Climate Change and Adaptation – Policies, Projects and Challenges for Regions

a report from the

Network of Regional Governments
for Sustainable Development (nrg4SD)

to be presented at the

United Nations Framework Convention on Climate Change (UNFCCC)
Eleventh Session of the Conference of the Parties (CoP 12)
First Meeting of the Parties of the Kyoto Protocol (MoP2)

Nairobi, Kenya
November 2006

The Network of Regional Governments for Sustainable Development-nrg4SD is composed of Regional Governments and Associations of Regional Governments, which are considered as bodies that are “in touch”, efficient and representatives of strategic territorial extensions. The mission of the Network is a commitment to Sustainable Development world-wide, following the criteria established in the Gauteng Declaration of the 31st of August 2002, during the Johannesburg World Summit for Sustainable Development (WSSD).

The Network has the following basic objectives: (i) to represent Regional Governments at a global level; (ii) to promote Sustainable Development at the regional government level throughout the world; (iii) to share information and experience concerning Sustainable Development policies with Regional Governments throughout the world; (iv) to promote understanding, collaboration and association between its members; (v) to seek international recognition of the contribution to Sustainable Development made by Regional Governments and (vi) to obtain representation at International Organizations and National Governments.

All Regions and/or Associations of Regional Governments that agree to the Gauteng Declaration of the 31st of August 2002 can be Members of the Network of Regional Governments for Sustainable Development-nrg4SD, subject to approval by the Steering Committee. In addition, stakeholders can participate as Associate Members, with a right to be heard but without voting rights. The term Region is understood in a broad sense as a territory where a system of government exists which is the major and first level of political subdivision, above the municipal level, within a state that is represented in the United Nations Organization. The term stakeholders shall be understood in a broad sense that includes non-governmental organizations, universities and academic institutes, trade unions, trade associations and others.

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1. Foreword

Since the signing in 1992 of the United Nations Framework Convention on Climate Change, and more particularly since the entry into force of the Kyoto Protocol on February 16, 2005, the struggle against climate change has been the main priority on the international environmental agenda. This was reconfirmed at the 12th Conference of the Parties, and the second Conference of the Parties to the Kyoto Protocol, staged in Nairobi on November 6th to 17th last.

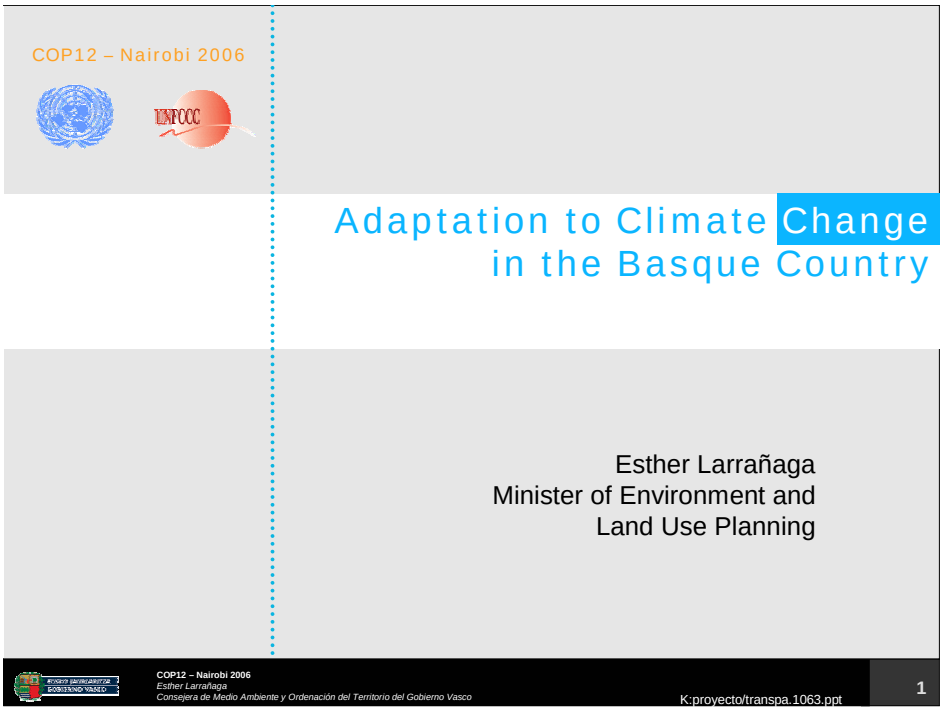
There is now widespread scientific consensus concerning the dramatic consequences of climate change for society, the economy and the environment. Those changes are already affecting many areas of the world, and can only be exacerbated in the future unless immediate decisions are made to mitigate climate change and to get countries to adapt to the new situation. The brunt of these consequences is felt by developing countries, so a solidarity-based view of the problem is required, in which developed countries help to find a solution.

The meetings in Nairobi did not achieve substantial advances in the struggle against climate change, but the agreement reached to review the Kyoto Protocol as from 2008 with new undertakings for the period after 2012, and the so-called Nairobi Framework on capacity building to help developing countries to develop CDM's represent a small step forward, albeit one that will need to be reinforced in the future.

As it has done ever since it was founded, the Network of Regional Governments for Sustainable Development (nrg4SD), took an active part in CoP12 with the organization of a side event under the title: "Climate Change and Adaptation: Policies, Projects and Challenges for Regions". The speakers at the event were representatives of Western Cape, the Basque Country, South Australia, North-Rhine Westphalia, Catalonia and the CRPM. Delegates from North Sumatera, Sao Paulo and Wales were unable to travel to Nairobi, but sent presentations which are included in this report.

We hope that this report, like the two previous reports on the same matter, will serve as a practical example of the ways in which the struggle against climate change can be tackled at regional (subnational) level, based on an approach of overall commitment to sustainable development and a desire to exchange information and share experiences, best practices, etc. to resolve this, the number one problem on the world environmental agenda.

2. Basque Country: Adaptation to Climate Change in the Basque Country



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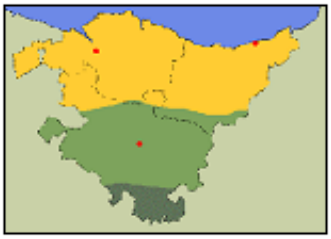
5. **SYNTHESIS**

1. CLIMATE SITUATION IN THE BASQUE COUNTRY

Climate Regions

- The main climate determining factors in the Basque Country are LATITUDE, the DISTANCE TO THE SEA and the RELIEF.
- Taking them into account **THREE BIG CLIMATE REGIONS** can be distinguished:



ATLANTIC SLOPE: moderate temperatures (mild winter and summer), very rainy, important ocean influence

MIDDLE/TRANSITION ZONE: intermediate climate, between oceanic and Mediterranean climates.

SOUTHERN REGION: Dry and hot summer, cold winter. Low monthly rainfall (< 50 mm/month)

2. EFFECTS DERIVED FROM CLIMATE CHANGE IN THE BASQUE COUNTRY

The most important climate variables

- **RAINFALL**:
  - Atlantic Slope: 1,100-2,000 mm/year
  - Mediterranean Slope: 700-900 mm/year
  - **HIGH UNCERTAINTY** related to models.
  - Likely **MAINTENANCE of rainfall in ABSOLUTE VALUES**.
  - Predictable **INCREASE** in **SEASONAL VARIABILITY** and of **INTENSITY**.

2. EFFECTS DERIVED FROM CLIMATE CHANGE IN THE BASQUE COUNTRY

The most important climate variables

- **TEMPERATURE**:
  - Annual average temperature: 14-15 ºC.
  - Coastal zone: 11-12ºC inter-monthly temperature oscillation.
  - Inland zone: 17-18ºC inter-monthly temperature oscillation.
  - During the **20th century** the temperature has had a **general increase**. The predictions for the end of the **21st century** show the following trends:
    - ***INCREASE IN AVERAGE TEMPERATURE***:
      - Coastal zone: 3-5ºC in summer and 1-2ºC in winter.
      - Inland zone: 5-7ºC in summer and 3-4ºC in winter.
    - **INCREASE**, in terms of extend and frequency, of **MONTHLY TEMPERATURE ANOMALIES**
    - **INCREASE** in the number of days with **EXTREME MAXIMUM** temperatures.
    - **DECREASE** in the number of days with **EXTREME MINIMUM** temperatures.

2. EFFECTS DERIVED FROM CLIMATE CHANGE IN THE BASQUE COUNTRY

Other effects derived from climate change :

- **SEA LEVEL RISE:**
  - Annual rise: 0.4 cm/year (40 cm at the end of the 21st century)
- **SWELL CHANGES:**
  - Increase in the **ENERGY** of swell
  - Variation in the **DIRECTION** of swell

The main natural risks of climate origin :

- **RISE IN EVAPOTRANSPIRATION:** 13 mm/decade (per every 0.1ºC/decade temperature increase).
- **Others**: increase in FOREST FIRES, FLOODS and EROSION EPISODES.

3. VULNERABLE SECTORS TO CLIMATE CHANGE

Climate Change Impacts in the Basque Country

Work Methodology

- Analysis of the main impacts in 15 sectors
- Analysis of sector vulnerability according to these elements:
  - Exposure
  - Sensitivity
  - Adaptation aptitude
- The most important sector impacts are evaluated depending on:
  - Uncertainty level
  - Temporality of the effect
- The sectors which have priority are those with relevant impacts and with
  - Uncertainty level: LOW OR MEDIUM
  - Temporality of the effect: IMMEDIATE OR MEDIUM TERM

3. VULNERABLE SECTORS TO CLIMATE CHANGE

SECTOR	RELEVANT IMPACTS	UNCERTAINTY LEVEL [HIGH (H), MEDIUM (M), LOW (L)]	TEMPORALITY OF THE EFFECTS [LONG TERM (L), MEDIUM (M), IMMEDIATE (I)]
Biodiversity	Phenologic changes (migration, reproduction, activity start, etc.)	M	M
	Distribution of species to higher altitudes and latitudes	M	L
	Changes derived from pollution (reproduction, acute toxic episodes, eutrofisation)	H	L
Water resources	Worsening of water balance (more evapotranspiration)	L	M
	Increase in pollution (more use of fertilisers and pesticides, turbidity derived from rainfall, UV radiation, etc.)	H	L
	Increase in water demand (household, agriculture, etc.)	M	M
	More variability of resources (irregular rainfall)	H	M

Priority: Worsening of water balance (more evapotranspiration)

3. VULNERABLE SECTORS TO CLIMATE CHANGE

SECTOR	RELEVANT IMPACTS	UNCERTAINTY LEVEL	TEMPORALITY OF THE EFFECTS
Forest sector	**Initial increase in forest production (deciduous species and Atlantic slope)**	H	M
	Transition from drain effect to emitting effect	H	L
	Increase in forest fires	H	L
	More difficulty in recovering from summer droughts (less water resources as a consequence of the increase in evapotranspiration)	M	M
	Increase in plagues and diseases (especially attacking conifers)	M	L
	Physiologic changes (associated to foliar renewal)	M	M
Agricultural sector (agriculture + livestock)	Phenologic and metabolism changes (cultivation seasons, sowing and crop seasons…)	H	M
	Risk of floods in crops which are near to rivers and the sea.	M	M
	Increase in water needs in order to maintain yield	L	M
	Modification of crops and apparition of new crops	M	M
	Decrease in animal well-being	M	L
	Increase in parasitic conditions	M	M

Priority: Increase in water needs in order to maintain yield
Forest activities to prevent erosion

3. VULNERABLE SECTORS TO CLIMATE CHANGE

SECTOR	RELEVANT IMPACTS	UNCERTAINTY LEVEL	TEMPORALITY OF THE EFFECTS
Continental hunting and fishing	Spread of Mediterranean hunting species instead of Atlantic species and thermophilic fishing species instead of cold water species	H	L
	Decrease in the population of salmon and trout (due to less volume of water and dissolved oxygen)	L	M
Coast zone	Increase of 20-25 cm in the level of floods	L	M
	Rise in sea level (11-13 m) and change of the direction of flow (additional 0-20 m)	L	M
	Deficit of sediments in the of bays	M	M
	Disappearance of beaches because of transport changes (open beaches)	L	M
	Waves surpassing maritime works (increase of 100-200%)	L	M
	Decrease in the stability of dikes	L	M
Marine ecosystems and the fishing sector	Fall in productivity	H	L
	Changes in the distribution of species	H	L
	Increase in invasive species	M	I

Priority: Increase of 20-25 cm in the level of floods
Rise in sea level (11-13 m) and change of the direction of flow (additional 0-20 m)
Disappearance of beaches because of transport changes (open beaches)
Waves surpassing maritime works (increase of 100-200%)
Decrease in the stability of dikes

3. VULNERABLE SECTORS TO CLIMATE CHANGE

SECTOR	RELEVANT IMPACTS	UNCERTAINTY LEVEL	TEMPORALITY OF THE EFFECTS
Mountain zones	Latitudinal migration of animals, plants and plagues	H	L
	Less innovation (ideas and continuation)	H	L
	More decomposition of organic carbon due to microbial activity	L	M
	Fenologic progresses	M	M
	Fall in the population of some species (due to the disappearance of wet environments)	M	M
Edaphic resources	Loss of organic carbon (> 20 kgC(m^2)	L	M
	Increase in erosion	H	L
Transport	Impact over the structural integrity of land, air and maritime infrastructures: in places with risk of floods, landslides, near to the coast or due to temperature rise.	H or M	M
Human health	Increase in morbidity-mortality rate (related to extreme thermic episodes due to temperature rise)	M	M
	Increase of acute respiratory illnesses (related to an increase in atmospheric pollution)	L	M
	Increase in existing parasites infectious diseases and establishment of new vectors	H	M

Priority: More decomposition of organic carbon due to microbial activity
Loss of organic carbon (> 20 kgC(m2)
Increase of acute respiratory illnesses (related to an increase in atmospheric pollution)
To launch epiodemiological and allergological analyses

3. VULNERABLE SECTORS TO CLIMATE CHANGE

SECTOR	RELEVANT IMPACTS	UNCERTAINTY LEVEL	TEMPORALITY OF THE EFFECTS
Energy	Impacts in infrastructures and energy installations	H	M
	Impacts in production and energy transformation	H	M
	Changes in energy demand:	L	I
Tourism	Danger in the integrity or disappearance of coastal tourist resorts	M	L
	Changes in tourist demand: increase in the demand of sun and beach tourism	H	M
Insurance	Increase in the indemnity and economic loss derived from new climate variables in the Basque Country	H	M
Town planning and construction	Danger in the integrity of infrastructures and buildings in the zones with risk of floods, landslides or forest fires	M	M
	Impacts in the living conditions of buildings	H	M
	Impacts in the activity and *modus operandi* of urbanising and land use planning agents	H	M

Priority: Changes in energy demand:
Analysis of economic implications of land uses (town planning)

4. PROPOSAL OF MEASURES TO ADAPT TO CLIMATE CHANGE IN THE BASQUE COUNTRY

Proposal of research measures

SECTOR	RESEARCH MEASURES
General	• Follow up and analysis of climate variations potentially affected by climate change and other affected by those in the Basque Country and local areas
Agricultural sector (agriculture + livestock)	• Researches on the real grade of agriculture and livestock affection derived from temperature rise and a possible increase in evapotranspiration • Research on edaphic and climate viability of energy crops as a consequence of mitigation measures (growing use of biofuels)
Coast zones	• Detailed analysis of vulnerability related to the Basque coast. • Inclusion of parameters that have not been included in the researches on coasts until now (economical or biological)
Marine ecosystems and the fishing sector	• Researches on the level of affection of the sea temperature growth in the marine production
Mountain zones and edaphic resources	• Researches on the level of affection of the change of climate variables in the plant and animal biodiversity • Control and follow-up of organic carbon in land
Energy	• Cartography of the impacts foreseen on the gas production and distribution infrastructures in the Basque Country • Cartography of impacts foreseen in the energy transport and distribution structure in the Basque Country

In general, we will have to limit the scope of the researches and we will have to define the questions we want to answer to

4. PROPOSAL OF MEASURES TO ADAPT TO CLIMATE CHANGE IN THE BASQUE COUNTRY

Proposal of action measures

SECTOR	ACTION MEASURES
General	• Creation a stable work/research group in terms of climate change which gives scientific bases that allow to argue politic decision-making
Water resources	• Agreement on a long term plan on water resources which gathers the previsions of demand and the reserves forecast including the effects derived from climate change
Agricultural sector (agriculture + livestock)	• Adaptation of the cultivation methods to help the productiveness of land and water saving
Coast zones	• Implementation of an integral management system of the coast which takes into account the effects of climate change • Re-evaluation of infrastructures in vulnerable zones and inclusion of the climate change effects in the design of new coastal infrastructures
Marine ecosystems and the fishing sector	• Additional systems to observe and control marine animal and plant species which indicate these effects
Mountain zones and edaphic resources	• Implantation of cultivation systems which through fertilisers, fallow systems or crop waste burial to compensate for its negative effects
Human health	• Creation of a centralised database which gathers data about hospitalisations due to heatwaves, acute respiratory episodes or tropical illnesses in order to evaluate the vulnerability of citizens to extreme situations derived form climate change • Spread of monitorisation systems of the pollution on air in cities • Programmes to reduce risks derived from exposure to allergenic agents (pollen, pollution…)

It will be essential to involve organisms and responsible institutions, the State, town councils, the University of the Basque Country, etc.

5. CONCLUSION

- The Basque Government has commit to fight against climate change and have assumed their responsibility within the Global Community.
- This commitment becomes action by establishing objectives to reduce greenhouse effect gas emissions and through a programme on adaptation to climate change.
- The reduction of emissions is the reflection of our commitment with the world environment and the future generations.
- The adaptation to climate change is our commitment with the citizens of the Basque Country.

3. Catalonia: An Example of Climate Change adaptation in Catalonia integrated management of Ebro Delta

An example of Climate Change adaptation in Catalonia
integrated management of Ebro Delta

Government of Catalonia
Minister of Environment
and Housing

Nairobi, November 2006

Government of Catalonia
Department of the Environment
and Housing

Nairobi, November 2006

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- Main action lines
- Conclusions

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The context: location of the Ebro delta (I)

Catalonia is an Autonomous Community of Spain. It's situated in the northeast of Spain, near France. The location of the Ebro delta is in the south of Catalonia in the Mediterranean sea.

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The context: location of the Ebro delta (II)

The Ebro delta is one of the coastal zone of Catalonia created and exposed to fluvial influences and coastal processes and the most exposed to the threat posed by climate change.

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The context: zone description (I)

Environment: The 20% of the Ebro delta surface is protected for its international importance (high diversity of habitats and key point of birds migration).

Economy: Rice production, fishing, shellfish farming, tourism, ports, yachting, urban sprawl.

Society: Recent human occupation (200 years ago), complex socio-economic network, overlap of administrative jurisdictions.

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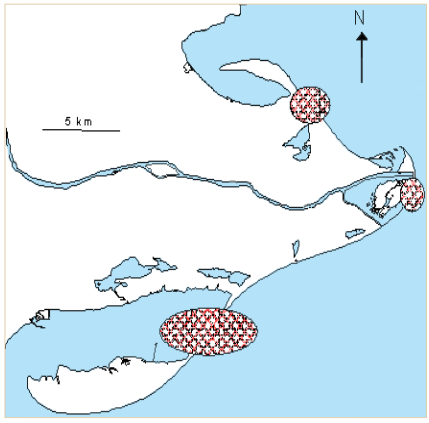
The context: zone description (II)

The Erosion, flooding and sea level rise risks related to the climate change affects different natural, human and economics assets of the Delta. In this map we can observe the most important erosion risk zones.



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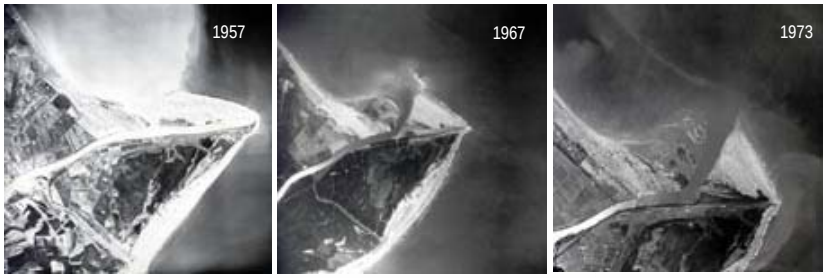
The context: the history (I)

The lost of territory by the erosion has been important in the past century but the climate change can increase and accelerate this processes



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The context: the history (II)

Long-term (decadal) shoreline changes in Cape Tortosa

Max erosion (Cap Tortosa) retreat > 1750 m in 43 yrs

Source: Jiménez et al (2005)

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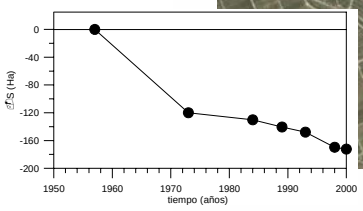
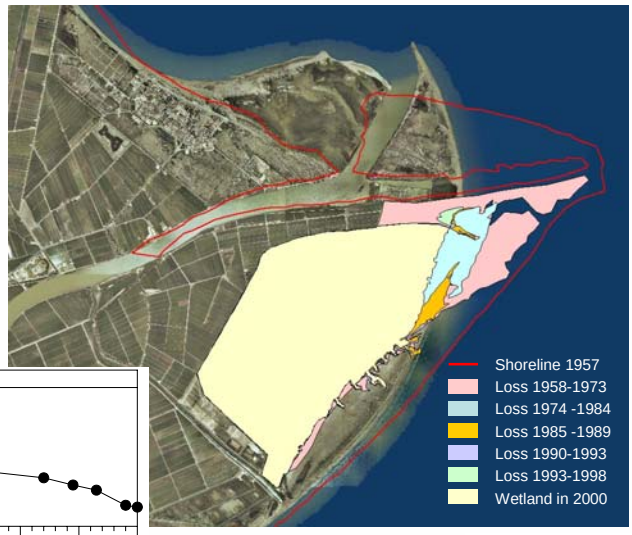
The context: the history (III)

The loss of natural elements by the erosion has been important especially in the Buda Island (one of the most important Delta wetland)

Wetland surface in Cape Tortosa





Source: Jiménez et al (2005)

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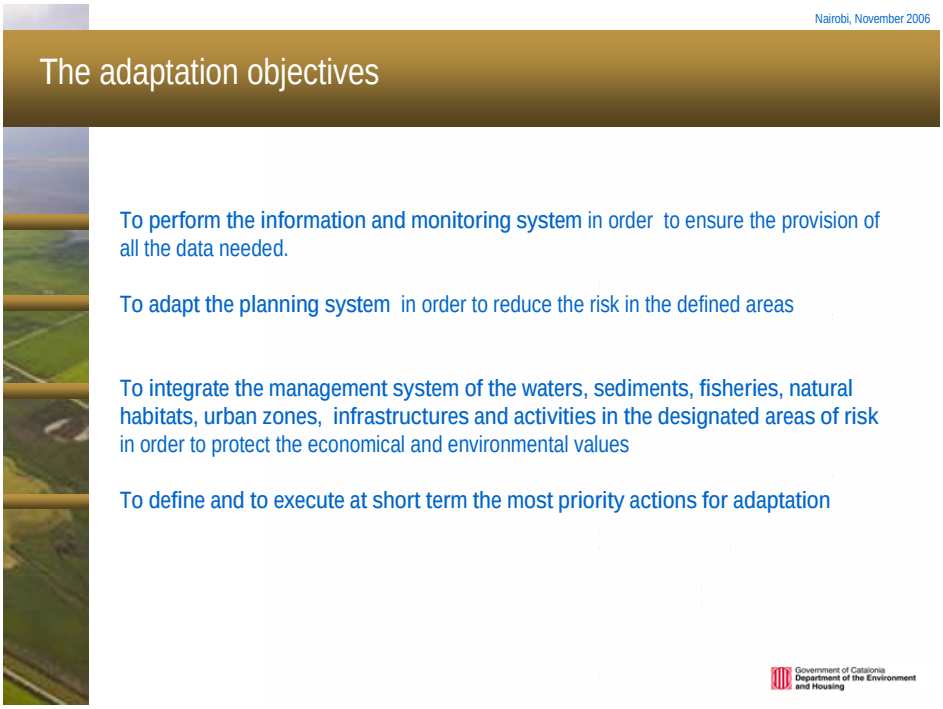
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The adaptation objectives
To perform the information and monitoring system in order to ensure the provision of all the data needed.
To adapt the planning system in order to reduce the risk in the defined areas
To integrate the management system of the waters, sediments, fisheries, natural habitats, urban zones, infrastructures and activities in the designated areas of risk in order to protect the economical and environmental values
To define and to execute at short term the most priority actions for adaptation
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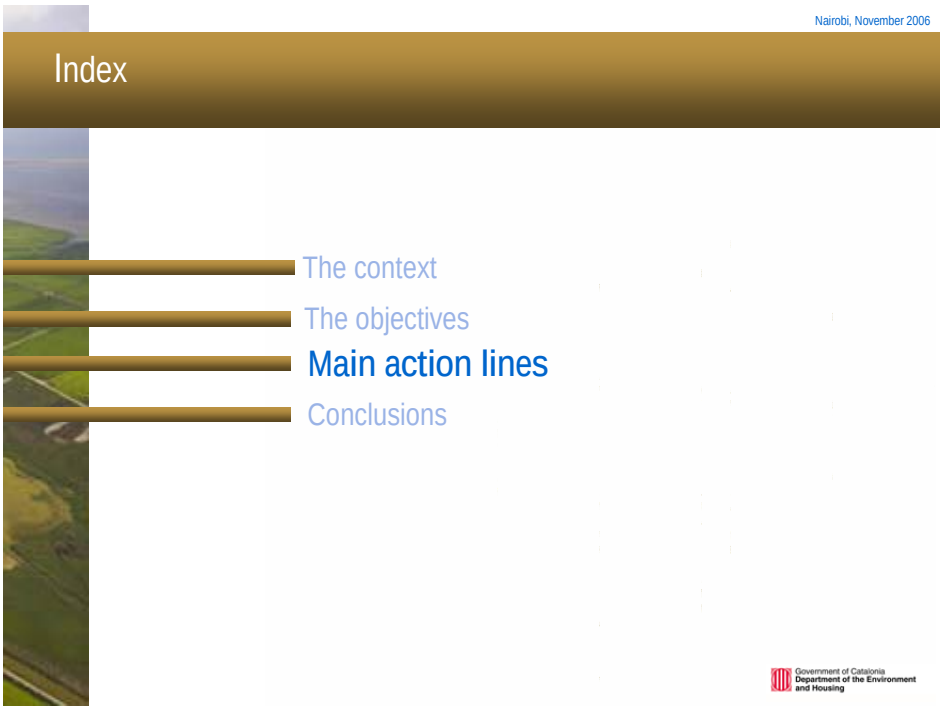
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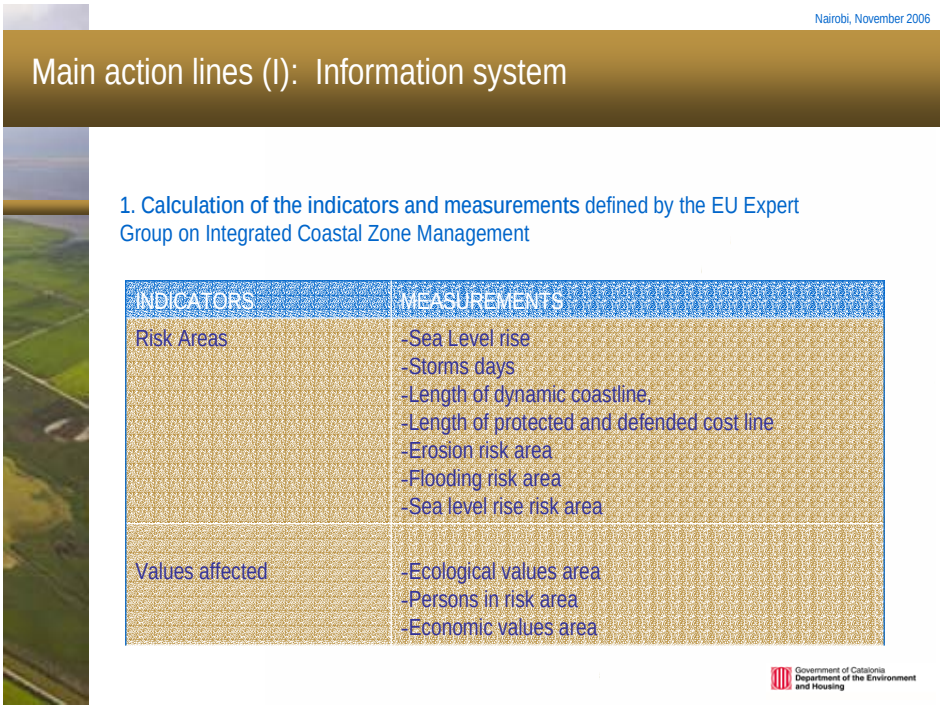
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Main action lines (I): Information system
1. Calculation of the indicators and measurements defined by the EU Expert Group on Integrated Coastal Zone Management
INDICATORS
MEASUREMENTS
Risk Areas
-Sea Level rise
-Storms days
-Length of dynamic coastline,
-Length of protected and defended cost line
-Erosion risk area
-Flooding risk area
-Sea level rise risk area
Values affected
-Ecological values area
-Persons in risk area
-Economic values area
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Main action lines (II) : Planning system

2. All the plans affected or that affects the designated risk zones must use the common information system to calculate the impact over the climate change indicators and measurements

Plans affected	Plans that affects
Natura 2000 Habitats plans Rice Areas plans and programs Urban plans Desalinization plans Shellfish plans	Ports plan Urban plans Irrigation plans Mobility and infrastructures plans

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Main action lines (III) : Integrated Management

3. To create a Consortium integrating all the organisms with competences in the risk areas. The first mission will be to prepare and develop an Integrated Plan for the adaptation measures

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Main action lines (IV): Integrated Management

4. This integrated management approach will be complemented with a participatory process with all stakeholders (Forum creation).

- Private sector
- Fisheries and shellfish farms
- Rice fields owners and farmers
- Salt works
- Tourism activities
- Urban owners
- Universities
- NGOs

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Main action lines (V): Priority actions

5. In order to solve the main problems at short term it will be necessary to define a set of urgent actions like:

- Acquisition of private land or requalification of land uses of the most risky areas
- Protection measures development of the risk areas with an ecological criteria
- Agreements with private sector to developed adaptation activities for risky zones

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Main action lines (VI): Ecological criteria protection measures

Examples of actions

- Reconstruction of the dune cord
- Breakwaters elimination and beach reconstruction in order to increase wave dissipation capacity
- Reconstruction of the dune cord
- River margins stabilization through the naturalization of slopes and bank vegetation
- River forestry and natural patrimony recovery
- Elimination of artificial obstacles
- Recovery the naturalness of the sandbank and management of its functionality

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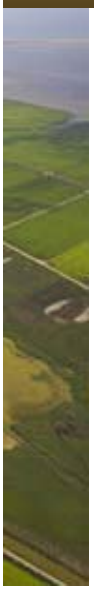
Main action lines (VII): Agreements within the private sector



Examples of actions

- Canals management modification to improve lagoon conditions
- Improving the mussel and shellfish aquaculture management
- Analysis of alternatives to the actual urban land use
- Management of its functionality
- New accesses and electrical line
- Substitution planning of areas and land uses

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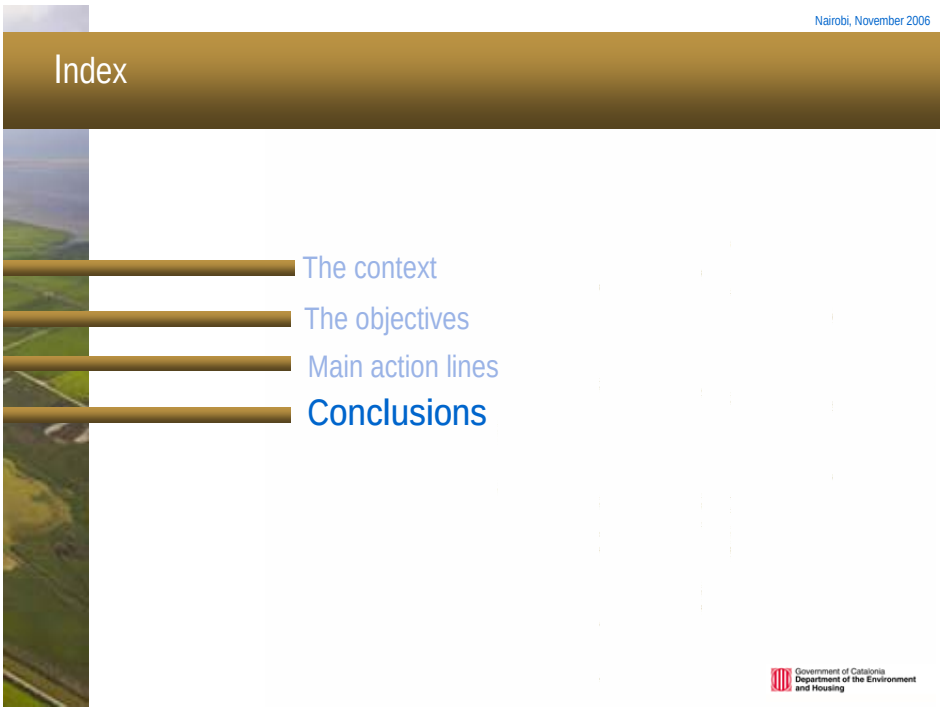
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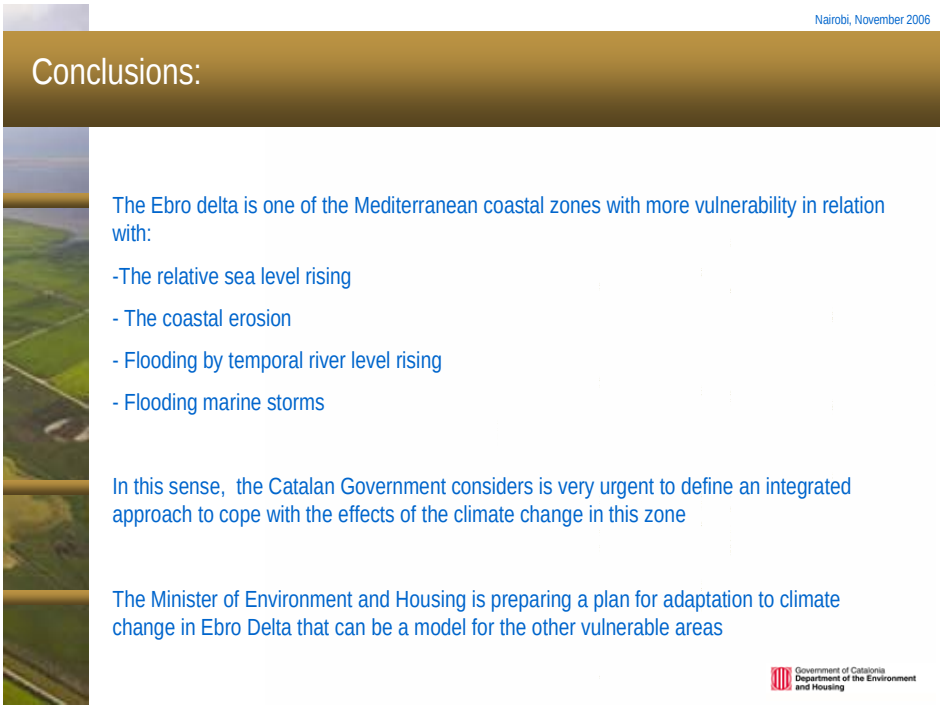
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Conclusions:
The Ebro delta is one of the Mediterranean coastal zones with more vulnerability in relation with:
-The relative sea level rising
- The coastal erosion
- Flooding by temporal river level rising
- Flooding marine storms
In this sense, the Catalan Government considers is very urgent to define an integrated approach to cope with the effects of the climate change in this zone
The Minister of Environment and Housing is preparing a plan for adaptation to climate change in Ebro Delta that can be a model for the other vulnerable areas
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4. CRPM: Climate Change Adaptation and European Maritime Regions

Adaptation to climate change involves considering climate change impacts on a range of sectors, organizations and people. The impacts of climatic changes will ,hit locally and regionally in different ways. The majority of adaptation actions will therefore need to be decided and to be undertaken at the local and regional level.

Almost all the analysis and studies in this field highligted the vulnerability of coastal areas and maritime territories; it's the reason why the European maritime regions are fully involved in this problematic and want to be part of the actions undertaken by the European Union.

The maritime regional governments must be faced to three mains questions:

- How must we be organised to be active and efficient?
- What are our needs in terms of data, know how and access to good practices and experiences?
- What priorities in terms of requirement and projects to be led in the context of interregional and trans national cooperation?

Concerning the first question we have several situations depending of the internal organisations of the regions:

- some regions have included the issue of climate change as such in their organisation chart; doing so collectively among several regions or with this issue under other policy area;
- some regions have launched specific projects as response;
- some other regions consider that they do not have enough in formation on the subject.

There is no clear correlation between a region's remit and its decision to take this issue into consideration. UK regional authorities for example do not have a particular remit in this area but this does not prevent them from dealing with this issue in their strategy and regional planning documents.

The most common stumbling blocks identified as to why little or no account is taken of these issues at regional level are:

- lack of political cohesion and share priorities between ministerial departments;
- lack of powers at regional and local level;
- insufficient awareness;
- lack of informztion, applicazble knowledge, operational solutions and successful experiences that could be used as references;
- lack of coordination between different regional departments.
-

Nevertheless a lot of regional initiatives and projects are in progress; they show that, at the current stage, the focus is still on prevention initiatives and organising how to address the issue at the regional level – establishing partnerships and structuring dialogue with the sectors concerned, reorganising internal organisation charts, drafting strategic papers and planning documents.

As far as the projects are concerned, the regions are currently concentrating on the following areas:

- drafting strategies, policies, plans and programmes;
- raising awareness;
- establishing regional partnerships;
- research;
- identify priority projects to be launched.

The expectations and requirements of the regions with regards to adapting to climate change are clear:

- the main requirement expressed by the regional authorities is to be informed in a practical and operational way; at the moment the most effective channels of information are through the respective national governments and the level of information most often depends on the degree of States involvement.
- On the whole the requirements relate to the entire process, from information to concrete actions; two clear priorities may nevertheless be identified: needs in terms of exchange of experiences and good practices on regional strategies and the desire to be involved in interregional cooperation projects.

With regards to the content of cooperation actions one area is always mentioned by the regions: the spatial planning and the implementation of the integrated coastal zone management principles.
The other priorities are:

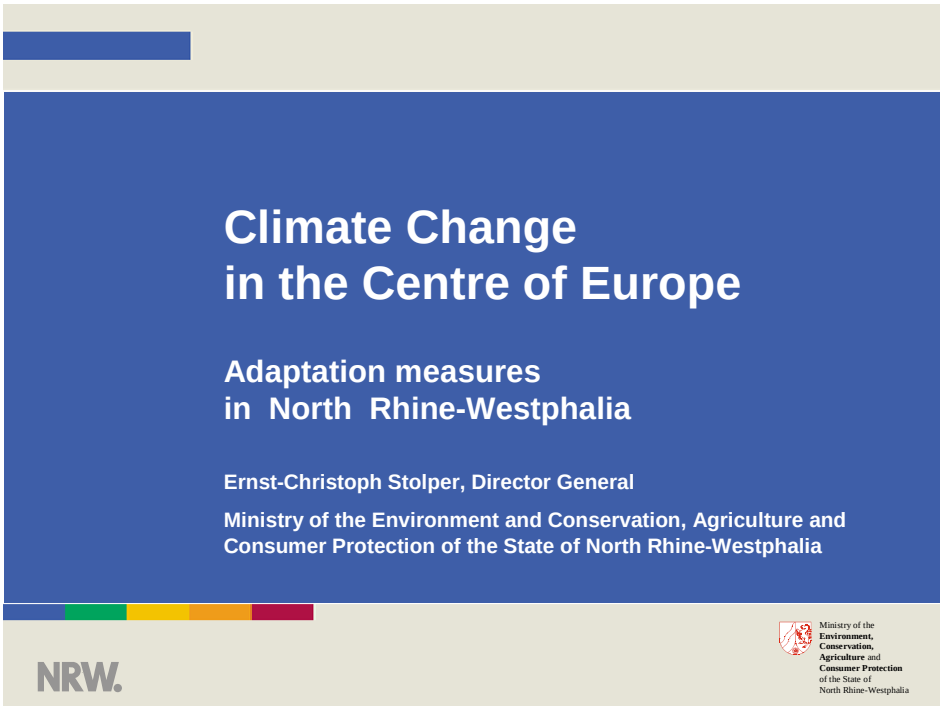
- the participation in networks of exchange of experiences – mainly those regarding the economic sectors most concerned like tourism, agriculture and forestry and infrastructures;
- the management of natural resources,
- the energy field;
- the water resources management issues and
- the question of information and data access.

Finally if most of the European regional governments have a clear awareness of this issue, most of them do not have a clear understanding of what must and could be do.

We have, as regional network, a role to play in identifying the needs and requirements of the regions and in launching a huge reflection of the regional internal models of development. CPMR is fully involved in that in connection with the United Nations Development Programme.

And to reach the necessary success we need nrg4SD is really the best network the regional governments have at their disposal.

5. North Rhine – Westphalia: Climate Change in the Centre of Europe



Assessment of Regional Vulnerability

NRW.

Ministry of the **Environment, Conservation, Agriculture** and **Consumer Protection** of the State of North Rhine-Westphalia

Climate Change in Germany and NRW

Expected impacts

- More heavy rainfalls, less rain during summer
- Increase of weather extremes
- Extension of the vegetation period by 8 days/a
- Loss of biodiversity

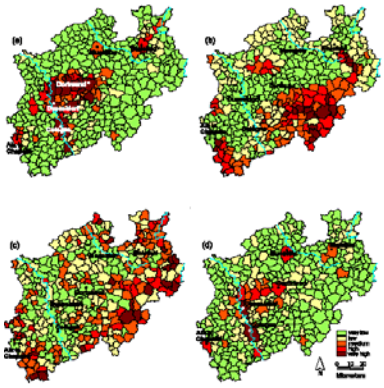
Costs of Climate Change in the last decade

- Flooding: 13 billion €
- Heat waves and droughts: 1 billion €
- Storms: 2,5 billion €
- 7,000 deaths because of weather extremes

NRW.

Ministry of the **Environment, Conservation, Agriculture** and **Consumer Protection** of the State of North Rhine-Westphalia

Assessment of Regional Climate Vulnerability Study for North-Rhine Westphalia



- Focus on extreme weather events like *heat waves, cold spells, wind- and hail storms, floods etc.*
- Identification of affected sectors like *agriculture, forestry, tourism, industrial production etc.*
- Selection of basic vulnerability indicators for each sector, for example: *population density, rivers and lakes, areas of monocultures, pending erosion etc.*
- Thematic maps visualize vulnerabilities to various extreme weather events

(Reference: Kropp et.al. "Semiquantitative Assessment of Regional Climate Vulnerability: The North Rhine-Westphalia Study, Climate Change 2005)

NRW.

Ministry of the **Environment, Conservation, Agriculture** and **Consumer Protection** of the State of North Rhine-Westphalia

Regional measures on adaptation

NRW.

Ministry of the **Environment, Conservation, Agriculture** and **Consumer Protection** of the State of North Rhine-Westphalia

Sustainable Flood Protection

- Less sealing of surface by means of
  - Prohibiting building outside specifically defined areas
  - Premium for de-sealing within the program "Ecological and sustainable water management in NRW"
- No settlement in areas with flood risk
- Planning and construction of retention areas (170 million m^3 until 2016)

NRW.

Ministry of the Environment, Conservation, Agriculture and Consumer Protection of the State of North Rhine-Westphalia

Study: Cross Border Impacts of Extreme Floods at the Lower Rhine I

Co-operating bodies

- Rijkswaterstaat Netherland
- Province of Gelderland
- Ministry of the Environment and Conservation, Agriculture and Consumer Protection NRW
- Funded by the EU

Core issues

- What is the expected maximum runoff volume?
- What happens if the flood level exceeds that of the embankments

NRW.

Ministry of the Environment, Conservation, Agriculture and Consumer Protection of the State of North Rhine-Westphalia

Study: Cross Border Impacts of Extreme Floods at the Lower Rhine II

Main results

- On a length of 200 km embankments will be too low by approx. one meter in case of a 1000 year flood.
- Parallel flows behind the flood protection facilities

Consequences of the study

- Presentation of the results at the German-Dutch Flood Conference in September 2004
- Production of detailed maps as basis for emergency plans
- Information and involvement of industry

NRW.

Ministry of the Environment, Conservation, Agriculture and Consumer Protection of the State of North Rhine-Westphalia

First consequences in the forestry sector

Facts

- Heat stress and draught threatens wide spread tree species “Norway Spruce”

Recommendations

- Shift of tree species
- New silvicultural solutions are needed

NRW.

Ministry of the Environment, Conservation, Agriculture and Consumer Protection of the State of North Rhine-Westphalia

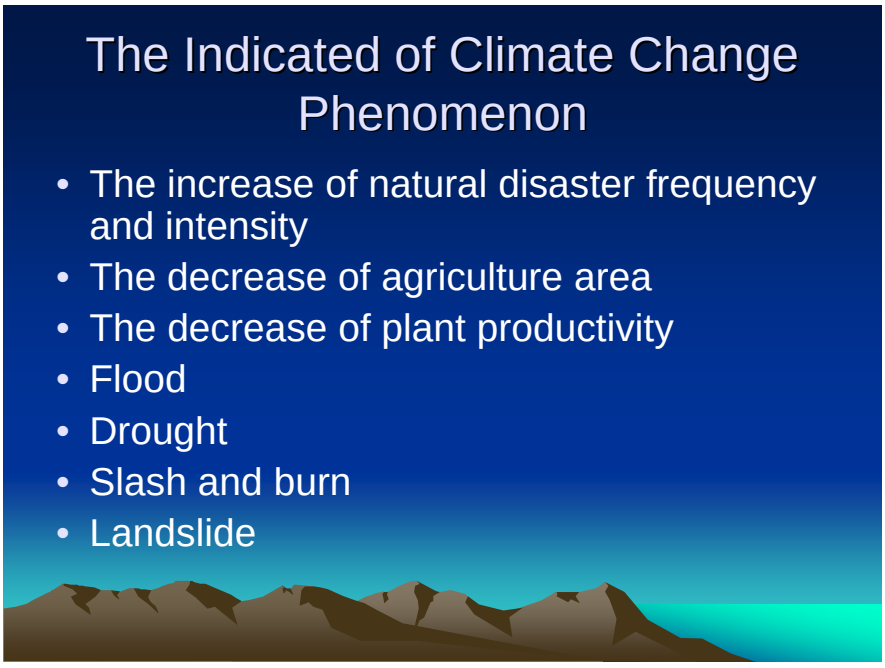
Conclusions

- Even in the centre of Europe – with it´s moderate Climate – Changes become obvious
- NRW set up a Task force on Adaptation
  - Gather facts and developments
  - Propose priorities for solutions
- General recommendation:
- Start with Climate protection measures (adaptation and mitigation) as early as possible to reduce costs and to gain time

NRW.

Ministry of the **Environment, Conservation, Agriculture** and **Consumer Protection** of the State of North Rhine-Westphalia

6. North Sumatera: The policy to Adaptate on Climate Change and Global Warming in North Sumatera Province

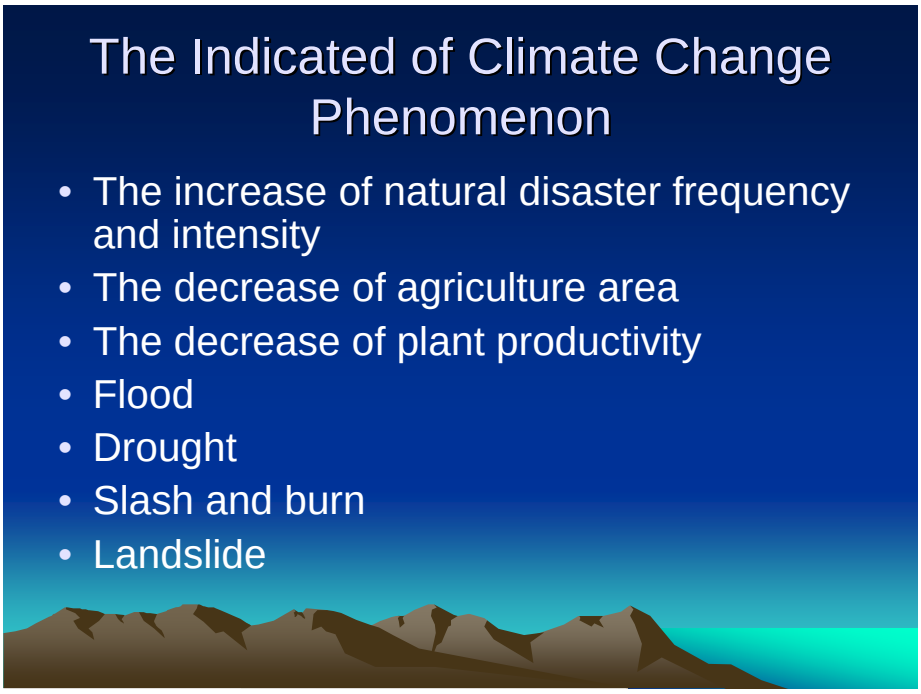


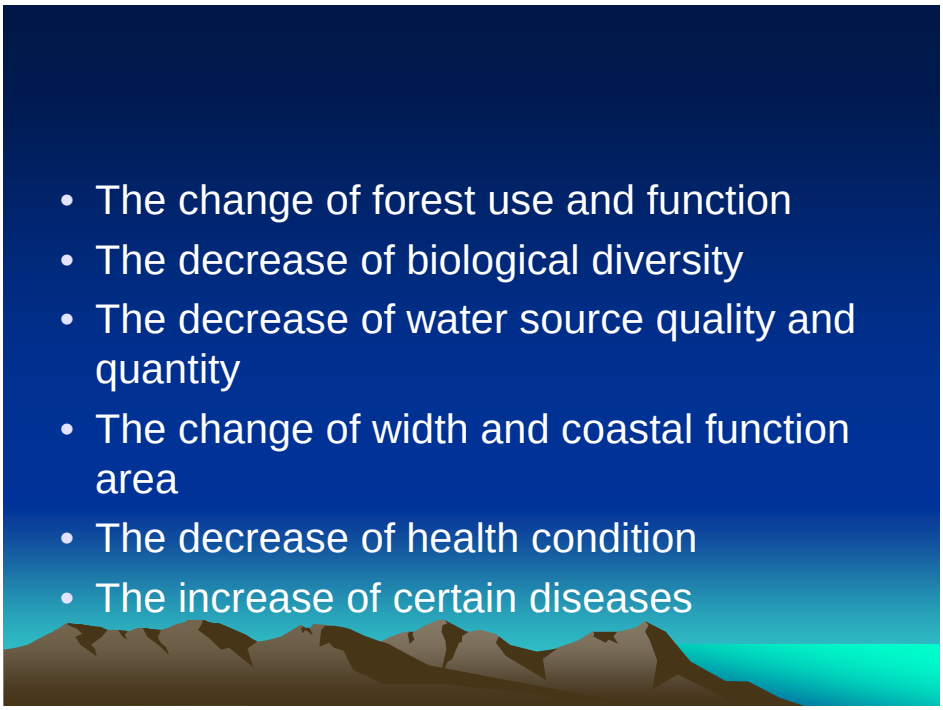
GENERAL CONDITIONS OF NORTH SUMATERA

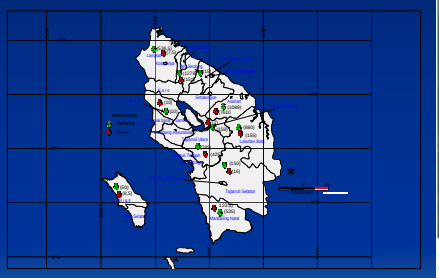
- North Sumatera as one of Indonesia province, which is archipelago country
- Between two continent Asia and Australia
- Between Pacific and Atlantic ocean.
- Population 12 million
- Population Growth 1.2%
- Life expectancy 68 years
- Total area 71.680 km2(3.7% of Indonesia)

Current issues

- Affected by climate change because of the circulation between two continents and two oceans
- Two third of inhabitant rely on agriculture. The decrease of harvest affected by climate change influence social and economic condition


The Indicated of Climate Change Phenomenon
• The increase of natural disaster frequency and intensity
• The decrease of agriculture area
• The decrease of plant productivity
• Flood
• Drought
• Slash and burn
• Landslide


• The change of forest use and function
• The decrease of biological diversity
• The decrease of water source quality and quantity
• The change of width and coastal function area
• The decrease of health condition
• The increase of certain diseases



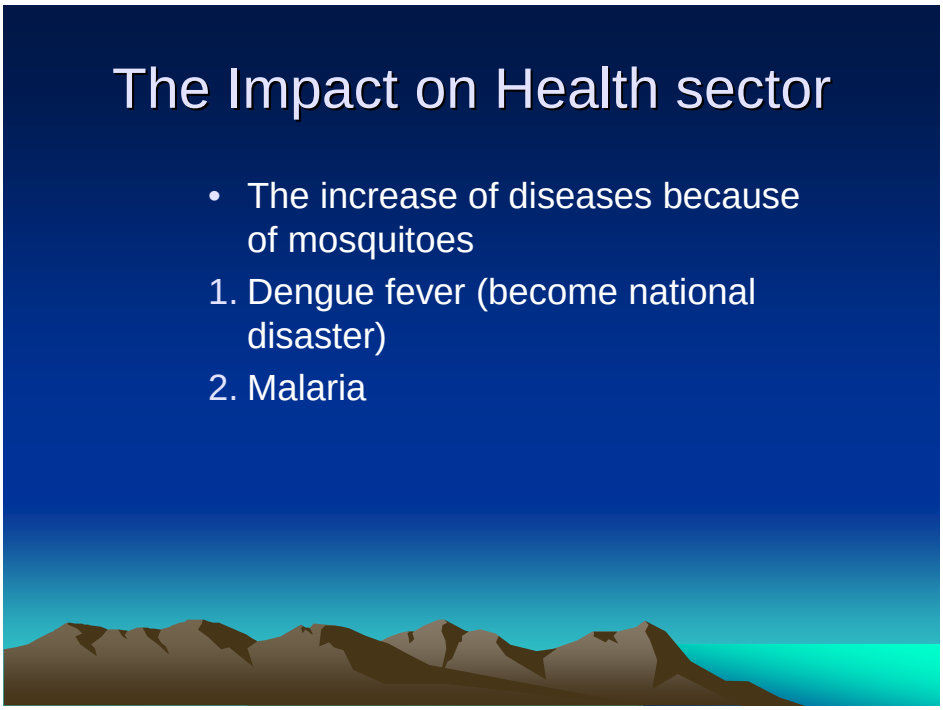
Deforestation exacerbates the problems faced by countries already prone to tropical cyclones and associated flooding. In Haiti, which suffered severe flooding in 2004, wood is the basic cooking fuel.

The Impact on Agriculture sector

- Agriculture product has decreased each year because of:

1. Flood
2. Erosion, the change of land humidity
3. Lost of fertile farm/land
4. Change of plant period
5. Drought become longer, water deficit
6. Acceleration of evaporation during the summer, influenced the irrigation techniques.
7. Rice Importing


The Impact on forest sector
• The huge of slash and burn took place in 1982,1983, 1987,1990,1994,1997,1998
• The width of Mangrove forest decrease continuously (although some because of human activity)


The Impact on Health sector
• The increase of diseases because of mosquitoes
1. Dengue fever (become national disaster)
2. Malaria

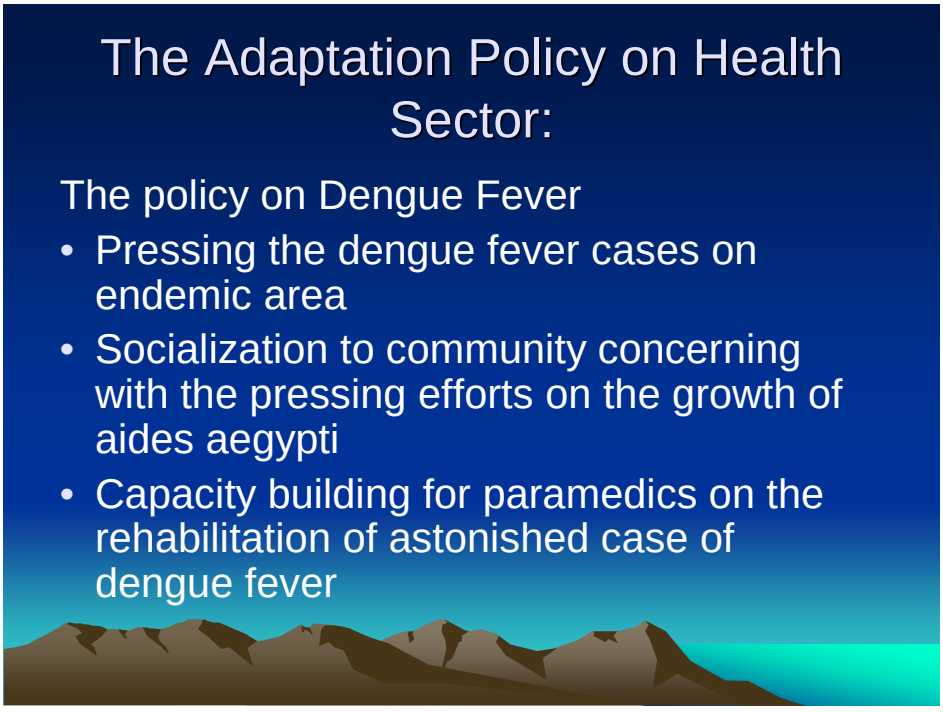
The Impact on the sea water surface

- The increase of sea water surface has occurred in Medan
- In Belawan (Medan harbor) the improvement of water surface is 7.83 mm/years
- The improvement of the sea water surface overflowed the shrimp and fishpond
- The improvement of temperature, evaporation and salinity, reduce the rapid grow of sea species

The Adaptation Policy on the Agriculture Sector:

- The adjustment planting system,
- The development of the alternative food product as the substitute of rice which could be survived on the water drought.


The Adaptation Policy on Forestry Sector:
• Reforestation
• Expansion of the urban forest and green area on river flood plain and open space
• Prohibition of illegal logging
• Regulation of the forest zone


The Adaptation Policy on Health Sector:
The policy on Dengue Fever
• Pressing the dengue fever cases on endemic area
• Socialization to community concerning with the pressing efforts on the growth of aides aegypti
• Capacity building for paramedics on the rehabilitation of astonished case of dengue fever

The policy on malaria

- Pressing malaria cases on endemic area by:

1. Treatment.
2. Intervention on environment and human attitude.
3. Pressing on vector growth.

The Adaptation Policy on Soil Water

- Controlling of the soil water use by change the community paradigm that water is spilled over
- Increasing of the absorption area
- Developing of the flood restrain Infrastructure

The adaptation policy on environmental sector:

- Reduce and suspend the use of ozone harmful material gradually, then completely annihilated in 2010
- Develop the alternative gas as the substitute of CFC

Recommendation

- The cooperation among some parties who concern on the climate change issues
- The forum establishment on crossing sector and regional to integrate the correct action on adaptation to climate change

7. São Paulo: Adaptation and Vulnerability to Climate Change in Latin America[1]

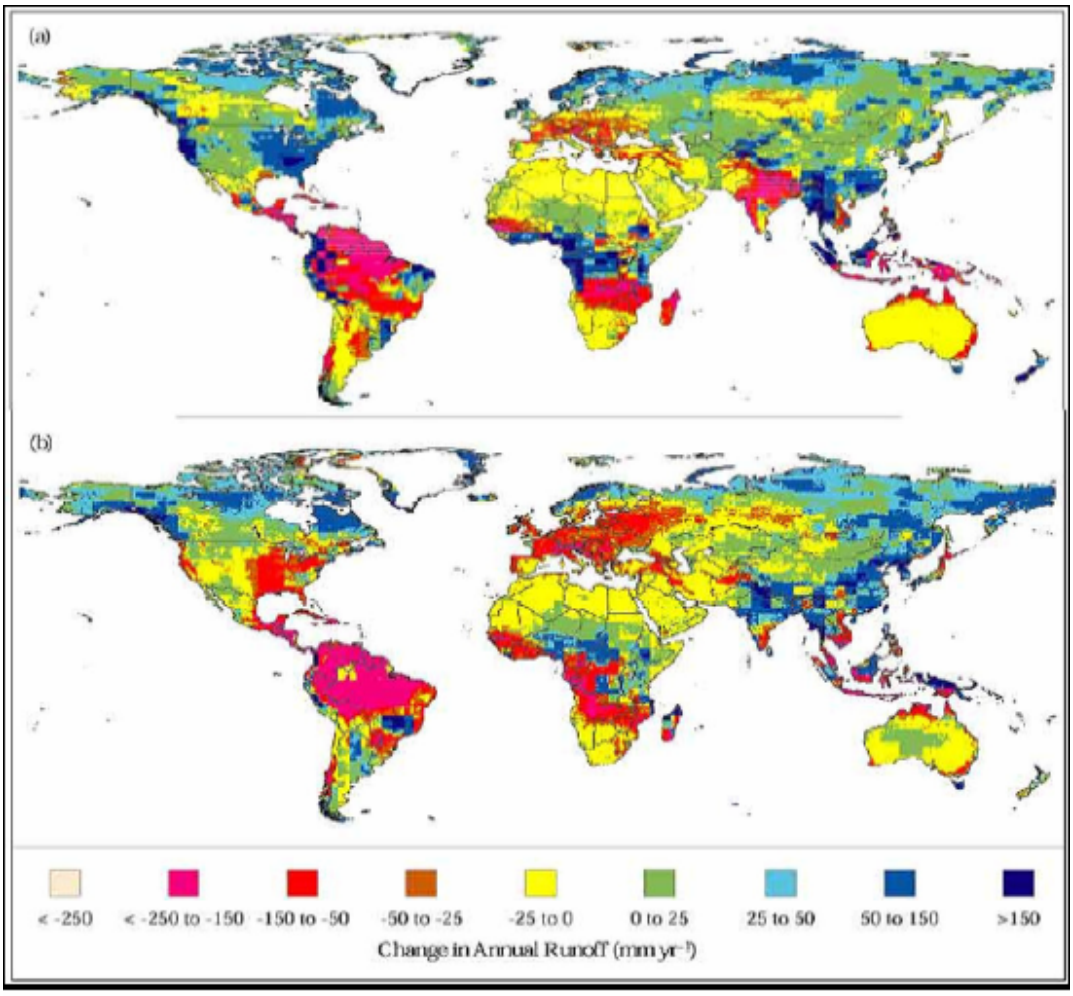
A text from São Paulo for the Network of Regional Governments (nrg4SD) side event at the 12th Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), November 16th, 2006 - Nairobi, Kenya1

Drought in the Amazon, 2005

1. The impacts of climate change in Latin America

Latin America has a large variety of climates as a result of its geographical configuration. It has the largest pluvial forest in the world (7.5 million km2), large and growing arid and semi-arid areas, the largest terrestrial and marine biological diversities in the world and the largest fish catch on the eastern Pacific. Seven of the world's most diverse and threatened areas are in Latin America and the Caribbean: 48% of all 191 ecoregions are critical (18%) or endangered (30%);
32% are vulnerable, 16% are relatively stable, and 5% are relatively intact.
Overall, climate change in Latin America will cause higher temperatures, less rainfall and humidity.
Adaptation, available at www.ipcc.int

[1] Prepared by the São Paulo State Environment Secretariat (Oswaldo Lucon), based on the IPCC Report on Adaptation, available at www.ipcc.int



Changes in global patterns

Also, there will be less permanent snow and melting glaciers. The sea level rise leads to losses of coastal land and biodiversity, saltwater intrusion and infrastructure damage.

Atmospheric circulation patterns will be more perturbed, with extreme events more often and intense. Desertification is increasing and the *savannization* of the borders of Amazon Rainforest is becoming irreversible, affecting nutrient cycling. CO2 enrichment is believed to contribute to observed imbalances between CO2 uptake and release.

With one of the greatest disparity in income distribution in the world, Latin America and the Caribbean are highly vulnerable to climate change. Population explosion is expected to reach 838 million by 2050 and most Latin American countries' economies depend on agricultural productivity; a critical problem is nutrition and availability of food. Regional variation in crop yields as a result of climate change

could lead to an increased risk of hunger for an additional 50 million people by 2050. Other problems include water scarcity and vector and human-borne diseases.

2. Adaptation and the UNFCCC

The United Nations Framework Convention on Climate Change (UNFCCC) considers adaptation as a natural step, not as an allowance to emit greengouse gases:

*Art. 2 – "The **ultimate objective of this Convention** (...) is **to achieve** (...) **stabilization of greenhouse gas concentrations in the atmosphere** at a level that would prevent dangerous anthropogenic interference with the climate system (...) within a time-frame sufficient to **allow ecosystems to adapt naturally** to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."*

*Art. 2 – "The **ultimate objective of this Convention** (...) is **to achieve** (...) **stabilization of greenhouse gas concentrations in the atmosphere** at a level that would prevent dangerous anthropogenic interference with the climate system (...) within a time-frame sufficient to **allow ecosystems to adapt naturally** to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."*

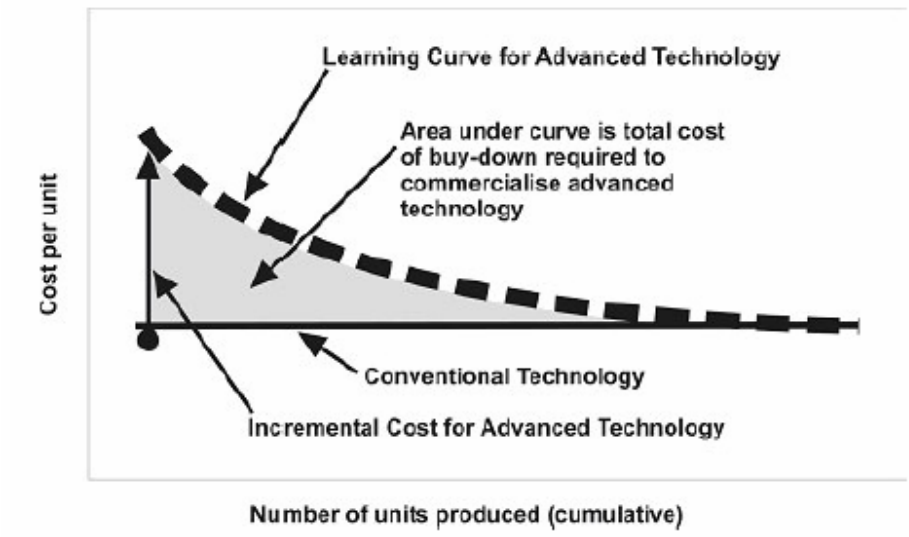
Using adaptation as an alternative solution to climate change is against the basics of the Convention, ratified by almost two hundred countries since 1992.

3. Adaptation is not a solution

Slowly boiling a frog

Deriving funds to adaptation delays progress and do not solve the problem. Approaches to address adaptation in developing countries, such as Official Development Assistance (ODA), targetted assistance, building adaptive capacity, climate risk management or even migration are **innefective** and **affect negatively**

the ongoing measures for **Mitigation**, especially the Clean Development Mechanism and the learning curves of cleaner energy systems.



The learning curve for cleaner technologies

4. A proposal for the nrg4SD on Adaptation

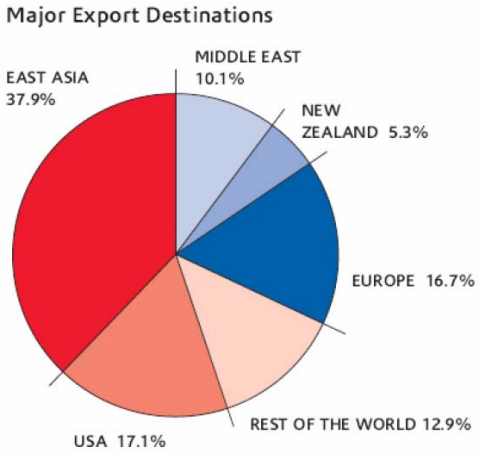
Regions: working together for a sustainable future

Acknowledging that poor people are less resilient to adaptation problems and by having an important role in the Climate Change debate, the nrg4SD partner regions should have a common position on Adaptation, in the sense that **"Adaptation should be pursued as a natural process and not as a GHG *emissions waiver*".** This will contribute positively to engage all nations in mitigating carbon emissions instead of adapting to its impacts in an unequitable way.

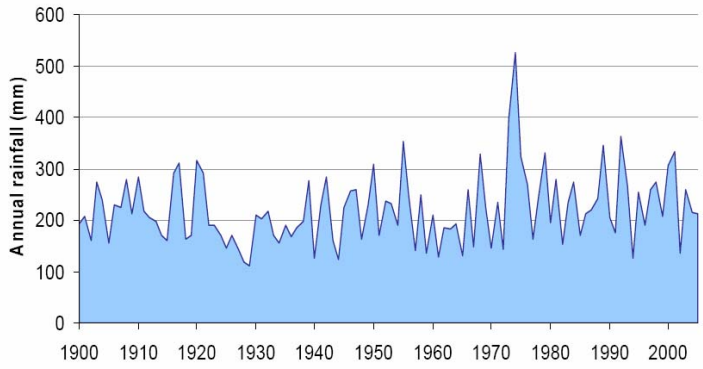
8. South Australia: South Australia, Land of the Dry- Reducing, Adapting and Innovating

South Australia

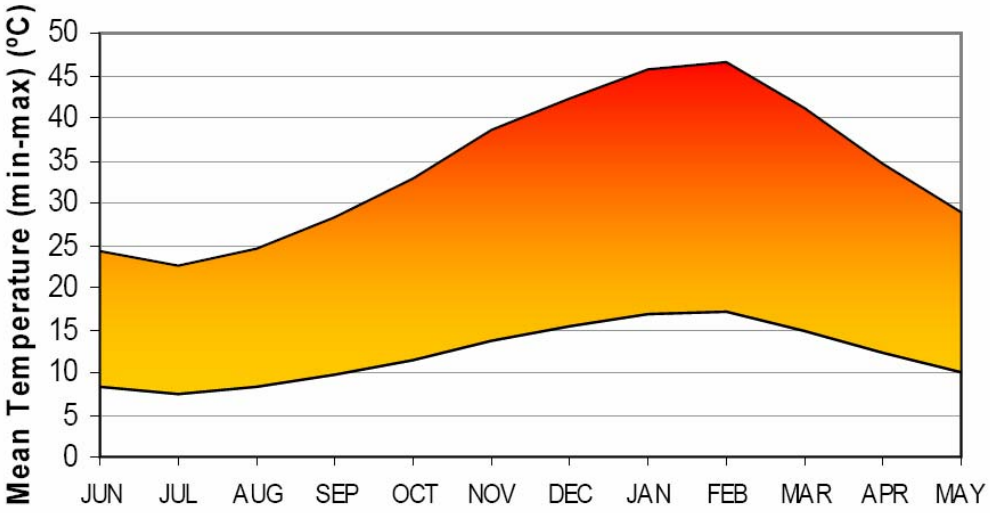
Exporting to the World



Variable Rainfall – last 105 years

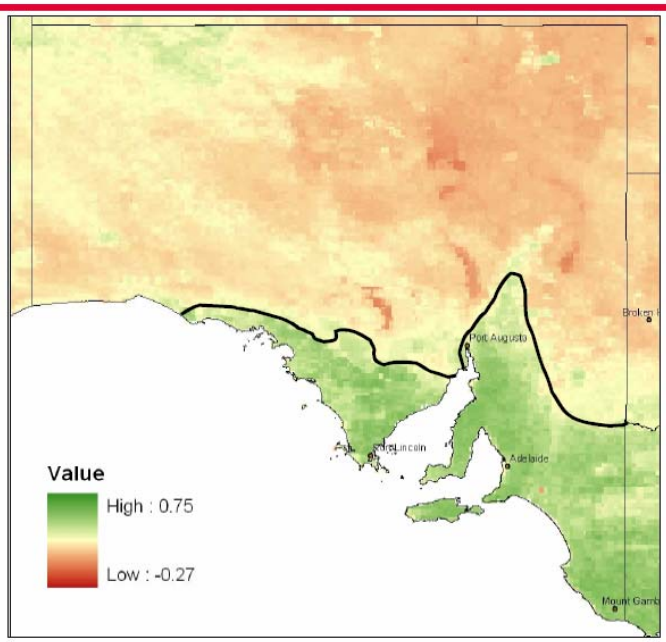


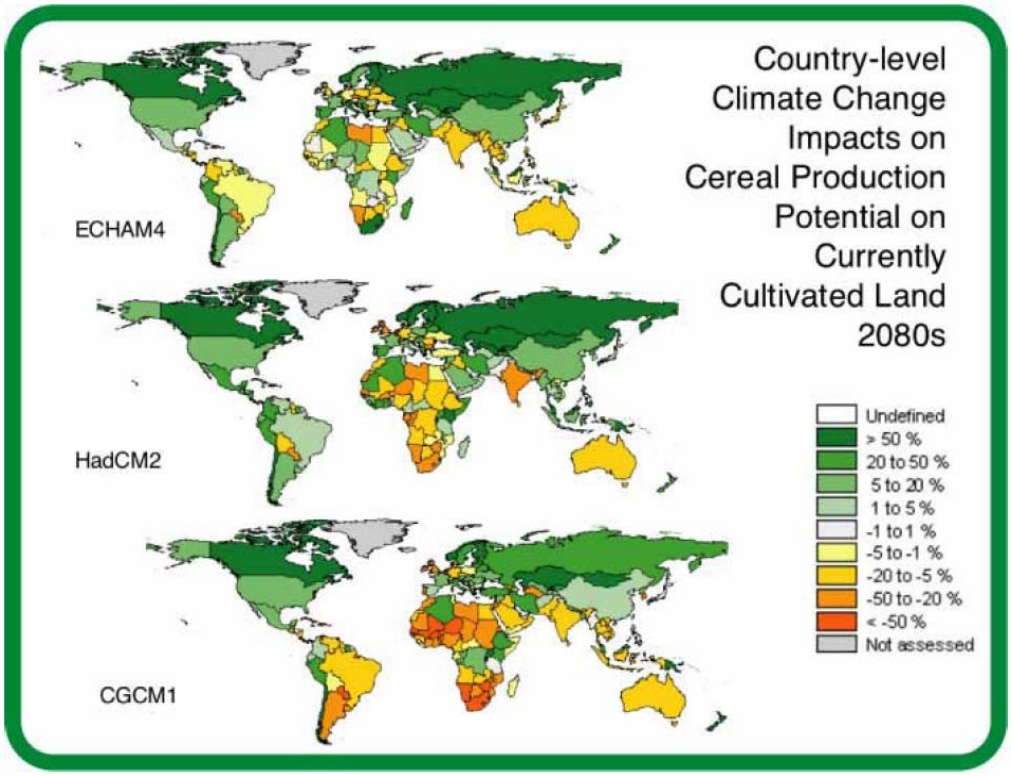
Average Temperature over a year



Vegetation Overview

Government of South Australia
Department of the Premier and Cabinet

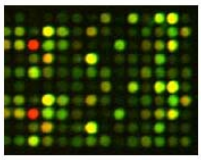




Adaptation

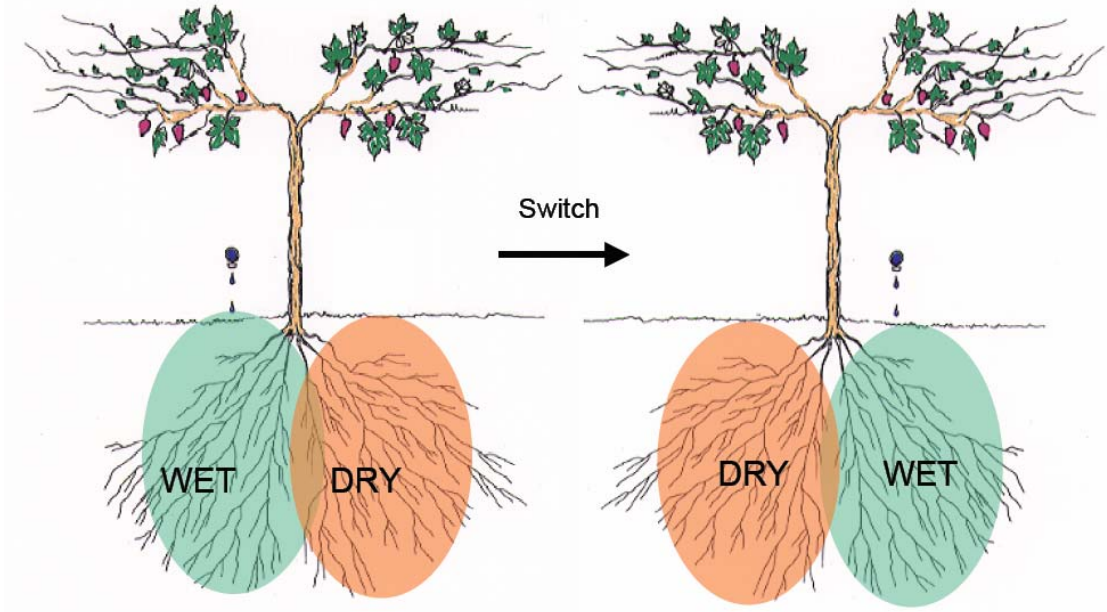
Government of South Australia
Department of the Premier and Cabinet

- Plants
- Field
- Farm
- Regional



Plants

Field

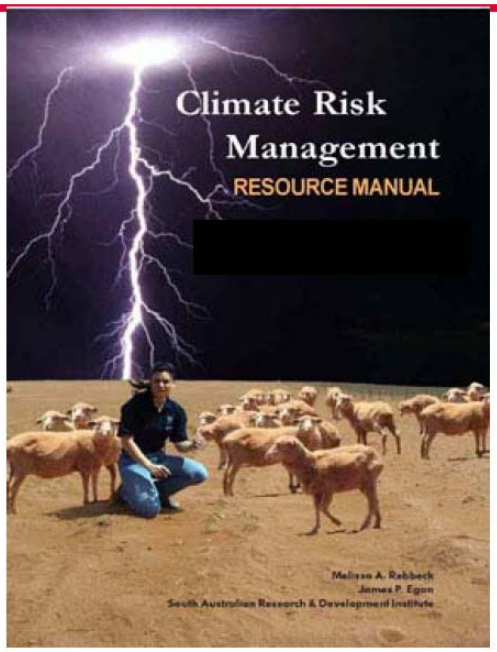


Farm

Government of South Australia
Department of the Premier and Cabinet

Farm

Government of South Australia
Department of the Premier and Cabinet



Farm – Workshop Modules

Government of South Australia
Department of the Premier and Cabinet

Module 1:
Understanding climate risks and seasonal forecasts

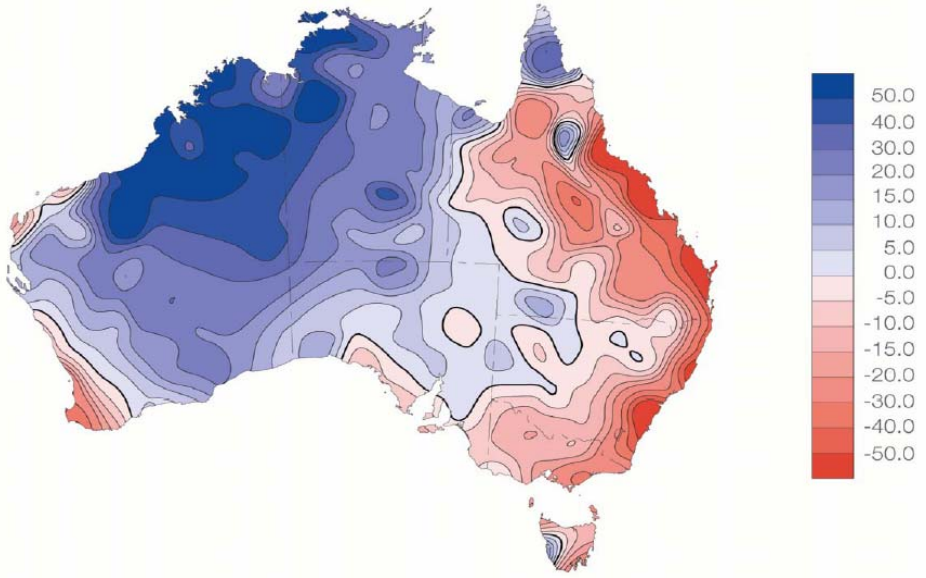
Module 2:
Understanding climate change in southern Australia

Module 3:
Decision support tools to manage climate risks

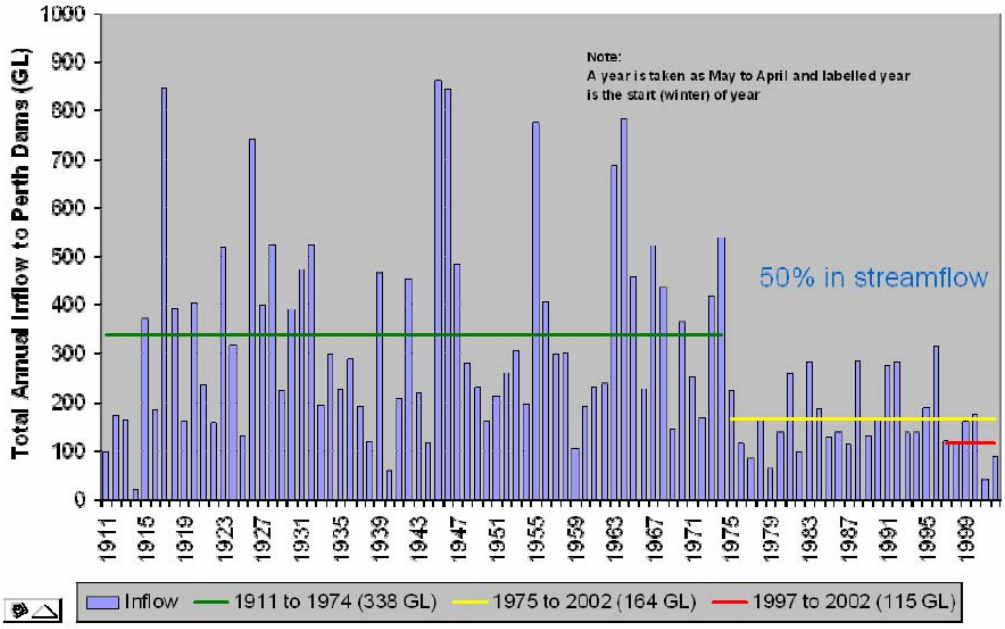
Module 4:
Developing management plans for climate risk

Regional

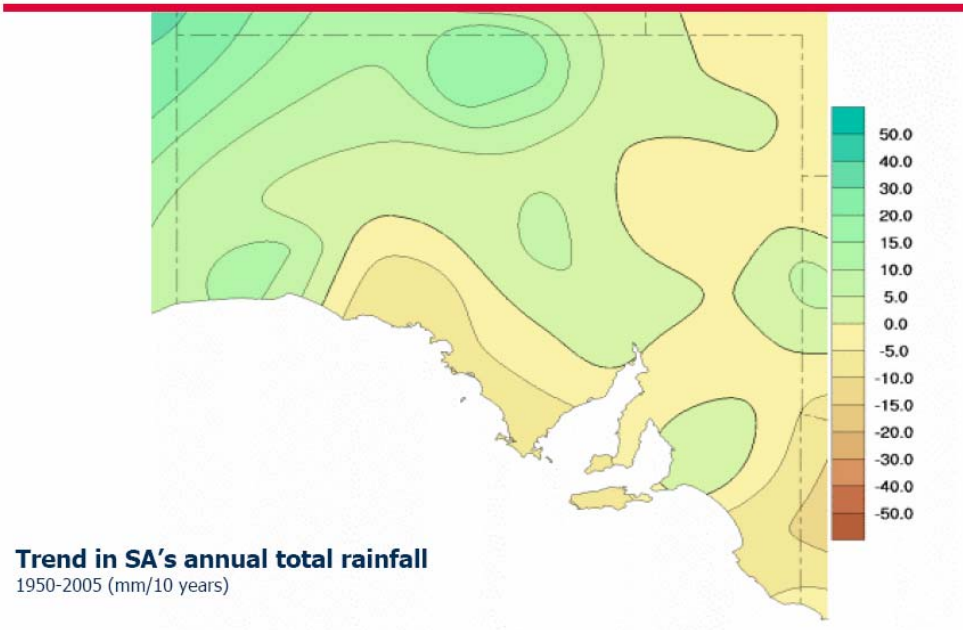
Trend in annual total rainfall 1950 – 2003 (mm/10 yrs)
Source: Bureau of Meteorology, 2004



Regional
Annual stream flow into Perth's water-supply dams



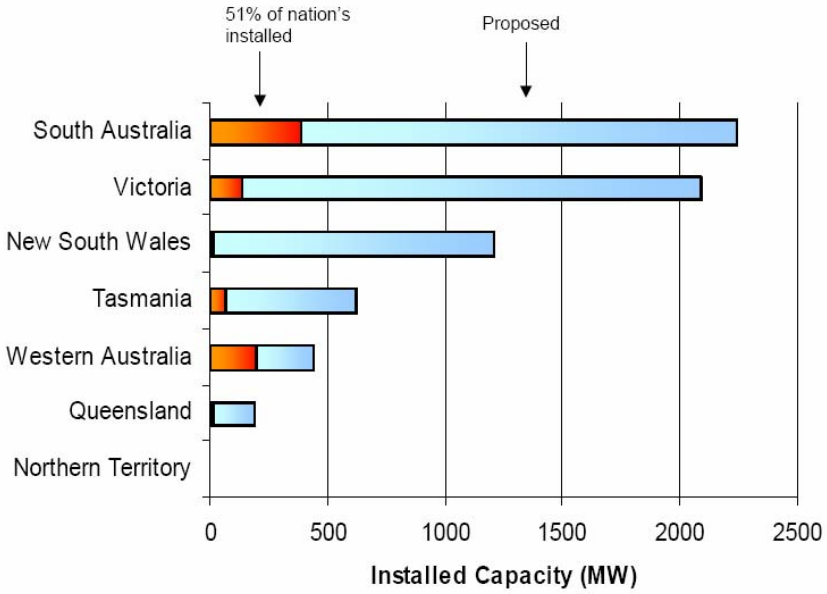
Regional



Trend in SA's annual total rainfall
1950-2005 (mm/10 years)

Renewable Energy

SA: Leading the Nation in Wind Power



Total installed PV capacity, Watts per capita

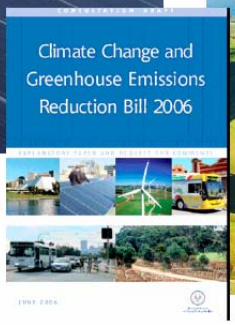
Solar Energy: Feed-In Legislation

Government of South Australia
Department of the Premier and Cabinet

South Australia – setting the pace

Government of South Australia
Department of the Premier and Cabinet

Government aims for 20pc green power use by 2008



Rann vow on climate change


www.climatechange.sa.gov.au
Government of South Australia
Department of the Premier and Cabinet
TOMORROW'S WEATHER IS BROUGHT TO YOU BY WHAT YOU DO TODAY.
CLIMATE CHANGE IS GLOBAL. BEHAVIOUR CHANGE IS LOCAL.
rooftop wind power
GREG KELTON
CARA JENKIN
Rann pushes harder for green energy
GREG KELTON
BANGALORE
BioDiesel

9. Wales: Adapting to the impacts of climate change in Wales

How climate change will affect Wales

The impacts of climate change for the next 30 – 40 years have largely been set by emissions that have already occurred.

The UK Climate Change Impact Programme (UKCIP) has modelled a number of scenarios based on different emission projections. In general terms the model suggests that Wales can expect:

- hotter average temperatures
- an increase in the number of hot and dry summers and an increase in the number of extremely hot days
- milder winters and a reduction of snowfall
- an increase in winter rainfall and in the frequency of intense rainfall
- an increase in the growing season
- rising sea levels

And that this will have a range of impacts:

- an increase in river and coastal flooding and erosion
- increased pressure on sewer systems
- increase in winter storm damage and coastal erosion
- habitat and species loss, for example in uplands and wetlands
- changes to the landscape
- summer water shortages and increased incidence of low river flows (coupled with higher demand)
- increased risk of subsidence in subsidence prone areas
- increasing thermal discomfort in buildings and health problems in summer, including heat-related deaths linked to high air pollution

It may also have some local advantages, depending on the scale and rate of change of climate, including:

- a longer growing season, enhanced yields and potential opportunities for agricultural and forestry diversification; balanced by the impact of increased storminess and potential risks from new plant pests and diseases
- less cold-weather transport disruption; balanced by greater disruption from storms
- reduced demand for winter heating and less cold-weather related illness
- increased tourist economy

What is the Assembly Government doing in response?

The Environment Strategy for Wales, published in May 2006, makes a commitment to developing a Climate Change Adaptation Action Plan setting out exactly what action the Assembly Government and partners need to take. We are now developing that Action Plan.

The Assembly Government has established a Cross Sector Group to advise on action to address climate change and build a consensus on the action needed. Group members include representatives of government and the public sector; businesses; the voluntary sector and NGOs and professional bodies.

In many sectors, action to adapt to the impacts of climate change is already underway. The Adaptation Action Plan provides a focus for this activity and will help identify and fill gaps.

Some examples of the work already underway are set out below.

Flood risk management

Flood risk, both from sea level rise and increased river flooding, will increase due to climate change. This means we need to move to an overall risk management approach, rather than expect to be able to defend against every risk.

To deliver this new approach to the management of flood and coastal risk we have put in place new administrative and funding arrangements with the Environment Agency as the lead flood risk management organisation working with the local authorities and others who are key in providing local services and emergency response.

Land use planning can play an important role in managing future flood risk. We have therefore produced a Technical Advice Note on flood risk, which forms part of statutory land use planning guidance. It sets out the principle that new development on the flood plain should be avoid and that development should go ahead only where it can be shown that the consequences of a flood are acceptable.

New coastal defence structures are built with an extra allowance for sea level rise and an increase in wind speeds and wave heights. New river flood defences are built to take account of a 20 per cent increase in peak flows.

Managing water resources

The Environment Agency produced a Water Resources Strategy for Wales in 2001. It gave full consideration to the possible impacts of climate change and set a framework for managing water resources within this context.

We have now asked the Environment Agency to review its Water Resources Strategy and, as part of this work, give further consideration of the latest predictions for climate change.

In line with the statutory obligations, we will require water companies to prepare water resources management plans that will take full consideration of the likely impacts of climate change in Wales.

We are encouraging water companies and the Environment Agency to provide water saving information to their customers and to look at ways of promoting water efficiency further.

Biodiversity

A changing climate poses profound challenges for terrestrial and marine biodiversity.

Habitat fragmentation is an issue in Wales and the problem will become more acute as habitats and species shift in response to changes in the climate. We are building up resilience by ensuring that key areas (often those officially designated for their biodiversity value) are in favourable condition. This involves focusing management effort and funding on key areas.

At the same time, we are also looking to enhance the wider countryside, in particular building connectivity between blocks of habitat.

The Countryside Council for Wales is mapping 'ecological connectivity' across Wales. These connections are not intended to become continuous semi-natural habitat, but to be areas of high diversity within which habitat management, restoration and expansion are prioritised so that protected sites are consolidated, and opportunities for species movement across the landscape improved.

Action to enhance habitats and connectivity includes: long term, funded management agreements with land owners; and using agri-environment schemes to focus action and working collaboratively with major public sector and NGO landowners.

10. Western Cape Province: Regional Adaptation for Climate Change the Provincial Study

The South African Country Study on Climate Change, carried out in the late 1990's, identified the Northern and Western Cape Provinces as being most at risk from projected climate change-induced warming and rainfall change in South Africa

The results of this study were summarized in South Africa's initial National Communication, prepared in accordance with Article 12 of the United Nations Framework Convention on Climate Change[2]. However, this study was based on a limited set of model projections of climate change that have now been superseded by projections using more advanced techniques.

The Western Cape department commissioned an "Adaptation Assessment of the Physical and Socio-Economic Effects of Climate Change in the Western Cape" in June 2005 on behalf of the provincial government of the Western Cape Province[3]. Dr Guy Midgley, a leading member of our UNFCCC national negotiating team led the study.

In this latter study we had a broad reassessment of the vulnerability of the Western Cape to climate change impacts carried out. The study covered a wider range of climate scenarios using more sophisticated climate models, and covered a broader range of sectors than the earlier national study. Our recent study did however exclude the agricultural and fisheries sectors that are the subject of additional sector specific studies.

The study identified some key adaptive strategies that might alleviate or avoid the worst impacts of climate change in some sectors. The study also made it clear that further detailed studies of some of the implications of the findings will need to be undertaken in order to guide future policy development.

The Western Cape

The South Western Cape Province is largely a Mediterranean type climate region, unique in southern Africa. It supports a range of specific agricultural activities. Our province is well known for products of the vine as well as deciduous fruit for example.

Our province has a very diverse combination of climate gradients. This, combined with the extremely diverse topography and soil types supports an immensely diverse flora. The world-famous Cape Floristic Kingdom, or more narrowly defined Fynbos Biome, tends to be associated with the nutrient-poor, highly leached

[2] Obtainable at: http://www.environment.gov.za/Documents/Documents/2005Feb22/NatCom_Nov2003 (b).doc
[3] Obtainable at: http://www.capegateway.gov.za/Text/2005/7/wcape_climate_change_impacts_11.

sandstone substrates of the Cape Fold Belt Mountains and adjacent coastal sand plains, while the less well-known but hardly less diverse Succulent Karoo Biome is found on the inland plains of the Little Karoo and Namaqualand.

Both of these typical and dominant vegetation types of the Western Cape are classified as global biodiversity hotspots – areas of exceptional biodiversity that are threatened by human impacts. The Cape Floristic Region and Succulent Karoo are home to roughly 8200 and almost 5000 species respectively[4]. This region therefore is identified within South Africa as particularly important in terms of unique habitats and species.

Our diverse economy has a very significant dependence on exported agricultural products and nature-based tourism.

Both the Cape Town metropolitan area as well as the southern coastal area between Mossel Bay and Plettenberg Bay, known as the Garden Route currently exhibit a massive urbanization rate and increasing demands for services, particularly water, energy, housing and associated services.

The provinces vulnerability to extreme climatic events, illustrated by recent drought and floods, together with the fact that we have been identified as vulnerable to the first effects of climate change means we have to actively implement adaptation measures without delay. One of our first challenges will be to implement strict water and electricity demand measures and inculcate a culture of water and electricity use efficiency across all sectors and communities in the province.

Data and observations - Emerging climate trends

Trends in temperature

Understanding the key impacts and vulnerabilities will inform our adaptive strategies and assist us to best address current and future concerns.

The study illustrated on this slide undertook an analysis of 12 rural climate stations with 40 year records for temperature trends and an analysis of several tens of climate stations using spatial interpolation for rainfall trends.

The first graph on this slide shows an approximate two-degree increase in the mean monthly minimum temperature over the past 30 years.

The second graph illustrates this increased minimum temperature on a seasonal basis.

[4] Myers et al. 2000

The increased minimum temperatures in our province are having a noticeable impact on our deciduous fruit growers and viticulturists. The deceasing annual quantum of so called 'chill units' is already making deciduous fruit growing in some regions of the province increasingly marginal and is also causing viticulturists to change to grape varieties that are more tolerant of warmer temperatures. Slight changes in the areas of the province that are suitable for growing different crops are already manifesting.

Trends in precipitation

This slide shows the trend in monthly total precipitation from 1950 to 1999, as the total change in millimetres over 50 years. The red tones represent drying and the blue tones wetting trends.

Generally, mountainous regions show increased rainfall, while lowland regions show decreased rainfall.

Seasonally, however, the trends are more complex. We will definitely need more research before we fully understand these complexities

Projected changes in monthly total precipitation

Essentially what this fancy graphic from 6 different climate change models tells us is that we will experience increases in late summer rainfall in the interior and to the east of the province and early and later winter decreases in rainfall for the south-west of the province.

The 2003 drought in the Western part of the province

The serious drought of 2003 that we experienced in our province really woke us up to our precarious water security situation and to the future impacts of climate change

This pair of satellite images of our province were both taken on 21 July – the one on the left in 2002 and the one on the right during the drought of 2003.

Adaptation Planning and Practices - Impacts and Vulnerabilities

Some of the key impact and vulnerability foci that will inform our adaptation planning and practices include:

- Water resources;
- Agriculture;

- Biodiversity and ecosystems/habitats;
- Fire;
- Coastal settlements/real estate/ infrastructure;
- Livelihoods; and
- Land-use planning and management.

With regard to the latter, we have adopted a strongly forward planning approach through our Provincial Spatial Development Framework (PSDF). The PSDF takes a triple bottom line approach that promotes our integrated human settlement initiatives and our two key bioregional conservation programmes and gives effect to our provincial motto, “A home for all”.

Adaptation planning and practice - Water resources in the Province

Because of time constraints, lets just look at a couple of these foci. For the purposes of water resource planning and management, 18 water management areas have been declared that encompass the whole of South Africa. Each water management area encompasses the drainage basin or catchment of a major river, as well as numerous other minor catchments. The Western Cape is made up of four these catchments, the Gouritz, the Oliphants/Doorn, the Breede and fourthly the Berg river catchment.

This illustrates how different sectors share water from the four major catchments in the province.

These graphs clearly show that water use by the irrigation sector is by far the largest water user in the Western Cape. Water resources in the region are already fully committed if the specified allocations to the ecological reserve are made in practice. In some places a water allocation deficit already occurs, implying that the demand is being met out of the ecological reserve, or from groundwater reserves beyond the natural recharge rate.

Adaptation planning and practice - Water resources in the Province

The Western Cape therefore already experiences significant water stress. In other words, there is currently not enough water to meet all the urban, irrigation and ecological needs. There is potential for the abstraction of significant quantities, approximately 70 million cubic meters per annum of groundwater from the Table Mountain Group aquifers, which underlie parts of the Olifants, Breede and Gouritz Water Management Areas. A pre-feasibility study for utilising this resource is currently in progress.

Under a drying and warming scenario of climate change, irrigation requirements would increase while water availability decreases. In a situation of reduced water availability, water quality will be severely impacted. One response or adaptation to this is that, in our province, effluent standards will have to be managed much more tightly. In general, it can be said that under climate change scenarios – there is a looming crisis in water supply in the Western Cape region.

Climate related risks and extreme events - Fire

The Western Cape is characterised by the dominance of fynbos vegetation, which is well known to be fire-prone, and indeed adapted to fairly frequent fires. It is clear, from the many adaptations that indigenous species have developed, that fire must have been part of the natural system in our province for eons.

An extended warm dry summer is a feature of the Western Cape, and today both humans and lightning provide ample sources of ignition. Fires are inevitable when three necessary elements are brought together – enough fuel of the right kind, warm, dry weather, and a source of ignition.

Fires are needed to maintain healthy ecosystems and biodiversity in the Western Cape. Fynbos is fire-dependent as well as fire-prone, and without fires many fynbos species would face extinction.

But fires can and do destroy crops, houses, and kill livestock and even people, and this is what makes fires seem undesirable.

Our provincial study included detailed analyses of fire frequency and intensity under the predicted climate change scenario and concluded that:

- By about 2050 extreme and high fire risk conditions may increase 2 to 3 times in the west and 30 to 40 percent in the east of the province.
- There will be a greater fire return frequency, increased costs of fire fighting and increased damages to biodiversity and property.

Climate related risks and extreme events - Coastlines

Coastlines, particularly estuaries are some of the most productive ecosystems on the planet. The Western Cape is endowed with more than 47 functional estuaries.

I'm sure that I don't need to explain the wide biological and economic importance of estuaries to those present. Their contribution to our national economy in terms of fisheries alone is considered to be highly significant. In 1997 the total value of estuarine and estuarine-dependent fisheries was calculated to be of the order of R950 million.

The potential impacts of global climate change on estuaries include:

- Changes in precipitation and runoff with the following consequences for estuaries, including:
    - Modifications in the extent of intrusion by seawater;
    - Changes in the frequency and duration of mouth closure;
    - Decrease in nutrients;
    - Decrease in the dilution and or flushing of pollutants; and
    - Changes in the magnitude and frequency of floods and sediment deposition/erosion cycles.

Other impacts include:

- Rising temperatures;
- Sea level rise;
- Changes in ocean circulation patterns; and
- An increase in the frequency and intensity of coastal storms.

Our provincial study indicates that the primary effect of climate change on our coastline will be felt in the form of sea level rise.

Our study recommended that specific identified coastal locations be carefully evaluated in terms of their vulnerability to potential impacts.

Key adaptive strategies

Finally a review of the key adaptive strategies that we need to implement in the Western Cape Province of South Africa:

- As far as water resources are concerned. We need to significantly improve our demand management systems. We need to pay particular attention to urban planning and where possible develop alternative sources of water.

- With regard to agriculture we need to adopt novel technologies and breed or switch to alternative crops and livestock;

- On the biodiversity front, we need to undertake a number of measures. These include:

    - Implement the ecological reserve provisions of our water legislation.

- Monitor and rehabilitate our wetlands and estuaries;
- Improve the management of alien species;
- Better manage fire;
- Monitor key terrestrial species and habitats;
- Improve involvement of land owners and managers in biodiversity conservation; and
- Increase the protection status of habitats and species.

• And with regard to human livelihoods. We must develop a greater understanding of the impacts of climate change on the quality of life of our citizens, especially of the poor and marginalized. However, in the meantime are already implementing a sustainable livelihoods programme with a focus on coastal and rural poor communities and especially women.

Conclusion

And in conclusion it must be stressed that:

• Climate change poses a real threat to sustainable development in the Western Cape;

• Key adaptive strategies to reduce pressure on natural resources and protect economic activities make sense both now, and into the future;

• Broad-based commitment and holistic planning will be needed to cope with this threat and its impacts;

• Integrated and innovative land-use planning and management are key to changing the status-quo; and

• Risk assessments, projections and adaptive strategies must be based on good science, and this capacity is critical for the Province.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