50 year return periods.

The CCCA recommends that the Government should take all the appropriate action to secure the implementation of the NFRP by the projected 2015 target date.

Recommendation 44

The Climate Change Committee for Adaptation recommends that the Government should take all the appropriate action to secure the implementation of the National Flood Relief Plan by the projected 2015 target date.

In tandem with the work underway with regards to the implementation of the NFRP plan discussed above, the CCCA is of the considered opinion that the Government should carry out cost benefit assessments with regards to the building of water soakaways in strategically identified locations, which will complement the NFRP infrastructure.

The soakaways will be designed in a manner towards which water is directed, ponded and allowed to percolate in order to provide groundwater recharge as well as tackling the collection and disposal of stromwater from the most upstream point of the catchment, discharging, where possible, to points along the valleys. Moreover, the construction of soakaways constitutes one of the ways by which the qualitative and quantitative status of the groundwaters can be improved.

The cost benefit assessment should consider the increase of the current local infrastructure by 100% in the period 2014 to 2021 and by 150% in the period 2022-2029. In the event that the cost benefit assessment shows that such a strategy will add value to the country then the Government should give strong consideration to secure EU Structural funding in the EU's next two financial cycles post 2013 for such investment.

Recommendation 45

The Climate Change Committee for Adaptation recommends that the Government should carry out a cost benefit assessment to study the impact of a 100% and 150% increase in rain harvesting infrastructure to be carried out between 2014-2021 and 2022-2029 and should the assessment show that such infrastructure would add value then it should consider securing EU Structural funding during the stated periods.

In the construction of new roads or the refurbishment of street/road landscaping the Malta Transport Authority should continue to ensure that inherent within their design include reservoirs to act as water catchment areas to cushion flooding as well as allow for the seepage of such water into the aquifer. Moreover, the number of existing soakaways along the road infrastructure should be progressively increased in such a way as to divide the catchment into manageable smaller catchment areas which allow for recharge of the aquifer.

Recommendation 46

The Climate Change Committee for Adaptation recommends that when constructing or refurbishing roads or undertaking road landscaping, the Malta Transport Authority should continue to ensure that the design for the said works, includes reservoirs to act as water catchment areas to cushion flooding as well as allow for the seepage of such water into the aquifer and should seek progressively increase the number of existing soakaways along the road infrastructure in such a way as to divide the catchment into manageable smaller catchment areas which allow for recharge of the aquifer..

It is, however, unrealistic to expect that Malta could ever do without desalination. Due to technological improvement, as well as other initiatives, the electricity demand to power the ROs between 1994 and 2007 has decreased by 52%. It is pertinent to note that the WSC continuously undertakes and introduces technical developments aimed at improving the efficiency of the RO process. For example:

- in 2002 pressure exchanger technology was introduced at the Lapsi RO Plant;
- between 2000 – 2002, the energy recovery systems were replaced at the Pembroke RO Plant;
- in 2007, a project was embarked upon directed to achieve a reduction of 20% in energy consumption by 2009, a 38.6% increase in the nominal capacity for the plants, and an improvement in water quality by decreasing chloride level by 40%.

The CCCA recommends that the Government, through the WSC, should continue to channel applied R&D&I financing in order to seek improvements in rendering RO water treatment management more efficient, particularly through the combination of renewable energy sources with RO operations.

Recommendation 47

The Climate Change Committee for Adaptation is of the considered opinion that whilst it is unrealistic to expect that Malta could ever do without desalination, the Government, through the Water Services Corporation, should continue to channel applied R&D&I financing in order to seek improvements in rendering Reverse Osmosis water treatment management more efficient, particularly through the combination of renewable energy sources with Reverse Osmosis operations.

Over the past decade, the WSC embarked upon a major infrastructure upgrading programme directed at managing leakages control in the corporation's water transfer and distribution network, motivated by the need of both conserving groundwater, as well as controlling the energy demand of producing and distributing the water.

The CCCA recommends that the government, through the WSC, should continue with the efforts to identify and reduce leaks in the water distribution system as a direct measure to conserve water to the maximum level possible.

Recommendation 48

The Climate Change Committee for Adaptation recommends that the Government, through the WSC, should continue with efforts to identify and reduce leaks in the water distribution system as a direct measure to conserve water to the maximum level possible.

One of the possible impacts that climate change could have on Malta's water resources is a possible increase in evapotranspiration rates leading to a higher incidence of drought periods. The CCCA recommends that the government prepare a contingency plan for drought periods.

Recommendation 49

The Climate Change Committee for Adaptation recommends that the government prepare a contingency plan for drought periods.

It is important to have a great understanding of the aquifers in Malta. The CCCA recommends that the government constructs a 3-D numerical model to further understand the aquifer systems in Malta as soon as possible.

Recommendation 50

The Climate Change Committee for Adaptation recommends that the government constructs a 3-D numerical model to further understand the aquifer systems in Malta as soon as possible

Artificial recharge of the aquifers could be a way of increasing water in the aquifers. The CCCA understands that government is preparing to carry out pilot studies to determine whether this is actually feasible. The CCCA recommends that the government continues with the studies underway.

Recommendation 51

The Climate Change Committee for Adaptation recommends that the Government continues with the studies underway to determine whether the artificial recharge of aquifers in Malta are technically and financially feasible.

Climate change could have diverse and profound consequences across many areas of society. The water sector is particularly vulnerable and is where many of the impacts will be felt first and most severely. This report provides a good start in preparing and planning for these impacts, but adaptation is an ongoing process and will require continued monitoring over a long-period of time. CCCA recommends that the government prepares an implementation plan for these adaptation measures and provide continuous monitoring of the measures in question.

Recommendation 52

The Climate Change Committee for Adaptation recommends that the government prepares an implementation plan for these adaptation measures as soon as possible, and provide continuous monitoring of the measures in question.

Agriculture is the largest land user, incorporating an estimated 10,254 hectares (ha) spread across Malta and Gozo, with the exception of the highly urbanised Southern and Northern Harbour district. The exceptionally high number of registered rural actors also means that the average holding size is significantly low at 0.9424 ha[134]. Of the total utilisable agriculture area (UAA), arable area is the dominant category taking up 77.7%, or 8,018 ha, followed by 12.8% or 1,321 ha used for permanent crops and the remaining 9.5%, or 987 ha, used as kitchen gardens[135].

Maltese agriculture is handicapped by a number of structural constraints, the most obvious is the severe scarcity of land, followed by an equally severe scarcity of water. The semi-arid climatic conditions, including low and erratic rainfall patterns, are not favourable to rain fed husbandry which, together with the effects of climate change, will impose further severe disadvantages on productivity.

Over time, intense human activity has resulted in a quasi-complete deforestation of the islands and, in many cases, with large denuded and exposed surfaces characterised by sporadic patches of thin layers of soils alternating with outcropping rock, exposing and subjecting the soil to the elements.

Consequently, Maltese soils are vulnerable to erosion by both water and wind. This is acknowledged as being a significant problem, increasing the threat of long-term land degradation. The consequences of the semi-arid climate are of particular relevance to water management.

As discussed in the preceding chapter, these consequences include: variability in inter-annual and intra-annual rainfall; high-intensity, short duration rainfall events; seasonal scarcity of precipitation when the water requirements of the agricultural sectors are highest; frequent occurrence of low rainfall years when groundwater recharge is likely to be low, and, finally, frequent occurrence of high rainfall years when runoff is likely to be high. Concurrently, the island ecosystem is undergoing a trend towards 'tropicalisation', trend due to the effects of climate change. Land degradation, coupled with complications as a result of climate changes, is a threat to the natural ecological dynamic equilibriums with repercussions on environmental and social stability.

As a result of centuries of farming activity, including extensive terracing and moulding of the land, farmers have contributed immensely to the shaping of the rural landscape and to the environmental character of the islands which is characterised by small-sized and fragmented agricultural land and a rich diversity of semi-natural habitats that are often under severe threat from human activities and urbanisation.

Changes in the Maltese production systems and consumer lifestyle have resulted in the setting aside of local animal breeds and plant varieties to make way for the introduction of modern and imported hybrids and / or synthetic type. Some of these 'Maltese' types can today only be found outside of Malta. The recuperation and reintroduction of these local genetic types into Malta may hold the key in the adaptation of agriculture to the challenges presented by climate change.

The Maltese agriculture sector generates, on average, approximately 2.2% of the GVA and employs the same proportion of the total gainfully employed. While the livestock sector accounts for 80% of the farm cash receipts, the bulk (90%) of the remaining 20% is generated by only 10% of the arable operations. Malta is considered as being self-sufficient in the production of fresh vegetables, potatoes and processed tomatoes. It is also classified as being self–sufficient in the production of eggs, poultry meat, rabbit meat, pork, and dairy products.

Self-sufficiency in animal products is somewhat of a misnomer and a misleading statement since Malta lacks any significant production of the primary material, that is to say, the production of cereal and fodder crops to meet the nutritional requirements of the livestock herd. In fact Malta is heavily dependant on the importation of grains for the feed and bakery industry. Fruit, sugar, vegetable oil, rice, butter, cheese, and beef are also imported in bulk to meet national needs. Although locally

[134] National Statistics Office, *Agriculture and Fisheries, 2005*, Retrieved from www.nso.gov.mt/statdoc/document_file.aspx?id=2635, hereinafter NSO 2008
[135] Ibid.

grown beef, pork, rabbit and poultry, as well as fruits and vegetables (mainly tomatoes for processing), olives and grapes are tapped by agro-processors, local production is not sufficient to meet demand and seasonal production may not be enough to keep the processing line fully utilised.

Today, agriculture remains a major contributor in maintaining the quality of the landscape. It is also an integral component of the cultural heritage and a crucial backdrop to the tourism industry. Agricultural and rural areas constitute the national green lung and a venue for recreation.

The adaptation of agriculture is crucial, not only from the primary production aspects, but also for its multiple functionality and values that go beyond its direct contribution to the Maltese economy. In order to understand which adaptation options are possible, it is important to identify the climatic variables to which the adaptations relate, and to consider the role of non-climatic factors that influence the sensitivity of agriculture to climate change. This addresses the question: what is it that Maltese agriculture is adapting to?

Malta's Second Communication to the UNFCCC[136], refers to the impacts of climate change on agriculture by describing the current average, or 'normal', growing season conditions and analysis possible future deviations from the present normal conditions, focusing on the changes in average (mean) temperature and precipitation, wind magnitude, and other weather parameters, all of which have a direct effect on the growing season's length and water budgets, and on other factors such as pests and diseases. Conditions associated with the growing season's length, heat units or solar radiations, and crop yield, were not addressed. In the projected forecasts, moisture extremes, that is to say, drought and excess rain, were thought to be the most relevant in our scenario.

The process of adaptation has to take into account that climate change does not only lead to long term gradual changes in mean growing conditions, but also includes change in the year-to-year variation, and the frequency and magnitude of extreme weather events. Adaptation must also take into account other non-climatic forces such as economic conditions, politics, environment, society, and technology, all of which have significant implications for agricultural decision-making. Adjustments in agriculture are made routinely in response to non-climatic conditions, especially the market, as much as to changing climate conditions. Non-climatic conditions may aggravate climate-related risks, or they may dampen, counteract or overwhelm the climatic effects. Adaptive decisions in agriculture are made in the light of the joint effects of climatic and non-climatic conditions and, for the Maltese rural actor, these effects are eventually experienced in an economic manner.

Year-to-year production variation is strongly associated with the climate. Both water shortages and heat stress have significantly challenged crop yields. Climate change is forecasted to lead to more extreme weather conditions, increase soil erosion, increases in pest problems, and severe water shortages.

A key factor in determining the magnitude of climate change impacts on agriculture is adaptation, allowing for the minimisation of losses by reducing negative impacts, and maximisation of profits through capitalising on the benefits that such change may bring about.

There are many different adaptation options available to the agricultural sector, which vary greatly in their application and approach. Selecting and implementing adaptation strategies will require consideration of the physical, socioeconomic and political influences on agriculture, as well as the contributing roles of producers, industry and government. It is also necessary to recognize that climate change is just one of many challenges facing the agricultural sector, and should not be addressed in isolation to the other issues.

06.1 Issues of Climate Change and their Effects on Maltese Agriculture

Rising atmospheric CO_2 concentration, higher temperatures, changes in annual and seasonal precipitation patterns and in the frequency of extreme events will affect the volume, quality, and stability of the Maltese agro-ecological food system. Climatic variations will have consequences on the availability of water resources, pests and diseases, and soils, leading to significant changes in the

[136] SNC, *supra.*

conditions for husbandry and cultivation. In extreme cases, the degradation of the agricultural ecosystems could lead to desertification, resulting in a total loss of the productive capacity of the land and a gradual degradation of the fragile Maltese natural environment.

A number of key knowledge gaps need to be addressed in order to fully assess issues of vulnerability. Emphasis has traditionally been placed predominantly on the biophysical impacts of climate change, with less attention given to socio-economic impacts. There is a need for detailed costing studies which consider all potential impacts on the sector, as well as the adaptation options. Research is needed to determine what barriers exist to adaptation in the Maltese agriculture sector and how these can be addressed.

Over the centuries, Maltese agriculture has proven itself to be highly adaptive within a certain range of climate conditions. New adaptive measures may serve to further expand this range, but there exist climatic thresholds beyond which activities are not economically viable and substantive changes in practices would be required. An improved understanding of where these critical thresholds lie will contribute to the development of appropriate adaptation strategies.

Thus, the CCCA is of the considered opinion that in order to bridge the significant knowledge gaps discussed above the MRRA should undertake a comprehensive review to draw up an Agricultural Policy which should be targeted for completion by end 2011.

Recommendation 53

The Climate Change Committee for Adaptation recommends that in order to bridge the significant knowledge gaps that are critically must be bridged in order to fully assess the issues of vulnerability a comprehensive study leading to the design of an Agricultural Policy should be embarked upon by the Minstry for Resources and Rural Affairs with a target completion by end 2011.

06.1.1 Impacts on Crops

Malta is considered as being self-sufficient in fresh vegetables, potatoes and processing tomatoes, but lacks any significant production of cereal and fodder crops relying heavily on imports of grain. Fruit, sugar, vegetable oil, and rice are also imported in bulk to meet national needs. The complex matrix, compounded further by considerations of climate change, will potentially have a number of impacts on Maltese agricultural production.

To date, no model has been developed to project these impacts on different types of crops grown in Malta. Nonetheless, increased moisture stress and drought are major concerns for both irrigated and non-irrigated crops. If adequate water is not available, yields decline and entire harvests may be jeopardised.

The potential longer growing seasons, higher temperatures and frequency of drought would surely increase the water demand. Higher temperatures are detrimental because plant growth and yields are conditioned by temperature thresholds linked to the key reproductive stages. Extreme weather conditions, such as heat waves and droughts will also severely disrupt production, in particular during critical phases of plant growth.

While there remain considerable uncertainties regarding the nature of future climate changes at the local scales, it is safe to predict that atmospheric CO_2 will most certainly increase. Enhanced atmospheric CO_2 concentrations could improve crop water use efficiency and rates of photosynthesis. However, the relationship is not simple and different crops will react in either direction, which is further complicated by other factors, including moisture conditions, the availability of soil nutrients, and other environmental stresses that could limit or negate the benefits of CO_2 fertilisation on plant growth.

Changing winter conditions would also significantly impact crop productivity and growth. Warmer winters will create problems, especially with respect to pests and the resilience of crops. Warmer temperatures will advance the date of flowering in fruit trees and water need is likely to rise. Many crops may be more sensitive to changes in the frequency of extreme temperatures than to changes in

mean conditions. Crops that require several years to establish, such as fruit trees, are especially sensitive to extreme events. Difficulties related to pests and diseases are expected to increase. The area under permanent crops in 2007[137] stood at 1,321 ha, or 12.8%, of UAA, mainly due to peach and citrus cultivation and, of recent, to the increase in land under vines and under olive trees.

The wind phenomena within the climate change context are in general poorly understood. However, it is clearly an important control on agricultural production, having strong influences on evapotranspiration and soil erosion.

Another important consideration for crop production is the observation that recent warming has been asymmetric, with night-time minimums increasing more rapidly than daytime maximums. This type of asymmetric warming tends to reduce crop water loss from evapotranspiration and improve water use efficiency. Horticulture is highly dependant on water availability and sensitive temperatures outside the optimal range, making this type of production highly vulnerable to climatic changes. Vegetable production is cultivated on 3,527 ha, or 34.4%, of the total UAA[138].

Impacts on the wine sector include changes in the ripening period and water stress, both of which can be highly damaging at the maturity stage, and may lead to changes in pest and disease patterns. Variability of fruit production will increase, thereby further influencing wine quality and quantity. Malta had 751 ha in 2007 planted with vines.

06.1.2 Impacts on Livestock

Dryer conditions and rising temperatures will affect livestock activities in different ways, including implications on health and welfare. Warming and extreme events, such as heat spells, will have direct impacts on health, growth and output, as well as on reproduction. There will also be indirect effects through changes in the productivity of forage crops and in the distribution of animal diseases. The precipitation deficits will decrease roughage production and its quality.

Temperature is generally considered to be the most important bioclimatic factor for livestock. Warmer temperatures are expected to present both benefits and challenges to livestock operations. Benefits would be particularly evident during winter, when warmer weather lowers feed requirements, increases survival of the young, and reduces energy costs. On the other hand, challenges would increase during the summer, when heat waves can kill animals. Thus, in terms of production efficiency, studies show that the negative effects of hotter summers will outweigh the positive effects of warmer winters.

Temperature and humidity interact to cause stress in animals, the higher the heat and humidity, the greater the stress and discomfort. Heat stress will adversely affect milk production, meat quality and dairy cow reproduction. Warmer summer temperatures will also suppress appetites, and hence reduce weight gain. As a result, animal production is projected to decline in a warmer Malta.

The forecasted increases in air temperatures will negatively affect animal operations, increasing production costs as a result of reductions in performance associated with lower feed intake and increased requirements for energy to maintain healthy livestock. These costs do not account for the increased death of livestock associated with extreme weather events such as heat waves. Night-time recovery is an essential element of survival when livestock are stressed by extreme heat. A feature of recent heat waves is the lack of night-time relief. Warming also affects parasites and disease pathogens, allowing greater proliferation and survival of parasites and disease pathogens. Heat-stressed animals have a reduced ability to cope with other stresses, such as diseases and parasites.

In addition to the direct effects on animals, storms may result in power cuts, causing great difficulties on farms that are heavily dependent upon electricity for daily operations and chores. Furthermore, in an attempt to better manage the internal environment of the barns, climate control will be heavily dependent on electrical powered fan forced ventilation. The lack of electricity will make it difficult to provide adequate barn ventilation, thereby making the animals more susceptible to stress.

[137] Ibid.
[138] Ibid.

There are more than 3,773 livestock holdings Malta involved in the production of pork, beef, dairy cows, sheep, goats, poultry, rabbits and horses, most of which do not have a land base. Farm cash receipts from this sector are estimated to amount to 80% of the annual agricultural GVA contribution. Malta has traditionally been described as being self-sufficient in the production of eggs, poultry meat, rabbit meat, pork, and dairy products.

As stated above in the Maltese context, self sufficiency in animal products is somewhat of a misnomer and a misleading statement since Malta lacks any significant production of cereal and fodder crops to meet the nutritional requirements of the livestock herd. In fact it relies heavily on imports of cereals for the feed and bakery industry. Despite the economic importance of livestock operations, no studies have examined how they could be impacted by climate change. The effects of climate change on the national market and even more so on the international one, for example in regard to grain procurement or the potential of increased cheap animal products from areas that have either adapted or been favoured by climate change, needs to be carefully examined.

06.1.3 Soil Degradation

Maltese soils, as discussed in Chapter 02, are affected by one or more of the following natural constraints: unfavourable soil chemical status as a result of alkalinity and the calcareous nature of the soils, soil salinity, unfavourable soil physical characteristics, shallow depth to bedrock, low soil organic matter, and high soil stoniness. Maltese soils are vulnerable to erosion by wind and water run-off. Human reaction to this harsh and demanding environment was to resort to the typical terrace landscape to capture and reduce soil and water loss, thus increasing the capacity of husbandry.

Climate change could impact soil quality through changes in soil carbon content, nutrient leaching, and run-off. Shifts in vegetation and changes in water cycles would also affect soil carbon and, therefore, soil quality and productivity. Wind and water erosion of agricultural soils are strongly tied to extreme climatic events, such as drought and flooding, which are commonly projected to increase as a result of climate change. Soil erosion will not only threaten agricultural productivity and sustainability, but would jeopardise the whole of the costal and terraced landscapes. Sound land management practices are essential for soil conservation. Long term management strategies that increase soil organic matter and strong water-holding capacity will also render the land better able to cope with future climatic changes.

The island ecosystem is already undergoing a “tropicalisation” trend due to the effects of climate change. Land degradation coupled with complications as a result of climate changes are a threat to the natural ecological dynamic equilibriums with repercussions of environmental and social nature.

06.1.4 Water availability

With no surface waters, rural and urban communities have over time developed and adapted various techniques to harvest rain water and channel it into holding vats for later use as irrigation or potable water. The extensive distribution and availability of electric power in all corners of Malta has facilitated the farming community’s focus on tapping into the underground water system.

Agricultural water users continue to be more dependent on the vagaries of the climate and access to water resources for irrigation. Water shortages have resulted in farmers shifting towards cultivation practices and irrigation systems that make efficient use of water resources. Although farmers are relatively more conscious of the importance of water conservation than urban water users, increased agricultural water use, and the excessive groundwater abstraction in recent years have affected the sustainability and viability of the aquifer systems.

Groundwater degradation linked to agriculture takes two distinct forms. Firstly, there is increasing salinity of the Lower Coralline Limestone sea-level aquifer systems as a result of seawater intrusion. Secondly, there is nitrate contamination of practically all the aquifer systems as a result of intensive livestock production, high levels of fertiliser use, and leakages in the sewage collection systems. The forecasted sporadic reliability of precipitation due to climate change will unavoidably put increasing pressures on groundwater resources. Increasing competition for water between different user will also concern rural population and economies.

06.1.5 Pests and Weeds

Weeds, insects and diseases are all sensitive to temperature and moisture, and some organisms are also receptive to atmospheric CO_2 concentrations. Therefore, understanding how climate change will affect pests, pathogens, and weeds is a critically important component of impact assessments of climate change on the Maltese agriculture. Scientific literature includes the following range of possible outcomes:

- elevated CO_2 concentration may also increase weed growth;
- livestock pests and pathogens found on the southern shores of the basin may shift northward;
- warmer winters may increase the range and severity of insect and disease infestations;
- longer and warmer summers may cause more frequent outbreaks of pests;
- pathogen development rate and host resistance may change;
- competitive interactions between weeds and crops may be affected.

The relationships between elevated atmospheric CO_2 concentrations, warmer temperatures, and pest species are complex. Invasive species are extremely adaptable and also tend to have rapid dispersal characteristics which allow them to shift quickly in response to changing climates and establish dominance. Literature indicates that climate change could depress the efficacy of pesticide and herbicide, necessitating heavier and more frequent applications, with potential threats to non-target organisms and increased risk of water pollution as well as increased associated costs.

06.1.6 Internal Markets

Presently, local farmers are operating within a market that is highly competitive, to the extent that they are finding it increasingly difficult to compete with the imported products. This, to some degree, is a result of past inward-oriented policy with which domestic supplies were secured to the maximum possible extent. As a result of the protection provided, the sector did not develop a sophisticated marketing approach. In many cases, farmers market their produce individually rather than collectively, and thereby limiting their ability to receive a higher return from the market.

There is a heavy dependence on traditional wholesale markets and little effort to identify and market produce through new marketing channels. This is mainly a result of poor collaboration between farmers and other stakeholders in the sector. As a consequence of climate change, traditional crop types, yields and the harvest season may change having a corresponding impact on the supply at the local market level.

06.1.7 Economic Impacts

Assessing the economic impacts of climate change on agriculture generally involves the use of a variety of tools, including climate, as well as crop and economic models. Each step in the modelling process requires that assumptions be made. On a general level the economic impacts of climate change are expected to mirror the biophysical impacts relating economic returns as a function of yield. It must be noted, however, that most economic impact assessments do not make allowance for the inclusion of factors such as the frequency and severity of extreme events.

The sensitivity of agriculture to extreme events suggests that overall economic losses could be more severe than commonly projected. At EU level, the effects of technology and farm management improvements and the continuous adaptation of farming practices have so far largely outweighed the impact of climate change. However, the variability of crop yields has increased as a result of extremes. In addition to disrupting annual production, climate extremes can severely affect farm infrastructure causing further major economic losses.

Forecasts of climate change impacts on agricultural prices are uncertain, nonetheless it is expected that the increase in extreme events will have consequences on the volatility of production. Traditionally, impacts on farm income depended on the interplay of many factors such as the global market and policy support. However, the higher likelihood of failures in production may lead to increasing instability in the economic situation of farmers affected by extreme climate events. International markets will also play a significant role in determining the economic impacts of climate change on the Maltese agricultural sector.

In fact, changes in other countries could have a substantial and significant influence on our agricultural system at large. Quantitative studies of these issues are presently lacking. Economic impact studies have to acknowledge the impacts on specific farm types and also consider the effects of climate change on the procurement of agricultural commodities from third countries.

Over the coming decades Maltese agriculture will be influenced by the effects of climate change at a local level, regional Mediterranean scale, within the larger EU dimension and globally. Local farmers will need to define their strategies for production, farm management and investment in the face of increasing uncertainty. Socio-economic factors, international competition, technological development, as well as policy choices will determine the impact that agro-climatic changes will have on the agricultural sector.

As farmers manage the majority of land in Malta, the Common Agricultural Policy (CAP) could have a huge role to play in facilitating adaptation to the changing conditions by helping farmers to adapt their production. Moreover, the White Paper on Adaption to Climate Change'[139], lays out a European framework for action to improve Europe's resilience to climate change, emphasizing the need to integrate adaptation into all key European policies and enhance co-operation at all levels of governance. It aims at engaging Member States and the farming community into a debate and into taking action on adaptation needs that result from climate pressures.

06.1.8 Agricultural Policies

Programmes and policies, such as financial incentives, research support, trade controls and crop insurance regulations, at the local and European level significantly influence agricultural practices. Programmes and policies may act to either promote or hinder adaptation to climate change. Protectionism, for example, may tend to decrease the propensity of farmers to adapt. For the past fifty years, Maltese agricultural activity survived as a result of a series of protective measures aimed at encouraging production by ensuring a regular income flow for local farmers and animal breeders through a system of price guarantees and quota restrictions on imports.

There were practically few incentives for active full-time farmers to rationalise production through the constant upgrading of plant and produce and through a consumer-orientated system of product selection and distribution. The present land tenure system, which was originally intended to protect farmers and cultivation, is actually proving to be a heavy deterrent to genuine new farming entrants.

The cheap prices at which agriculture land is rented encourages both the tenants and private landowners to hold on to their land. On the other hand, the exorbitantly high prices for agricultural land, precludes potential entrepreneurs from acquiring their own land for agricultural purposes. The land tenure system is further complicated by the fact that land use and rent policies are the remit of other ministries other than the MRRA which act independently of agricultural policy.

Policies designed to promote climate change adaptation in the agricultural sector must recognize the dynamic nature of both the biophysical and social systems in agriculture. There is a need for designating responsibility for action, as adaptation occurs at many levels. A general goal of policy development should be to increase the flexibility of agricultural systems and halt trends that will constrain climate change adaptation. ‘No-regrets’ measures that improve agricultural efficiency and sustainability, regardless of climate change impacts, should also be encouraged.

[139] White Paper on Adaptation, *supra*.

06.1.9 Producers' Attitudes

Maltese rural actors have demonstrated their ability to adapt to changes in climate and other factors in the past, and they will continue to adapt in the future. However, the key question for the agriculture sector is whether adaptation will be predominantly planned or reactive. The answer appears to depend largely on the background, attitudes and actions of individual producers. A particular characteristic of the Maltese agricultural labour force is an aging farming population, whereby, for every farmer under the age of 35, there are 10 farmers of 55 years or above.

This trend is expected to continue in the future, as no large influx of young farmers is expected. Very often, farmers acted on their own initiative and marketed their produce individually rather than collectively, thereby limiting their ability to reap higher return from the market. In various cases, farming is not perceived as a full-time occupation but rather part-time activity. Furthermore, the skill base is mainly derived from practical experience passed on from father to son or gathered on the field and through peers. Only 3.8% are exposed to some form of training. The copy-cat attitude prevails even when practices are not amiable to the local characteristics, and there is little knowledge of the spin-off effects of certain agricultural practices.

This situation demands correction as its implications are various even within the context of climate change adaptation. Producers have, in general, little concern regarding climate change. Their tendency is to be more concerned with present day political and economic factors, the primary influences on producer decision making. This suggests that climate change adaptation measures taken by producers will be incidental to other adaptations, when adaptation should be viewed as one element of an overall risk management strategy.

06.1.10 Rural Socio-economic Consideration

Figures for 2007 establishes the UAA at 10254 hectares shared amongst 11071holdings resulting in an average holding size of 0.9424 hectares[140]. The situation is compounded further by the nesting of problems of ownership, fragmentation, and tenancy rights. According to the latest Agriculture Census of 2001[141], 80.4% of the agricultural land area cultivated is rented, with only 19.5% being occupied by the farmer that owns it. Land fragmentation very often leads to problems in relation to access roads, water share, agricultural investment and tenancy rights.

The extent of this reality is revealed by the number of parcels registered in the Land Parcel Information System (LPIS) which has by now reached 94,000 parcels. The fact that other sectors provide more appealing employment possibilities, has meant that parcels are being utilised not for commercial agriculture but more for gardening by approaching agriculture more as a hobby and with tenants using the holdings as a weekend retreats.

The Maltese food manufacturing sector is characterised by a large number of micro enterprises. These small firms are characterised by a number of features, including: high level of motivation, high degree of flexibility and adaptability to sudden changes, a low degree of bureaucratic time wasting, and minimal industrial relations problems. Before promoting adaptation options, however, it is necessary to consider the full range of socio-economic impacts. Since more than 98% of Maltese farms are family owned and operated, the effect that adaptation options to climate change will have on culture and livelihood must also be considered.

06.2 Scenarios of the Maltese Agro-eco Systems

Although the climate change impact on agriculture has been widely studied, adaptation has received little explicit consideration. This is mainly due to the fact that many studies restrict their focus solely on estimating crop yield responses in relation to food supply and security, and essentially completely ignoring completely human decision-making in the sector. While no such studies have been carried

[140] NSO 2008, *supra.*
[141] National Statistics Office, *Census of Agriculture*, 2001, Retrieved from www.nso.gov.mt/statdoc/document_file.aspx?id=2069

out in Malta, conventional, scenario-based studies have addressed adaptation mostly by making assumptions about human responses.

Early impact assessment models are based on the assumption that no adaptations would occur, while later impact assessment models assumed adaptive responses on the part of agricultural producers or the system as a whole with respect to changes in average temperature and moisture conditions. Agricultural adaptation to climatic change includes various elements, such as; plant/plot/field/holding location and employ several different perspectives, including climate change impacts on; natural hazards; European/Maltese agrarian political economy; innovation adoption; agricultural systems and farm decision-making; risk management; and agricultural vulnerability and adaptation. Studies that focus on the role of human element by researching Maltese farmer perceptions, their risk management choices and on how such decisions relate to public policies need to be commissioned.

06.2.1 Natural Hazards

Rural areas are exposed to a wide range of impacts from climatic variations beyond those directly affecting agriculture. Natural hazards that could also affect agriculture are the likely result of year-to-year variability and the frequency and magnitude of extreme climatic events manifested as an increased risk of flooding as well as risks of damage to infrastructure in such eventualities due to other extreme events. Adaptation will involve the interactions of humans with the environment as well as the adjustments called for because of these calamities.

Given our reality, characterised by land that is practically suffocated with far too many occupants and far too small, fragmented parcels of land, it is of the utmost importance to define the Maltese agro-eco system and the perceptions of hazard risk by those impacted and thus allow for the understanding of how rural society will cope with strategies and adjustments. In proposing actions to counteract natural hazards, the question of how the rural actors perceive the risks has to be addressed. What's more the fact that adaptation is directly related to the perception of risks and involves conscious (planned) decision-making has to be well understood.

The vulnerability of Maltese soils to erosion by both water and wind had long been recognised as having prompted early human settlers to resort to the typical terrace landscape to capture and reduce soil and water loss. Centuries of farming activity have contributed immensely to the shaping of the rural landscape and the environmental character manifested in the extensive terracing characterised by small-sized and fragmented agricultural land supporting a rich diversity of semi-natural habitats. The rubble walls perform a number of functions by namely: retaining naturally evolved soil, acting as ramparts behind which man made soil accumulates slowly to form artificial fields, and as part of a larger technological structure involved in rain water management and harvesting.

Adaptation to extreme climatic conditions has to focus on reducing the potential negative impact they may have on the general Maltese agro-eco systems. Minimising run-off soil erosion in times of torrential downpours and maximising rain water harvesting and storage capacity to ease off periods of drought should be a priority. Concurrently, protected cropping has to develop and adopt techniques and materials capable of withstanding the harshness of the forecasted calamity.

06.2.2 Agricultural Policy Contributing to Adaptation

The part played by government policies, institutional arrangements, and macro-level social and economic conditions institutions and other macro-level forces in the agri-food sector is essential to promote rural and agricultural change. The effectiveness of government policies in Maltese agriculture has often been criticised because the objectives behind these policies were considered to be too ambitious and often led to negative side-effects.

Various authorities have, in fact, indicated that one of the principal reasons for this sector's past inability to meet its objectives relates more to the somewhat misguided objectives behind these policies and to the way these policies were implemented, rather than to poor performance of the sector. Programmes and policies at the local and European level significantly influence agricultural practices and thus may act to either promote or hinder adaptation to climate change. As already stated, protectionism may tend to decrease the propensity of farmers to adapt.

The key objectives of the Common Agriculture Policy (CAP) for the adaptation for EU agriculture are to ensure resilience to climatic variations, socio-economic viability of agriculture and rural areas, and coherence with environmental protection objectives. The present CAP provides a basic level of income security, irrespective of production, enabling farmers to respond to external requirements, to market signals as well as to developments resulting from climate change. The rural development policy offers a range of measures through which targeted support could be provided to activities that contribute to adaptation to climatic changes.

Policies designed to promote climate change adaptation in the agricultural sector must recognize the dynamic nature of both the biophysical and social systems in agriculture. A general goal of policy development should be to increase the flexibility of agricultural systems and halt trends that will constrain climate change adaptation. The challenge and opportunity for the EU and its Member States in the period up to the end of 2013, is to make the best possible use of the available CAP tools available to support adaptation. 'No-regrets' measures that improve agricultural efficiency and sustainability, regardless of climate change impacts, should be encouraged.

06.2.3 Innovation

The adoption of technological innovations in agriculture is one of the most frequently advocated strategies for adaptation in agriculture to climate change in the sector. Innovation adoption research provides insights into the decision-making process by which adaptations are implemented by producers and diffused among farming communities. Studies in this field focus on the characteristics of producers that influence their decisions about adaptation measures. Malta ranked rather low in innovation and knowledge transfer at the Lisbon Review of 2006[142], classifying the 19th place out of 25 Member States. There is, however, a strong national drive to ameliorate in this respect. The National Strategic Plan for Research and Innovation for 2007-2010[143], outlines national priorities and courses of action that should lead to significant improvements in the innovative capacity of the country.

Innovation adoption is a multi-faceted decision-making process where factors such as attitudes, values, motivations, and perceptions of risk all come into a complex play to distinguish between producers who are 'innovators' and those who are 'laggards'. Keeping in mind that the Maltese rural population is ageing (75% over 55 years), huge efforts have to be invested into supporting and prompting the local research community to develop innovation and to work together with the rural stakeholders.

Most rural actors have a copycat attitude and are very willing, on a voluntary and individual solitary basis, replicate in a discreet way their neighbour's initiatives. Other factors such as profitability, complexity and compatibility distinguish between innovations that are quickly up-taken and those that are not widely employed.

06.2.4 Maltese Agricultural System and Farm Decision Making

Observations of agriculture in the Maltese Islands suggest that farming systems changed at varying rates over time in response not only to natural conditions, but also to a wide range of production factors related to availability of land, labour, input materials, and the prevailing market situation. While other natural factors, geology, topography, climate, and soil types provided the basis for land utilisation, the cumulative results of long continued action plus the interaction of historical, political, economic, and technological factors, not only influenced the changing patterns of land use, but dominated over factors of production.

Adaptive decisions are not likely to be made in the light of the climatic conditions or risks alone, but are invariably driven by the joint effects of multiple forces. Such decisions are likely to be made as part of on-going risk management. Adaptation of agronomic techniques and farm strategies has been

[142] World Economic Forum, *The Lisbon Review,* 2006, Retrieved from http://www.weforum.org/pdf/gcr/lisbonreview/report2006.pdf

[143] Malta Council for Science and Technology, *The National Strategic Plan for Research and Innovation*, 2006, Retrieved from http://www.mcst.gov.mt/page.aspx?id=48, hereinafter National Research Strategy.

happening for centuries in Malta and has been important in shaping the rural landscape and the environmental character of the islands. Today, agriculture remains a major contributor in maintaining the quality of the landscape exhibiting multiple functions and values beyond its economic contribution. In the coming decades, however, the magnitude of climatic changes may exceed the adaptation capacity of many farmers.

The Maltese agricultural system is somewhat unique due to a number of structural constraints. The most obvious of these is the prohibitive cost of land due to land scarcity, further compounded by fragmentation, tenure issues, ownership and poor soil quality. The second constraint is the lack of fresh water reserves, resulting in the farming community tapping all water aquifers for irrigation. Both these handicaps have driven the evolution of a highly intensive type of husbandry. Malta is considered as being self-sufficient in fresh vegetables, potatoes and processed tomatoes. It is also classified as having the capacity to transform imported grains into animal products to satisfy the demand for eggs, poultry meat, rabbit meat, pork, and dairy milk. Agriculture accounts for 47.8% of the total territory contributing 2.4% of the total GVA generated by the Maltese economy.

The Maltese agro-eco system is inherently sensitive to climate conditions. Adaptation is certainly an important consideration without which climate change will be problematic for agricultural production and the environment. Through adaptation, vulnerability from the exposure to adverse climate impacts and on the socio-economic context can be reduced. Existing agro-ecological conditions, and the experience in dealing with changing conditions, influence farmers' adaptive capacity. Awareness of vulnerability recognises the pertinent climatic conditions to which the Maltese agricultural systems is sensitive and provide insights into the conditions under which adaptive decision might be made. Socio-economic factors which will influence the farmers' decisions include:

- farm characteristics such as production type, size of the holding and parcel numbers, and the level of intensity of production;

- diversity of cropping and livestock systems, and of the farm supplementary income;

- access to relevant information, skills and knowledge about climate trends and adaptive solutions as well as to the role played by advisory services in facilitating adaptation;

- access to available technology and infrastructure capacity.

The uneven effects of climatic changes are expected to amplify regional differences and exacerbate economic disparities. The Maltese agricultural production systems are characterised as a complex system within which changes are driven, not just by the local scenario of the joint effects of economic, environmental, political and social forces, but, since it is highly dependent on imports, also by any slight offshore movements has local repercussions on the local sector.

While little can be done to influence external non-domestic forces, local decision-makers should manage and facilitate the evolution of a more efficient economically viable local agricultural system. In the long run, climatic pressures may lead to further marginalisation of this sector or even to the abandonment of agricultural land significantly affecting the Maltese landscapes and biodiversity. In this sense, adaptation will be the result of individual decisions influenced by forces internal to the rural household as well as the external forces that affect the agricultural system at large.

06.2.5 Risk Management

Climate change, including variability and extremes, is a pervasive source of risk to agriculture. Risk management has to recognize that decisions in agriculture involve both risk assessment and specific actions taken to reduce, hedge, transfer or mitigate risk.

Adaptation within this field is often considered a response to financial risk in agriculture. In order to remedy risk management, farmers have to be encouraged in uniting within cooperatives or producer organisations (PO) and these organisations have to be sufficiently supported to modulate market forces. To achieve this, the support given to these cooperatives and organisations needs to address issues of training, planning and optimisation of output.

Concurrently, efforts have to be invested in ameliorating the general lack of the managerial capacity, especially in terms of qualified and suitable human resources to empower the management structure of the cooperatives and producer organisations. The importance of creating specific professional figures, both at management and administration level, could drastically in the improvement of activities.

06.3 Characteristics of Adaptation Responses

Adaptation of the agriculture sector is an important component of climate change impact and vulnerability assessment, and is one of the policy options in response to these impacts. Studies have identified risks and have noted needs for planned measures of adaptation. While adaptation is generally perceived as instigated by, and associated with, government policy, the contribution of decision-making by agri-business, and more specifically by the producers at the farm-level, has to be recognised.

While adaptation within the sector is an ongoing process, the extent of adaptation varies with respect to type and severity of climatic stimuli and according to the differing farm types and locations. Malta, like many other countries, recognises adaptation as an important component of its climate change response strategy. Adaptation has the potential to encompass a variety of measures and/or actions, all of which have distinguished characteristics, amongst which, are intent and purposefulness, timing and duration, scale and responsibility, and form.

Intent and purposefulness differentiate between measures of adaptation that are undertaken spontaneously, or autonomously, or as part of on-going management, as against those that are consciously and specifically planned. Public sector measures of adaptation usually consist of consciously planned strategies, whereas private sector and individual adaptations can be autonomous, planned or a combination of the two. The timing of adaptation measures differentiates between responses that are anticipatory, concurrent, or responsive. The duration of adaptation measures distinguishes responses according to the time frame over which they apply, such as shorter-term versus longer-term.

Adaptation responses occur at a variety of spatial scales, including plant/plot/field/farm/holding, region, and national. At the same time, responsibility can be differentiated among the various actors that undertake or facilitate adaptation responses including, individual producers (farmers), agri-business (private industries), and governments (public agencies).

However, most discussions of adaptation do not distinguish between the roles of different decision-makers. Any realistic assessment of adaptation options needs to systematically consider the roles of the various stakeholders. Adaptation in agriculture occurs via a variety of processes and can take many different forms at any given scale or with respect to any given stakeholder and may differ according to their administrative, financial, institutional, legal, managerial, organisational, political, practical, structural, and technological characteristics. Forms of adaptation at the farm-level include modification of resource management, purchasing crop insurance, and diversification. Forms of policy-level adaptation responses include aid for research and development, incentive strategies, and infrastructure measures.

Potential agricultural adaptation options could encompass a wide range of type (technical, financial, managerial), scales (national, EU) and participants (government, local councils, local action groups, agro-industries, farmers). Most options represent possible or potential adaptation measures, rather than ones actually adopted. It is imperative to understand the Maltese realities and comprehend what types and forms of adaptation are possible, feasible and likely; who would be involved in their implementation; and what is required to facilitate or encourage their development or adoption. A necessary first step in addressing these concerns is the identification and characterisation of adaptation options in agriculture.

To assess the vulnerability of agriculture to climate change, it is necessary to consider the role of adaptation. Appropriate adaptation responses can greatly reduce the magnitude of the impacts of climate change. Assessment of adaptation options must consider six key questions:

- to what climate variables is Maltese agriculture most sensitive to?;
- who needs to adapt (for example, producers, consumers, industry)?;
- which adaptation options are worth promoting or undertaking?;
- what is the likelihood that the adaptation response would be implemented?;
- who will bear the financial costs?;
- how will the adaptation response affect culture and livelihoods?.

06.4 Agro-Eco System Services

Taking into account the projected impacts of climate change on the hydrological cycle, as well as on habitats and biodiversity, the maintenance of Maltese agro-ecosystems through the management of agricultural landscapes has a central role to play in contributing to overall resilience to climate change.

Given the high degree of complexity intrinsic to the Maltese ecosystems, which dovetails into spaces devoted to husbandry, agriculture can assist in the protection of habitats and biodiversity as well as in the maintenance and restoration of the Maltese multifunctional landscapes. Conservation of indigenous species and the facilitation of migration of species can be assisted by establishing networks of wildlife corridors across agricultural land.

The potential role of agriculture in providing such 'green infrastructure' has already been recognised and defined in the Rural Development Plans[144] and is in line with efforts to promote organic agriculture and even more so in supporting the initiative to develop Gozo into an ecological island, the ECO GOZO concept.

Current agri-environmental measures under Axis 2 of the Rural Development Plan contribute to this objective, but may not sufficiently enhance connectivity between areas protecting biodiversity. In this context, the applicability of rural development measures on a territorial scale, also through the involvement of Local Action Groups, beyond the level of individual farms, and involving local Action Groups, could be considered to help successful adaptation.

Recommendation 54

The Climate Change Committee for Adaptation recommends that serious consideration is given to the maintenance of Maltese agro-ecosystems through the management of agricultural landscapes since this has a central role to play in contributing to overall resilience to climate change.

06.5 Enhancing Agricultural Infrastructure

Agriculture as a production system is dependent on fixed assets and infrastructure, which can be impacted by extreme events. The potential economic losses triggered by such events can become a serious concern to the sector, in particular since the value of fixed assets tends to be significant compared to the average annual output and farm income.

Of further relevance is the fact that two thirds of the Maltese territory, the fixed asset with the largest value, belongs to the state dampening the propensity of individual producers to invest in fixed infrastructures.

[144] For further information relating to Malta's Rural Development Plans consult http://www.agric.gov.mt/rural-development?l=1

Serious considerations has to be given to the idea of introducing a system that would encourage new, young entrants into agriculture, by giving them access to land to which they can claim ownership. This would involve drastic changes in tenancy law and in the privatisation of state-owned arable land for the redistribution into units of economic viability. It is essential to development instruments tailored to rectify the existing local situation is essential.

Recommendation 55

The Climate Change Committee for Adaptation recommends that serious considerations should be given to introducing a system that encourages new young entrants into agriculture by giving them access to land to which they can claim ownership.

06.6 Synergies Between Adaptation and Mitigation

Agricultural activity can contribute to climate change mitigation by reducing its emissions, through the production of renewable energies and bio-products, and by storing and accumulating carbon in soils.

Synergies between adaptation and mitigation have to be adopted in addressing the double challenge of reducing GHG emissions as well as coping with the changing climate as much as possible. Measures that provide co-benefits in terms of reducing emissions and increasing resilience have been identified in the Code of Good Agricultural Practices (CoGAP)[145] for the Maltese Islands and in the Code for Good Agricultural and Environmental Conditions (GAEC)[146].

These measures need to be promoted, encouraged and implemented. Possible conflicts between objectives should be considered when deciding upon appropriate measures, and trade-offs may in some cases be necessary. Malta could make use of rural development funds to implement these measures.

Recommendation 56

The Climate Change Committee for Adaptation recommends that synergy should be sought that would vitalise agricultural activity since this can contribute to climate change mitigation by reducing its emissions, through the production of renewable energies and bio-products, and by storing and accumulating carbon in soils.

06.7 Adaptive Capacity of Rural Actors

Enhancing the adaptive capacity of farmers is a necessary condition for sustaining adaptation in agriculture. In tandem with the above, given that 75% of the farmers are over 55 years of age, new blood has to be attracted into the sector, Tenancy rights are inherited in a similar manner to ownership and without obligation of informing the landlord. Land, whether, government or privately owned, is normally automatically re-let to the existing tenant or his/her descendants in accordance with the Agricultural Leases (Re-letting) Act[147].

Drawn up in 1967, this law effectively impedes the eviction of tenants or any substantial increases of the rent, even in the case of privately owned land. Given the cheap rates at which land is rented, both the tenants and private landowners tend to hold on to their land, resulting in a dire shortage of land on which young farmers can set up an agricultural activity. Moreover, this attitude of land banking is being reinforced as a result of strong land speculation experienced over the last years. The exorbitantly high land prices for agricultural land preclude potential entrepreneurs from acquiring their own land for agricultural purposes.

[145] MRRA, *Code of Good Agricultural Practices*, 2004.
[146] *MRRA* and MEPA*, Code for Good Agricultural and Environmental Conditions,* 2005.
[147] Agricultural Leases (Reletting), 1967, Chapter 199 of the Laws of Malta, Act XVI, as amended.

Thus, the present land tenure system, which is meant to protect farmers and cultivation, is actually proving to be a heavy deterrent to genuine new farming entrants. The land tenure system is further complicated by the fact that land use and rent policies are the remit of other Ministries other than MRRA, which act independently of agricultural policy. Only when the new generation of farmers is facilitated entry into the sector, will the agricultural sector fully reap and capitalise on the potential benefits of any adaptation initiatives.

Strengthening information and advisory support on climate-related matters to farmers and agricultural workers is essential to foster motivation and preparedness to adapt. Various means could be made available to players operating in this sector such as sector-related courses, specialised press, and the use of communication technologies. It is also important to include climate change into the educational programmes for young farmers, farm workers and apprentices. Farm advisory services could be developed so that they become an instrument for disseminating regionally-specific information and practical adaptive solutions, enhancing farmers' skills to respond to future changes. Given that the majority of rural actors are over 55 years of age, very little self-generated interest can be expected from this group.

The measures adopted in the framework of the CAP 'Health Check' provide additional possibilities, within the rural development policy, for funding dissemination and training programmes, and for using farm advisory services.

Recommendation 57

The Climate Change Committee for Adaptation recommends that the strengthening of information and advisory support on climate-related matters to farmers and agricultural workers which is considered as essential for nurturing motivation and preparedness to adapt.

06.8 Co-operation

Although the Maltese agricultural sector has operated on the basis of the co-operative philosophy and legal framework for the past 60 years, the general tendency is that members of rural society operate more on an individualistic basis rather then on a collective one. Notwithstanding the fact that most fruit and vegetable producers are members of co-operatives, they market their produce individually rather than collectively.

Due to land fragmentation, small holdings, and limited production, local farmers usually grow a variety of crops, both to ensure their independence from the prevailing market conditions on which they have little control, as well as to provide a limited form of insurance against the vagaries of climate, disease, and pests. To date a total of 1011 producers, or just under 6% of the total number of farmers, are members of producers organisations.

The lack of collectivistic mentality may stem from the fact that in general; agricultural organisations lack technical expertise, marketing strategies and policies, and have low level of investment and innovation resulting in weak support and lack of loyalty by the members themselves and lack of loyalty. Individualism is evident horizontally across most sectors. Government recognises the existing structural deficiencies and as a remedy supports newly set up producer groups for five years from their formation in terms of the European Agricultural Fund for Rural Development (EAFRD) measures. Each producer organisation receives support on the basis of its annual marketed production at the specified rates. Continuous encouragement to prompt the coming together of rural actors has to persist.

Development of regional and national programmes and policy thinking on climate change adaptation need to be encouraged. Exchanging approaches, experience, and best practices in respect of adaptation options in the agricultural sector between the Mediterranean countries and EU Member States can help advance those farming practices and production systems, which are best lend themselves to adaptation in the face of expected climatic developments.

Recommendation 58

The Climate Change Committee for Adaptation recommends that current government measures directed to prompt rural actors to come together should continue to receive strong support.

06.9 Enhancing Research on Climate and Agriculture

Climate change was identified as a priority area by the Standing Committee on Agricultural Research (SCAR)[148], which recognised a significant gap in the coordination of research at the European level. Adaptation planning in Maltese agriculture cannot rely solely on knowledge about global climate patterns, but needs detailed information on regional and local impacts and a meaningful assessment of the adaptation options and their feasibility at the local and farm level.

Research is needed to assess how climate change affects Maltese agriculture, and how agriculture can suitably adapt to and mitigate these effects. In addition, since rural areas are characterised by economic multifunctionality, an integrated understanding of the impacts of climate change on rural economies and societies is important. Socio-economic research on the climate challenge and its impact on rural sustainability could thus be enhanced.

Agricultural research needs not only to address the introduction of new crops, varieties, and herds, which are more likely to lend themselves better to adaptation to future conditions, but also to invest huge efforts in the genetic recuperation of our local genotypes. Mitigation will also need to be supported by research efforts to further develop suitable and affordable technology and innovation. A critical element is called for to integrate findings from the physical and agronomic sciences with local knowledge from farmers, so as to develop robust adaptation strategies, which, over a range of climate and socio-economic scenarios, can minimise the negative impacts of climate change. The Farm Advisory System can also prove itself an important tool also in this regard.

Equally important is the need to strengthen the capacity of the research institutions to make use of appropriate tools to address climatic changes. The Institute of Agriculture of the University of Malta has been identified in The National Strategic Plan for Research[149] as being the entity responsible for research in agriculture. It needs to be further supported through financial resources and also provided with an adequately equipped research farm. Partnerships between national and regional research institutions, advisory services, and social partners in agriculture, as well as setting up of regional (Mediterranean and European) networks, would provide information to farm communities that will help in the design of adequate site-specific strategies.

Recommendation 59

The Climate Change Committee for Adaptation recommends strong support for research that is needed to assess how climate change affects Maltese agriculture and how agriculture can suitably adapt to and mitigate these effects, and that the Institute of Agriculture of the University of Malta should be supported in this regard.

06.10 Vulnerability Indicators

Specific indicators for Maltese agriculture, such as an index for adaptive capacity and vulnerability, have to be established. The identification of vulnerability has to be carried out at a low spatial scale, on the basis of current sensibility to climate variability and natural hazards, as well as scenarios of changes in weather patterns.

[148] established by Regulation (EEC) No. 1728/74 of the Council of 27 June 1974 on the coordination of agricultural research.
[149] National Research Strategy, *supra.*

Building a vulnerability indicator scheme, including the aspect of adaptive capacity, will require a multi-dimensional approach combining climatic, environmental, and socio-economic factors.

Recommendation 60

The Climate Change Committee for Adaptation recommends that specific indicators for Maltese agriculture, such as an index for adaptive capacity and vulnerability, have to be established whereby the identification of vulnerability has to be carried out at a low spatial scale, on the basis of current sensibility to climate variability and natural hazards, as well as scenarios of changes in weather patterns.

06.11 Types of Adaptation Options in Agriculture

Adaptation is being defined as being the 'adjustments in ecological-social-economic systems in response to actual or expected climatic stimuli, their effects or impacts'[150]. Consequently, the types of adaptation measures needed are activities that represent changes in some attribute of the agricultural system directly related to reducing vulnerability to climate change.

While the most popular reaction by governments is to initiate a campaign to provide information on climate change and its potential impacts and thus improve general awareness or prompt consideration of adaptations, this, in itself, does not lead to direct changes in this respect. Nonetheless, the dissemination of information can promote adaptation responses and it may be a necessary precursor to taking up adaptation measures. This is especially important given the role of the farmer's perception in the adaptation process. However, while the provision and dissemination of information and training are important elements in encouraging adaptation, they are not specific agricultural adaptations in their own right.

Much of the adaptation research in agriculture has focused on water shortages. Common suggestions for addressing water-related concerns include improving irrigation systems and adjusting the selection of planting dates and cultivars to allow for earlier planting and harvesting dates. Water conservation measures are also important adaptation mechanisms.

Recommendation 61

The Climate Change Committee for Adaptation recommends that, in an effort to counter water shortages, incentives should be made available to the agricultural community to build or re-active water catchment systems as well as improve irrigation systems.

Local breeds and varieties, together with new species and hybrids could play an important role in agricultural adaptation. Introduction of new heat, drought, and pest-resistant crop varieties is a frequently recommended adaptation option. Improving the adaptability of agricultural species to climate and pests, together with the potential role of biotechnology and soil organisms in enhancing the resilience of soils and plants, should be a priority research area. The fruit tree sector may benefit from the introduction of new cultivars and species, while a longer growing season may allow new fruit varieties, such as the date palm tree, to be grown.

Recommendation 62

The Climate Change Committee for Adaptation recommends that local breeds and varieties together with new species and hybrids could play an important role in agricultural adaptation.

150 Interngovernmental Panel on Climate Change, *Third Assessment Report: Climate Change*, 2001.

Maintaining livestock production would require modifying facilities to reduce heat stress on animals while using the best understanding of the chronic and acute stresses that livestock will encounter to determine the optimal modification strategy. Some simple adaptation measures may include adjusting shading and air conditioning and the use of sprinklers to cool livestock during excessive summer heat, although these options may lead to incur considerable expense for the operator. The re integration of indigenous breeds and the introduction of new breeds and/or species may also play a significant role in reducing climate change impacts on livestock.

Recommendation 63

The Climate Change Committee for Adaptation recommends that maintaining livestock production would require modifying facilities to reduce heat stress on animals while using the best understanding of the chronic and acute stresses that livestock will encounter to determine the optimal modification strategy. The Government should incentivise simple adaptation measures, such as adjustment of shading and air conditioning, and the use of sprinklers to cool livestock during excessive summer heat.

Changing livestock species as part of an adaptation strategy is a much more extreme, high-risk, and, in most cases, high-cost option than changing crop varieties. Accurate predictions of climate trends and development of the infrastructure and market for the new livestock products are essential to making this an effective response.

It is noteworthy that none of these actions is likely to prove effective in mitigating the impacts of extreme climate events. Sound land management practices are essential for soil conservation, which, together with flexibility regarding land use, will help minimise the impacts of climate change on agricultural soils. Long term management strategies that increase soil organic matter, resulting in a soil that has a high nutrient content and strong water-holding capacity, also renders the land better able to cope with future climatic changes.

Recommendation 64

The Climate Change Committee for Adaptation recommends that the Government should encourage the farming community to adopt sound land management practices which are essential for soil conservation and which, together with flexibility regarding land use, will help minimise the impacts of climate change on agricultural soils. The Government should also encourage the farming community to embark on long-term management strategies that increase soil organic matter, resulting in a soil which has a high nutrient content and strong water-holding capacity, which renders the land better able to cope with future climatic changes.

Literature indicates that adaptation options for agriculture may be grouped into four main categories that are not necessarily mutually exclusive: (i) technological developments, (ii) government programmes and insurance, (iii) farm production practices, and (iv) farm financial management.

The first two categories are the responsibility of public agencies and agri-business, while the last two mainly involve farm-level decision-making by producers. Some categories may also be interdependent. These adaptation measures could be implemented by a number of different groups, including individual producers, government organisations, and the agri-food industry. However, since each group may have differing interests and priorities which may at times conflict with those of other groups, it is imperative, that, before determining which adaptation options should be promoted or implemented, they should be carefully and thoroughly assessed.

06.11.1 Technological Developments

Technological adaptation measures are to be developed through research programmes undertaken or sponsored by EU, local government, or through research and development programmes undertaken

by private sector industries. The following are some of the technological adaptation measures that could be developed and introduced in the agriculture sector:

Crops:

- development of a seed bank to conserve, maintain and propagate seeds of indigenous plant and crop varieties that are generally more tolerant to temperature, moisture and other relevant arid climatic conditions. Locally grown fresh fruit and vegetables should, as much as possible be of the local type, not only to capitalise on their acclimatised nature, but also to give an identity and help raise the profile of Maltese gastronomy;

- adoption and/or development of new crop varieties, including hybrids, to increase the tolerance and suitability of plants to temperature, moisture and other relevant Mediterranean climatic conditions.

Livestock:

- genetic recuperation to conserve, maintain and propagate local livestock breeds adapted to the arid climatic conditions;

- development of appropriate housing facilities that mitigate temperature extremes utilising green technologies;

- development of appropriate rations based on diets containing locally available ingredients, thereby also giving an identity to Maltese animal products;

- determination of the Islands carrying capacity of the type and herd numbers of the different livestock that would best thrive under the forecasted climatic conditions as well as be least dependant on imported fodder.

Weather and climate information systems:

- development of early warning systems that provide daily weather predictions and seasonal forecasts.

Resource management innovations:

- development of water management innovations, including irrigation infrastructure, rain water harvesting, use of treated sewage effluent and ground water abstraction to address the risk of moisture deficiencies and increase in the frequency of droughts;

- development of soil management innovations to address the risk of moisture deficiencies and increase in the frequency of droughts;

- adoption and popularisation of crop protection technologies utilising closed circuit water systems;

- abandonment of crop varieties that have low profits in comparison to the volume of water utilised;

- development of farm-level resource management innovations to address the risk associated with changing temperature, moisture and other relevant climatic conditions.

06.11.2 Programmes and Insurance

European and local government programmes and insurance are responses to the economic risks associated with climate change and have the potential to influence farm-level risk management strategies. These include agricultural support through the CAP and the rural development programme, private insurance, and resource management.

These following are some of the adaptation measures that can be introduced through European and local government programmes as well as through insurance:

Agricultural support programmes:

- support given to the organisation of the fresh fruit and vegetable sector into well managed and adequately sustained producer organisations;

- increased encouragement to producer organisations to develop crop insurance programmes within their operational programmes to influence risk management strategies with respect to climate-related loss of crop yields;

- provision of rural development measures to influence risk management strategies with respect to climate-related income loss;

- modification of the support and incentive measures to influence production practices and financial management;

- development of schemes to integrate new young adequately trained farmers into the sector.

Income support & farm insurance:

- development of agriculture/cooperative banks and private insurance facilities to reduce climate-related risks to farm-level production, infrastructure, and income.

Resource management programmes:

- development and implementation of policies and programmes to influence farm-level land and water resource use and management practices in the light of changing climate conditions;

- promotion of investment in the sector by developing policies and schemes through which land owners can have access to their land; which encourage land consolidation so as to achieve a feasible holding size; and which ensure that young, adequately trained individuals can obtain access and ownership of land.

06.11.3 Farm Production Practices

Farm production practices involve changes in operational practices, which may be stimulated or informed by government programmes or through initiatives by industry. Agriculture production adaptation measures include farm holding level decisions with respect to production, land use, land topography, irrigation, and the timing of operations. Each measure may include, more specifically and among others, the following considerations:

Production:

- diversification of crop types and varieties, including crop substitution, to address the environmental variations and economic risks associated with climate change;

- diversification of livestock types and varieties to address the environmental variations and economic risks associated with climate change;

- change of the intensification of production to address the environmental variations and economic risks associated with climate change.

Land Use:

- change of the location of crop and livestock production in accordance with the propensity of the land and to address the environmental variations and economic risks associated with climate change;

- modification of cultivation practices to address climate change-related moisture and nutrient deficiencies.

Land topography:

- modification of land topography to address the moisture deficiencies associated with climate change and reduce the risk of erosion during extreme events.

Irrigation:

- implementation of irrigation practices to address the moisture deficiencies associated with climate change and reduce the risk of income loss due to recurring drought.

Timing of operations:

- adaptation of the timing of farm operations to address the changing duration of growing seasons and associated changes in temperature and moisture.

06.11.4 Financial Management

Financial adaptation options are farm-level responses using farm income strategies to reduce the risk of climate-related income loss. Government agricultural support and incentive programmes greatly influence farm financial management decisions. Farm financial adaptation measures involve decisions with respect to crop insurance, income stabilisation programmes, and household income. Financial adaptation measures may include:

Crop insurance:

- participation in producer organisations in order to have access to crop insurance to reduce the risks of climate-related income loss.

Income stabilisation programmes:

- participation in rural development measures aimed at reducing the risk of income loss due to changing climate conditions and variability.

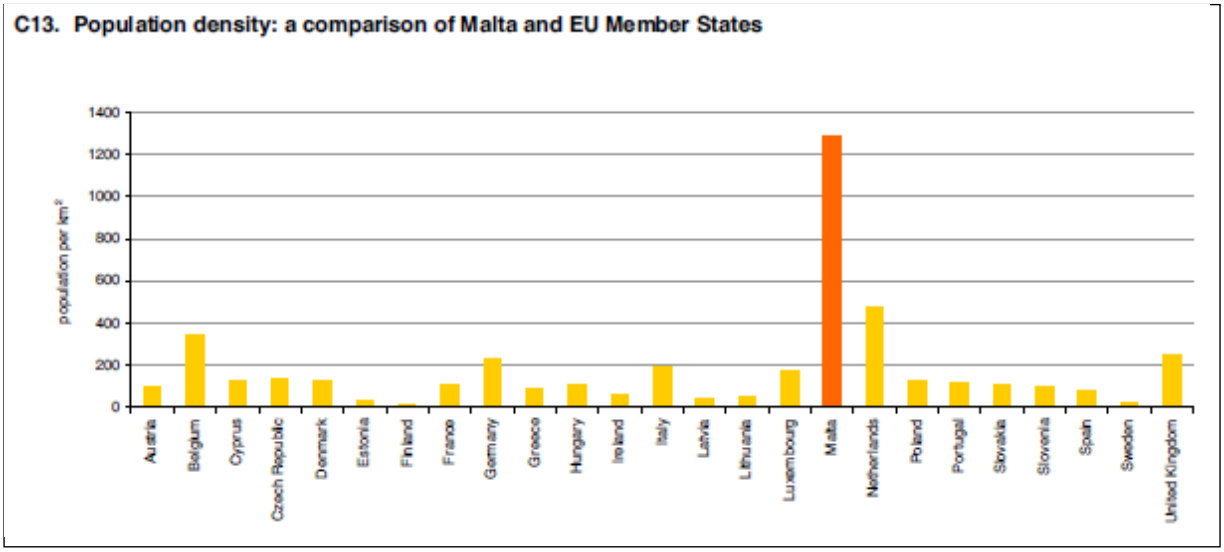
Household income:

- diversification of the sources of household income in order to address the risk of climate-related income loss.

The above typology illustrates the myriad of agricultural adaptation options available to reduce vulnerability to climate change risks. There are many kinds of technological, public policy and farm management options with potential to moderate problematic climate change effects or to realize opportunities. This reinforces the view that the agricultural sector is very adaptable. However, It is also undeniable that the process of adaptation in agriculture itself remains a very challenging and complex issue.

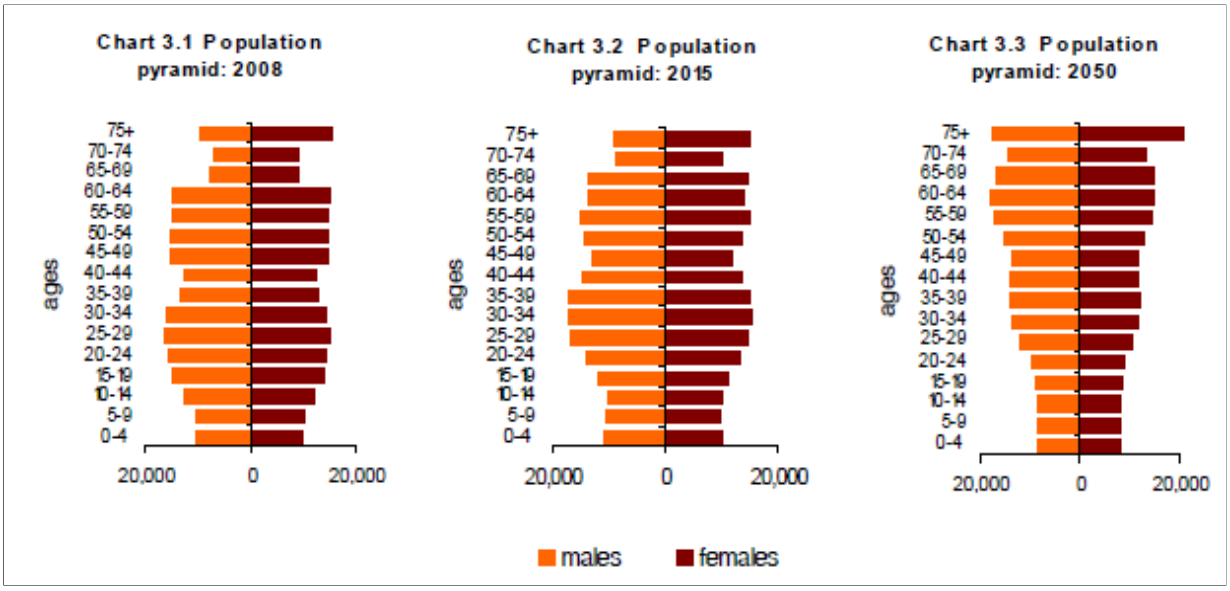
Malta is densely populated. The density of the Maltese population stood at 1,309 persons per square kilometer by end 2008[151]. This is way beyond the average density of the European Union (Fig 5). This high density and the fact that Malta is an island, together with the fact that the Maltese population is ageing (Fig 6), heavily predispose the Maltese islands to the impacts of climate change.

Figure 11: Population density of Malta as compared to other EU member states



Source: National Statistics Office, Census (2005)

Figure 12: Population pyramids for Malta



Source: National Statistics Office, Demographic Review (2008)

However, while the impacts of climate change on the Maltese Islands are and no doubt be, common to those experienced by other countries in the Mediterranean region and by other small island states, the degree to which the health of the Maltese community is affected, however, also depends on socio-economic development and on the vulnerability of the community to climatic changes and events.

[151] National Statistics Office, *Demographic Review*, 2008.

It is well known that those most vulnerable to the effects of climate change are the elderly, very young children, those suffering from chronic cardio-respiratory diseases, the poor, the socially isolated, and those who suffering from mental health conditions.

An ageing population, as is being experienced in Malta and in the rest of Europe, means that Malta will be having a bigger proportion of its population that is vulnerable to future impacts of climate change such as heat waves, floods, infectious diseases, and deteriorating air quality, in the future. While some of these effects could lead to death, as for example injury after a flood or cardiac arrest during a severe heat wave, most of the consequences of climate change on health are expected to manifest themselves in terms of disability, morbidity, hospitalisation and a reduction in the quality of life.

People suffering from cardio-respiratory and mental health conditions are also considered particularly vulnerable to the effects of climate change. Epidemiologically, it is important to note that, today in Malta, cardio-respiratory diseases and mental health conditions are already the cause of considerable morbidity in terms of disability-adjusted life years (DALYs) lost. (Fig 7)[152]

Figure 13: In 2002, Malta was classified under WHO European Region A (i.e. those countries with a very low child and a very low adult mortality)

Disability-adjusted life years (DALYs) by cause, 2002, WHO European Region A, EU and Europe						
	WHO European region A	% of total DALYs lost	EU - DALYs lost (1000s)	% of total DALYs lost	Europe - DALYs lost (1000s)	% of total DALYs lost
Cardiovascular disease	8838	17.1%	11108	18.4%	34418	22.9%
Diabetes	1105	2.1%	1190	2.0%	2193	1.5%
Cancer	8549	16.5%	9078	15.0%	17160	11.4%
Infectious Diseases	891	1.7%	1424	2.4%	5665	3.8%
Neuropsychiatric Disorders	13732	26.5%	14932	24.8%	29349	19.5%
Respiratory Diseases	3406	6.6%	3641	6.0%	6735	4.5%
Digestive Diseases	2414	4.7%	2859	4.7%	7396	4.9%
Musculoskeletal / Non-rheumatic diseases	2197	4.2%	2501	4.1%	5634	3.7%
Injuries	4081	7.9%	5498	9.1%	20945	13.9%
Total	51,725	100.0%	60320	100.0%	150322	100.0%

Source: Data was taken from the European Cardiovascular Disease Statistics 2005 edition.

The Second National Communication of Malta to the UNFCCC[153] was taken as the reference document to project the human health effects of climate change on the Maltese community according to the scenarios projected in the document. The IPCC Fourth Assessment Report[154] was also used to determine projections of climatic phenomena where the Second National Communication data was considered to be insufficient for developing projections.

Since climate change adaptation from a health perspective depends more on the individual climatic phenomena that will be affected, as for example a higher frequency of heat waves or change in ecological habitats of vectors of vector-borne diseases, rather than the overall scenario per degree rise, adaptation to climate change to protect health was discussed on the different trends, observed and projected, of different climatic elements.

[152] Petersen S, Peto V, Rayner M, Leal J, Luengo-Fernandez R and Gray A, *European cardiovascular disease statistics*. British Health Foundation, London. 2005.

[153] SNC, *supra*.
[154] IPCC Report, *supra*.

07.1 Human Health Effects

In order to understand how climate change affects human health, it is important to understand that the effects of climate change are not felt in isolation from other factors such as urbanisation, air pollution, water availability, technology, and appropriate systems, which may or may not affect health independently. To the contrary, climate change normally accentuates already present human health effects or aggravates them. It acts in combination with the other factors and in the absence of adequately present compensatory measures, the contributory effect of climate change may be enough to decompensate systems and lead to adverse human health effects, which sometimes may be profound.

For example, a decrease in annual precipitation on the Maltese islands could possibly be of detriment to human health but, with the availability of reverse osmosis technology and a number of desalination plants that are running effectively and providing the whole country with adequate amounts of potable water, the effect on human health, if present, could be minimal. This does not mean that we should depend entirely on water desalination plants for the provision of potable water since, as pointed out in Chapter 5, such dependence comes at a high cost. It is, however, an indication that, from a provision of water for potable use point of view, in the worst case scenario, Malta can produce enough potable water from desalination.

On the other hand, climate change may compound already present air pollution by contributing to the formation of a powerful respiratory irritant - tropospheric ozone – from other compounds, such as nitrogen oxides and volatile hydrocarbons, that are already pollutants themselves and that aggravate cardio-respiratory conditions. In the absence of the daughter compounds, higher temperatures caused by climate change would have had a negligible effect on the formation of ozone and would not have affected human health in this respect.

Likewise, in the presence of adequate early warning systems and air-conditioning facilities, heat waves, which are becoming more frequent and more intense because of climate change, are less likely to take their toll on human health. It falls directly within the scope of this adaptation strategy to outline ways and empower systems by which the Maltese community would be more resilient and better prepared to meet the effects of climate change.

As a final example, flooding occurrences are not only the result of heavy precipitation, but also the result of urbanisation and built infrastructure. Thus, in the eventuality that heavy precipitation events become more frequent, and in face of the reality that built infrastructure will not be turned back into arable land, solutions have to be found whereby heavy precipitation possibly does not lead to flooding and damage infrastructure; dampening houses; overwhelming a sewage system that is inappropriately linked to the drainage system; and causing injuries, casualties and possibly even death.

07.1.1 Body

In the light of the climate change projections for the Maltese islands, the Maltese community is likely to suffer from a number of human health effects if no corrective action is taken.

Malta is likely to continue experiencing overall higher summer temperatures with more frequent and more intense heat waves. Precipitation patterns are changing and it is expected that overall annual precipitation may decrease by a few percentage points over the coming century, while rainfall will become more sparse but heavier. The sea level rise around the Maltese islands has already been discussed earlier in this Report.

In light of the changing Maltese habitat, globalisation and increasing trade, mosquitoes, insects and other arthropods are changing distribution across the globe, including Europe and also Malta. Some of these arthropods are well-known vectors of infectious diseases such as Dengue fever and Chikungunya fever, and may give rise to outbreaks of disease.

Air quality is a perennial issue with the Maltese islands. The incidence of asthma in children has been shown to have disproportionately increased over these last two decades[155]. In the light of the fact that climate change compounds air pollution, adequate attention should be given to the issue of air pollution when discussing adaptation to climate change.

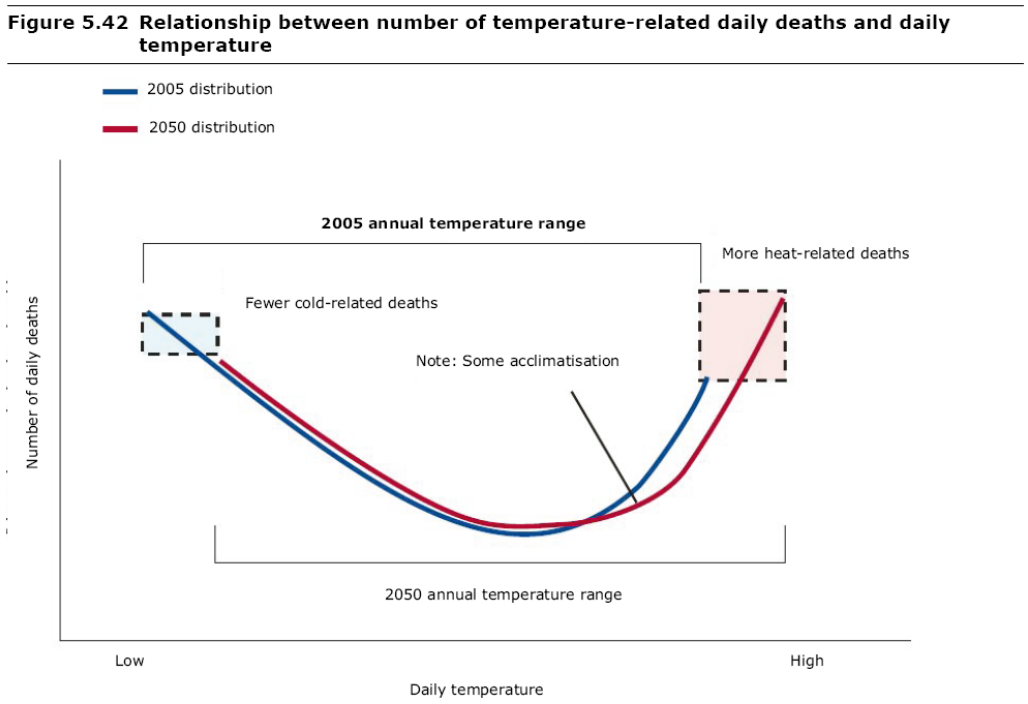
07.1.2 Temperature and Heat waves

A relationship exists between ambient temperature and mortality. This relationship is usually in the form of a U-shaped linear graph where the trough of the graph represents the minimum mortality temperature, or the temperature at which the minimum number of deaths occur. As temperature rises above this threshold, or goes down below the threshold mortality rises (Fig 4).

This minimum mortality temperature, or optimum average apparent temperature, varies between different populations by latitude but is usually around 25ºC. Above such a temperature and below such a temperature, mortality rises.

As shown in Figure 4, at higher temperatures, daily mortality rates increase more rapidly than at lower temperatures, increasing temperatures are likely to increase the number of heat-related deaths. It is estimated that mortality risk increases by between 0.2 and 5.5% for every 1ºC increase in temperature above a location-specific threshold[156]. A study on temperature related mortality on the Maltese population is currently being conducted but is as yet unpublished[157].

Figure 14: Relationship between number of temperature-related daily deaths and daily temperature



Source: McMichael. A. J.; Woodruff, R. E.; Hales S., (2006) Climate change and human health: present and future risks. *Lancet* 367 (9513): 859–869

[155] Montefort S, Ellul P, Montefort, M., Caruana, S., Agius Muscat, H. *Increasing prevalence of asthma, allergic rhinitis but not eczema in 5- to 8-year old Maltese children (ISAAC). Paediatric Allergy Immunology,* Feb; 20(1), 2009, 67-71.
[156] World Health Organisation*, Impacts of Europe's Changing Climate , Indicator-based Assessment*, 2008, hereinafter WHO 2008.
[157] England K. et al., *The relationship of ambient temperature and humidity with mortality on the Maltese Islands 1992-2005.* Unpublished as at 21st February 2010.

Apart from average annual and summer rising temperatures, heat waves are, in their own right, detrimental to human health. Heat poses direct physiological stress on the cardiovascular system of the human body. The Summer of 2003 saw a particularly intense and prolonged heat wave which swept over Europe, claiming at least 70,000 excess deaths in 12 European countries[158].

When environmental heat overwhelms the heat-coping mechanisms, the body's core temperature rises which may lead to heat stroke, heart failure, or death. The elderly, people with chronic diseases, and the socially isolated are particularly sensitive to heat-related events. Long heat waves of more than 5 days have an impact of 1.5 to 5 times greater than shorter events[159]. Heat wave effects can be reduced by keeping indoor temperatures low, keeping out of the heat, keeping the body cool and hydrated, and helping others.

It is important that institutions for the elderly and hospitals offer some degree of air-conditioning and are insulated against outside temperature variability. Since air-conditioning a whole building, or all the rooms where the elderly reside, may turn out to be unfeasible, the provision of a cold room that is accessible to people residing within the institution has been found to be beneficial in counteracting the adverse effects of heat waves, as even a couple of hours in a cold room per day during a heat wave may give the necessary physiological break to elderly people during such events.

In a survey conducted during 2008 by the Department of Health Care Services Standards on 'Heat Wave Measures in Homes for Older Persons', only 61.5% of institutions for the elderly were found to have air-conditioning facilities, and only 7.7% of institutions had a cool room. 30.8% had their roofs insulated[160].

This document also presents a list of recommendations that include the introduction of air-conditioning facilities in elderly homes, the provision of a cold room, the installation of indoor digital thermometers and monitoring of inside temperatures, increasing outdoor shading as a cost-effective means to reduce warming, the training of staff to deal with residents suffering from a heat-stroke, and contingency plans to deal with power failures.

These recommendations are still in the format of guidelines. Distribution of these guidelines to all the relevant entities, together with monitoring of adherence to these guidelines, is recommended. In addition, these guidelines should become a standard by which all institutions should abide by and action should be taken if these standards are not respected. Only institutions which abide by these standards should have their licence renewed.

Recommendation 65

The Climate Change Committee for Adaptation recommends that health care facilities and hospitals should be provided with appropriate room cooling technologies as heat waves may lead to heat stroke, heart failure or death and that only institutions which abide by these standards should have their licence renewed.

People who live in top apartments are particularly exposed to outside temperature variability and to the effect of heat waves during the summer months. This was the case in France during the summer of 2003, where the people who suffered the effects of the heat wave most were those who were old, socially isolated, and living in top apartments[161].

Since climate change is likely to increase the frequency and severity of heat waves on the Maltese Islands and since the Maltese Islands have witnessed an increasing trend in the construction of apartments over these last years, it stands to reason that the number of people living in top apartments has increased. In order to determine the vulnerability of these people to heat waves, data about air-conditioning facilities, demographic variables, and socio-economic strata would be needed.

[158] WHO, *supra.*
[159] Ibid.
[160] Department of Health Care Services Standards, *Heat wave Measures in Homes for Older Persons. Survey Summary Report,* 2008.
[161] Poumadere M. et al., *The 2003 Heatwave in France: Dangerous Climate Change Here and Now, Risk Analysis*, Vol. 25, No. 6, 2005

This data could then determine whether policy to safeguard the health of people living in top apartments would be needed or not. Measures could include subsidies on photovoltaic driven air-conditioning facilities, which would automatically favour those living in top apartments or those who have a roof, and the encouragement or enforcement of insulating of top apartments against outside temperatures.

07.1.3 Flooding Occurrences

Extreme precipitation events can lead to floods. In the past, flooding usually affected the central part of Malta, where urbanisation was most dense. However, because of increasing urbanisation in other parts of the island over these last 10 years, flooding is affecting other areas, noticeably the south eastern coast, the northwesterly parts of Malta, and some parts of Gozo. Occasionally, Malta experiences flash floods, as a result of torrential rain over a very short period of time. Over the past 40 years, Malta has experienced an average of six major flash floods, that is to say one every 6-7 years

Flooding occurrences affect health in a variety of ways. Firstly, during an acute episode, fast-running waters may cause injuries, drowning or damage to infrastructure. Since flooding occurrences are usually characterised by congestion of traffic, it may be difficult to provide healthcare and emergency services on time to people in difficulty. Early warning systems, which are already in place, play an important role in this respect.

Secondly, houses in flooded areas may be damaged or remain humid and wet for weeks to follow. Damp houses are known to have a detrimental effect on health in general, on respiratory conditions such as asthma, and on psychological health. It is also not unusual to experience sewage overflows from the system into the roads, or sometimes into houses, as the sewage system becomes overwhelmed during a flooding event. Dispersed sewage is a direct environmental health threat to the community. Local studies on the human health effects of flooding occurrences, following the acute phase are however, lacking.

07.1.4 Infectious diseases

Vector-borne diseases such as Malaria, Dengue fever, and Lyme disease, have been observed to be changing their distribution, not only globally, but also in the European continent[162]. Malta has generally observed a decreasing secular trend for vector-borne diseases such as Leishmaniasis and Typhus over the past decades. However, the establishment of new species on the Islands, and the possibility of increasing transmission of vector-borne diseases as a result of changes in habitat conditions because of climate change, remain a concern.

Vector-borne diseases are diseases that are spread by the presence of vectors, including mosquitoes, ticks, and sandflies. If a vector is introduced into a new environment that is conducive to the breeding of the vector and for the multiplication of the organism that causes disease, the cycle of the vector would be established, and an outbreak of disease within the community is possible. Thus, continuous and rigorous surveillance of infectious diseases and their vectors is important to ensure that outbreaks do not occur and if they do occur, they are controlled as early after the outbreak as possible.

At this point in time, the most important climate change related to vector-borne diseases of concern on our Islands are Chikungunya fever and Dengue fever.

Chikungunya fever is a mosquito-borne viral disease with symptoms such as fever, joint pain, muscle pain, headaches, and nose and gum bleeding[163]. The vector of Chikungunya fever is the Asian tiger mosquito (*Aedes albopictus)* and has established itself in Europe over the last 15 years (Fig 9). In

[162] Semenza J. and Menne B., *Climate Change and Infectious Diseases in Europe. The Lancet Infectious Diseases*, 2009; 9: 365-375, hereinafter Semenza and Menne.
[163] European Centre for Disease Prevention and Control. Retrieved from http://www.ecdc.europa.eu/en/healthtopics/Pages/Chikungunya_Fever.aspx

2007, there was the first ever recorded outbreak of Chikungunya fever in mainland Europe[164]. Lately, the *Aedes albopictus* has also been identified on the Maltese Islands[165] [166].

Dengue fever is the most important arboviral human disease worldwide. However due to the nearly universal use of piped water, the disease has disappeared from Europe[167]. The vector *Aedes aegyptii,*, which is the principal vector of Dengue fever is absent in Europe but was well established until after World War II[168]. One can assume that the risk of locally transmitted dengue is currently low, and any that increase would depend on the introduction of *Aedes aegyptii* in to Europe[169]. However, *Aedes albopictus* (Asian tiger mosquito) is also a competent vector of Dengue fever.

Since *A. albopictus* has adapted itself to breeding in man-made container habitats, increasing aridity during the summer period, due to climate change, is not likely to hinder its establishment and spread.

The Infectious Disease Prevention and Control Unit (IDCU) within the Department for Health Promotion and Disease Prevention has an important role in the surveillance and study of infectious diseases, including vector-borne diseases and food borne illnesses. The Department uses information on incidence and trends of disease to carry out risk assessments and introduces direct policy to reduce the burden of infectious diseases.

In light of the fact that climate change is affecting the distribution of vector-borne diseases worldwide, and that globalisation, through increased travelling and trade, may mobilise diseases from one continent to another, it is of utmost importance that surveillance of vector-borne diseases and their vectors (for example, mosquitoes) is strengthened.

It is only with this information at hand that one can carry out proper risk assessments on vector-borne diseases for the Maltese population. In general, locally there is a lack of entomological expertise, and knowledge about the distribution and activity of vectors is very limited. The European Centre for Disease Prevention and Control (ECDC) sent some experts over to Malta in 2009 and they identified the presence of the tiger mosquito *Aedes albopictus* on the Maltese Islands.

Being the prime vector for Chikungunya fever and a secondary vector for Dengue fever, the identification of the tiger mosquito on the Maltese Islands meant that risk assessments on the possibility and probability of local transmission of these diseases should they be introduced on the Maltese Islands needs to be carried out. However, more information on the activity of the vector and on the different stages of the cycle of the vector needs to be available before proper and rigorous risk assessment can be carried out. Surveillance for vectors and research on vector borne diseases needs to be enhanced to ensure Malta is prepared for the impacts of climate change in this respect.

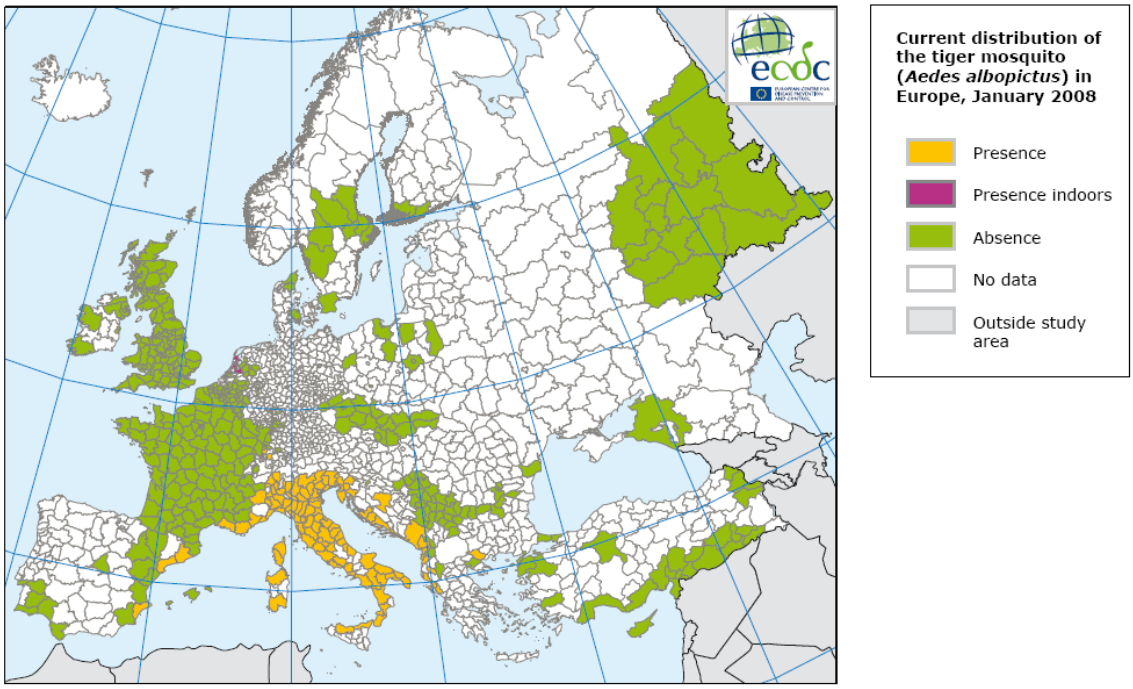
Recommendation 66

The Climate Change Committee for Adaptation recommends that the continuous and rigorous surveillance of infectious diseases and their vectors is important to ensure that outbreaks do not occur and, if they do occur they are controlled as early after the outbreak as possible.

[164] Ibid.
[165] Gatt P., Deeming, J.P. and Schaffner F., *First record of Aedes (Stegomyia) albopictus (Skuse) (Diptera: Culicidae) in Malta*. European Mosquito Bulletin 27, 2009, 56-64.
[166] Buhagiar J., *A second record of Aedes (Stegomyia) albopictus (Diptera: Culicidae) in Malta*, Malta European Mosquito Bulletin, 2009, 65-67.
[167] Semenza and Menne, supra, 365-375.
[168] WHO 2008, *supra.*
[169] WHO 2008, *supra.*

Figure15: Presence of *Aedes albopictus* (the tiger mosquito) in Europe (2008)

Map 5.46 Presence of *Aedes albopictus* (the tiger mosquito) in Europe in January 2008



Note: Developed by Francis Schaffner (BioSys Consultancy, Zurich), in partnership with Guy Hendrickx/Ernst-Jan Scholte (Avia-GIS, Zoersel, Belgium) and Jolyon M Medlock (Health Protection Agency, UK) for the ECDC TigerMaps project.

Source: Based on Schaffner *et al.*, 2008.

Figure 1: Schaffner, F.; Hendrickx, G.; Scholte, E.J.; Medlock, J.; Angelini, P.; Ducheyne, E., 2008. Development of *Aedes albopictus* risk maps. TigerMaps project report. Stockholm: European Centre for Disease Prevention and Control. http://ecdc.europa.eu/.

07.1.5 Food-borne illness

The presence of certain food-borne illnesses, in particular Salmonellosis, correlates very closely in incidence with average temperature rise (Fig 10). Higher ambient temperatures have been associated with 5-10% higher salmonellosis notifications for each degree increase in weekly temperature, for ambient temperatures above 5ºC[170] [171]. There may be a number of factors to explain this phenomenon such as inappropriate food handling and storage at the time of consumption. [172]

Salmonellosis is a diarrhoeal infection that can causes significant morbidity and is the cause of the second largest number of human food-borne diseases[173], It is usually manifested in fever, diarrhoea, abdominal pain, nausea, and vomiting, that last a few days Moreover, in some instances hospitalisation may sometimes be required because of dehydration and in the elderly and weak patients, it may sometimes lead to death. Furthermore, in about 10% of cases, post-infectious complications such as reactive joint inflammation manifest themselves.[174]

While systems for notification of foodborne illnesses, programmes of education on food safety and hand hygiene, the enforcement of quality standards of hygiene in the food production and catering

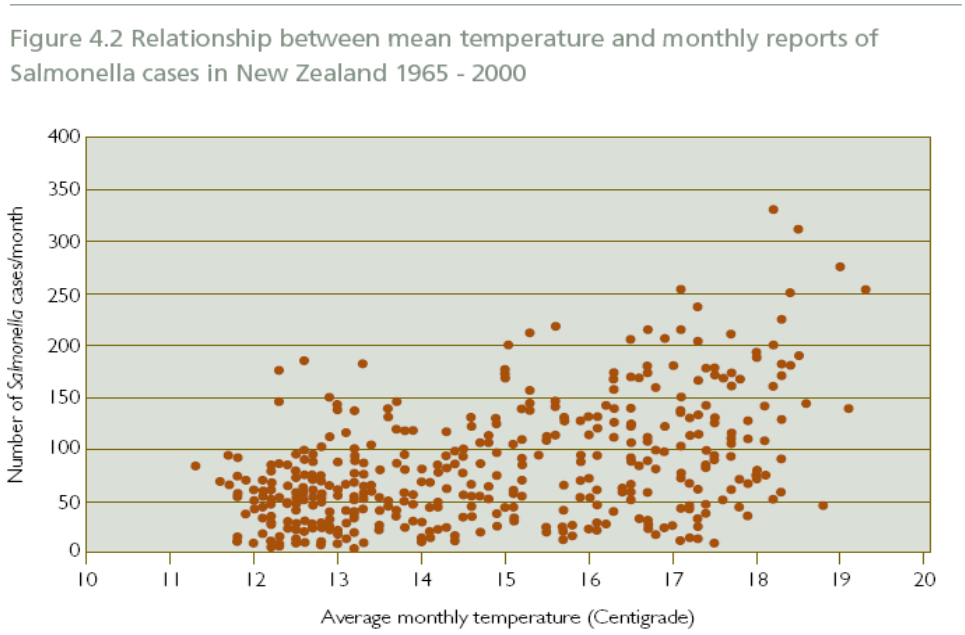
[170] Kovats RS, Edwards SJ, Hajat S, Armstrong BG, Ebi KL and Menne B. *The effect of temperature on food poisoning: a time-series analysis of salmonellosis in ten European countries,* Epidemiol Infect, 2004;132(3):443-53.
[171] Lake IR, Gillespie IA, Bentham G, et al. *A revoltutionary of the impact of temperature and climate change on foodborne illness.* Epidemiol Infect, 2004; 132:443-53
[172] Semenza and Menne, *supra,* Retrieved from http://www.ecdc.europa.eu/en/healthtopics/pages/climate_change_food_borne_diseases.aspx
[173] European Food Safety Authority. *The Community Summary Report on Trends and Sources of Zoonoses and Zoonotic Agents in the European Union in 2007*, The EFSA Journal 2009, 223:1-215.
[174]European Centre for Disease Prevention and Control (ECDC). Retrieved from http://www.ecdc.europa.eu/en/healthtopics/Pages/Salmonellosis.aspx

industry and other measures are already in place, in view of the fact that almost one third of cases is attributed to temperature influences[175], it is very important that these systems and programmes are strengthened. These include programmes to increase public awareness on food safety, education on the hygienic methods of preparing food, and.

Recommendation 67

The Climate Change Committee for Adaptation recommends that the potential risk on food from elevated temperatures related to climate change can be counteracted through concerted public-health action, food safety measures and education.

Figure 16: Incidence of Salmonella against average monthly temperature



07.1.6 Air quality

Air pollution is mainly the result of emissions of pollutants from motor vehicles and electrical power plants, and as such is not a direct consequence of climate change. However, climate change exacerbates air pollution through the formation of tropospheric ozone since higher summer temperatures and the increase in the frequency of heat waves will facilitate the formation of tropospheric ozone from nitrogen oxides and hydrocarbons.

Since tropospheric ozone is a respiratory irritant, higher temperatures would mean worse air quality which can in turn precipitate respiratory conditions and can bring about or aggravate chronic obstructive pulmonary diseases, asthma, and cardiovascular conditions. High temperatures and air pollution acting in synergy can also have compounding effects on human health even in terms of mortality.

Tackling the issue of air pollution would not only decrease the human health impacts from these phenomena, but would also contribute to meeting the obligatory national mitigation targets.

[175] [175] Semenza and Menne, *supra*, Retrieved from http://www.ecdc.europa.eu/en/healthtopics/pages/climate_change_food_borne_diseases.aspx

The prime contributor of air pollution is motor vehicle use, which affects health in a variety of ways, such as for example, noise pollution, light pollution, and the take up of land,that can be used for recreational use and the occurrence of road traffic injuries.

Green transport policy is crucial to climate change adaptation and in the improvement of health conditions. Decreasing car use, strengthening public transport, promoting walking and cycling, are all ways by which air quality may be improved and the issues of obesity and physical inactivity tackled. In addition, green travel has a lower carbon footprint.

Recommendation 68

The Climate Change Committee for Adaptation recommends that the tackling of pollution from vehicles and power plants would decrease the human health impacts from climate change and air pollution.

07.1.7 Others

There are other human health effects of climate change such as those resulting from the proliferation of harmful algal blooms thriving in slightly warmer waters and possibly resulting in shellfish poisoning. Another possible effect is scrombotoxin tuna fish poisoning that can also result from fish spoiling faster in higher ambient temperatures. In addition, the possible sea level rise coupled with a higher preponderance of coastal storms can have significant negative impacts on the dwellings and residencies that are close to the coast.

07.2 Consolidation of Early Warning Systems

Malta already has early warning systems in place, in particular for heat waves/high temperatures and flooding events. With the prospect that both heat waves and flooding events are likely to become more frequent and more intense, it is important that these systems are maintained, developed and strengthened.

Early warning systems maintained in Malta, include:

- Heat waves: It is pertinent to point out the existence of links between the Meteorological Department of the Malta International Airport plc and the Public Health Department. When weather forecasts predict that temperatures will rise above 30^{o}C and that this will be coupled with high humidity, the public health department is informed beforehand and the latter releases various health warnings on the media. These warnings include advice for people to stay inside during peak hours of heat and to drink substantially.

- Flooding: The Meteorological Department of the Malta International Airport plc. and the Civil Protection Department work together during events of meteorological instability to ensure the coordination of a rapid alert and response system.

Even though early warning systems are already in place and are effective, a more methodological approach may be needed to ensure that all stakeholders involved in an early warning system know exactly what their roles and responsibilities are.

During a workgroup on adaptation to flooding events that was held during a National Seminar on the Health Effects of Climate Change, held in April 2009, reference was also made to the need to set up an inter-ministerial committee with the role of coordinating a plan for responding to floods and delegating a shared responsibility to different entities was stated.[176] Reference was also made to the need to study the health effects of flooding occurrences, for example in terms of measuring the

[176] Working Group on Flooding and Water Stress, National Seminar on the Health Effects of Climate Change – Raising Awareness and Developing Capacity held on 23 April 2009, Malta. Organised by the Department for Environmental Health (Public Health Regulation Division), Ministry for Social Policy in collaboration with the WHO Regional Office for Europe.

incidence of diarrhoeal disease and asthmatic events following such occurrences, was also mentioned.

The Maltese Government commissioned a consultancy firm from Italy to draw up a Master Plan for the Maltese Islands to deal with flooding.[177] The Plan makes reference to the necessity of strengthening the early warning system and of educating the public on how to cope with situations arising from flash floods.

Recommendation 69

The Climate Change Committee for Adaptation recommends that whilst Malta already has early warning systems in place, in particular for heat waves/high temperatures and flooding events, it is imperative that these systems are maintained, developed and strengthened.

07.3 Preventive Health Care: Invest in a Healthier Population to Reduce Vulnerability of the Population to Climate Change

A healthy population is undoubtedly more resilient to the effects of climate change than an unhealthy one. Consequently, investing in health can also be seen as an investment in climate change adaptation.

It is thus important that the National Climate Change Adaptation Strategy supports other strategies that improve health such as the National Health Strategy that is currently being drafted by the Ministry of Health.

Recommendation 70

The Climate Change Committee for Adaptation is of the considered opinion that a healthy population is undoubtedly more resilient to the effects of climate change than an unhealthy one the National Climate Change Adaptation Strategy is to support other strategies that improve health such as the National Health Strategy.

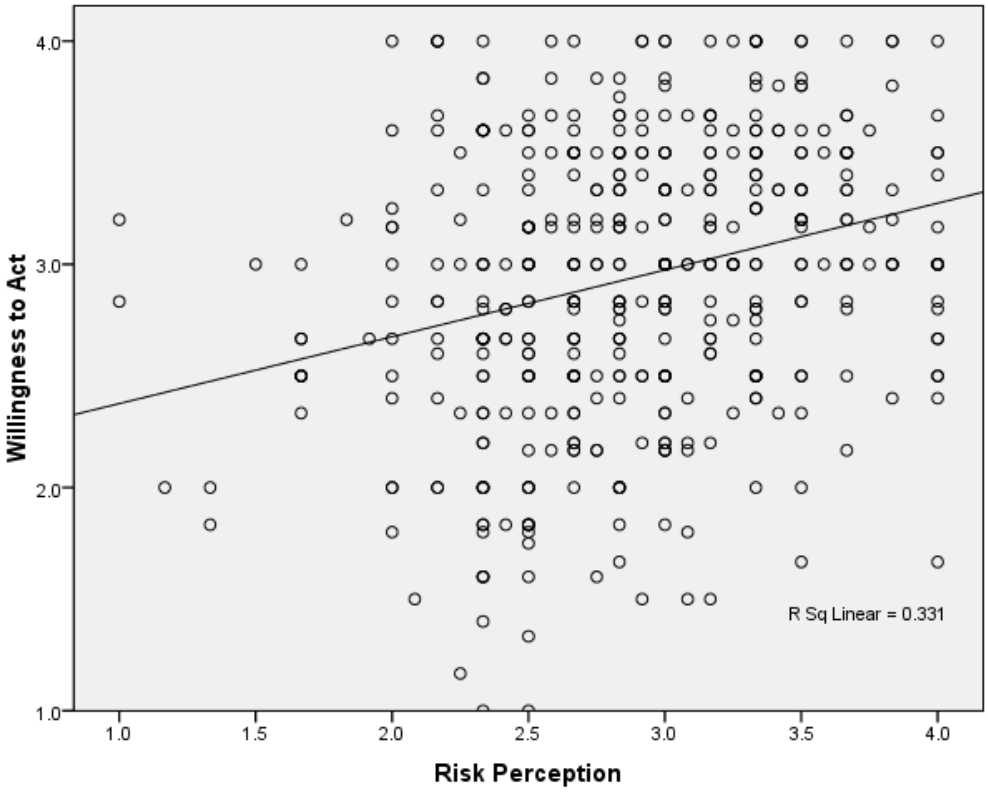
07.4 Framing Climate Change Education to Health

Education campaigns should be a core part of the strategy for adaptation to climate change as this would make the Maltese public more receptive and more supportive of an eventual climate change adaptation policy.

Worryingly, local research shows that 16% (+/-3.1%) of the Maltese public is not even aware of the climate change phenomenon[178]. Research also shows that if climate change is framed as a threat to health rather than just a distant ecological concern, the public would be more willing to change lifestyle and to be supportive of climate change mitigation policy (Fig 13).

[177] Master Plan. Civil Protection Department. Still on the way!
[178] DeBono, R., *Maltese Public Perceptions on Climate Change and Health*, 2009. Dissertational thesis in partial fulfilment for the Degree of Masters in Public Health Medicine, University of Malta.

Figure 17: Maltese Public Perception on Climate Change and Health



Source: Debono, R. 2009. Maltese public perceptions on climate change and health. Dissertational thesis in partial fulfilment for the Masters of Science Public Health Medicine. University of Malta.

Recommendation 71

The Climate Change Committee for Adaptation is of the considered opinion that an education campaign on adaptation to climate change should be framed within the health context as local research indicates that the public would be more willing to change their lifestyle and to be supportive of climate change mitigation policy if it is presented in this manner.

08.1 Introduction

With its close connections to the environment and climate itself, tourism is considered to be a highly climate-sensitive economic sector similar to agriculture, insurance, energy, and transportation. Indeed, climate change is not a remote future event for tourism, as the varied impacts of a changing climate are, even now, becoming evident at a number of destinations around the world and climate change is already influencing decision-making in the tourism sector[179].

There are four broad categories of climate change impacts that will affect tourism destinations, their competitiveness, and sustainability. Malta is affected by all four impacts. These are:

01. Direct Impacts

Climate is a principal resource for tourism as it co-determines the suitability of locations for a wide range of tourist activities. It is a principal driver of global seasonality in tourism demand and has an important influence on operating costs such as heating-cooling, snowmaking, irrigation, food and water supply, and insurance costs. Consequently, changes in the length and quality of climate-dependent tourism seasons (for example; sun-and-sea in the case of Malta or winter sports holidays) could have considerable implications for competitive relationships between destinations and therefore on the profitability of tourism enterprises. Uncertainties related to tourist climate preference and destination loyalty require attention if the implications for the geographic and seasonal redistribution of visitor flows are to be projected. Increases in the frequency or magnitude of certain weather and climate extremes (for example; heat waves, droughts, floods, tropical cyclones) as a result of projected climate change will have an immediate affect on the tourism industry of Malta through increased infrastructure damage, additional emergency preparedness requirements, and higher operating expenses[180].

02. Indirect Environment Change Impacts

Since environmental conditions are such a critical resource for tourism, a wide-range of climate-induced environmental changes will have profound effects on tourism at the local and regional destination level. Changes in water availability, biodiversity loss, reduced landscape aesthetic, altered agricultural production (for example; food and wine tourism), increased natural hazards, coastal erosion, and inundation, damage to infrastructure, and the increasing incidence of vector-borne diseases, will all impact tourism to varying degrees. In contrast to the varied impacts of a changed climate on tourism, the indirect effects of climate induced environmental change are likely to be largely negative[181].

03. Impacts of Mitigation Policies in Tourist Mobility

National or international mitigation policies; that is policies that seek to reduce GHG emissions; may have an impact on tourist flows. They are likely to lead to an increase in transport costs once the ETS auctioning of aviation related CO_2 emissions are introduced. This may foster environmental attitudes that lead tourists to change their travel patterns (for example, shift transport mode or destination choices)[182].

04. Indirect Social Change Impact

Climate change is thought to pose a risk to future economic growth and to the political stability of some nations. As shown in a 2009, Joint Research Centre (JRC) and Institute for Prospective

[179] Pg 12, Simpson, M.C., Gössling, S., Scott, D., Hall, C.M. and Gladin, E. (2008) Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices. UNEP, University of Oxford, UNWTO, WMO: Paris, France,2009,12.
[180] Ibid.
[181] Ibid, 13.
[182] Ibid.

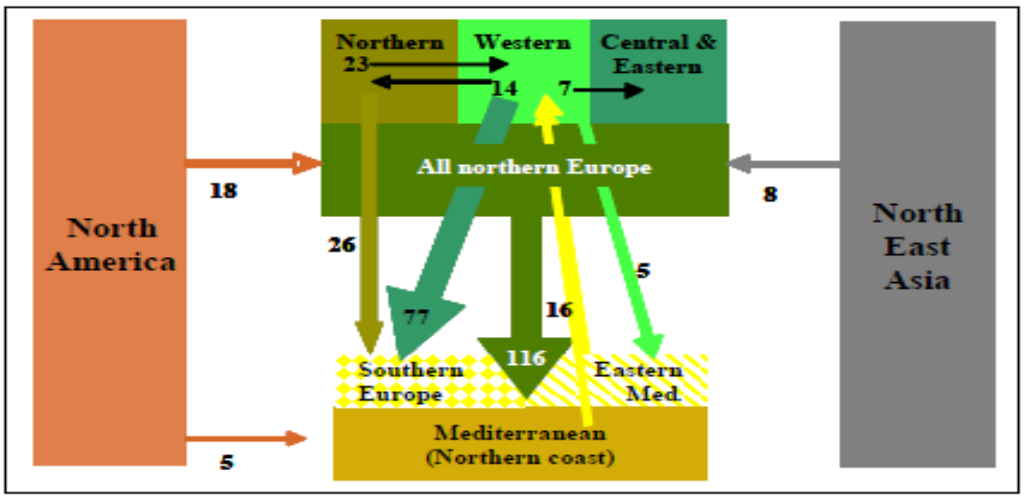
The study of climate change and tourism is particularly hamstrung by the difficulty in assessing the impact of both direct and indirect effects – which will differ from one location to the other. Direct effects include the natural resources that influence the tourist's attraction to a particular location or destination: beaches, sunshine, mild temperature – or the continued presence of snow in ski resorts – etc. Indirect effects of climate change relate to increased frequency in storms, floods, unpredictability of weather change, et al. A destination where-in due to climate change is likely to suffer from increased unpredictability is likely to be less attractive than one which has a stable climate around which a tourist can plan his or her visit.

Rezenweig et al, as quoted in the document titled 'Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices' identifies that as a result of the complex nature of the interactions that exist between tourism, the climate system, the environment and society, it is diffi cult to isolate the direct observed impacts of climate change upon tourism activity. There is sparse literature about this relationship at any scale'.[183]

Technological Studies (IPTS) study[184], the annual migration of northern Europeans to the countries of the Mediterranean coast in search of the traditional summer 'sun, sand, and sea' vacation is the single largest flow of tourists across the globe; accounting for 1/6 of all tourist trips in 2000.

This large group of tourists, totaling around 100 million per annum, spends an estimated €100 billion per year. Thus, in the event that this region is negatively affected by climate induced change, the implications to the countries affected, including Malta, would be considerable since the economic wealth generated through tourism would be in jeopardy,

Figure 18: International Tourism in Europe: Origins and Destinations



Source: Todd, (2003)

08.2 The Future of Beach and Recreational Activities in the Mediterranean

The abovementioned JRC-IPTS study shows that with regards to light outdoor activities, summer is the best season for most types of such tourism and that excellent conditions can be found around the Mediterranean sea. Models carried out to determine a base line show that conditions in parts of Spain, Greece, and Turkey are ideal and the general conditions in the south of Europe as excellent[185].

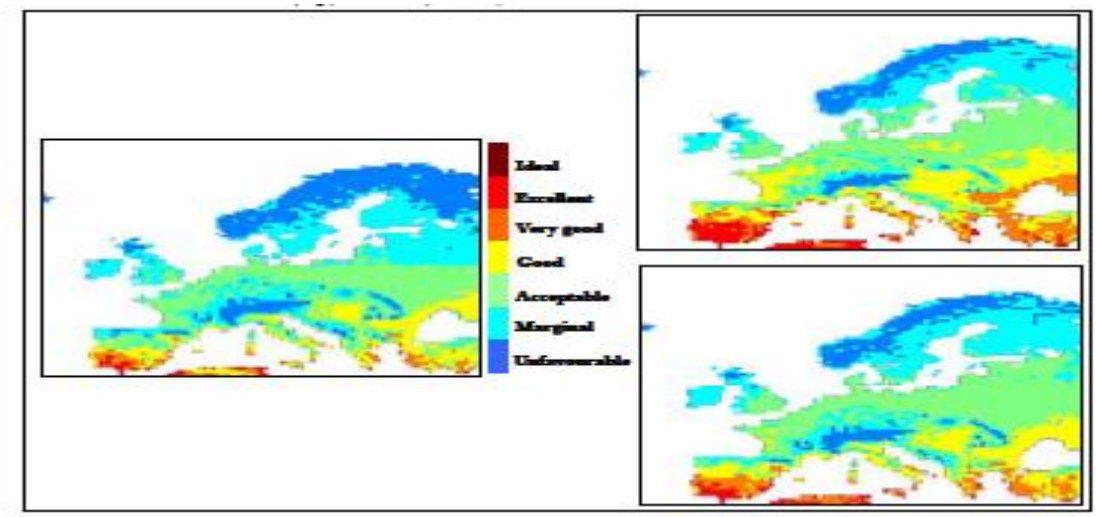
[183] Ibid, 24
[184] Amelung, B., and Moreno, A., *Impacts of Climate Change in Tourism in Europe, PESETA-Tourism Study*, Joint Research Centre-Institute for Prospective Technological Studies, European Commission, 2009, hereinafter JRC-IPTS Study.

[185] Pg 13, Ibid

The said study also indicates that the distribution of climatic resources in Europe between 1970s and 2080s, is projected to change significantly. For the spring season, all models show a clear extension towards the north of the Mediterranean. Good conditions are projected to be more frequent in France and the Balkans[186].

A significant adverse negative climate change impact on the Mediterranean.

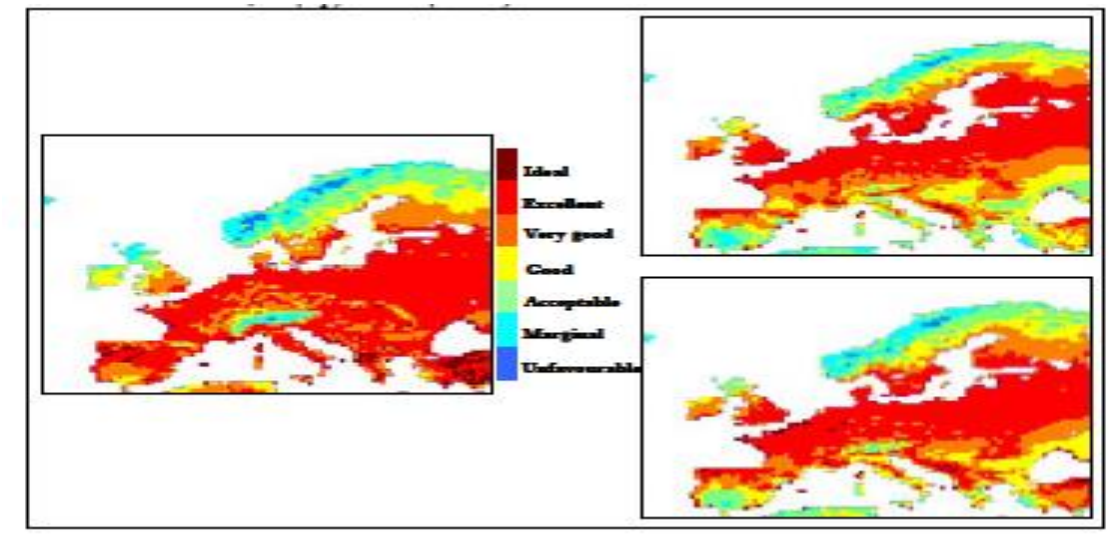
Figure 19: JRC-IPTS HIRHAM Modeling: 1970 (Left) and 2080 (Right): Spring



Source: JRC-IPTS Study, (2009)

In summer, the zone of good conditions also expands towards the North but this time at the expense of the South. Conditions will become excellent throughout the northern part of continental Europe, as well as in Finland, southern Scandinavia, southern England, and along the eastern Adriatic coast. At the same time, climatic conditions in Europe deteriorate enormously. In parts of Spain, Italy, Greece, and Turkey conditions sometimes drop from excellent or ideal to marginal[187].

Figure 20: JRC-IPTS HIRHAM Modeling: 1970 (Left) and 2080 (Right): Summer



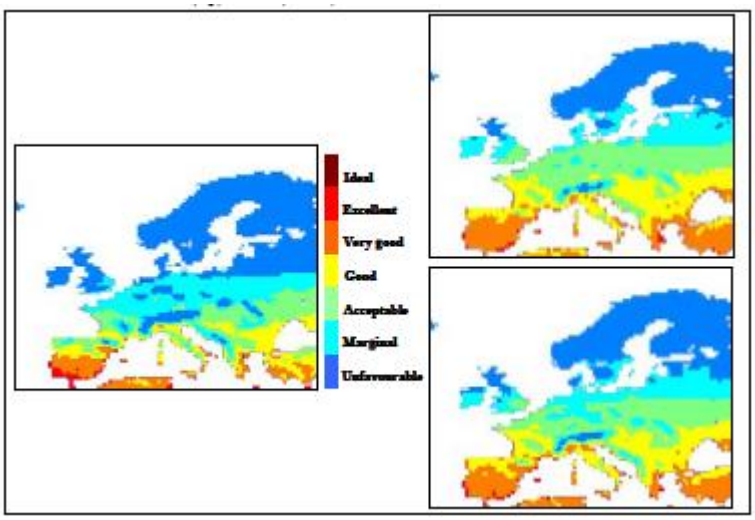
Source: JRC-IPTS Study, (2009)

Changes in autumn are more or less comparable to the ones in spring with excellent conditions covering a larger part of Southern Europe and the Balkans[188].

[186] Ibid, 18.
[187] Ibid, 19.
[188] Ibid, 19.

In winter, in the southern periphery of Europe, such as the south of Spain, conditions are projected to improve from being unfavourable to marginal or even acceptable[189].

Figure 21: JRC-IPTS HIRHAM Modeling: 1970 (Left) and 2080 (Right): Winter



Source: JRC-IPTS Study, (2009)

The projected climatic changes illustrated above have a significant impact on the definition of a 'holiday season' as well as on the length of the holiday season for Malta. Thus, whilst Southern Europe today has significantly more good months than northern Europe the projections of the modeling referred to in this Chapter show that if the projected climate change impacts take place this will no longer be the case.

Southern Europe will thus experience a decrease in the so-called 'good' months in summer whilst in Northern Europe there will be an increase in good months in summer, spring, and autumn.

Should the results of this model materialise, there is a high risk that the Maltese Islands may not necessarily remain the attractive tourist destination, the go to place for 'sun, sea and sand', for one of its largest markets: the United Kingdom. If the United Kingdom witnesses an increase in 'good' days during summer, whilst Malta on the other hand, experiences less 'good' days during the same period, the motivation for UK tourists to come to Malta during the summer, is expected to decrease.

The Deutsche Bank Research in a policy brief on Energy and Climate Change supports this conclusion:

> The Mediterranean region, with its focus on seaside and beach holidays, loses attractiveness if there is an increased number of heatwaves in the summer months: during the past few years such events have already begun to increase in frequency in the region. People who repeatedly find that their holiday activities are restricted by extreme heat could be inclined to spend future holidays in other regions, or to go to the Mediterranean region in spring or autumn. In contrast, the North Sea and Baltic regions, the northern Atlantic coast of Spain and the Canary Islands are some of the holiday destinations that could become more popular with tourists due to (actual or expected) excessively high temperatures in the Mediterranean region."[190]

[189] Pg 20, Ibid
[190] Pg 4, Climate Change and Tourism: Where will the journey lead?, Energy and Climate Change, Current Issues, Deutsche Bank Research, 11th April 2008

08.3 The Need for Research to Design Adaptation Policy

Comprehensive studies of the likely impacts of climate change on tourism for the Maltese Islands have not been carried out. The CCCA hopes that this Report will act as the spur for the undertaking of local studies that look at national as well as sub-sector impacts of climate change on tourism. The quality of travelers should be improved, if necessary through the adoption of adaptation tourism measures. Consequently, all stakeholders – the private sector as well as government – should assume an active role in identifying and adapting to extra risks arising through climate change by means of intelligent planning.

Thus the CCCA recommends that the Government should set-up a Task Force for Tourism and Adaptation that is constituted of representatives of the Parliamentary Secretariat for Tourism, the Malta Tourism Authority, the Malta Hotels and Retailers Association and other key stakeholders in the tourism value chain to carry out by the end of 2011 a detailed and comprehensive analysis of international and local data with regards to the impact of climate change on the Southern Mediterranean generically and of Malta specifically and subsequent to which to identify the macro as well as micro impacts on the tourism industry in Malta.

Recommendation 72

The Climate Change Committee for Adaptation recommends that the Government should set-up a Task Force for Tourism and Adaptation that is constituted of representatives of the Parliamentary Secretariat for Tourism, the Malta Tourism Authority, the Malta Hotels and Retailers Association and other key stakeholders in the tourism value chain to carry out by the end of 2011 a detailed and comprehensive analysis of international and local data with regards to the impact of climate change on the Southern Mediterranean in general and of Malta specifically and subsequent to which to identify the macro as well as micro impacts on the tourism industry in Malta.

The afore mentioned Task Force should in parallel to the above assessment carry out a detailed study for target completion in June 2012 to determine how water resources scarcities will affect the tourism industry in general and micro segments of the tourism industry specifically – such as for example agro- and eco-tourism; the impact this will have on the competitivity of the tourism industry and the adaptation measures required to counter climate change effects and retain Malta as an attractive destination,

Recommendation 73

The Climate Change Committee for Adaptation recommends that the proposed Task Force should carry out a further parallel study for target completion by the end of 2011 to determine how water resources scarcities will affect the tourism industry in general and micro segments of the tourism industry specifically – such as for example agro- and eco-tourism; the impact this will have on the competitivity of the tourism industry and the adaptation measures required to counter climate change effects and retain Malta as an attractive and competitive destination,

Furthermore, the proposed Task Force should also in parallel to **Recommendations 72 and 73** above carry out a comprehensive study for target completion by the end of 2011 on the impact of winter and summer energy and power demand of hotels and other tourist establishments as a result of anticipated changes in climate behavior**;** the impact this will have on the competitivity of the tourism industry and the adaptation measures required to counter climate change effects and retain Malta as an attractive and competitive destination,

Recommendation 74

The Climate Change Committee for Adaptation recommends that the proposed Task Force

should carry out a further parallel study for target completion by the end of 2011 to determine the impact of winter and summer energy and power demand of hotels and other tourist establishments as a result of anticipated changes in climate behavior; the impact this will have on the competitivity of the tourism industry and the adaptation measures required to counter climate change effects and retain Malta as an attractive and competitive destination,

Finally, the proposed Task Force should carry out a final comprehensive study for target completion in June 2012 to determine the impact of the anticipated climate changes on energy, water and road infrastructure, on the historical heritage, on the landscape and rural environment. The study should seek to assess the actual physical cost in repair arising damages to the infrastructure as well as the actual and opportunity cost this may have on the tourism services sector. This report should present specific adaptation measures in this regard.

Recommendation 75

The Climate Change Committee for Adaptation recommends that the proposed Task Force should carry out a final parallel study for target completion by the end of 2011 to determine the impact of the anticipated climate changes on energy, water and road infrastructure, on the historical heritage, on the landscape and rural environment; assess the actual physical cost in repair arising damages to the infrastructure as well as the actual and opportunity cost this may have on the tourism services sector; and present specific adaptation measures in this regard.

The Malta Tourism Authority, should complement the work of the proposed Task Force for Tourism and Adaptation by the undertaking of the following studies by the end of 2012. :

(1) National assessments of likely climate induced demand on the tourism industry. Such studies are needed to prevent negative large-scale effects.

(2) Specific analyses on macro-tourism realities in different areas of the Maltese islands are required to define other hidden aspects of tourism (i.e. inner urban, village; and coastal areas).

(3) Continuous in-house research is required to analyse the commercial viability of different local tourism markets and to craft new forms of tourism and new safe recreational habits (for example, an intensive innovative approach to cultural tourism and eco/agro-tourism);

(4) Research may to enhance innovation and creativity in the tourism industry. This may reduce risks and would lead to stimulate tourism in new areas and zones in the Maltese islands (especially in the South of Malta and other villages in Gozo without incurring adverse infrastructural and construction operations);

Recommendation 76

The Climate Change Committee on Adaptation recommends that the Malta Tourism Authority complements the work of the proposed Task Force on Tourism and Adaptation by the undertaking of series of focused studies directed at different aspects of the tourism industry and its potential climate change impact to be completed by the end of 2011. .

There is little doubt that the climate should feature more prominently in the minds of hoteliers, tourism planners, and policy makers who have the responsibility for tourism and recreation in the Maltese islands.

A greater awareness of climatic variations is needed not only for long-term planning but also to deal with existing conditions and realities of local tourism. Data shows that there is insufficient understanding of the current weather and climatic sensitivity of tourism in Malta and Gozo.

Therefore the hospitality industry in general has much to learn about the practical application of weather and climatic information.

As already shown in other research conducted in the Maltese islands, tourists are becoming more sophisticated, especially with the emergence of independent traveling[191]. As the awareness of climate change grows, hotels and resort areas will have to improve their products and marketing strategies. On the other hand, one may say that the most urgent need is to determine the effect of phased increases of winter and summer temperatures currently projected by climate models on Maltese tourism.

Thus, on the basis of the work that the proposed Task Force for Tourism and Adaptation as well as the Malta Tourism Authority should carry out by the end of 2011 as proposed in the recommendations above, the Government should draw up by the end of 2012 a Tourism Action and Contingency Plan that incorporates both mitigation and adaptation measures specific to the tourism sector. The Tourism Action and Contingency Plan should – but not be limited to - amongst others:

- assess the sensitivity of eco / agro-tourism to Climate Change scenarios. The introduction of new national nature parks or cultural parks (situated in the midst of high density heritage or historical zones) may increase the level of participation and interest amongst this tourist segment.

- determine how outdoor sport and activities are to be safeguarded with reasonable and professional safety measures to reduce risks. This is especially needed in the coastal regions where boulder collapse together with the effect of physical erosion and weathering, in areas such as Golden Sands, Gnejna Bay, Fomm ir-Rih, Mellieha area, and in San Blas, Mgarr ix-Xini, and Ramla in Gozo may cause a safety hazard.

- determine how beaches which run the risk of being eroded even without the effect of climate change are safeguarded. The costs of shoreline protection, plus any beach preservation and replenishment are expensive;

- determine how beaches and coastal ecosystems, with or without sea level increases, given the importance to Malta as a summer destination are to be protected. Coastal ecosystems could be developed as a tourist attraction in their own right. Thus, coastal habitats used for recreation should be protected. Moreover new beaches, natural saline swimming pools, and recreational areas should be developed.

- asses how coastal safety is to be strengthened through measures such as the introduction of life guards and of patrolling motor boats so as to counter the hazards that may result from the increased recurrence of storms which will affect winter/summer water sports such as small boat sailing, wind surfing, wind gliding, up-sailing, and so forth.

- assess the development of regional and village tourism. Thus for example, local councils could invest more resources to embellish their village outskirts and create regional projects to protect the existent ecosystem. In this way, there would be more balance in the competitive use of land between outdoor recreation and agriculture. Nature watch experiences, bird watching and bee-keeping sites will not only offer new forms of outdoor recreation to the locals but will also prove attractive to tourists.

- assess the impact of undertaking extensive afforestation and greater supervision on the existent natural habitat as a potential determinant towards the creationof a new tourism sector, ‘green tourism’, which can be suitable and viable in the light of the adaptation of tourism to climate change. The Eco-Gozo concept, for example, could complement the position of Gozo as an agro-tourism tourist venue extremely well.

1. [191] New trends of tourism together with a tourist profile survey research was conducted in the Maltese islands to develop a new strategic marketing plan to establish a new form of tourism called Integrated Relational Tourism. Such project was called PRISMA and was co-financed by the European Union in 2007.

Recommendation 77

The Climate Change Committee on Adaptation recommends that the Government, on the basis of the work that the proposed Task Force for Tourism and Adaptation as well as the Malta Tourism Authority should carry out by the end of 2011 as proposed earlier in this Report, should draw up by the end of 2012 a Tourism Action and Contingency Plan that incorporates both mitigation and adaptation measures specific to the tourism sector.

Malta is probably less climate sensitive when compared to other tourist destinations. Culture tourism (i.e. visits to historic cities, villages, and heritage sites and the first hand experience of local gastronomy, hand-made products, traditions, and local festivities, together with everyday life) for instance, may increase the potential for some mainstream outdoor activities whilst at the same time acting as a counter balance to the pure 'climate' – sea and sun – destination. The two are not mutually exclusive and can be packaged together.

Paradoxically enough the strength of our tourism industry is currently directly linked to our specific regional Mediterranean climate. Therefore, tourist promotions should take more consideration of our weather conditions. For instance, the marketing of 'short break holidays' can be explored more within the macro-climate of the Maltese islands as it stands as a *sui generis* phenomenon. At the same time, the promotion and workability of Eco-Gozo as a real haven in the Mediterranean, not only can increase a new segment of tourists but could also increase internal tourism and mobility all year round.

Increased collaboration between the National Meteorological Office and the industry is required in order to optimise on future weather sensitivity issues. Positive weather forecasts may be used as a competitive advantage to attract more tourists on our shores all year round.

Communication and education are essential elements in the response to climate change adaptation. Effective communication and education are important because they can be used to identify problems, encourage participation, invite innovation in problem solving, and promote the adoption and embracement of climate change adaptation policies as people understand better the reason of why they are being introduced.

The public, however, is not a homogenous body. As we have seen earlier in this report, adaptation climate change policies affect different cohorts of the public and the behaviour of the different cohorts, in turn, has diverse climate change impacts on policy sectors.

Thus for example, a water preservation culture affects the general public, industry, farmers, live stock husbandry et al. A communication and education policy targeted towards the general public to conserve rain water, re-use grey water, not use waste water unnecessarily for landscaping and washing cars since both can be serviced by re-used grey water, warrants a different communications and education campaign than that directed towards industry.

In the design of an effective communications and education campaign, the CCCA is of the considered opinion that a survey is undertaken directed at the different cohorts of the public, which will be affected by climate change, in order to obtaining a snap shot of the level of understanding of the different sections of the public of what is climate change adaptation.

The CCCA recommends that in early 2011, the MRA together with the National Statistics Office design a comprehensive survey instrument directed to gauge the level of understanding of climate change adaption in Malta.

Recommendation 78

The Climate Change Committee for Adaptation recommends that in early 2011 the MRA together with the National Statistics Office design a comprehensive survey instrument directed to gauge the level of understanding of climate change adaption in Malta.

In the design of a communications and education strategy for climate change adaptation careful attention should be given to the tone set for the campaign. The communication of climate change adaption is complex for a number of primary reasons. Firstly, climate change – both mitigation and adaption strategies – project events that scientists believe will happen in sixty, seventy years time.

Human behaviour is conditioned by factors such inertia, myopia, habits, et al. People find it difficult to plan in the long term for their own future – such as saving for retirement – let alone for matters which may happen outside their life time. Thus, people are rarely motivated to act by threats to their long-term survival. In fact, when it comes to climate change, people are generally not even motivated by concern for their children's future.

Secondly, the public is neither science nor risk literate. The CCCA is recognisant of the fact that to most of the general public, this report will be difficult to follow as it is to a large extent a technical report.

Thirdly, research shows that it is important not to create fear about climate change without showing what people can do about it. If people can simply avoid frightening issues, or put them to the back of their minds, they will. There may be a temptation to shout about climate change in order to get the message across, but the likelihood is that the message will be discounted or ignored. Described in sensational terms, a climate change message will fail the 'anti-hype' test, and will be discounted as untrustworthy and most likely motivated (e.g. by the need to sell papers, the desire to make the public submissive to the authorities, the desire to justify higher insurance premiums). Moreover, it is also

likely to be ignored: if the problems are presented as insurmountable, then there's nothing to be done, so there is no practical meaning in the message[192].

Fourthly, irrespective of whether one agrees with it, there is a competing school of thought which argues that climate change is a natural phenomena that is part of the evolution process of the earth. This is a competing message which results in clouding people's views of the issue.

The communications and education campaign that should follow the publication of this report should seek to de-technicalise the report and any further work on climate change in order to ensure that climate change and adaptation are portrayed as simply as possible to the general population and targeted groups of the general public.

Recommendation 79

The Climate Change Committee for Adaptation recommends that the communications and education campaign that should follow the publication of this Report careful attention should be directed.

Good practice in public policy design and implementation recognises that the success of a particular policy instrument lies not in the design of the policy but rather in the input garnered from various cohorts of the public. Thus, consultation, in so far that it is sincere and as open as possible, is a fundamental tenet for the subsequent ownership of the policy instrument by the different stakeholders involved.

The CCCA, therefore recommends that following the publication of this report, the MRA should carry out an active broad national consultation process that should be directed to different publics, stakeholders, environmental pressure groups, and civil society. Whilst the afore-recommended survey should constitute part of the consultation process MRA should seek to hold a public consultation at both a national and local level to generate the highest level of feedback possible.

Recommendation 80

The Climate Change Committee for Adaptation recommends that following the publication of this report, the Malta Resources Authority should carry out an active broad national consultation process that should be directed to different publics, stakeholders, environmental pressure groups, and civil society.

Subsequent to the adoption of the report and following the closure of the consultation process, the MRRA should ensure that MRA has the appropriate capacity as well as funds to enable it to undergo a sustained communications and education campaign in order to graft onto the national conscious the importance of climate change adaptation awareness.

The CCCA is moreover of the considered opinion that whilst the need for communication and education is recognised amongst policy makers too often, it is this very important factor that is abandoned in the face of competing pressure for funds.

As discussed earlier, climate change is a nebulous concept for many people. The policy implementation recommendations are too often not scientific or technical solutions but behavioural solutions: stopping industry from illegally extracting ground water; convincing citizens that re-used grey water has the appropriate level of quality for landscaping, use of toilet facilities, and educating a farmer to change from a particular crop and rotation cycle to another one.

The CCCA believes that it is pertinent to underline that unless such mobilisation in implementing a sustained education and communications campaign, that is both long term and targets simultaneously

[192] Department for Communities and Local Government , *Climate Change Communication Strategy: A West Sussex Case Study*, , 4, retrieved from http://www.espace-project.org/part1/publications/reading/WSCCClimateCommunications%20Strategy.pdf

different cohorts of the public, is given effect, then the recommendations of this Report, as well as any subsequent report, are highly unlikely to be successful.

Recommendation 81

The policy implementation recommendations relating to climate change adaptation are too often not scientific or technical solutions but behavioural solutions. Consequently, Climate Change Committee for Adaptation proposes the implementation of a sustained education and communications campaign that is both long term and targets simultaneously different cohorts of the public, if the recommendations of this report are to be successfully implemented.

In the design of a communications and education strategy, the CCCA recommends that MRA should develop communication partnerships to assist it in the implementation of the said strategy.

Such communication partnerships can be developed at various levels. MRA could identify message themes that designated communication partners can subsequently divulge by acting as intermediaries.

Thus, for example, the MRA can work with:

- representatives of employees so that such union representatives can communicate and educate their respective members on climate change adaptation;

- representatives of employers so that their respective constituted bodies can communicate and educate their respective members on climate change adaptation;

- different environmental pressure groups to assist it in promulgating climate change adaptation simply across the polity;

- representatives of teachers in order to assist teachers in garnering knowledge on climate change and partake in the design and identification of teaching aids;

- the Malta Council for Science and Technology with regards, on the one hand, to exposing youth on the subject matters through science fairs, competitions et al, and on the other hand, to the awarding of research grants so that a body of indigenous scientific literature on the impact of climate change in Malta is developed.

Recommendation 82

The Climate Change Committee for Adaptation recommends that the Malta Resources Authority should establish communications partnerships with stakeholders such as employee representatives; employer representatives, environment pressure groups, et al where-in such partners could act as intermediaries on communication themes assigned to them.

The communication and education strategy should be based on the use of different channels. These should include, but not necessarily limited to the following:

- TV is one of the most effective message channels. Nevertheless the buying of airtime space on TV can be prohibitive. Thus, TV should be used for the most sensitive messages that the campaign seeks to deliver;

  TV can however, be complemented by the streaming of videos on MRRA, MRA, as well the gov.mt portals. A quick search on the Internet and You Tube brings up a considerable list of good quality videos on climate change that could be freely used. Thus, resources in this direction could be channelled towards creating local climate change adaptation content.

Channel 22 is an effective medium for the delivery of a learning based TV programme directed towards children and other cohorts of society. MRA should work with other institutions such as MCST and vie for funding under appropriate financing tools.

Moreover, MRA should work with local TV news and discussion programmes to establish climate change adaptation as a theme for discussion.

- radio is far more easily accessible than TV and hence should be exploited to the extent possible. The morning and late afternoon programmes on the local radio stations, particularly during the winter programming period, is full of daily discussion programmes. This provides an excellent opportunity for MRA to work with various radio stations to ensure a weekly presence on radio in one station or another;

- the holding of a round-robin annual sessions across local councils in Malta by MRA to discuss and answer questions in an environment within which participants are comfortable, promotes trust and a chance to expand further on the issue;

- the identification of a select number recognised and respected persons in Malta – sports icons, singers, et al, - who would represent the 'face' of the climate change communication and education process and through whom the public can relate to the climate change message;

- the holding of climate change adaptation awareness sessions in schools;

- the setting up of a mobile climate change roving exhibition with demonstrable exhibits and dynamic media which would complement sessions held at local councils and schools;

- the holding of an Annual National Conference on climate change adaptation where local researchers and inventors are supported and during which papers are submitted;

- the creation of a climate change website with interactive multiple media tools directed at all generations designate to represent climate change impacts and effects on Malta, and other customisable scenarios that can be generated by a user.

Recommendation 83

The Climate Change Committee for Adaptation recommends that the Malta Resources Authority adopts a comprehensive communication and education strategy based on the multiple use of different channels.

Successful climate change adaptation requires appropriate knowledge, skills and behavior change that education can provide. Specifically, education can enable individuals and communities to make informed decisions and take action for climate resilient sustainable development. Policymakers, not just in Malta but globally, have not fully engaged the education sector, even though existing climate change frameworks are in place that could utilise education as a mitigation and adaptation strategy[193].

For example, two major climate treaties, the UNFCCC and the Kyoto Protocol, have articles calling on governments to support education for climate change. This is complemented by the focus on education and knowledge as a priority for risk reduction within the *Hyogo Framework for Action: Building the Resilience of Communities and Nations to Disasters, 2005-2015*[194].

The CCCA is not aware that in Malta a structured education strategy for climate changes has been designed or implemented. Thus, MRA should enter into discussions with the Directorate of Education Services within the Ministry of Education to assess how the curriculum of the personal and social development subject taught at both primary and secondary level can be calibrated to allow for the teaching of climate change.

[193] Anderson, A., 2010, *Combating Climate Change through Quality Education, Policy Brief 2010-03*, The Brookings Institution, 5

[194] Ibid

Furthermore, MRA should hold discussions with the Ministry of Education to see how the teaching of climate change adaptation can be taught indirectly as a supporting means to main subjects such as mathematics, physics, sciences, et al.

It is pertinent to underline a UNESCO policy brief on education for sustainable development and climate change states that:

> 'Simply introducing new content about climate change science, causes, consequences, and solutions will not be an adequate response to climate change. Central to processes of mitigation, adaptation, and transformation are *new values*, *creative thinking* and *problem solving skills*. These skills require learners to engage in critical analysis of causes and consequences, creative proposals for possible solutions to problems, testing of new solutions, and evaluation of the outcomes. This requires Education for Sustainable Development teaching and learning methodologies that are **participatory**, **experiential**, **critical,** and **open-ended**.[195]'

The same policy brief adds that in preparing societies for adaptability to risk and physical environmental change, climate change education also needs to be **practice-centred** and focused on **solutions**. Learning-centred actions for change are needed (for example, learning to implement energy saving measures), so that learners can *experience* and *reflexively review* their participation in climate change solutions. Such methodologies are culturally situated and learner-centred. They require teachers to have a good knowledge and understanding of their content and possibilities. For effective change, such participatory, practice-centred methodologies need to be well researched and prepared to ensure maximum benefit and real engagement with change.

In this regard, the MRA should also work with the Ministry of Education to developing teaching aides and material as well as identify free resources on climate change adaptation available on the Internet[196].

Recommendation 84

The Climate Change Committee for Adaptation recommends that the Malta Resources Authority enters into discussions with the Directorate of Education Services to assess how the curriculum of the personal and social development subject, taught at both primary and secondary level, can be calibrated to allow for the teaching of climate change; identify how indirect teaching of the subject can be achieved indirectly through other subjects, identify and design teaching aids.

[195] UNESCO, *Policy Dialogue 4: Education for Sustainable Development and Development Policy*, retrieved from http://unesdoc.unesco.org/images/0017/001791/179122e.pdf
[196] Ibid

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