Image sourced: www.teara.govt.nz

Climate impacts, vulnerability and the capacity to respond and adapt are known to be the result of complex relationships between human and biophysical systems. Yet, in spite of this understanding and the certainty that all social-ecological systems are affected by direct and indirect changes in climate conditions, few studies, with specific populations and communities in Aotearoa/New Zealand, have been carried out to discover the nature of these factors and the various determinants of change.

It is recognised that Māori society is climate sensitive, due to the strong links that exist between Māori economic, social and cultural systems and the natural environment. Furthermore, the projected impacts of a changing climate on Māori will be different depending on social, political, economic and environmental circumstances.

This study looked at some of the issues facing Māori community vulnerability, resilience and adaptation to climate variability and change, with Ngati Huirapa community members from Arowhenua Pā – Te Umu Kaha (Temuka), the *hapū* [sub-tribal kin group] representative body Te Rūnanga o Arowhenua Society Incorporated, and NIWA's Māori Environmental Research and National Climate Centres.

Broad patterns of change over New Zealand for the next 50-100 years

- Rising temperature of ~1^{o}C by 2050 and 2^{o}C by 2100 – with greater increases in the winter season, and in the north of New Zealand.
- Decreased front risk but increased risk of very high temperatures.
- Enhancement of westerly winds.
- Stronger west-east rainfall gradient (wetter in the west and drier in the east).
- Increased frequency of extreme (heavy) daily rainfalls resulting in more floods.
- Large areas of the east are likely to have less soil moisture.
- Snow line rise and glacier shrinkage.
- Continued sea-level rise, possibly of the order of 1m or more by 2100.

Study Methods

Current and past climate conditions and risks that the community at Arowhenua Pā cope with were discussed with community members. This involved consideration of how the community currently responds to such challenges, as well as consideration of the factors and processes that enable and constrain choices and actions. Use of downscaled projections of future climate change scenarios enabled examination of future impacts and risk – with attention (based on community knowledge of local environmental risks) given to flooding of the Temuka River and inundation of the coastal zone surrounding the Opihi River mouth due to sea-level rise.

Interviews were conducted with 42 'home-people' who resided within, or in close proximity to, the Arowhenua Pa, to understand their experiences, values and concerns surrounding present and future climate induced hazards and stresses.

Results

Conversations at the beginning focused on:

- Local flooding and impacts on whanau;
- Historical changes in river courses, flows and *mahinga kai* (food gathering areas); and
- Causes and amplification of flood risk due to human modification of the environment; as well as the important role of local planning in setting regulations and managing natural hazards and risks.

Community insights were offered on the 'things' that specifically contribute or influence the way people are affected by, and deal with, climate hazards and stresses. Matters discussed intersected environmental, economic, social, political and cultural aspects of community life.

Four principal determinants of community sensitivity and adaptive capacity were subsequently identified:

1. Social networks, conventions and transformation;
2. Knowledge, skills and expertise;
3. Resourcing and finance; and
4. Institutions, governance and policy.

The community at Arowhenua Pā possess considerable capacity to deal with climate hazards and related stresses. Much of this capacity is rooted in elemental cultural values and approaches such as *tikanga* (Māori conventions, culture, custom) and *kawa* (ceremonial rituals, protocol, etiquette, correct procedure) and actioned through *whanaungatanga* (relationships, interconnection, mutual support), *manākitanga* (hospitality, kindness, care) and *kotahitanga* (solidarity, unity, collective action).

In addition to the importance of internal social networks and connections, knowledge of place and closer human-environmental relationships, through *mahinga kai,* were expressed as central to community strengths and well-being and being able to deal with environmental risks.

However, such capacities are not uniform across the community, and some individuals are better equipped to cope and adapt than others. Rapid transformations in local community structure, decreases in Māori-owned land holdings, lack of financing for infrastructural maintenance and insurance, a growing reliance on modern services, land-use change, resource management regimes, and *whānau* spending more time

away from traditional areas for employment and education were all identified as increasing the sensitivity of the community to climatic risk and inversely undermining certain aspects of adaptive capacity.

Impact on Community Based on Modelling Scenarios

The results produced from modelling of future extreme peak flood levels for the Temuka River in 2040 AD and 2090 AD, showed that in a high emissions world (i.e. the A2 emissions scenario), local inundation extents for the equivalent of an extreme flood event with a current average recurrence interval >500 years, are unlikely to differ markedly from the inundation extents measured from a ~100-150 year extreme flood event that occurred on the Temuka River in 1986. That is, the most extreme modelled estimate of future peak flood levels in this study was more than 30% greater than those recorded for the 1986 flood event, but the relatively steep elevation of local terrain resulted in little additional surface area being flooded.

While these results are favourable in terms of the higher ground occupied by the Marae, school buildings and many whanau homes, they also demonstrate that lower lying properties and infrastructure are likely to be at greater risk of flood damage under an A2 Emissions Scenario in 2040 and 2090. Heightened flood peak levels also raise the likelihood of harm to farm stock that sometimes graze the lower plains of the Arowhenua Pa. Less is known about the direct and indirect impacts of such physical changes on local ecosystem services and related wild-food availability.

Coastal inundation extents surrounding the Opihi River mouth under current high tide levels, extreme storm tide levels and sea-levels for 2040 AD and 2090 AD, with an assumed 40cm and 80cm sea-level rises respectively, were also investigated. The most notable change for the area, under projected high-tide levels was increased flood extents over time on the northern side of the Opihi River. Currently, this area is occupied by a mix of leasehold bachs, and a small number of permanent residents as well as extensive dairying operations that stretch along the coast. Such land-uses are likely to be impacted and disrupted more frequently under such scenarios, and therefore, the on-going value of such leases are likely to decline, particularly as permanent inundation occurs.

Integrating these results together, it is clear that considerations of vulnerability and adaptation to climate change are inseparable from issues linked to natural hazards management and sustainable development. Even without climate change and on-going climate variability and extremes, Māori from Arowhenua Pā remain affected by social-economic and political processes that will likely influence their capacity to cope with challenges in the short-term and adapt in the longer-term. This point is critically important for leaders and decision makers across a range of scales and institutions, as well as *te hau kāinga* (home-people) on the ground, who indicated either how overwhelming and contentious the climate change issue can be or how much lesser of a priority it was when compared with other challenges currently confronting the community.

In spite of these views, many of the community members in the study also acknowledged the need to strengthen their social, cultural and institutional capacities to assess, plan and respond to the direct and indirect challenges brought on by changing climate regimes and conditions.

It is further evident that the constraints and strengths discussed in this study, identify present points of entry for strategic community, iwi, and government level planning and policy development that can minimise existing sensitivities and enhance coping and adaptive capacities.

Advice for other Māori communities

For other Māori communities interested in examining in their own climate change challenges, it is important to emphasise that consideration of community vulnerability and resilience does not require the science of climate 'prediction' to be more developed, and it does not require location–specific climate information of the kind produced in this report.

Image sourced: nzfarms.co.nz

Climate projections are readily available and these can be used to enhance awareness about potential impacts and associated risk. Strategies and policies to tackle vulnerability and how to adapt to future climate risks can be developed in spite of the uncertainties, because most of the factors and processes that constrain choices and actions meet existing issues of whanau development and social-ecological well-being.

Further Information

The full report can be downloaded at www.climatecloud.co.nz/CloudLibrary/niwa_report_akl2011-015_0.pdf