executive summary climate change impacts on new zealand

This report examines the likely impacts of climate change and global warming on New Zealand, based on expert reports and peer-reviewed scientific studies, published internationally and in New Zealand. It does not attempt to provide a comprehensive summary, but updates the last government-led assessment of climate change impacts carried out in 1990 and concentrates on areas where new knowledge has been gained over the last decade.

Scientific basis and global impacts of climate change

A broad range of observations shows that the world has warmed during the 20th century. There is now stronger evidence that most of the warming observed over the last 50 years is attributable to human activities, namely the emission of greenhouse gases.

This report uses two emission scenarios to assess future climate change and its impacts. Scenario 1 assumes no attempts to control greenhouse gas emissions, while scenario 2 assumes that steps are taken to stabilise the atmospheric concentration of carbon dioxide and to limit emissions of the other major greenhouse gases methane and nitrous oxide. Neither scenario is a prediction or represents a policy target; both serve only to answer "what-if" questions.

Climate models predict a global warming by 2100 between 2.1 and 3.8 degrees Celsius for scenario 1 and between 1.4 and 2.6 degrees Celsius for scenario 2, compared to an observed warming of about 0.6 degrees Celsius during the 20th century.

Global impacts of climate change, particularly on world markets and developing countries, will have repercussions for New Zealand. However because very few clear predictions of these indirect effects can be made at this stage, this report focuses on the impacts of local climate change in New Zealand.

Projected New Zealand climate changes

Temperatures in New Zealand are likely to increase faster in the North Island than in the South Island, but generally less than global average temperatures. Rainfall is projected to increase in the west of the country and decrease in many eastern regions. While these general trends are considered relatively robust findings, the magnitude of the projected changes depends on the global greenhouse gas emission scenario and also varies considerably between different climate models, particularly for local rainfall patterns.

Quantitative regional climate projections are more likely to undergo revision in future assessments than global projections. Comprehensive impact assessments in which rainfall is a key component therefore need to incorporate a range of different scenarios of regional climate change, even for a single given global warming assumption.

Under the projected reductions of average rainfall in eastern areas and higher temperatures, dry periods will increase in some regions. Models suggest that at the same time, extremely heavy rainfall events could become more frequent in many areas, increasing the risk of flooding and erosion. No predictions about frequency and intensity of mid-latitude storms are currently available.

Many climate models indicate a greater future variability of rainfall with an increased risk of droughts, but no quantitative predictions are possible at this stage. Other expected changes in climate extremes are, on average, fewer frost days during winter and more hot days during summer.

Sea-level rise and coastal processes

Sea levels are expected to rise under global warming, but scientific uncertainties are large. Global sea levels are estimated to rise between 9 and 88cm by 2100 under global warming, with ranges from 13 to 70cm for scenario 1 and from 9 to 53cm for scenario 2. During the 20th century global sea levels rose on average between 10 and 20cm.

A quantitative assessment of the impact of rising sea levels on New Zealand coasts is difficult. Major earthquakes can lead to local changes in land elevation which can override the effect of a gradual sea-level rise. In addition, circulation patterns of oceans and the atmosphere cause regional sea-level variations. On time scales of decades these changes have a larger influence on the sea level around New Zealand than global warming induced sea-level rise.

In the long term, rising seas are expected to increase the erosion of vulnerable beaches and cause more frequent breaches of coastal protection structures. Quantitative predictions depend heavily on local variables, and only limited long-term data of sufficient quality exist. Hence no national-scale assessment of coastal risks under climate change is currently available.

Agriculture

The agricultural sector has opportunities for productivity gains and diversification under climate change, but also faces risks.

The key benefit to agriculture is likely to be from elevated carbon dioxide concentrations which could lead to substantial improvement in growth rates and water-use efficiency. In addition, warmer conditions and lengthened growing seasons could allow the long-term southward shift of climate-limited activities, and new crops and related industries could be introduced. Currently resource-poor areas could benefit from such shifts.

The most significant risks are associated with the potential increase of droughts and floods and water limitations in some areas. Warmer temperatures could also make the growing of some fruit crops in some northern areas uneconomical. Shifting land-use activities to adapt to altered climate conditions will incur costs, resulting in regional winners and losers. Pests and diseases could spread in range and severity, and pasture composition is likely to change with uncertain outcomes to animal productivity and nutrient balances. The full range of effects has not been quantified yet.

The assessment of climate change impacts on agriculture has been greatly helped by the development of an integrated assessment programme (CLIMPACTS) which combines climate and agricultural expertise. However, information on regional climate change and its impacts is still too limited to quantify the overall economic effect on the agricultural sector. Adaptation to altered climate conditions would also influence future economic outcome through proactive utilisation of opportunities and mitigation of negative impacts. Overseas markets will also change under a warming climate, offering indirect climate risks and opportunities to New Zealand farmers.

Native ecosystems

With few exceptions, climate change alone is unlikely to be the dominant cause of native species extinction, but may act as compounding pressure on ecosystems which are already under threat. Fragmented native forests of drier lowland environments in Northland, Waikato, Manawatu, and in the east from East Cape to Southland are probably the most vulnerable to climate change, and some terrestrial and freshwater species which are currently at their climatic limit may be at long-term risk of extinction. However many complex interactions between elements of natural ecosystems, introduced exotic species and climate are not yet fully incorporated in assessment models.

Urban environment, transport and energy

The main threat to the urban environment comes from possible increases in heavy rainfall which would put pressure on drainage and stormwater systems and increase the risk of flooding in some areas. Erosion could also increase road maintenance costs, but warmer winters would lead to reduced costs for snow and ice clearing. Warmer conditions will substantially reduce home heating costs, leading to reduced electricity demand during the peak winter season, but possibly increase demand for air conditioning during summer. The reduced winter demand would combine with an increased availability of water in hydroelectric storage lakes from projected rainfall increases over the Main Divide, providing the opportunity for a more balanced electricity supply and demand.

Health

Higher temperatures are expected to reduce winter illnesses, but have also been found to be correlated with increased mortality during summer. A warmer climate would also allow the better establishment and spread of mosquitoes capable of transmitting diseases such as Ross River virus and dengue fever. The impacts of climate change on human health are however not just determined by climatic conditions, but also the vulnerability of the exposed population. Border controls, vector eradication programmes, safe food and water supply, and primary health care services all influence the impact of climate change on actual changes in disease risks and outbreaks.

Recent research also found that climate change could lead to a delay in the recovery of the ozone layer. Ozone is destroyed by chlorofluorocarbons (CFCs) used in refrigeration and as propellants. Since the banning of CFCs the ozone layer was expected to recover over the next few decades, but scientists have found that emissions of other greenhouse gases such as carbon dioxide and methane could delay this recovery by another 15 to 20 years. This would increase the period during which New Zealanders are exposed to high levels of ultraviolet radiation, which is known to lead to skin cancers. However quantitative model studies of the possible effects of greenhouse gases on the ozone layer are still highly uncertain.

Climate impacts on Māori

The reliance of Māori on the environment as both a spiritual and economic resource makes them more vulnerable and less adaptable to climate change. Land presently owned by Māori is often of lower quality which makes it more prone to invasion by subtropical grasses and erosion. Because of the high spiritual and cultural value placed on Māori traditional lands and statutory sales restrictions, business relocation in response to climate change may not be seen as an adaptation option. Multiple land-ownership and generally lower socio-economic status could hinder implementation of costly or non-traditional adaptation measures. This may increase the risk of reduced economic output from Māori land compared to the New Zealand agricultural sector as a whole. Impacts on the coastal environment are also of great importance to Māori culture and economy, but the impact of climate change on fisheries production is highly uncertain at present.

International links

New Zealand has close social and institutional links with many Pacific Island countries. Many of these countries are highly vulnerable to climate change from rising sea-level, changes in rainfall patterns affecting agricultural productivity, destruction of coral reefs, and human health effects of higher temperatures and vector-borne diseases. Such impacts could have considerable flow-on effects for New Zealand through increased demand for development aid and, in worst cases, disaster relief. Climate change in competing export countries will contribute to changing commodity prices and market structures in some key export markets. These changes offer both risks and opportunities to New Zealand exports, but information is too limited at present to allow predictions or outline specific adaptation strategies.

Summary and outlook

New Zealand's climate is very likely to change during the 21st century. Impact projections are limited by uncertainties of regional climate changes and frequency of extreme events. At this stage, an assessment of the overall impact of climate change on New Zealand society and economy is impossible, but it is likely that there will be short-term winners and losers. Negative impacts could be reduced and potential gains increased by ongoing proactive adaptation to altering climate conditions. Because of the regionally varying impacts of climate change and the different effects on different sectors, future comprehensive quantitative impact studies and development of adaptation strategies would require greater incorporation of climate effects in sector-specific models.