



# Climate Change and Community Resilience in the Waipapu Catchment

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## Preface

The Ministry for Primary Industries (MPI) Sustainable Land Management and Climate Change (SLMACC) programme provides funding for research into the impacts of a changing global climate on New Zealand. The programme described in this report is part of the SLMACC investment priorities for 2012/13 that addresses the impacts of climate change on community resilience in the Waipua Catchment.

The Waipua Catchment and the people who depend on its resources have been subjected to a series of environmental, social and economic shocks for over a century. These shocks have had impacts on the wellbeing of Ngāti Porou in the catchment and appear to have played a contributory role in the current low socio-economic profile for the area (Porou, Barnard, Fitzgerald et al., 2012). The social, economic, and cultural impacts of environmental degradation associated with deforestation and unsustainable land management practices in the catchment has resulted in serious damage to stocks and flows of critical natural capital upon which people base their livelihoods. This has compromised the ability of local people to meet their needs, especially in the form of abundant good quality seasonal food, fresh clean water and a sustainable land use base.

Climate Change may be expected to deliver more shocks (i.e. extreme weather events) which may further undermine community resilience and erode its cultural sustainability.

Extensive re-forestation is required in the catchment, both in the short and long term, to restore its ecosystem function. It is estimated that up to a further 25,000 hectares require afforestation to arrest erosion, and the need is urgent (Jones et al., 2012). The majority of the remaining highly erodible land is in private and, in particular, Ngāti Porou ownership. Therefore, any attempt to promote afforestation will depend heavily upon voluntary participation and agreement.

## Key messages

The social, economic and biophysical trends, processes and events that have contributed to the current degraded state of the environment and low-socio-economic profile of the community will continue into the future. Climate change is expected to add another layer of stressors and generate further shocks (floods, drought and storms) that the community will have to overcome.

It is expected that under current climate-change projections, the Waiapu Catchment will be warmer, drier and windier, with a small increase in sea level, and experience more extreme storm events and droughts. Whilst many are aware of the need to take climate change into account, they have little time and few resources with which to make the alterations necessary to modify their existing livelihood strategies.

The community does regard itself as resilient at a basic level. It has strong social capital in the form of networks and linkages that contribute to high levels of social cohesion. Cultural capital also remains strong but with a number of vulnerabilities including the loss of traditional knowledge and understandings of 'ways of doing things'. Most whanau groups in the Waiapu Catchment employ diversity as their main livelihood strategy with a high degree of dependency on the land and natural resources. Further erosion of natural capital will reduce resilience and the ability of the community to sustain itself over time.

The leadership of change rests within the community itself and within Ngāti Porou governance structures. The leadership picture at the local level is complicated, but will prove critically important if future resilience is to be achieved. The quality of the relationship between the leadership of Ngāti Porou and the wider community (hapu and whanau) is vital. The future must be built on the strengths of the community and its current realities and resources. Agencies have a supporting role to play through the development of coalitions and partnerships where the community does not have the asset base to achieve success on its own or where the scale of the challenge is beyond its resource base, as with erosion control.

The Waiapu Restoration Partnership between the Ministry for Primary Industries (MPI), Te Runanga o Ngāti Porou (TRONPnui) and Gisborne District Council (GDC) represents an exciting new phase in the future development and restoration of the Catchment. Whilst the immediate focus of the partnership is on afforestation of highly erodible land, it has the potential to become the vehicle for new initiatives that may build resilience and cultural sustainability. However, achieving this in a holistic way that is culturally relevant requires a level of political sophistication and process that, arguably, has not yet been achieved anywhere in New Zealand.

In charting a future pathway, it is recommended that:

- A high priority continues to be given to the treatment of highly erodible land over the next ten years and that this remains the focus of the East Coast Forestry Project and current Partnership.
- That a new approach is needed to engage a wider community of interest in delivering holistic approaches to the restoration of the catchment and in building community resilience. A 'Model Forest' be established as an umbrella for the development of:
  - A strategic overview of land use and value-chain optimisation, including ecosystem valuation to aid local decision making.
  - Coalitions are developed to aid local action and implementation.
  - New approaches to decision-making and co-management of resources are developed.

# Introduction and background

*Ko te mana ko te hauora o te whenua, ko te hauora o nga awa, ko te hauora o te lwi*

## HEALTHY LAND, HEALTHY RIVERS, HEALTHY PEOPLE

The Waiapu River and Catchment is of great cultural and spiritual significance to all Ngāti Porou:

*For people from Ngāti Porou ... this is where you belong, nowhere else in the world. You can go and live in Adelaide or in Wellington... but really your centre is here, nowhere else... This is why we get so peculiar about things like our environment, our river, our mountain, because they are all part of us.*

*Our strength is our identity. We've got to keep our identity and our culture; we are Tangata Whenua, we belong to this land and this land belongs to us.*

## RESTORING THE WAIAPU CATCHMENT

The biophysical environment that constitutes much of the natural capital of the Waiapu Catchment (Figure 1) is described in the Waiapu River Catchment Study report (Scion, 2012). In summary, the Waiapu Catchment is located in a dynamic tectonic and climatic setting. Deforestation between 1890 and 1920 has exacerbated already high natural rates of erosion and sedimentation. In 2008, land use cover of the catchment comprised 35% indigenous forest and scrub, 25% planted forest, 35% grassland, and the remaining 5% of other types of land use.

Gully erosion began to develop following the initial deforestation period and now accounts for 49% of the catchment sediment yield (total sediment yield in 2008 was 23.97 Mt). The remaining 51% of sediment yield is derived from other erosion processes (i.e. landslides, earthflows, sheetwash, stream-bank erosion, and river-bed degradation). Recent research shows that afforestation is the most effective method of controlling erosion. For example, afforestation in the catchment reduced gully erosion sediment yield by 17% compared with a similar area with no forest planting.

In short, extensive re-forestation is required in the Waiapu Catchment to restore ecosystem function and to ensure a prosperous and healthy future for the local community.

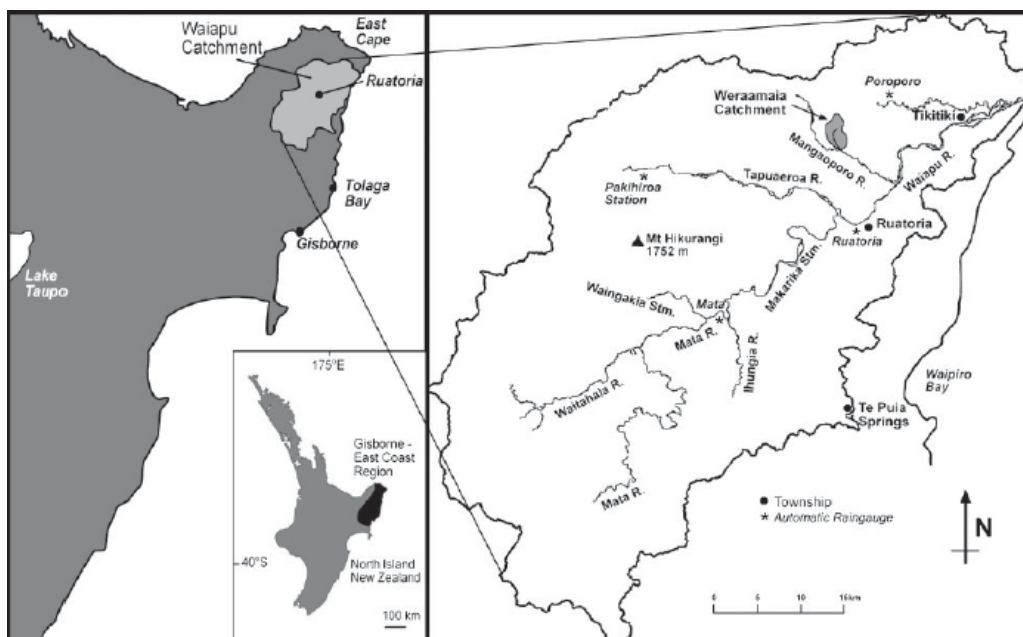


Figure 1: Location of the Waiapu Catchment, East Coast. The major tributaries are shown on the right (reproduced from Parkner, et al. (2007)).

## The Waiapu Catchment Restoration Partnership

The relationship between the health of the river, the land and its people has always been at the heart of Ngāti Porou concern for the catchment. This is now widely acknowledged by others and sits at the heart of a Memorandum of Understanding<sup>1</sup> (MoU) signed in April 2014, between TRONPnui, MPI and GDC.

The three signatories have co-developed the outline of a restoration programme, which extends over 100 years with a more detailed focus on the first ten years. The restoration of the Catchment is widely acknowledged to be a complex and inter-generational process. The desired outcomes shared by the Partnership, through the Waiapu Restoration Programme include<sup>2</sup>:

### *Healthy Land:*

- Erosion management.
- Natural forests, biodiversity and cultural values are restored.
- Wāhi tapu are protected.
- Downstream infrastructure is protected; communications and transport are more secure.
- The productive capacity of downstream land is maintained.

### *Healthy Rivers:*

- Sedimentation and aggradation from hill country erosion is reduced.
- Land lost through river-bank erosion is reduced.
- Water quality is improved.
- The river is again an abundant source of food and drinking water, and useable for recreation.

### *Healthy People:*

- The relationship between Ngāti Porou and the land and river is renewed.
- Damage to communities is reduced.
- Local knowledge and aspirations are central to decision making.
- The Catchment produces high-value commodities that generate high-income jobs within the area and, in turn, generate prosperity for all the people.
- Economic independence and prosperity is restored for Ngāti Porou and all the people of the Catchment.

Over the next decade four phases have been outlined as a basis for future progress:

### *Phase I (Oct 2013 to Sept 2014)*

During this period, the three Partners have committed to:

- Draw together the expertise and information within GDC, MPI, TRONPNui and other parties;
- Accelerate land remediation by targeting priority land blocks;
- Simplify and remove barriers to uptake of the East Coast Forestry Project (ECFP) funding;
- Assist owners of land in Māori Title with planning and management and in accessing finance;
- Assist landowners to implement erosion control and follow-up treatment; and,
- Encourage sustainable land use practices, and build innovative and profitable businesses.

### *Phase II (2014-16)*

By the end of Phase II, work plans and treatments will be developed for all priority sites to enable as many blocks as possible to be treated before the expiry of the ECFP in 2020. Priorities will be set for all remaining priority blocks with untreated erosion-prone land in the Waiapu catchment and wider Gisborne District.

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<sup>1</sup> <http://www.mpi.govt.nz/environment-natural-resources/programmes/restoring-the-waiapu-catchment>

<sup>2</sup> Restoring the Waiapu Catchment Flyer – Te Runanga o Ngati Porou, Gisborne District Council and the Ministry for Primary Industries.  
<http://www.mpi.govt.nz/Default.aspx?TabId=126&id=2232>



Future development of the programme will draw on the research developed through the Waiparu River Catchment Study (Scion, 2012) and this research.

#### *Phases III (2017-19) & IV (2020-22)*

These phases are expected to focus on any residual priority work carried over from the previous phases and maintenance of effective tree cover post 2021.

The desired outcomes of the Partnership are, put simply, environmental restoration, economic profitability, cultural revitalisation and social prosperity.

## Methodology

As an action research project, the underpinning philosophy of the project was to engage local Ngāti Porou researchers at the heart of the programme. These researchers are embedded in the on-going work in the Catchment and in the development of future strategy. They are also members of the community and therefore face the same challenges as many others in building a more resilient future. As research team members, they have been able to integrate the findings of this work as it progressed directly into the emergent institutional partnerships in the Catchment and into the policy environment. Furthermore, regular update reports have been sent to the Ministry for Primary Industries to ensure they were informed of findings as they emerged. This information exchange led to a hui being conducted in March 2014 with the aim of aligning the remainder of the research programme with the roll out of Phases I and II of the Waiparu Restoration Programme.

The following research streams were developed for this project. The overarching research process is shown in Figure 2:

1. **Climate change in the Waiparu** – *To outline climate change trends that will be the most significant for the Waiparu Catchment and its community.*
2. **Sustainable livelihoods, community capital, assets and the vulnerability context** – *To describe the range of livelihood strategies, community capitals and the vulnerability context of the Waiparu community.*
3. **Quantification and indicators of community capitals and assets** – *To design indicators that quantify community capitals and assets and measure improvement in community wellbeing/resilience over time against policy interventions.*
4. **Community dialogue and participation in community generated livelihood strategies** – *To work alongside the community to identify locally generated and preferred livelihood strategies using forests and other land use options.*
5. **Institutions and network analysis** – *To analyse the role of key agencies and institutional networks with a direct interest in the Catchment and building resilience.*
6. **Strategy formulation and implementation pathways** – *To develop strategies to build community resilience within the Catchment and to transfer this knowledge to key institutions and individuals.*

A detailed description of the methods is included in the Appendix.

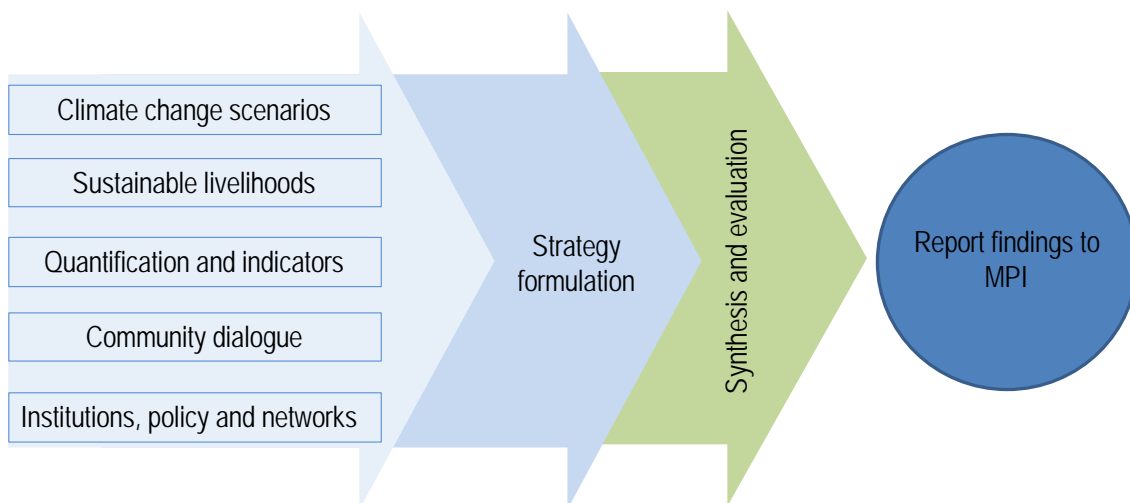


Figure 2: The research process.

## THE WAIAPU – THE ENVIRONMENT AND PEOPLE – A SUSTAINABLE LIVELIHOODS (SLA) APPROACH

### Introducing the SLA

The Sustainable Livelihoods Approach (SLA) advocated by the United Kingdom Department for International Development (DFID)<sup>3</sup>, provides a useful framework for analysing individual and community livelihoods and the factors influencing those livelihoods, including unplanned events and changes. It is also a way of thinking about the objectives, scope, and priorities for environmental, community, social and economic policy interventions that may build resilience. Understanding and describing the assets and capitals a community holds allows institutions and policy agencies to better design effective interventions that either build from existing community strengths and assets by addressing environmental challenges such as climate change or by addressing weaknesses that may be eroding resilience (Marshall, 2010).

Sustainable Livelihoods, as an ‘approach’, has been characterised by DFID as a people-centred, holistic, dynamic, strengths/capabilities-based, and a sustainability-focused way of looking at people’s living situations. Livelihoods approaches offer a way of bridging the gap between macro-level policy and institutions and the micro-level livelihood options of communities and individuals. The development of the SLA reflects wider shifts in approaches to development towards a focus on human well-being and sustainability rather than economic growth. As an intentional or interventionist approach, it is focused on understanding and improving the sustainability of livelihoods, on the basis of what is feasible in the circumstances – those circumstances being controllable or otherwise. The SLA framework is set out diagrammatically in Figure 3.

A ‘livelihood’ refers to the means by which an individual, whanau or hapu obtains the things necessary for their existence and presence in a geographic space. A livelihood therefore does not simply refer to sources of income or employment. We are not only interested in the means of peoples’ existence, but also the extent to which they are or can be made sustainable without undermining the assets and capabilities on which they are built.

<sup>3</sup> <http://www.ifad.org/sla/>

The assessment of different capitals that contribute to livelihood at the level of the individual, household, group, or community is central to the SLA. These capitals or assets can be classified as:

- **Natural (N)**, the resources and services provided that are available from the biophysical environment, including water, land, plants, minerals, energy, animals, and environmental/ecosystem services etc;
- **Physical (P)**, covers the ‘hardware’ of people’s lives, such as infrastructure (roads, bridges etc.), facilities (schools, meetings houses, houses etc.), equipment (cars, implements etc.) and technology;
- **Social (S)**, the social relationships that people have, including their social networks, organisations, affiliations and obligations;
- **Human (H)**, people’s skills and education, physical and mental capabilities (to think, communicate, labour, etc.), good health, i.e. the capabilities that are embodied in human beings; and
- **Financial (F)**, including cash or equivalent, savings, and credit.

‘Cultural capital’ (not shown in Figure 3) may also be added to this list.

- **Cultural capital** refers to the unique attributes and values of Ngāti Porou such as language, traditions, arts, customs, knowledge system, special places and ways of doing things (Ngāti Poroutanga). A detailed description of local indigenous knowledge may be found in a report by Harmsworth and Warmenhoven (2002) on cultural knowledge and understandings of the Waiapu and its ecosystems and also in Barnard, et al. (2012).

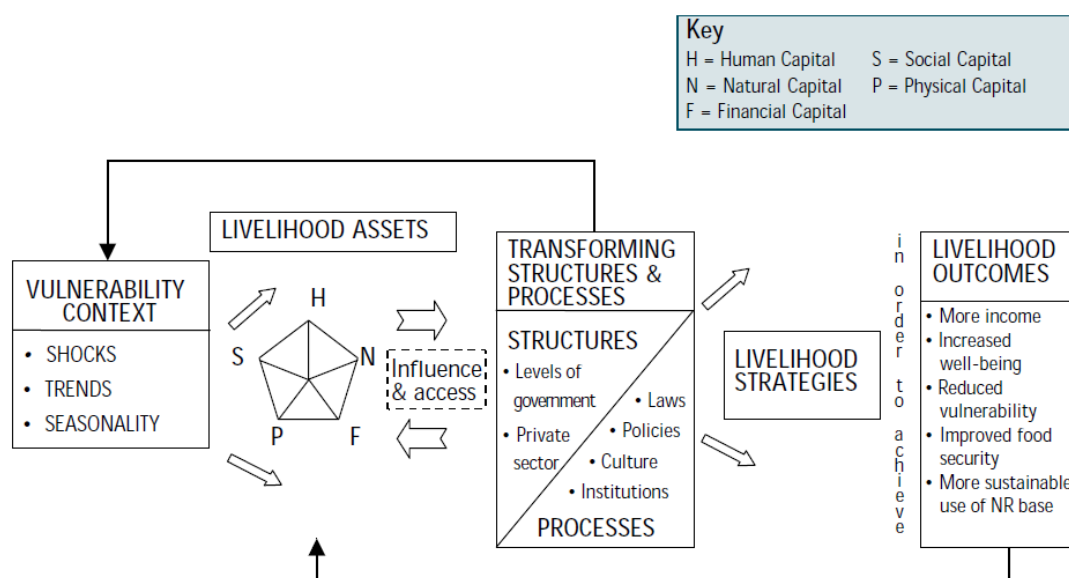


Figure 3: Sustainable livelihoods framework<sup>4</sup>.

The ‘vulnerability context’ within the SLA refers to the risk (and opportunity) environment in which people exist. Its consideration draws analytical attention to complex influences that directly or indirectly impact on livelihoods. ‘Shocks’ (or sudden happenings), seasonality, and critical trends over which people have limited or no control may significantly affect people’s livelihoods and the wider availability of assets and capitals. While such changes most often represent risks to people’s livelihoods, they can also provide opportunities<sup>5</sup>. ‘Shocks’ destroy or damage assets or access to them as in the case of floods and storms and sometimes force people to abandon or dispose of assets prematurely or to change their overall livelihoods strategy. ‘Trends’ are more predictable and, while they may or may not be more benign, they have a marked influence on the success of a chosen

<sup>4</sup> <http://www.ifad.org/sla/>

<sup>5</sup> For this reason, the vulnerability context may be better called ‘the vulnerability and opportunity context’.

livelihood strategy. ‘Seasonal changes’ in production, food availability and associated employment opportunities may undermine livelihood potential and represent hardship for some people. In each of these types of vulnerabilities, historical factors may be very important and there may be cumulative risks, for example, the flooding of productive fields due to on-going upstream catchment erosion.

As defined by the SLA, the vulnerability context is the aspect of life that lies furthest outside people’s control. In the short-to-medium term, less can be done at an individual, group or community level to alter it directly. In such circumstances, the role of institutions, organisations and agencies may become critical.

The SLA is depicted as being a linear process but, in practice, it is more complex and involves partnerships with, and the genuine participation of, diverse groups of people. As such, the SLA is described as a ‘rights-based approach’ to sustainable development. This means that it has the potential to support the United Nations Millennium Development Goals for 2015<sup>6</sup> and the Treaty of Waitangi, through the principles of partnership, protection, and local participation and empowerment.

## HOW THIS REPORT WORKS

This report presents the findings drawn from existing literature and research undertaken during this project, under the following sections:

- The Waiapu – a local way of life;
- Current livelihood vulnerabilities and challenges;
- Quantification of capitals under a changing climate – a planning tool;
- Building resilience to climate change;
- Adaptive systems and the adaptation coalition approach to building resilience;
- Summary – Creating a future for the Waiapu; and,
- Recommendations.

## The Waiapu – a local way of life

Most whanau groups in the Waiapu Catchment employ diversity as their main livelihood strategy. Many undertake a mix of activities, usually having one or two people in a household earning an income through paid employment occasionally supplemented by benefit payments or a pension. Often people are engaged in several part-time jobs, which are commonly seasonal. A lack of continuity in employment presents many challenges for individuals and families seeking to secure a sustainable livelihood. Produce generated from farming, gardening, hunting and gathering constitutes a significant resource for families. On occasions commodities are informally exchanged within the community and this exchange may play a major role in building both social cohesion and resilience. Items are not always swapped at the same time, but people reciprocate or share resources when and where they are able.

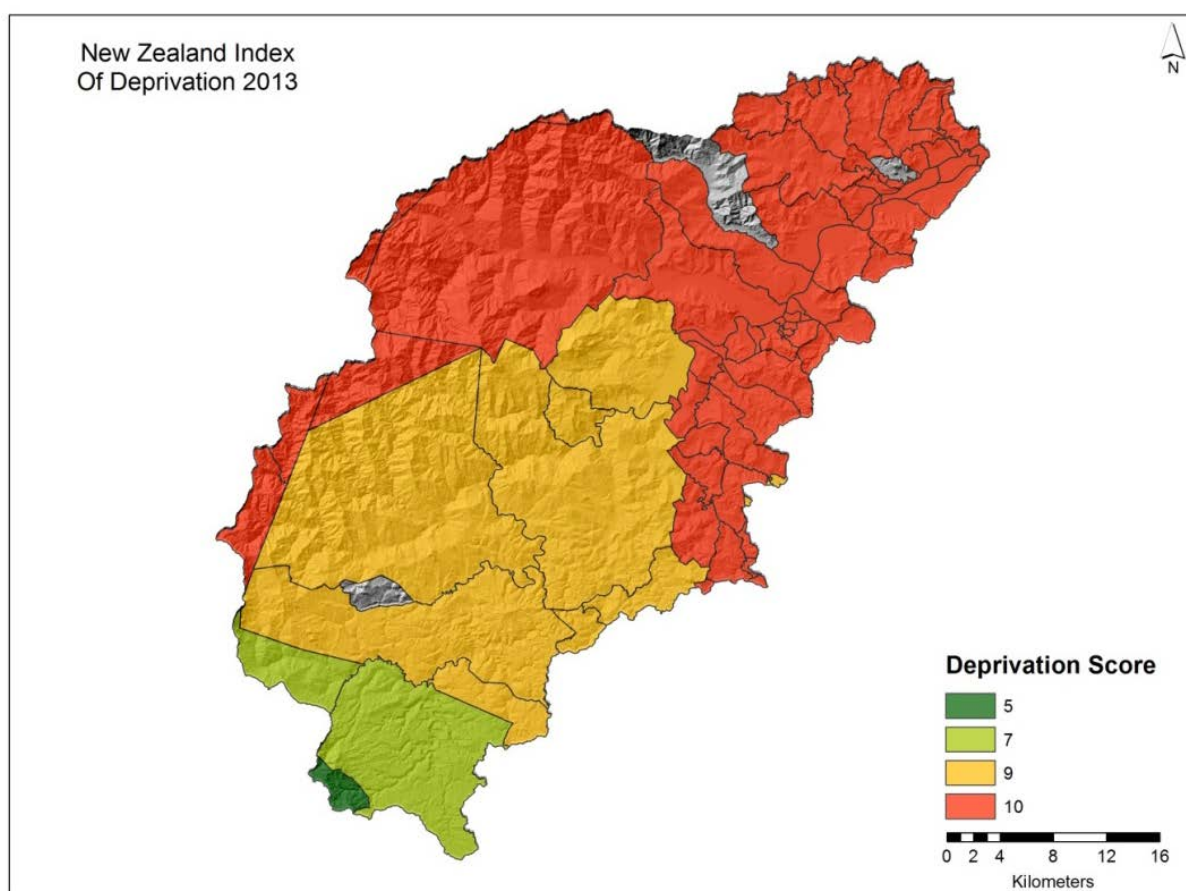
Whanaungatanga is one of the most important livelihood assets for Waiapu families. It provides access to other resources and enables people to “bridge” to other communities and networks as required. These networks and relationships of trust and reciprocity are a traditional and important characteristic of life in the area. Often as a result of limited employment opportunities, a family member will relocate to the city, another region or overseas to earn money, sending contributions back to the family who may be looking after their children. However, remittances from extended

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<sup>6</sup> The Millennium Development Goals (MDGs) are world targets for addressing poverty in its many dimensions: income poverty, hunger, disease, lack of adequate shelter, and exclusion while promoting gender equality, education, and environmental sustainability. They are also basic human rights – the rights to health, education, shelter, and security (United Nations Development Programme: <http://www.unmillenniumproject.org/goals/>).

family members who have moved elsewhere in New Zealand (and increasingly to Australia) are not common.

The New Zealand Socioeconomic Index of Deprivation (NZDep2013)<sup>7</sup> published by the University of Otago allows a snapshot to be taken of the socioeconomic wellbeing of communities across the country. The people of the Waiapu Catchment, especially the communities' resident in the northern part of the District continue to be ranked amongst the 10% most deprived in New Zealand (Figure 4). It should be noted that many in the community do not regard themselves as poor. The richness of local and cultural identity, the East Cape lifestyle and close proximity to family members are regarded by many as more important than more widely 'accepted' measures of community wellbeing. However, in terms of access to resources, members of this community are less well equipped than many others in New Zealand to respond to significant change or future shocks.



**Figure 4: Socio-economic deprivation levels in the Waiapu Catchment (on scale of 1-10).**

No data for a mesh block is represented by grey colour. A score of 10 means the area is within the most deprived 10% (lowest decile) in the country<sup>8</sup>.

Whilst the community may be relatively poor by 'standard' measures of wellbeing, future community resilience may be best understood in terms of the assets held under each of the six capitals described in the SLA. These assets provide the platform from which the community may address the vulnerabilities it faces and build a more sustainable future. The description of each capital below is based on both the community's own assessment and available data.

<sup>8</sup> <http://www.otago.ac.nz/wellington/research/hirp/otago020194.html>

## SOCIAL CAPITAL

The 2006 census indicates that there were approximately 72,000 people identifying themselves as Ngāti Porou in New Zealand with only 12,400 living in the Gisborne/East Coast Region<sup>9</sup>. Of these 4,212 were resident in Gisborne with 8,202 living in the surrounding rural areas. Whilst Ngāti Porou are the second largest iwi in New Zealand - they are the most dispersed. The continued outward migration of Ngāti Porou from the Waiapu Catchment has been mentioned repeatedly by research participants. This continued flow of individuals away from the rohe will, in time, have an impact on social capital and cohesion in the Catchment.

Whanaungatanga and kaitiakitanga form an interconnected and interdependent basis for strong social cohesion. These deeply embedded connections between individuals, as family members and neighbours, and between people and place are regarded as the most important asset the community holds. This is evident in a powerful sense of local identity and pride held by Ngāti Porou underpinned by the vitality of Marae-based activity and the practice of Ngāti Poroutanga. The strength of social capital is also demonstrated in the strength of sport and sports clubs in the Catchment.

Outward migration driven by limited employment opportunities offers a serious threat to social capital and the ability to withstand future shocks. However, the emergence of hapu clusters within the Catchment does offer a building block on which future action may be based and on a scale that may deliver significant benefits. The networks associated with each of the clusters provide effective and efficient mechanisms through which knowledge and resources may be exchanged and change processes put in place.

## CULTURAL CAPITAL

For those in our study, a sense of place and belonging is expressed many ways. A prime example is the Ngāti Porou proverb of collective identity: *‘Ko Hikurangi te maunga, Ko Waiapu te awa, Ko Ngāti Porou te iwi’* (Hikurangi the mountain, Waiapu the River, Ngāti Porou the people). A participant in this study highlighted the centrality of this whakatauki to Ngāti Porou:

*Culturally, and in terms of identity for us, that saying [above] is like the holy trinity – God the Father, God the Son, and God the Holy Ghost.*

‘Place’ is an integral part of a person and tribal grouping - rather than something that is separable and divisible. This is seen in the notion of being Tangata Whenua and in the strong, shared identity as Ngāti Porou. “Love of place” is a common value of those interviewed for the study. Despite lack of physical and financial capital, some consider their native area as “paradise”, and they are lucky to live there. The importance and strength of identity may be seen in the following statement:

*Our strength is our identity. We’ve got to keep our identity and our culture; we are Tangata Whenua, we belong to this land and this land belongs to us.*

While outward migration has had an impact on aspects of both social and cultural capital across the Waiapu community, the essential components of Ngāti Porou cultural capital remains strong. There is concern for the loss of cultural knowledge held and performed by pakeke and kaumatua (learned elders). There is also perceived to be a corresponding decline in the intergenerational transfer of knowledge. Knowledge of genealogies is held in great esteem by Ngāti Porou. The ability to trace connections back through generations serves many purposes that support both social and cultural capital. There are still those in Ngāti Porou who are considered to be guardians and stewards of Whakapapa but again the erosion of social capital through outward migration and loss of a leadership cohort present a threat to their future survival.

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<sup>9</sup> <http://www.ngatiporou.com/Whanaungatanga/Whenua/>

The physical expression of cultural connectedness are Marae; these are the places where the whānau community come together to organise and collectively get things done. Hence a considerable amount of effort goes into maintaining them. A declining population base coupled with limited access to resources means that “keeping the home fires burning” is an on-going challenge for the people of the Waiapu:

*The strengths socially, and probably one of the most important ones and the strongest one for us, are our Marae, our hapu, and our whānau of course. At a marae level we can achieve a lot, we can achieve anything we want to achieve at that level.*

Language is a critically important cultural asset (Owen, 2011) as is tikanga and kawa. The ways in which Ngāti Porou interact with each other, with visitors and with the natural environment through values, norms and social structures are unique and need constant practice through ritual to ensure their survival.

Ngāti Porou art forms, whether through whakairo, whaikorero, waiata, oral history, written historical accounts, tukutuku, taniko and raranga are very rich in the Waiapu Catchment. These art forms serve to maintain the intricate connection between the people and the land and offer a valuable resource for the communication of aspirations and hopes for the catchment.

## **NATURAL CAPITAL**

Many in the Waiapu community believe they are still relatively well-endowed with natural capital and the goods and services that flow from it (Harmsworth & Warmenhoven, 2002; Jones, et al., 2012) - a view that is held regardless of the high levels of erosion, loss of native biodiversity and sediment loading in the River itself. A shrinking population base and increasing reliance on local shops may be reducing some of the pressure on the resource which as previously discussed, does play a major role in supporting local livelihoods.

There is a perception that land is generally underutilised as a livelihood asset. Some interviewees report that farms typically provide a living for one or two families at most, perhaps housing for others and produce for Marae events and locally resident whānau members. Along with pastoral and horticultural products, people mentioned that their land provides them with fruits, wild foods, firewood, wood for carving, medicines and game for hunting. Farms can also be places for people to get together:

*The big aspect of the family farm... is that it recognised and performs as the family hub. It's not gazetted as a Marae, but we do use it as a Marae and has become more so over the years. We have a family cemetery there, maintenance for which is basically underwritten by the farm. Family members and sometimes their friends can come onto the farm (within reason, after talking to the manager) and go for hunts, go for your walk, go for a swim etc .. It's a place for hunting, a place for recreational activities, and a place for partying.*

Many note that the once abundant kai moana (food from the coast and ocean) and mahinga kai (freshwater food) has been reduced in recent years. Hunting occurs in both natural and planted forests, this is not just a recreational activity but an essential resource for many in the community:

*I don't hunt for the sake of hunting. I'll only go hunting if we need some meat. And there's no shortage of game. There's goats in abundance. We'll kill a cow about once every six months and go halves with the guy down here, we do it together, and it gives us enough.*

Several interviewees spoke about the potential for cooperative enterprises with reference to farming and the processing of primary products. Opinions varied on whether a co-operative model would work in Catchment:

*Co-ops [are] definitely the way to go for farms. I can't see us getting into co-ops because the make-up of people today... I think people have just gone into a self-survival mode and aren't necessarily able to think of the greater good, so to try and get people to think outside of themselves gets a bit more difficult.*

*The Runanga started with some really great stuff a few years back, they started a land-owner's forum. They ended up setting up a cooperative approach to farming but just used the farmers in the Waiorongomai Valley and then all the rest of them just got dropped by the wayside, and they stopped that engagement and other farmers actually started losing faith with the whole developmental idea.*

Rongoa (medicinal plants) are collected from a few accessible areas and wood is gathered from any available source and remains a major fuel for many homes.

## **HUMAN/POLITICAL CAPITAL**

Human capital is generally perceived to be declining. Outward migration, an on-going loss of traditional knowledge and low levels of educational achievement within the community are all contributory factors.

Returnees to the community play a significant role in the leadership cohort but the core leadership comes from those who have remained within the community. Those who are at home are seen as vitally important, retaining tribal knowledge and caring for the Marae for the benefit of others. While the community is relatively isolated, there are many who have international linkages and work experience.

Practical skills and a sense of self sufficiency are two areas in which the community has considerable depth but even those skills are thought to be in decline. Those interviewed for this study felt that basic survival skills of rural people in the Waiapu were a significant asset. Local people commonly have skills in hunting (and associated skills of butchering, preparation and cooking meat), home gardening, bush craft, working with horses and farm work, machinery operation, and fishing. Some, however, warn that these practical skills may be eroding as a result of social changes and trends. Generally people "pick up their skills from whānau or friends," sometimes as part of informal exchange, rather than under the supervision of an elder.

In terms of knowledge of the natural environment 'hunters and gatherers' are said to be observant and often the first to notice changes in the environment, such as erosion, coming floods (water bubbles in the streams) and subtle changes in climate:

*Different people have different skills. Some people might have kai skills - like as far as growing; some people might have skills to do with seafood, other people might have skills to do with the bush or whatever.*

*When you look at our hunter gatherers, you know, their sense of observation about what goes on out there is huge so they know all the little changes, the nooks and crannies... they are very observant.*

Gender equality is an interesting aspect of life the Waiapu Catchment. Women play a major leadership role in decision making at the local level and in developing 'on the ground' projects and initiatives. The extent to which women play a major role across formal levels of tribal leadership appears to be less prevalent than at the 'grass roots' level.

Working through Iwi structures, Treaty processes, including Trusts and Boards and the challenge presented by multiple land ownership arrangements, has meant that many in the community have developed very strong organisational skills. This knowledge of institutional processes has created a



cohort with the ability to engage with, shape and influence partner agencies through effective and targeted coalitions. The demands on the time of those engaged in these processes are a major concern. The community often carries a heavy 'in kind' burden in partnership arrangements, especially as there is little financial capital to support engagement.

## **PHYSICAL CAPITAL**

Physical capital in the form of public infrastructure (such as the road network) to support livelihoods activities is not strong and is highly vulnerable to weather-related events and to investment decisions by external agencies. Telecommunication services are patchy, expensive and unreliable. Many families cannot afford broadband nor is it readily available to them. Energy generation and transmission is challenging on the East Coast and is perceived to be a limiting factor on future development of primary processing from which wealth may be generated for the community.

Marae facilities, as well as being an indicator of the cultural health of the community, are important physical assets for hapu and whanau, though their upkeep is a challenge as a result of the decreasing number of individuals with the time and resources to maintain them. Reciprocal sharing of machinery, tools and equipment is common place amongst whanau groups and other networks, a cost-effective arrangement and a way of overcoming the challenge of low financial capital.

The quality of housing stock is a local concern. There is some anecdotal evidence that families wishing to return to the tribal rohe are struggling to find suitable accommodation as rental properties are scarce. There has been a strong focus on papakainga (Ngāti Porou community housing) as a way to reinvigorate these social connections and to overcome sub-standard housing.

## **FINANCIAL CAPITAL**

A lack of financial capital prevents many from attempting to improve their wellbeing and build local livelihoods. Limited access to financial capital means that the community is locked into incremental change – “doing what can be done when it can be afforded”. The transformational changes needed, for example, in developing new enterprises, implementing new forestry strategies, intensifying land use, are beyond the means of many at the present time (Park, et al., 2012).

Treaty Settlement has brought to the Iwi significant financial resources. There is an expectation that TRONPui will invest some of these assets back into the community. But, at a hapu and whanau level, the outcomes of Treaty Settlement currently remain an intangible benefit with the expectation that this will change in time.

Environmental degradation has had a direct impact on the financial capital of the community. The cost of engineering works associated with river management in the Catchment has historically been carried by local residents through the Local Authority targeted rating system. This added a significant financial burden to an already disadvantaged community - a recent concession has lightened this load.

Other strategies employed to overcome the limited availability of financial capital include intergenerational household living in which financial assets may be pooled. Other income may be derived from cash and payments from dividends from farm leasing and forestry blocks but it was not clear to the extent to which they form a major component of local livelihoods.

Like many isolated rural Māori communities in New Zealand, the Waiapu Community remains asset rich in land but cash poor.

## Current livelihood vulnerabilities and challenges

The vulnerabilities facing the community (Table 1) fall into the following broad categories:

- **Environmental vulnerabilities** – land/river degradation and erosion, extreme and more frequent climatic events (especially storms and droughts), seismic events, loss of biodiversity and geographic isolation.
- **Cultural vulnerabilities** – loss of cultural knowledge/practises and sites, language retention.
- **Social vulnerabilities** – outward migration and depopulation, lack of opportunity, changing social attitudes and values.
- **Human capital vulnerabilities** – limited local capacity and capability to drive local projects and programmes. Institutional interactions often demand large ‘in kind’ contributions from local people, the impact of poverty on the ability of individuals to respond, and availability of education and training to build resilience.
- **Political and economic vulnerabilities** – land held in multiple-ownership hinders development and decision making, changes in government regulations, support and policies, collective land ownership, resource ownership and shifting markets, economic instability/uncertainty, financial hardship, discrimination and social justice issues.

**Table 1: Principal livelihoods activities for the Waiapu community and vulnerabilities.**

Main livelihood activities	Vulnerabilities, issues and challenges
<p>Paid employment.</p> <p>Public sector, Iwi sector, primary production.</p> <ul style="list-style-type: none"> <li>- Multiple jobs.</li> <li>- Seasonal work.</li> <li>- Commuting.</li> </ul>	<p>Few permanent jobs available. Few local businesses.</p> <p>Recruitment occurs through social networks.</p> <p>Low skill base in local population to compete for higher paying jobs.</p> <p>Relatively low wages.</p> <p>Road closures due to slips, washouts.</p>
Pensions and benefit payments.	<p>Vulnerable to policy changes.</p> <p>Declining payment levels relative to high costs in remote area/s.</p> <p>Changing eligibility criteria.</p> <p>Welfare dependence is perceived to have negative impacts on some.</p> <p>Ageing population.</p>
<p>Coastal fishing and collecting kai moana (subsistence &amp; events).</p> <ul style="list-style-type: none"> <li>- Crayfish, paua, kina.</li> <li>- Mullet, kahawai.</li> <li>- Eels (subsistence livelihoods).</li> </ul>	<p>Seasonal.</p> <p>Resources are under pressure and declining.</p> <p>Impacts of commercial fishing.</p> <p>Access issues.</p> <p>Sedimentation impacts from the Waiapu River.</p> <p>Diminishing resource quality and availability.</p>
<p>Hunting for feral animals on family and public land (subsistence &amp; events):</p> <ul style="list-style-type: none"> <li>- Pigs, cattle, deer, goats.</li> </ul>	<p>Problems of legal and physical access – especially with forestry companies/corporates.</p> <p>Cost of access.</p> <p>A declining skill and knowledge base in the community and decreased willingness to participate in subsistence activities.</p>
Gathering food, fuel, and materials from the land and fresh water (subsistence).	<p>Environmental decline/loss of resource.</p> <p>Access issues.</p> <p>Declining knowledge and skills.</p> <p>Diminished resource or reduced access to suitable land and sites.</p>
Home gardening/food production (subsistence).	<p>Multiple land ownership hinders decision making</p> <p>Declining skill base.</p> <p>Increasing dependence on supermarkets and processed foods.</p>
Pastoral farming (and related contracting, employment).	<p>Land conversion to forestry.</p> <p>Erosion impacts and cost of control.</p> <p>Lack of access to capital among owners.</p> <p>Lack of skill and interest in farming.</p> <p>Theft of livestock undermines viability of some units.</p> <p>Scale issues affect viability.</p> <p>Multiple-ownership reduces innovative uses of land or the development of new opportunities.</p> <p><b>Fragmented ownership (local, Ngāti Porou and overseas owners).</b></p>
Rental /lease income from land.	<p>Properties running down and lack of investment.</p> <p>Long wait for return to owners (forestry).</p>
Horticulture (legal & illegal).	<p>Multiple land-ownership hinders decision-making.</p> <p>Small scale and seasonal.</p> <p>Lack of sustained investment by buyers &amp; processors.</p> <p>Remote from markets.</p> <p>Vulnerable to weather and road closures.</p> <p>High risk crops.</p> <p>Limited knowledge base.</p>
<p>Plantation forestry (mainly from paid employment, subcontracting, and royalties/rental).</p> <p>Includes carbon credits.</p>	<p>Seasonal work and lack of continuous employment.</p> <p>Predominantly radiata pine which is not favoured by many in the community.</p> <p>Forestry /seasonal jobs done by visiting crews.</p> <p>Long time before financial returns come to owners.</p> <p>Capital intensive as a grower and contractor.</p> <p>ECFP rules /requirements.</p> <p>Displaces farming from family blocks and fractures historic land use patterns.</p> <p>The future loss of East Coast Forestry Project.</p> <p>Low returns from Carbon forests to the community – dependent on national policy.</p> <p>Illegal activities – use and growing of drugs.</p>

## CLIMATE CHANGE AND VULNERABILITY

Climatic events have greatly influenced the current state of the Waiapu Catchment and the wellbeing of its people (Table 2). Since the late 1800s, the Catchment has experienced a series of significant and dramatic weather events including over 57 large floods. Cyclone Bola was the largest storm to hit the area resulting in severe erosion and widespread damage to infrastructure, homes and property estimated at \$10 million (Glade, 1998).

**Table 2: Description of major climatic events since 1880 (adapted from (Harmsworth & Warmenhoven, 2002; Scion, 2012)).**

Major climatic events	Comments
1938 Flood	762 mm of rainfall within 30 hours. Extensive erosion of the hill country.
1980 Christmas Flood	2000 stock lost, Horo Horo bridge washed away and 400 hectares covered in deep silt.
1982 Cyclone Bernie	Trees uprooted, property damaged and shelterbelts wrecked. One fatality.
1983 Drought	Westerly winds led to an acute fire risk in the new Radiata pine plantations. Farmers were forced to sell stock due to a shortage of water and feed (Rau 1993).
1986 Drought	A second severe drought hits the catchment.
1988 Cyclone Bola	The largest cyclonic event recorded, with 600 mm rainfall recorded in 4 days near the coast, and 900 mm rainfall in the headwaters. Huge and widespread storm damage (erosion, sedimentation and flooding). The community was devastated by the scale of damage.

The Waiapu Catchment has a warm temperate maritime climate and an average rainfall of 2400 mm/year. The headwaters have a higher average rainfall (>4000 mm/year) compared to the coast (1600 mm/year) and the catchment does experience frequent intense rain events. Cyclone Bola was estimated to be a 1 in 100 year (+/- 20%) event in the Waipaoa River with no estimates for the Waiapu Catchment (Rosser, et al., 2012).

The climate in the Catchment is highly influenced by the El Nino/Southern Oscillation (ENSO), which is a naturally occurring phenomenon brought about by fluctuating ocean temperatures and climatic changes in the Pacific Ocean. La Nina events are characterised by an increase in major cyclonic rainfall events and El Nino in an increase in severe droughts for the Waiapu Catchment.

It is expected that under climate change the Waiapu Catchment will be warmer, dryer and, windier - with a small increase in sea level at the mouth of the river. It is also likely that it will experience more extreme storm events including severe droughts (see Table A1 in the Appendix). Storm events with a probability of a 1 in 50 year return period are forecast to increase by 10% by the middle of the 21<sup>st</sup> century. Furthermore, major droughts with a probability of a 1 in 20 year return period are expected to double. As erosion is already a severe issue for the Waiapu Catchment, more frequent and intense rain storm events are going to heighten existing vulnerabilities. Aggradation, sedimentation and flooding have also had a negative impact on natural capital and the flow of natural resources to the community (Rosser, et al., 2012). A number of mitigation initiatives mainly involving afforestation have been developed in response to the erosion problem (Scion, 2012). Also, flood control measures protecting Ruatoria Township from the erosion caused by the Waiapu River have been undertaken using porous groynes or dolos (Gisborne District Council).

Drought is also a risk in the Waiapu Catchment (particularly during an El Nino phase) for primary sectors and community water supply. There have been limited mitigation responses to the risk of drought in the catchment. During past droughts there has been a high reliance on freshwater springs in the headwaters (Harmsworth, Warmenhoven, et al., 2002).

The most likely climatic changes and associated risks are summarised below:

- **Extreme rainfall** – impact of increased risk of erosion, aggradation, sedimentation and flooding;
- **Major drought** – impact through increased pressure on water supply, soil moisture deficit, and increased risk of fire.

Other climatic changes in the Waiapu Catchment are also important and will have a gradual change over time impacting on the Waiapu and its people and will be considered in the analysis of pressures on community resilience:

- **Warmer, drier, and windier climate** – increasing pressure on water supply, shift in biological habitats, shift in pest and weed range, and shift in primary sector production and risks (Clark, et al., 2012; Savage, 2009).

An increase in sea-level is considered to effect only a very small area of land at the mouth of the Waiapu (see Appendix; Table A1, Figure A1 and A2). Increasingly it is being recognised that impact of sea-level rise is much greater than the area of land lost or degraded. Social and cultural values tend to be very strong in coastal areas for many reasons – not least the legacy of settlement and occupation. Increasingly a sense of belonging, culture, community cohesion, identity, self-determination and attachment to place are being regarded as critical to social understandings of climate risks and impacts (Graham, et al., 2013). Ngāti Porou, as a coastal people, has a long and significant cultural relationship with the Waiapu estuary. Its loss or modification has implications for whakapapa, livelihoods and the ability meeting the cultural obligations of Manaaki.

## Quantification of capitals under a changing climate – a planning tool

The economic, social and biophysical trends, processes and events that have contributed to the current degraded state of the environment and low-socio-economic profile of the community will continue into the future if unchecked (Porou, et al., 2012). Climate change, as discussed, is expected to add another layer of stressors and generate further shocks (floods, drought and storms) that the community will have to overcome (Marshall, 2010).

Assessing the impacts of climate change on social, cultural and human capital is difficult over either a medium or long-term horizon. The community does regard itself as resilient at a basic level especially to specific events. The experience of Cyclone Bola is often cited as an example. Cyclone Bola, which occurred on 7-10 March 1988, affected the whole region. The impact of this event on the Catchment has been described in a range of studies and papers (Eustace, et al., 1999; Hicks, 1991; Scion, 2012; Webber, et al., 1990). Cyclone Bola provides a graphic example of the effects of an extreme climatic event on the people of the Waiapu and their livelihoods, their natural resources, livelihoods capitals and institutions. Whilst the community inevitably struggled, it did manage to cope with the immediate impacts of this event. However, the long-lasting effects are still being felt. It would be reasonable to assume that if community capitals or assets continue to be eroded by background economic, institutional, cultural, demographic and political forces, the ability of the community to recover from future climate-related shocks or trends will be further reduced.

Whilst aware of climate change as a potential threat to the community, it was difficult for many to envisage how they could usefully plan for likely impacts given the everyday reality of making a living from the land. This prioritisation is not unusual amongst communities struggling to deal with a range of pressing social, environmental and economic challenges.

In the light of these uncertainties, a planning tool has been developed using an approach developed after Halpern, et al. (2012) to aid future planning, policy development and deliberation. This tool may be used to assess or consider the extent to which climate change may influence livelihood capitals and the potential role of policy in mitigating impacts and in building resilience.

The status of each capital is defined by a set of indicators developed from 95 aspirational values described by Porou, et al. (2012). These values were mapped into indicators drawn from the Montréal Process Criteria and Indicator framework<sup>10</sup> and populated with available data (see Appendix).

The impact of climate change on sustainable livelihood capitals was run for two scenarios 1) under current climatic conditions, and 2) under climate change. The results are shown in Figure 5 and Table 3.

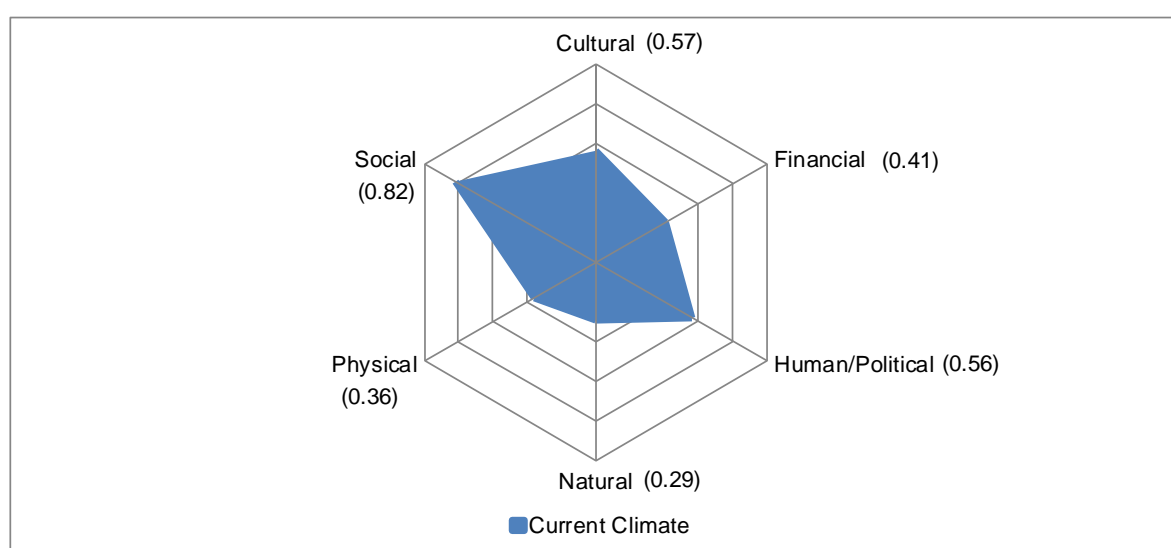


Figure 5: Current status of the capitals in the Waiapu Catchment, capital values in parentheses (scale 0 – 1).

Table 3: Data of climate change impacts and policy (goal specific regulation) on capitals in the Waiapu Catchment.

Capital	Current climate (%)	Climate change (%)	Difference (%)	Contribution of Goal Specific Regulation * (%)
Cultural	57	56	-0.57	0.24
Financial	41	40	-0.35	0.00
Human/Political	56	56	-0.29	0.00
Natural	29	29	-0.29	0.89
Physical	36	35	-0.74	0.00
Social	82	81	-0.45	0.00

\*The positive input of policy (goal specific regulation) to the capital value under climate change (Note: does not take into consideration the present status and trend of individual indicators, only the maintenance of the current goal specific regulation with climate change).

Climate change had a negative impact on all capitals and on physical capital in particular, revealing its high degree of vulnerability to extreme climatic events. Current policy (i.e. goal specific regulation, for example, the ECFP and LO3A) had a significant and beneficial effect on the level of natural capital available to the community through greater protection afforded to soil and water resources. Both these policies also benefitted cultural capital as erosion prevention, through further planting, helped

<sup>10</sup> [http://www.montrealprocess.org/Resources/Criteria\\_and\\_Indicators/index.shtml](http://www.montrealprocess.org/Resources/Criteria_and_Indicators/index.shtml)

to mitigate the loss of sites of cultural significance. In summary, both the ECFP and LO3A are already playing a major role in building resilience.

It is important to note that the model used to undertake this analysis only presents a picture of the near likely future. In reality, the status, pressures and future trends used in the model may change creating a different outcome. However, the tool is useful in shaping future deliberations over land use in the catchment and in understanding both the benefits and impacts (both primary and secondary) of policy decisions in a more holistic way. Figure 6 below shows an adaptive management cycle linking drivers to pressures and the need to assess impacts on the state of the environment and likely flow-on effects. This tool helps to inform the adaptive approach to decision making in capturing all aspects of the cycle (Driver, Pressure, State, Impact and Response) in a single a model.

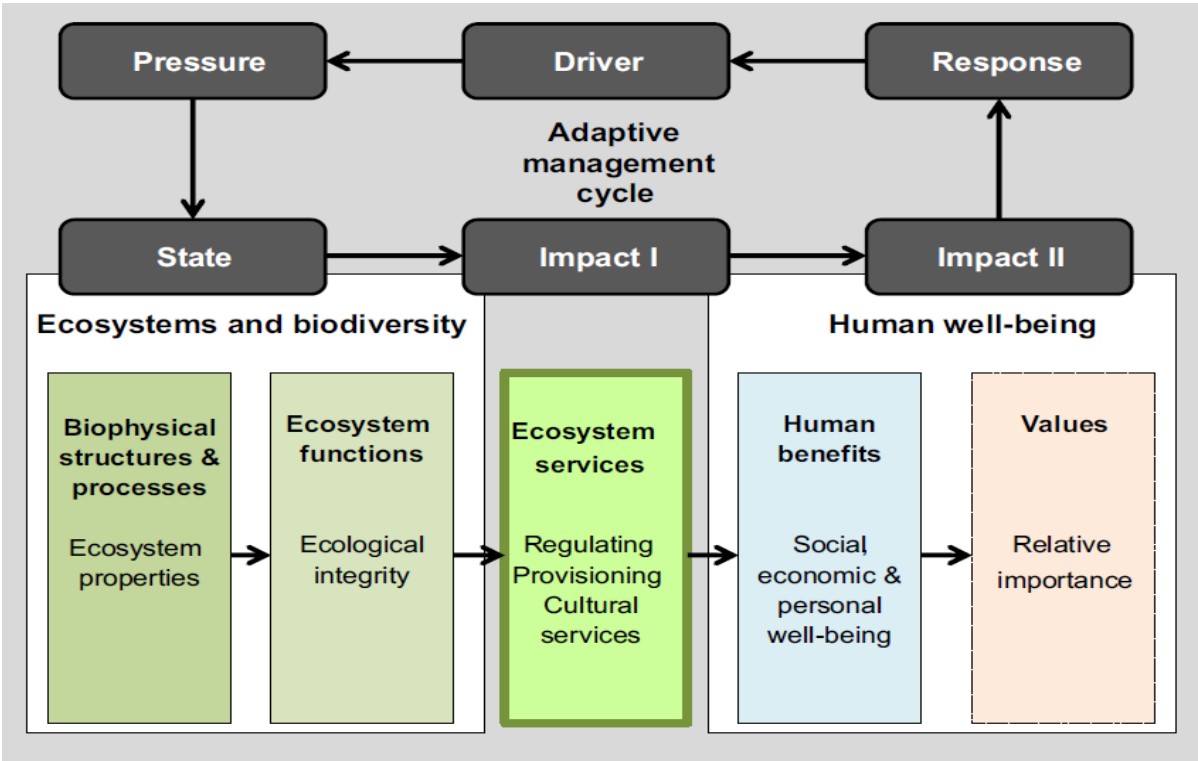


Figure 6: Adaptive management cycles (Müller, et al., 2012).

## Building resilience to climate change

### ASPIRATIONS, MITIGATIONS, ADAPTATIONS AND THE ROLE OF FORESTRY

Both GDC and MPI have been quite specific about their goals within the Catchment with regard to the treatment of highly erodible land. This has, at times, been at odds with some members of the community who regard holistic approaches to land management as the only logical and culturally relevant way to tackling the restoration of the health of the land, rivers and people. In particular, Ngāti Porou has often felt that land management decisions in their own rohe are made by those who do not adequately understand the implications of those decisions on the land or the local community.

To date, the East Coast Forestry Project (ECFP) administered by MPI and the Council’s Sustainable Hill Country Project implemented through its Land Overlay 3A District Plan Rule, has led to approximately 42,000 hectares of target land in the Region being put into forestry. A further 25,000 hectares of untreated land remains within the Waiapu Catchment. Problems associated with the uptake of the ECFP funds and compliance with Overlay 3A have been well documented by Scion (2012) and others. This has been recognised by MPI. Phase I of the Restoration of the Waiapu Catchment Programme

which includes a review of the ECFP criteria with the expressed aim of accelerating uptake of remaining funds.

Support for afforestation through the ECFP programme will end in 2020 although planting maintenance funding will continue to 2028. The window of opportunity currently presented by the ECFP to the community will close in the near future. This places a degree of urgency on the co-development of resilience strategies over the initial phases of the Waiapu Catchment Restoration Plan.

## **COMMUNITY ASPIRATIONS - RESTORING THE CLOAK OF THE WAIAPU**

### **Te Korowai o Papatuanuku, Te Korowai o Waiapu**

The overriding aspiration held by interviewees for the catchment is for a patchwork of diverse and varied land uses, delivering economic, environmental, social and cultural benefits for the community. These aspirations match closely those described in Scion (2012) also listed in Table A5 of the Appendix, and may be grouped to include values associated with:

- The restoration and utility of biodiversity;
- Knowledge of the natural environment and sites of cultural importance;
- Increased economic wellbeing and prosperity for all the community;
- Poverty eradication;
- Mana motuhake;
- A healthy and well educated community;
- Access to the financial and physical resources the community needs;
- Restored ecosystem services; and,
- A vibrant hapu/whanau community and well-used Marae.

The reforestation of the catchment and halting the loss of natural capital available to the community is seen as a high priority. The challenge for many is to find ways of achieving environmental restoration whilst securing enhanced wellbeing for all the people. Social equity features strongly in many comments made by research participants. It is recognised that the impacts of erosion on the whole community are not shared equally and that some carry an 'unfair' burden.

More intensive use of what is left of the alluvial plains is often advocated, along with the development of forestry options that meet the aspirations of the community. Within this broader context, the following land use options were discussed by research participants, either directly or indirectly through interviews and hui.

### **Conventional Radiata pine forestry**

Community attitudes to conventional Radiata pine forestry in the Gisborne and East Coast area have been well documented (Langer, et al., 2003; Tomlinson, et al., 2000). Whilst many of the concerns highlighted in existing literature still resonate within the community, there does appear to be a softening in attitude and growing acceptance of Radiata pine forestry as a productive land use and as an agent for effective erosion control. It is here to stay. An analysis of each option has been used to help collate the varied comments attributed by capital (Table 4).



**Table 4: Radiata pine planted forests – assets and deficits.**

Community Capital	Asset	Deficit
Social	Ngāti Porou Whanui Forestry is an Iwi-owned entity with the ability to deliver local benefits and develop networks and opportunities.	Forestry workers may have to travel to find work which is temporal and seasonal. This may take workers outside the rohe for long periods of time. Forestry is not thought of as a long-term career option. It offers seasonal and demanding work, long hours and its difficult to get well-paid jobs in the industry.
Cultural	Planted forests, as providers of ecosystem services, are helping to restore cultural values within the Catchment. Ngāti Porou Whanui Forestry is a source of pride and an example of local entrepreneurial activity.	Land owners who have put their land into forestry leases often feel that they become distanced from their land and decision-making processes.
Natural	Plantations are now regarded as an acceptable land use option on suitable sites providing benefits to the community (fuel, hunting, non-wood forest products). Forests offer biodiversity benefits for the community providing refugia for native species. Forestry has proven value as an erosion-control mechanism. Radiata pine forestry is thought to be resilient to climate change trends but vulnerable to specific events including storm damage and fire during times of drought.	The loss of the East Coast Forestry Project funding in 2028 and associated support funding may leave considerable areas of land untreated and exposed to further erosion. Felling activity on steep land is seen as harmful to the land, exacerbating environmental degradation and heightening the risk of erosion and debris flows. There is a “window of vulnerability” for erosion between when trees are logged and the new trees planted (Phillips, et al., 1994). Whilst the GDC have rules to mitigate these effects they are still regarded by the community as threat.
Human	An established skill base in forestry and forest management in the community.	Worker wellbeing and safety is an extremely high priority for the community. There are concerns that the remoteness of the Catchment, a lack of supervision and the complexity of steep-land harvesting makes local workers extremely vulnerable to accidents and harm. Drug use presents a risk to forestry workers safety and employment.
Physical	New road development and supporting infrastructure to support forestry operations.	The impact of logging trucks on an already pressured road network is a major concern for many. Major storm events may result in road closures at a number of vulnerable points in and out of the catchment, flooding being a major threat. Loss of railways linkages. No port facilities.
Financial	The East Coast Forestry Project (ECFP) has provided a level of support albeit subject to unfavourable conditions. Financial benefits are now being returned to the community.	Loss of ECFP support will place the burden back on a community with low financial capital on erodible lands. Perceived lack of social equity – financial benefits thought to be realised outside the host community. A commodity product that is very susceptible to market forces. An increase in carbon price to \$15, as advocated by some, would lead to an increase forestry planting across the Catchment and deliver more revenue Back into the local economy (see Appendix Figure A4).

### *Continuous cover forests on steep-lands*

Some in this study would like see permanent or continuous cover-forestry practiced more extensively in upland areas. The benefits of continuous cover-forestry appear to be reasonably well understood and include: a more resilient landscape to the effects of erosion; improved habitat for native biodiversity; increased utility values for hunting, fuel collection, medicinal plants; and potentially improved water quality in upland streams. As mentioned earlier, it is also recognised that continuous cover forests may have a negative impact on a number of individual land or lease owners who may

lose the opportunity to earn revenue from their land. In this case, a shared agenda that embraces those in the community that have to bear the brunt of the cost was often advocated.

The conversion of existing Radiata pine forest to native forest was mentioned on several occasions, especially on land where financial returns after harvesting are thought to be negligible. A commonly expressed concern is that these forests may become unmanaged with the risk of unstable even-age pines falling over further exacerbating the risk of erosion and increasing future vulnerability to severe weather events.

**Table 5: Continuous cover forestry on steep land – assets and deficits.**

Community Capital	Asset	Deficits
Social	Excellent local networks to share knowledge.	Displacement of landowners or loss of revenue from the setting aside of land in permanent forests. Catchment becomes a 'forest park' with few people.
Cultural	Enhanced ecosystem service provision and the potential to develop cultural resources (rongoa, etc.).	Landowners who have put their land into continuous-cover regimes become distanced from their land.
Natural	A long-term solution to environmental restoration whilst providing benefits to the community (fuel, hunting, non-wood forest products). Greater biodiversity benefits for a wider range of native species. Greater resilience to climate-change events but vulnerable to specific events including storm damage and fire during times of drought.	Old unmanaged Radiata pine plantations may become vulnerable to wind damage and become unstable increasing the risk of erosion.
Human	Local knowledge of forest management. Local knowledge of resources provided by forests.	Little knowledge of how to effectively establish and manage continuous-cover forests.
Physical	Access provided by forest roads.	Uncertain.
Financial	Potential support from ECFP.	Limited financial capital available to implement regime. Loss of revenue.

### *Indigenous forestry and alternative species*

There was considerable interest in alternative forestry models at the final community hui and, in particular, in indigenous species. The use of indigenous species meets many locally held aspirations for the catchment but also brought with it some perceived vulnerabilities (see Table 6). Alternative species too, were thought to have the potential to play an important role in delivering a patchwork of land uses that will help build resilience. Barriers to implementation include:

- Little knowledge of the species and their needs;
- Limited knowledge of 'silvicultural' techniques;
- A lack of knowledge of future markets and the infrastructure needed to develop a local niche industry;
- Little knowledge of how to source plants or develop local nurseries; and,
- Low levels of financial capital needed to support uptake.

**Table 6: Indigenous forestry and alternative species – assets and deficits.**

Community Capital	Asset	Deficit
Social	Strong networks to within the community to transfer knowledge.	Displacement of individuals from the land. Limited knowledge of networks/markets for alternative species.
Cultural	Indigenous species are more closely aligned with aspirations to restore the Catchment to an earlier period in its history. Enhanced ecosystem service provision and the potential to develop cultural resources (rongoa).	Uncertain.
Natural	Longer rotations providing potentially offer greater biodiversity benefits as well as fuel, hunting and non-wood forest products. Resilience to climate change events but vulnerable to specific events including storm damage and fire during times of drought.	Desire to use locally sourced stock for indigenous species if available (provenance issues).
Human	Local knowledge of forest management. Local knowledge of resources provided by forests.	Little knowledge of how to effectively establish and manage indigenous forestry regimes.
Physical	Uncertain.	Few nurseries to raise the stock. Few milling and wood processing facilities?
Financial	Benefits from ecosystem service payments?	Limited financial capital to support establishment. Loss of revenue from the land.

*Modified Radiata pine forestry regimes: Multi-cropping*

Multi-cropping refers to the planting and harvesting of crops within the forest. There are examples elsewhere in New Zealand that have been grown successfully. The obvious benefit perceived by the community is increased revenue from the existing forest estate together with the potential to develop new value chains and niche markets. However, limited human capital in the form of local knowledge or practical experience, or even awareness of where to get information and training is a limiting factor. Little knowledge of markets or how to commercialise products are also barriers to further development. Low financial capital held within the community also heightens the risk around investment in expertise or equipment. The planting of illegal crops within the forest estate is an unfortunate aspect of the local economy yet it plays an important part in the livelihoods of some in the community.

*Agro-forestry*

The planting of willow and poplar for erosion control purposes has been practised in the Catchment for over a century. Almost by default, it has resulted in a form of agro-forestry in the area albeit at a low level. Some landowners cut poplar as a supplementary feed as it has perceived health benefits to livestock.

*Farming and land-based enterprises*

Many Ngāti Porou land owners wish to farm their own properties rather than lease them out for rental income. Several noted they would like to see the community able to feed and support itself directly from the land and that this would help build resilience as well as generate improved health outcomes. However, the number of Ngāti Porou actively farming the land is perceived to be falling. Farm co-operatives or land amalgamation are thought to be a good option; affording greater economies of scale and thereby increasing viability of the enterprise. However, many prefer to work and plan alone as coordination is difficult and the development of collaborations is seen as a challenge with high degrees of risk. Therefore, successfully achieving greater cooperation is considered to be problematic. Further land amalgamation was also considered by some to be a threat to the social fabric of the community as it was perceived to lead to a further loss of employment opportunities.

Other local economic development opportunities were identified which generally may be regarded as niche market activities. Manuka honey and oil production is already well established on the East Cape and has been under consideration by several hapu clusters in the Waiapu area. Reasons for not pursuing some of these activities included a lack of knowledge, know-how, resources, finance or in some cases, a lack of interest.

### *Tourism*

Tourism was not regarded as an option that was likely to bring significant benefits in the long term given infrastructural challenges. Small-scale enterprises have a place in the local economy but linked to other land-based activities, for example, manuka oil and honey production or hunting and fishing.

### *Energy*

Self-sufficiency in energy was a strongly held community aspiration. Favoured options for power generation were wind, solar and bio-energy using forest waste. Local power generation was also seen as a basic pre-requisite to any form of local wood processing. Several respondents also spoke about the potential for oil exploration on the East Coast and the conflicting views within the community on its merits and acceptability. No direct mention was made of geothermal or tidal and coastal energy generation.

## **Systems and the adaptation coalition approach to building resilience – Challenges for the Waiapu Catchment Restoration Partnership**

If resilience is to be successfully built in the Waiapu Catchment with Ngāti Porou, then it must be grounded in the community's strengths or assets. Agencies have a role to play in developing strategies that build on these strengths and supporting areas where the capitals are weak (in deficit) and vulnerabilities high. These adaptive coalitions (World Bank, 2011) empower local people to address climate change through inclusive, cohesive and accountable processes through strategic partnerships with supporting agencies.

Adaptive coalitions, may be simply interpreted as groups of individuals or organisations (local and non-local) that form alliances around climate change related issues in order to achieve shared desired futures that a community or group of individuals is willing to plan for. The Waiapu Catchment Restoration Partnership represents an excellent example of the type of coalition that is going to be required in future.

The benefits of this approach include:

- Knowledge exchange;
- Local leadership and capability development;
- Local information gathering and use in decision-making processes; and,
- Coalition development leading to effective and efficient policy development and resource deployment.

Ultimately, whether or not resilience may be achieved in such a complex environment is uncertain (Stokes, et al., 2009). This makes the requirement to build coalitions and develop strategies in anticipation of expected change all the more important. The basis of resilience theory, and the underpinning theme of this report, is that social, economic and ecological systems are inextricably linked and constantly face change 'the outcomes of which are inherently unpredictable' (Marshall, 2010). In the face of so many uncertainties, coalitions will be required to overcome the many challenges the Waiapu community will face in an uncertain future.

## SYSTEMIC APPROACHES TO THE CHALLENGES FACING THE CATCHMENT

At a finer level of resolution, systemic analysis was used to explore the nature of the interactions within and among current agencies and coalitions to explore pathways that may build greater resilience and underpin development. These relationships are critical to overcoming the deficits in the capitals held within the community and in building off its strengths.

Similar approaches have been applied across the primary sector in several countries, including New Zealand, as a means of developing solutions to problems or identifying barriers to implementation. In this study, we have used an innovation policy framework developed by Wieczorek, et al. (2012). Data from nine semi-structured interviews with individuals from Government, Iwi, industry and science have been integrated with the outcomes of the livelihoods hui process to construct an analysis of the barriers to greater resilience within the Waipatu Catchment.

Structural components of an innovation system include actors or players (for example, GDC, TRONPnui and MPI); institutions, in form of legislative and policy frameworks; the nature of interactions, whether they are formal or informal; and supporting infrastructure (knowledge, expertise, strategic information and finance). Functional components of the system have been modified from Wieczorek, et al. (2012) to include change-agent activities, knowledge development, knowledge dissemination, leadership and guidance, resource mobilisation and, legitimacy and advocacy. The functions are described in more detail below:

- **Change-agents, champions and entrepreneurs** describes those individuals with an influence in the catchment, who can act and bring together networks, resources, both old and new knowledge, have market or business know how and deliver specific and real actions on the ground.
- **Knowledge development** is at the heart of action-orientated activity. It describes the knowledge base on which actions and decisions are taken, its quality, quantity, whether it is basic or applied and relevant research that is applicable.
- **Knowledge transfer** reflects the way in which knowledge is shared, any aspects of co-learning and fit between knowledge development and expressed need.
- **Leadership and guidance** is the process by which action is targeted, underpinning research directed and wider discussions with the community are developed and led.
- **Resource mobilisation** embraces the gathering, harnessing and use of financial, physical and human capital in addressing the challenge.
- **Legitimacy and advocacy** for change is the process by which the institutional arrangements and structures necessary to support change are enabled to support action.

## CHALLENGES TO THE CREATION OF A MORE RESILIENT COMMUNITY

### Change agents, champions and entrepreneurs

#### *Supporting change-agents - overcoming asset deficits*

The community holds a considerable amount of social capital, particularly in the form of networks and linkages among groups. This allows for the effective exchange of knowledge and information. However, the lack of financial capital, physical capital and aspects of human capital, in terms of a skilled workforce often presents barriers to uptake. The development of resilience-based or economic development projects or initiatives, even from within Ngāti Porou's own organisations, without reference to community assets, may fail unless weaknesses in the community's capital base are addressed at the same time, for example, in training and human capital development. The development of new forestry regimes based on indigenous or alternative species provides an excellent example. While many in the community may have aspirations they lack the knowledge and resources to take the concept forward to implementation.

### *Overcoming the challenge of subsistence lifestyles and multiple land ownership*

While many Ngāti Porou regard themselves as entrepreneurial, a lack of financial capital and a need to meet immediate needs of their existing livelihoods or subsistence lifestyles undermines the capacity to act for change. This results in only limited or incremental changes to current activities. Obtaining investment for new initiatives on land in multiple-ownership is also regarded as problematic, particularly from mainstream financial institutions.

### *Limited capacity to support entrepreneurs/change-agents*

Few local members of the community have the time or resources to assume leadership roles. The funding of community engagement and, in particular, those with leadership capability is an obstacle to progress that is seldom recognised by agencies. The appointment of an Iwi Coordinator by the Partnership represents a major step forward in taking forward the implementation of Phases I and II of the Restoration Plan.

### *Defining the leadership of change activity*

There is wide acceptance that key decisions that will underpin future resilience of the community will occur at the hapu and whanau level. Therefore, the relationship between hapu and TRONPnui is critical to future success. The Runanga is the elected representative body with responsibility for administering some collectively owned Ngāti Porou assets, providing one level of political leadership, promoting education and health and developing a viable, independent and sustainable economic base for the Iwi. The Runanga is seen as an important asset, offering both a leadership and enabling role to the community for hapu and whanau alike. This dichotomy, with hapu leading resource based change activity on the ground and TRONPnui developing strategic and collective approaches to the development of health, education and political leadership is seen as the desired model. Some concerns were expressed that, in the short term, there may be both capacity and capability gaps within Iwi organisations that will need to be addressed. Areas of need included help with the assessment of specific land use options, support for business development activity and market awareness.

## **Knowledge development**

### *Defining the scope and focus of knowledge development/research activity*

Some of the issues and problems facing the catchment have been extensively researched over a number of years. There is now a considerable body of information and data available to the community of relevance to its future sustainability. However, knowledge development processes have, in the past, often occurred in isolation of community aspirations and needs. The extent to which the wider Ngāti Porou community have been able to shape the research agenda appears to be limited and is often dependent on external agencies approaching the community on an informal basis. The Partnership, particularly through MPI, has the opportunity to explore new research opportunities linked to the Restoration Programme outcomes and secure alignment between research signals and community aspirations/needs.

Ngāti Porou, and TRONPnui in particular, have been proactive in the development of science and research strategies, but the extent to which these have been carried forward with key agencies is not clear. However, there are indications that this situation may be changing with development of new initiatives with external partners in the catchment.

### *Knowledge development/research is problem focussed*

The complexity of the challenges the community faces cuts across research, organisational and disciplinary boundaries. An integrated approach to research planning is required to ensure that knowledge gaps are filled and that the human capital within the community is developed. The research community, in general, is perceived to excel at researching issues, but often it is felt it produces more questions than answers, and does not provide product development, practical land

use assessment advice nor does it provide wider support in taking the results to market. Often it is felt the researchers “get more out of the research than the communities themselves”.

## Knowledge transfer

*Traditional and cultural knowledge held in the community is declining and not being used to support decision making*

The loss of traditional/cultural knowledge and the loss of elders with a connection to traditional ways of life, practices and values are undermining the quality of decision making and its relevance to the land and people. This knowledge is regarded as critical to maintaining cultural capital in the rohe.

*Knowledge transfer to support alternative land use decision making has been weak and un-sustained*

Whilst economic realities and a lack of financial capital are restricting the implementation of alternative land use options, the absence of a sustained knowledge transfer mechanism is seen as a problem. There have been some attempts to share science knowledge within the community, for example, through road shows, but they have been ‘one off events’ and have not been supported over time. In the absence of supporting networks, individuals often then fall back on what they know and look to small-scale improvements reinforcing a low risk, business-as-usual model.

*Obtaining knowledge is costly and complex process*

External advisors may be costly and may not have the knowledge of all the options available or aware of the latest science research. Equally, the advisers may not be aware of the needs of the community or have the resources or skills to transfer information in a way that eases the pathway to implementation.

## Leadership and guidance

*Long-term commitment to meet long-term goals – Government (local and central) and research organisations partnerships*

The future resilience of the community will rely on actions taken to address vulnerabilities and weaknesses in the assets held by the community. The effectiveness with which these are tackled will rely on the quality of the knowledge transfer mechanisms between and within agencies and long-term commitment. Aligning the aims and objectives of government agencies, including local government, may be problematic and difficult. There is a legacy of mistrust in the community from a number of high profile interventions over many years that failed to deliver the outcomes expected (Scion, 2012). A fundamental pre-requisite to an integrated approach to policy and decision making in the catchment is open and free access to data and knowledge – especially where it is driving action on the ground.

*Integrating goal-led and holistic approaches to Catchment planning is problematic*

The community’s aspirations articulated in Harmsworth and Warmenhoven (2002), Porou, et al. (2012), and echoed in this report, embrace a holistic view of what constitutes a healthy environment and community. Agency engagement is often goal-driven, for example, Overlay 3A is explicit in its aims and objectives and similarly the East Coast Forestry Project has explicit targets which may not encapsulate all aspects of the vision the community for the catchment. Goal-led approaches alone will never meet community aspirations unless an attempt is made to develop integrated catchment planning processes – including both economic and social development. The aspirational desire for ‘healthy land, healthy rivers and healthy people’ will not be met without more interaction between relevant parties through appropriate coalitions (Figure 7).

*Activity and progress will be measured through a cultural lens, success needs to stack up on this measure as well as others ...*

Failure to address the gap between agency goals and locally held aspirations will remain a source of frustration for many in the Waiapu community until they are addressed.

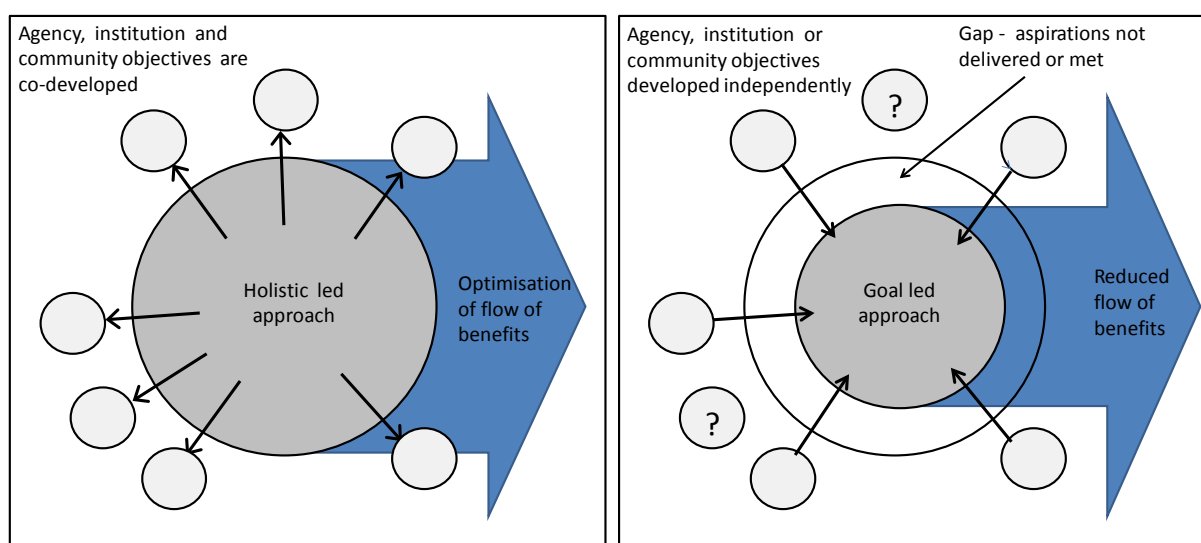


Figure 7: Holistic led versus goal-led approach adapted from (Garrett, et al., in preparation).

### *Leading local agendas for action*

There is uncertainty as to who and how future land use strategies should be driven from within Ngāti Porou. The strength of the community, the most valuable aspect of its social capital, is to be found in the hapu and whanau structure. TRONPnui as the key player in the relationship with the Crown is also regarded as a significant driver of change. The relationship between hapu and the Runanga is an important key to the successful economic and environmental regeneration of the Catchment. This relationship also has important implications for resource allocation from within the Iwi.

### *Stream-lining land use decision making*

The problems associated with decision making in multiple land ownership were described as one of the major barriers to change. The Government's attempts to resolve this through an amendment to Te Ture Whenua Act (1993) to enable 'engaged' owners of Māori land to make governance and land utilisation decisions without wider consultation has created some concern locally. Much rests on the definition of 'engaged' and there are concerns that this stipulation may disenfranchise some from the land and reduce the need to maintain the networks which are an integral part of the social and human capital of the community.

## **Resource mobilisation**

### *Resource mobilisation from within Ngāti Porou*

TRONPnui is regarded by many as a key player in negotiating funding arrangements for landowners or by directly investing in new land use options that may build resilience and meet community aspirations. The management of expectations around all post-settlement entities is challenging and this is recognised as a challenge for the Iwi. TRONPnui is regarded by some as a resource broker rather than the sole deliverer of resources to support Iwi development. They will need to develop robust, close relationships with their communities to ensure that they may support where needed and in a way that reflects wider aspirations.

### *Multiple land ownership and barriers to change*

Having large numbers of owners with small land blocks is a barrier to the development of new land use options. This inertia in the local decision-making process is exacerbated by the difficulty in obtaining financial capital from banks and other investment institutions due to the terms of their loan agreements. Multiple land ownership and fragmentation has also resulted in a loss of scale that



undermines the economic viability of alternative and integrated land use and forestry options (Braatz, 2012) across the catchment.

#### *Remediation activity in the River is a heavy burden on a small rating base*

The relatively small rating base in the community carries a financial heavy burden associated with management of the river. Whilst attempts have been made to address this, the cost of intervention is still relatively high, especially as it remains one of the poorer community's in New Zealand. Remediation remains a major drain on resources in an already resource poor and disadvantaged community.

#### *There are insufficient resources available to achieve full remediation of the Catchment*

The scale of erosion in the upper catchment is such that many feel that there are insufficient funds and resources available to meet the challenge. A major challenge for the community will be how to live with this level of environmental degradation and make 'best' decisions over future resource allocation.

### **Legitimacy and advocacy**

#### *A fixed carbon price is a disincentive to forest planting in the Catchment*

The current carbon price is low and Ngāti Porou has campaigned for an increase. Carbon trading is viewed as a key to the future expansion of afforestation in the Catchment, a price of \$15 has been advocated by the Iwi. The land use implications of an increase in the carbon price are shown in the Appendix (Figure A4).

## Summary – Creating a future for the Waiapu Catchment

The Waiapu community possesses significant social capital. This plays a major role in underpinning a basic level of resilience. The community is highly resourceful but with a declining or literally eroding resource base. Low natural and financial capital, in particular, has trapped many in a cycle of incremental change unable to make the transformational changes that will significantly improve their wellbeing or the health of the catchment.

The leadership of change rests within the community itself and the governance structures of Ngāti Porou. The leadership picture at the local level is complicated but critically important in building resilience. The quality of the relationship between TRONPnui, Ngāti Porou landowning trusts and hapu/whanau is vital. The future must be built on the strengths of the community and its current realities and resources. Agencies have a supporting role to play through the development of coalitions and partnerships where the community does not have the asset base to achieve success on its own or where the scale of the challenge is beyond it, as with erosion control.

There appears to be growing cohesion amongst some in the community of the issues and vulnerabilities the community faces and what needs to be done to address them. There is also increasing evidence of a strengthening in 'bridging social capital'<sup>11</sup> or networking within the leadership of Ngāti Porou in which individuals have been able to develop effective coalitions with outside agencies to bring knowledge and resources to the community.

As this research programme has progressed, the expressed view that the time is now right for action has occurred on many occasions, in hui and through the interview process. The development of the Waiapu Restoration Programme, the signing of a Memorandum of Understanding between Ngāti Porou, MPI and GDC and review of the ECFP have represented significant steps forward in achieving the quality of partnership arrangements that are required to successfully restore the catchment.

Conventional Radiata pine forestry is regarded as part of the solution for the Catchment but not the whole solution. New forestry models and regimes, integrated within a diverse land use pattern that reflects community values (Porou, et al., 2012) are regarded as having a major role in building future resilience.

The Waiapu Restoration Partnership does provide a platform for the development of new coalitions and partnerships that address the challenges the catchment faces, including a changing climate. Achieving this in a holistic way, which is culturally relevant, requires a level of political sophistication and process that arguably, has not yet been achieved anywhere in New Zealand.

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<sup>11</sup> Bridging social capital is the strengthening of networks with external institutions with significant resources that may be deployed in the catchment (World Bank, 2011)

## Recommendations

The challenges the people of the Waiapu Catchment face in building greater resilience are not unique. They are shared by many communities around world. The alignment of agency goals with community aspirations, fragmented leadership structures at various levels, lack of accessible, relevant and useable information, uncoordinated research agendas, insufficient resources to initiate change including uncoordinated resource deployment are all perceived to be playing out in the Catchment to a greater or lesser degree, as previously discussed.

The key to future success lies in the quality of the relationships, coalitions and platforms that are built to support greater community resilience. The following recommendations relate to the initial phases of the Waiapu Restoration Action Plan: Phase I: October 2013 – September 2014; Phase II: 2014-16; Phase III: 2017-19; and, Phase IV: 2020-22.

### TREATMENT OF HIGHLY ERODIBLE LAND AND THE EAST COAST FORESTRY PROJECT

Recommendation One:

**That the Waiapu Restoration Partnership and ECFP continue to prioritise the treatment of highly erodible land within the Catchment to restore ecosystem health, function and services.**

*Timeframe: Phase I, II, III and IV.*

#### *Rationale*

The immediate challenge presented by high rates of erosion, leading to a loss of ecosystem function and services, remains a very high priority for all in the Catchment. Until this is addressed, the community has little chance of achieving its aspirations. The recent review of the ECFP criteria has aligned the programme more closely with the aspirations of the community (Porou, et al., 2012) and appointment of an Iwi Coordinator is a major step forward in putting in place a pathway that will facilitate uptake and delivery of the ECFP funding.

### BUILDING A 100-YEAR COMMITMENT: THE ESTABLISHMENT OF A 'MODEL FOREST PROGRAMME' IN THE WAIAPU CATCHMENT

Recommendation Two:

**That the Waiapu Restoration Partnership, together with other key agencies, explores the potential to establish a Model Forest Programme within the Waiapu Catchment as a vehicle for the effective coordination of agency involvement and community partnership.**

*Timeframe: Evaluation and planning to be undertaken in Phase II with a view to implementation at the start of Phase III.*

#### *Rationale*

Wider aspirations for the Catchment, discussed in this and earlier reports (Harmsworth, Warmenhoven, et al., 2002; Porou, et al., 2012) extend beyond the goals of the Waiapu Restoration Partnership and ECFP to embrace broader social, economic and cultural objectives for the whole catchment. An umbrella mechanism and supporting designation is required to build off the success of the Waiapu Restoration Partnership. This new arrangement must have the potential to endure beyond the life-span of the ECFP, if the long-term aims of the programme are to be realised. An evaluation of the feasibility of establishing a Model Forest style Programme should be undertaken within Phase II with the appointment of a Model Forest facilitator to drive a catchment wide programme.

The Model Forest concept is now well established elsewhere in the world and in Canada in particular. Model forests, based on international experience, generally include the following attributes, many of which are to be found in the Waiapu Catchment<sup>12</sup>:

- Representative partnerships and coalitions consisting of a broad range of interests including aboriginal communities, community and public interest groups, various levels of government, industry, research providers, training and educational institutions.
- The use of science and technology to aid strategic and local decision making. These include the use of models by planners and managers to provide a strategic context and biological and social science projects that increase knowledge of ecological processes and awareness of the social and economic impact of forestry and land use activities.
- Linkages developed between the partnerships and, science and technology.
- A land base large enough to incorporate all of the forest's uses and values (including towns, rivers, farms, forests, conservation land and protected areas) a range of activities reflecting the value of forest resources and addressing the needs of the community.

Model Forests provide an opportunity to test and demonstrate best forest management policy and practice which can then be shared or adapted elsewhere. Model Forests require the support of national governments to function effectively. As the guardians of public land, or by virtue of their policy and regulatory responsibilities, governments are critically important stakeholders. Model Forests also serve as demonstration areas of national significance and as testing grounds for innovative forestry management policies, options and practices.

The strengths of Model Forests in the Canadian experience have been described as follows:

- Each Model Forest partnership is a transparent, democratic and usually consensus-based process where the rules for the partnership process are defined by the partners.
- Model Forest partnerships are defined by local conditions. Local participation means Model Forests deliver approaches to issues that are 'owned' by the community.
- The Model Forest structure allows for effective exploration of new and innovative approaches as exemplars to land management that in turn reflect local values and needs.
- Each Model Forest organisation does not, in itself, have jurisdiction over all the forest area. Model Forests become forums first for the sharing of resources, both human and financial, and second for the discussion of a wide range of issues and solutions to problems without threatening partner roles and engagement. Over time discussions may move to the sharing of decision-making responsibilities once shared agendas are agreed.

The characteristics and strengths noted above have given rise to a range of capabilities that enable the Model Forests to:

- Examine interactions between human activity and the natural world;
- Build local capacity and capability;
- Incorporate traditional knowledge into building wellbeing and resilience;
- Incorporate multiple values into land management and development;
- Develop broad functional partnerships/coalitions for sustainable development;
- Demonstrate best practice on both public and private lands; and,
- Measure and evaluate progress towards shared goals.

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<sup>12</sup> <http://www.fao.org/docrep/article/wfc/xii/0399-c3.htm>

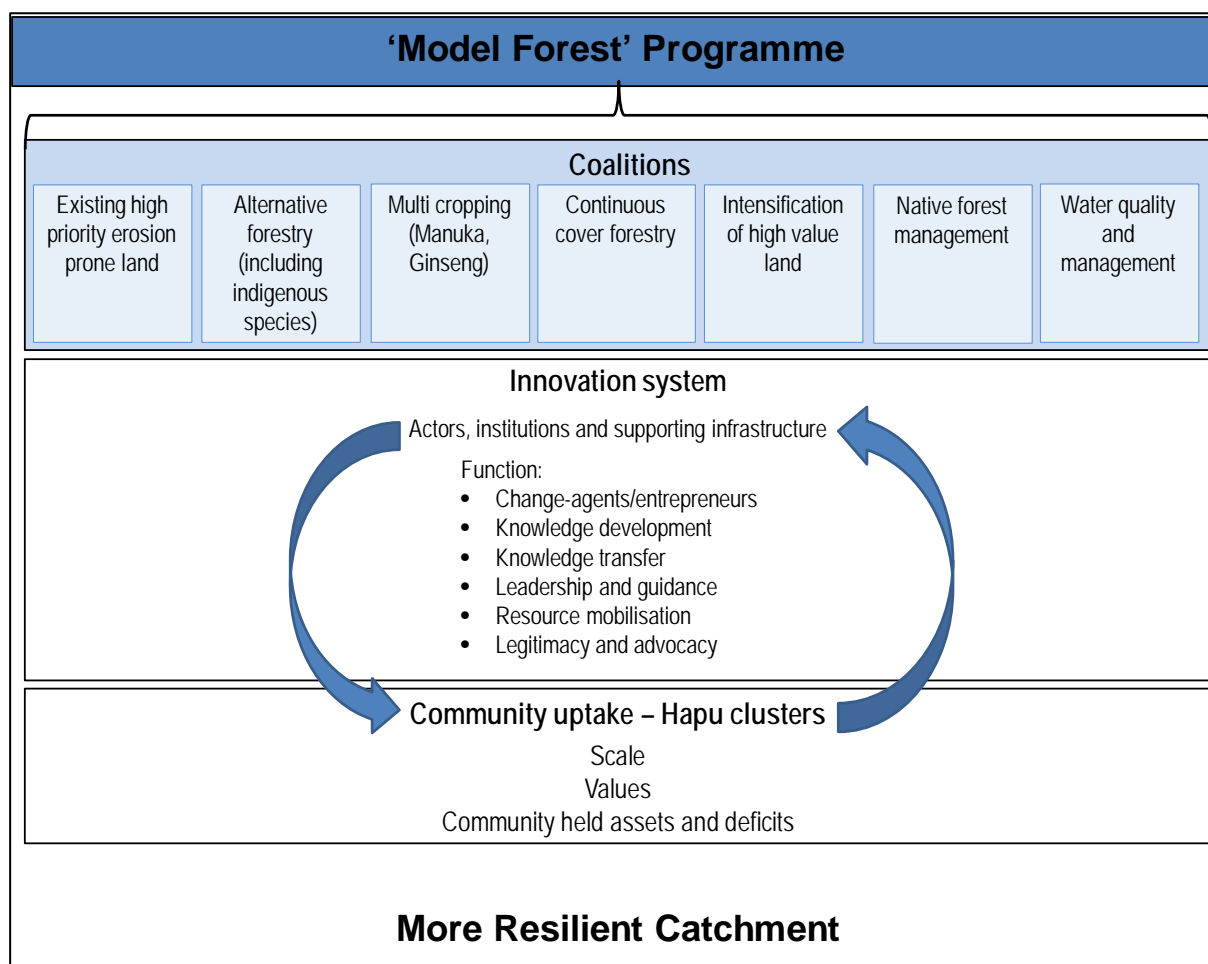


Figure 8: Model Forest Programme.

## BUILDING A STRATEGIC PLATFORM

Recommendation Three:

***That a strategic platform for future dialogue (a kōrero) with landowners is developed through a Catchment wide integrated assessment of land use options - including value chain optimisation and the value of ecosystem services.***

*Timeline: Commence during Phase II.*

### *Rationale*

Landowners are often faced with a wide selection of options – choosing the most appropriate land use is challenging without an initial assessment of suitable alternatives. There is a gap in contextual understanding and a strategic overview (beyond erosion control) that can be used to guide decision making at the grassroots level and the nature of institutional support required.

A high level of assessment of land use options, that captures not only economic outcomes but also other intangibles, for example cultural values and the value of ecosystem services, will assist in meeting both the community's aspirations and effective targeting of agency resources.

The outcomes of this assessment will underpin the value-case for a Model Forest style of approach.

## BUILDING COALITIONS FOR ACTION

### Recommendation Four:

***That under the umbrella of a Model Forest or similar arrangement, coalitions are developed that assist hapu with the assessment and implementation of a range of land use aspirations based on an understanding of community assets and deficits, and the role of systems in building successful implementation. In addition to the work currently underway on erosion-prone land it is proposed that coalitions are formed around establishment, management and value chain development of:***

- a. Alternative forestry models (including indigenous species);***
- b. Multi-cropping (e.g. Manuka, Ginseng);***
- c. Continuous cover forestry;***
- d. Native forest management; and,***
- e. The sustainable intensification of lowland management.***

*Timeline: Two pilot coalitions are established in Phase II, with the remainder to be initiated in Phase III. Review of the two coalitions to be undertaken in Phase IV.*

### *Rationale*

In establishing each coalition, consideration should be given the roles that participants play in supporting effective delivery of outcomes for the community Wieczorek, et al. (2012) and in overcoming the deficits that landowners and communities face, for example in providing knowledge, training, financial or physical resources. Engagement in a coalition would be open to representatives from hapu clusters and the wider community.

## BUILDING LOCAL COALITIONS FOR IMPLEMENTATION

### Recommendation Five:

***That hapu clusters consider the establishment of cooperatives or coalitions to generate the scale and resources necessary to deliver land use change and resilience whilst achieving locally held aspirations and safeguarding cultural assets and community values.***

*Timeline: Phases II, III and IV.*

### *Rationale*

Several interviewees spoke of the need to build scale into land use decision making. There are many reasons why this isn't occurring, not least the challenge of meeting day-to-day needs. There were also concerns that the development of larger entities, whilst delivering economies of scale, may be detrimental to cultural values.

*The consolidations are fine for economic development and the financial returns. But the cultural damage is huge. A lot of people had to go away from here for a job.*

As part of the kōrero and discussion around alternative land uses and economic viability, care needs to be taken to ensure that existing and valued livelihoods and other community assets are not damaged or destroyed. These conversations should rightly be held within the hapu and whanau structure.

## BUILDING COALITIONS FOR DEVOLVED GOVERNANCE AND CO-MANAGEMENT

Recommendation Six:

***That shared decision making and the co-management of natural and other resources is advanced as an integral part of the establishment and on-going development of a Model Forest approach to partnership within the catchment.***

*Timeline: Commence during Phase III.*

### *Rationale*

A characteristic of many model forests is their relevance to local values, livelihoods, assets and needs. To achieve this, diverse and dynamic partnerships are required that integrate science and local knowledge, but that also allow for increased local engagement in resource allocation. Local capability development and a move to greater local control often go 'hand in hand'.

## BUILDING SHARED MEASURES OF SUCCESS

Recommendation Seven:

***That shared measures of success be developed under the umbrella of a Model Forest approach to assess progress toward future resilience.***

*Timeline: Commence during Phase II.*

### *Rationale*

This report demonstrates how locally held aspirations may be integrated into an international indicator set developed by the Working Group<sup>13</sup> on Criteria and Indicators for the Sustainable Management and Conservation of Forests (the Montréal Process)<sup>14</sup> and adopted by MPI to report on the state of New Zealand's forests. These indicators form the basis of a sustainable livelihoods planning tool that may be used in future to inform decision makers and partners, through deliberation processes, of the impact of policies on the community resilience in the face of a changing climate. As the Partnership develops, a new consensus will need to be achieved on the content of the indicator set and revisions made as appropriate as well as improved data.

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<sup>13</sup> <http://www.montrealprocess.org/>

<sup>14</sup> <http://www.mpi.govt.nz/forestry/forestry-in-nz/international-forestry/montreal-process.aspx>

## Acknowledgements

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## References

- Barnard, T. D., Porou, T., Moore, D. J., Garrett, L. G., & Barry, L. (2012). Literature review & kōrero – impacts of land use change & erosion on Ngāti Porou in the Waiapu catchment *Waiapu River Catchment Study –Final Report* (pp. 103-137). Scion Confidential Client Report No. 15201. Rotorua, New Zealand: Scion.
- Basher, L., Douglas, G., Elliott, S., Hughes, A., Jones, H., McIvor, I., Page, M., Rosser, B., & Tait, A. (2012). Impacts of climate change on erosion processes and plant-based erosion control. *Report prepared for the Ministry for Primary Industries, May 2012.*
- Braatz, S. (2012). Building Resilience for adaption to climate change through sustainable forest management. *FAO, Rome.*
- Clark, A. J., Nottage, R. A. C., Wilcocks, L., Lee, J. M., Burke, C., Kalaugher, E., Roche, J., Beukes, P., Lieffering, M., Newton, P. C. D., Li, F. Y., Vibart, R., Teixeira, E. I., Brown, H. E., Fletcher, A. L., Hernandez-Ramirez, G., Soltani, A., Viljanen-Rollinson, S., Horrocks, A., Johnstone, P., Clothier, B., Hall, A., Green, S., Dunningham, A., Kirschbaum, M. U. F., Meason, D., Payn, T., Collins, D. B. G., Woods, R. A., Rouse, H., Duncan, M., Snelder, T., & Cowie, B. (2012). *Impacts of Climate Change on Land-based Sectors and Adaptation Options*. Clark, A.J.; Nottage, R.A.C.; Hansford, D. (eds) Stakeholder Report to the Sustainable Land Management and Climate Change Adaptation Technical Working Group, Ministry for Primary Industries, 76 p.
- Eustace, K., Macdonald, C., & Long, N. (1999). Cyclone Bola: a study of the psychological after-effects. *Anxiety, Stress & Coping, 12*, 285-298.
- Garrett, L. G., Barry, L. E., Barnard, T. D., Harrison, D. R., Baillie, B. R., Chetcuti, J., Smith, M., Palma, J. H. N., Yao, R. T., Payn, T. W., & Ray, D. (in prep). A holistic ecosystem services assessment and management framework for sustainable development and decision-making based on experiences with Loch Katrine, Scotland.
- Glade, T. (1998). Establishing the frequency and magnitude of landslide triggering rainstorms in New Zealand. *Environmental Geology, 35*, 160-174.
- Graham, S., Barnett, J., Fincher, R., Hurlimann, A., Mortreux, C., & Waters, E. (2013). The social values at risk from sea-level rise. *Environmental Impact Assessment Review, 41*(0), 45-52.  
doi:<http://dx.doi.org/10.1016/j.eiar.2013.02.002>
- Halpern, B. S., Longo, C., Hardy, D., McLeod, K. L., Samhuri, J. F., Katona, S. K., Kleisner, K., Lester, S. E., O'Leary, J., Ranelletti, M., Rosenberg, A. A., Scarborough, C., Selig, E. R., Best, B. D., Brumbaugh, D. R., Chapin, F. S., Crowder, L. B., Daly, K. L., Doney, S. C., Elfes, C., Fogarty, M. J., Gaines, S. D., Jacobsen, K. I., Karrer, L. B., Leslie, H. M., Neeley, E., Pauly, D., Polasky, S., Ris, B., St Martin, K., Stone, G. S., Sumaila, U. R., & Zeller, D. (2012). An index to assess the health and benefits of the global ocean. *Nature, 488*(7413), 615-620.  
doi:<http://www.nature.com/nature/journal/v488/n7413/abs/nature11397.html#supplementary-information>
- Harmsworth, G., & Warmenhoven, T. (2002). *The Waiapu project: Maori community goals for enhancing ecosystem health*. Broadsheet, New Zealand Association of Resource Management (NZARM).
- Harmsworth, G., Warmenhoven, T., Pohatu, P., & Page, M. (2002). *Waiapu Catchment report: Maori community goals for enhancing ecosystem health*. FRST contract TWWX0001. Landcare Research Ltd.
- Hicks, D. L. (1991). Erosion under pasture, pine plantations, scrub and indigenous forest: a comparison from Cyclone Bola. *New Zealand Forestry, 36*(6), 21-22.
- Jones, H. S., Bloomberg, M., Page, M. J., Rosser, B. J., Porou, T., Barnard, T., Peacock, D. H., & Moore, D. (2012). Toward a desired state for the Waiapu River & catchment *In Scion. Waiapu River Catchment Study –Final Report* (pp. 260-293). Scion Confidential Client Report No. 15201. Rotorua, New Zealand: Scion.
- Langer, L., & Barnard, T. (2003). Local community attitudes to plantation forestry, Gisborne and East Coast Region. *New Zealand Journal of Forestry, 47*(4), 14-16.
- Marshall, N. A. (2010). Understanding social resilience to climate variability in primary enterprises and industries. *Global Environmental Change, 36*-40.

- Montréal-Process. (2009). Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests. *Fourth Edition*. 49pp. ISBN 978-0-9825274-0-3.  
[http://www.montrealprocess.org/documents/publications/general/2009p\\_4.pdf](http://www.montrealprocess.org/documents/publications/general/2009p_4.pdf).
- Müller, F., & Burkhard, B. (2012). The indicator side of ecosystem services. *Ecosystem Services*, 1(1), 26-30. doi:10.1016/j.ecoser.2012.06.001
- Owen, C. (2011). Language and cultural identity: Perceptions of the role of language in the construction of aboriginal identities. (Order No. MR83089, Carleton University (Canada)).  
*ProQuest Dissertations and Theses*, , 197. Retrieved from  
<http://search.proquest.com/docview/993579650?accountid=14782>.
- Park, S. E., Marshall, N. A., Jakku, E., Dowd, A. M., Howden, S. M., Mendham, E., & Fleming, A. (2012). Informing adaptation responses to climate change through theories of transformation. *Global Environmental Change*, 115-126.
- Parkner, T., Page, M., Marden, M., & Marutani, T. (2007). Gully systems under undisturbed indigenous forest, East Coast Region, New Zealand. *Geomorphology*, 84, 241-253.
- Phillips, C. J., & Watson, A. J. (1994). *Structural tree root research in New Zealand: a review*. Lincoln: Manaaki Whenua Press.
- Porou, T., Barnard, T., Fitzgerald, G., Moore, D., Barry, L., Garrett, L., & Harrison, D. (2012). Benchmarking, scope assessment, & critical evaluation – social, cultural, & economic aspects of erosion for Ngāti Porou & a desired state for the Waiaapu catchment *Waiaapu River Catchment Study –Final Report* (pp. 192-259). Scion Confidential Client Report No. 15201. Rotorua, New Zealand: Scion.
- Rosser, B. J., Page, M. J., Peacock, D. H., Bloomberg, M., & Morgenroth, J. (2012). Benchmarking, scope assessment, & critical evaluation – geophysical aspects *Waiaapu River Catchment Study –Final Report* (pp. 138-172): Scion Confidential Client Report No. 15201. Rotorua, New Zealand: Scion.
- Savage, L. (2009). An update on climate change: New developments since 2006 in climate science and legislation. *Report prepared for Gisborne District Council No. 62 p*.
- Scion. (2012). *Waiaapu River Catchment Study –Final Report*. Scion Confidential Client Report No. 15201. Rotorua, New Zealand: Scion.
- Scoones, I. (1998). Sustainable rural livelihoods: a framework for analysis. *IDS working Paper 72*. Sussex. Institute for Development Studies.
- Stokes, C., & Howden, S. M. (2009). Adapting Agriculture to Climate Change: Preparing Australian Agriculture, Forestry and Fisheries for the Future. *Stokes, C., and Howden, S.M. (Eds). CSIRO, Canberra*.
- Tomlinson, C. J., Fairweather, J. R., & Swaffield, S. R. (2000). *Gisborne/East Coast Field Research on Attitudes to Land Use Change: An Analysis of Impediments to Forest Sector Development. Socio-economic Characteristics Associated with Land Use Change*. Research Report No. 249. Agribusiness and Economics Research Unit, Lincoln University, Canterbury, New Zealand.
- Webber, D., Buchan, D., Rivers, M., & Rayner, T. (1990). Cyclone Bola Agricultural Assistance Scheme Economic and Social Impact Study. *Wellington, Ministry Of Agriculture*.
- Wieczorek, A. J., & Hekkert, M. P. (2012). Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. *Science and Public Policy*, 39, 74-87.
- World-Bank. (2011). The Adaptation Coalition Toolkit - Building Resilience to Climate Change. *The World Bank Social Development Unit Latin American and Caribbean Region*.

# Appendix

## DETAILED METHODOLOGY

The following outlines the detailed methodology for each research stream.

### Climate change in the Waiapu

Literature was reviewed to understand the key historical climate history and events, the current climate related issues and responses and the future climate change. The key references were Scion (2012) 'Waiapu River Catchment Study – Final Report' and Basher, et al. (2012) 'Review of climate change impacts on erosion in New Zealand'.

The climate change scenarios were sourced from NIWA's projection release in 2008. Where possible the magnitude to change is presented specifically for the Waiapu Catchment by 2040 and by 2090. The key climate change projections for the Waiapu are described in this report with a focus on, temperature, rainfall, and the increased frequency of extreme weather events (e.g. storms and droughts) in two periods 2030-2049 (1°C rise in average temp – scenario A1B 2040), and 2080-2099 (2°C rise in average temp – A1B 2090, and 4°C rise – A2 2090 rise in average temp). The scenarios and how projections were calculated are described in chapter 2 of the MPI report "Impacts of Climate Change on Land-based Sectors and Adaptation Options" (Clark et al., 2012).

The projected climatic changes for the Waiapu are presented in Table A1. The key literature and climate change scenarios were synthesised for an assessment of the impacts of climate change on the Waiapu Catchment and its people. The most significant climatic changes that will impact on the Waiapu and its people were identified and underpinned the discussions on community resilience of the Waiapu.

**Table A1: Summary of climate change expected in the Waiapu Catchment indicating the direction, magnitude of change, and important spatial/seasonal variations (adapted from (Clark, et al., 2012)).**

Climate variable	Direction of change (degree of confidence) <sup>1</sup>	Magnitude of change <sup>2</sup>	Seasonal variation
Mean temperature	Increase (****)	>0.9°C by 2040 >2.1°C by 2090	Most increase in spring and winter temperatures
Mean rainfall	Annual decrease (**)	<5% by 2040 <6% by 2090	Most decrease in spring and winter: By 2040 – Spring (<8%) and winter (<7%). By 2090 – Spring (<14% to <15%) and winter (<7% to <9%)
Extreme rainfall	Heavier and/or more frequent extreme rainfalls (**)	High intensity rainfall events - with a probability of a 50 year return period (mm/24hr): >10% by 2040 >18% to >34% by 2090	-
Major drought <sup>3</sup>	Increase in all areas that are currently drought-prone (***)	Major drought events – with a probability of a 20 year return period (10-15% of time in drought): >10% additional time spent in drought by 2040 and 2080 (i.e. doubled)	-
Wind (average) <sup>3</sup>	Increase in the annual mean westerly component of wind flow across New Zealand (**)	Approximately 10% increase in annual mean westerly component of flow by 2040 and beyond (*)	By 2090, increased mean westerly in winter (>50%) and spring (20%), and decreased westerly in summer and autumn (20%)
Strong winds <sup>3</sup>	Increase in severe wind risk possible (**)	Up to a 10% increase in the strong winds (>10m/s, top 1 percentile) by 2090 (*)	-
Storms <sup>3</sup>	More storminess possible, but little information available for New Zealand (*)	-	-
Sea level <sup>3</sup>	Increase (****)	At least 18–59 cm rise (New Zealand average) between 1990 and 2100	-
Storm surge <sup>3</sup>	Assume storm tide elevation will rise at the same rate as mean sea-level rise (**)	-	-

<sup>1</sup> National changes from Clark et al. (2012). Degree of confidence for direction of change from Clark et al. (2012): \*\*\*\* Very confident, \*\*\* Confident, \*\* Moderate, \* Low confidence.

<sup>2</sup> Specific Waiapu Catchment magnitude of change and seasonal variation.

<sup>3</sup> National changes reported only from Clark et al. (2012) – no specific Waiapu Catchment data, is described as Eastern areas.

Note: Any range given for 2090 is the difference between a temperature 2°C rise in average temp – A1B 2090, and 4°C rise – A2 2090 rise in average temp.



Figure A1: The Waiapu Catchment and the impact of a 2 m sea – level rise (in red) on existing land area.



Figure A2: The Waiapu Catchment and the impact of a 10 m surge and 2 m sea – level rise (in red) on existing land area.

## The Waiapu – the environment and people

### *The environment and people*

The biophysical and socio-cultural environment of the Waiapu Catchment was summarised from the Waiapu report key findings, Scion (2012).

### *Socioeconomic Deprivation Map*

The 2013 Socioeconomic deprivation Index Map is based on the following criteria developed by the University of Otago and mapped at meshblock level (Table A2).

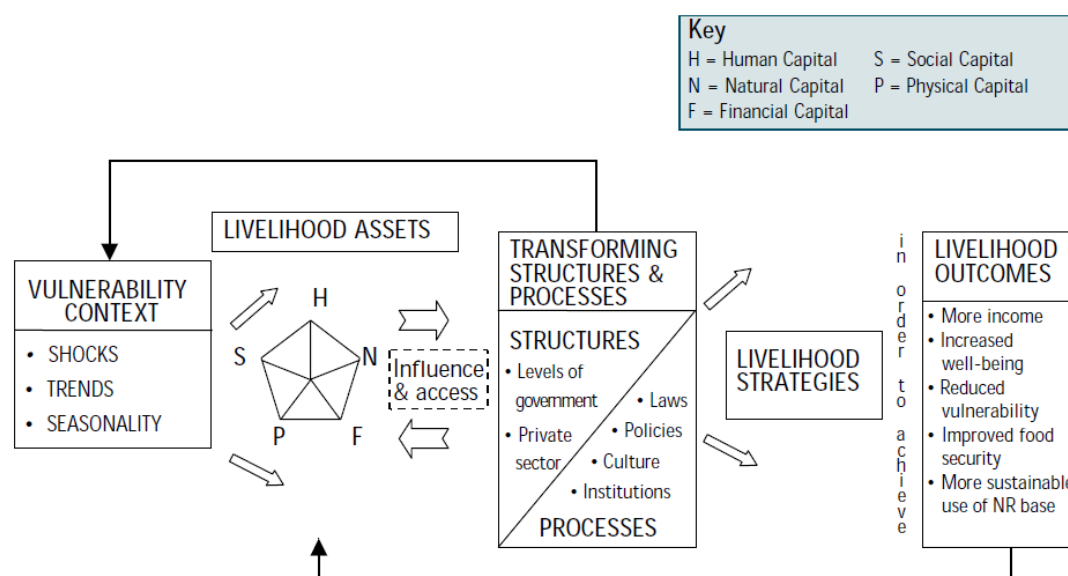
**Table A2: The Components of the NZ Index of Deprivation (from Salmon et al., 2007).**

Dimension of Deprivation	Variable – in order of decreasing weight
Income	People aged 18-64 receiving a means tested benefit.
Income	People living in equivalised* households with income below an income threshold.
Home ownership	People not living in their own home.
Support	People aged <65 living in a single parent family.
Employment	People aged 18-64 unemployed and seeking work.
Qualifications	People aged 18-64 without any educational qualifications.
Living space	People living in equivalised* households below a bedroom occupancy threshold.
Communication	People with no access to a telephone.
Transport	People with no access to a car.

\* Equivalisation: Methods used to control for (or standardise) household composition.

### Framework used for the livelihood assessment

A Sustainable Livelihoods Framework (Figure A3) was used to structure the investigation and analysis of livelihoods in the Waiapu. Community capitals are described in terms of the human (H), natural (N), financial (F), physical (P) and social (S) capital held within the community. In keeping with the ethnic composition of the community, and Ngāti Porou’s own development visioning, we have specifically included cultural capital (C) in our analysis.



**Figure A3: Sustainable livelihoods framework (FAO and ILO, 2009).**

*“A livelihood comprises the capabilities, assets and activities required for a means of living. . . A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base.”*

The process of building a qualitative and quantitative picture of local livelihoods and their sustainability has involved:

- Describing the community's assets/capabilities (H,N, P, S, C, F), liabilities/deficits, trends, and vulnerabilities (events, trends etc);
- Describing the perceived impact of a reduced or degraded ecosystem function on their livelihoods; and,
- Establishing explanations for the ecosystem and community's current condition, the effect of shocks, and what might happen under predicted climate change.

The capitals used in the livelihoods assessment in the Waiapu Catchment and a definition of each capital is outlined in Table A3.

**Table A3: Capitals and their definition used to assess sustainable livelihoods in the Waiapu Catchment.**

Capital	Definition
Human	Represents the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives.
Natural	The natural resource stocks from which resource flows and services used for livelihoods are derived. There is a wide variation in the resources that make up natural capital, from intangible public goods such as the atmosphere and biodiversity to divisible assets used directly for production (trees, land, etc.).
Physical	The basic infrastructure and producer goods needed to support livelihoods, e.g. affordable transport and roads; secure shelter, community facilities; adequate water supply and sanitation; clean, affordable energy; and access to information (communications). Infrastructure is commonly a public good that is provided and used without direct payment.
Social	The social resources upon which people draw in pursuit of their livelihood objectives. These include: <ul style="list-style-type: none"> <li>• Connections and networks, that increase people's trust and ability to work together and expand their access to institutions and other groups, such as political or civic bodies;</li> <li>• Membership of more formalised groups entailing adherence to agreed or commonly accepted rules, norms and sanctions</li> <li>• Relationships of trust, reciprocity and exchange that facilitate co-operation, reduce transaction costs and provide informal social security.</li> </ul>
Cultural	Specific unique cultural resources, skills, knowledge, practices, and relationships that indigenous people draw on to meet their social, physical and spiritual needs and aspirations.
Financial	The financial resources that people use to achieve their livelihood objectives. It includes flows and stocks and it can contribute to consumption as well as production. It covers the availability of cash, savings, or equivalent that enables people to adopt different livelihood strategies.

### *Data collection*

This stream of work involved the collation and analysis of primary qualitative data and secondary quantitative data. For the primary research, a protocol (including free prior and informed consent) was developed in consultation with Ngāti Porou collaborators. The fieldwork was conducted by team members, including locally-resident research partners. The work included

- The identification and a description of communities of interest, place and practice within the Waiapu community, including a stakeholder analysis.
- Individual and household face to face semi-structured interviews.
- Engagement with key individuals, through interviews, focused discussions with regard to local livelihoods.
- The collation of data from existing reports, census and other sources to describe trends in the various community capitals, and livelihoods.

### *Analysis*

Analysis of the qualitative data, including the in-depth interviews and workshops is being done using N-Vivo. This involves coding the transcribed interviews according to key topics and nested and related subtopics; interrogating the data iteratively, drawing links between topics and subtopics, and then summarising the key points and issues that emerge. A first cut at a summary of the key points about local livelihoods and community capitals is attached.

## Quantification and indicators of community capitals and assets

The aim of the livelihood quantification assessment was to measure the vulnerabilities of Waiapu Catchment and its people under climate change with consideration that forestry will play a key role in the rehabilitation of the catchment. Therefore, the livelihood assessment needed to measure change that will aid in planning for future forestry scenarios (sustainable forest management) that is tailored to the Waiapu Catchment and its people.

The livelihood assessment was run for two scenarios 1) under current climatic conditions, and 2) under climate change (end of century climate change).

### *Model used for the livelihood quantification*

The livelihood quantification of the Waiapu Catchment adapts the methodology presented by Halpern, et al. (2012) who developed an index to assess the health and benefits of the global ocean, as a way to balance competing goals and match human development with the oceans ability to sustain progress. This study is interested in the community's ability to pursue different livelihood strategies relating not just to the ocean but the catchment as a whole. This is dependent on the basic material and social, tangible and intangible assets that people have in their possession (Scoones, 1998). The methodology from Halpern, et al. (2012) has therefore been adapted to consider the wider landscape and assets available to the community. It assesses the resources available to the community in the form of different "capitals". The sustainable livelihood approach allows consideration of the various resources available to the community, through natural, financial, social, human and physical capitals (FAO & ILO, 2009). We therefore, start at the community level to assess the status of each capital through the status of its indicators, which are proxy measurements for the capital. We use the community capitals along with information on the status, trends, and resilience of indicators relevant to each capital and the pressures facing each of them. The methodology was developed to overcome certain issues in order to provide a holistic framework which can help guide change, rather than an oversimplification of a complex problem. The issues are:

- Varying levels of data availability across indicators;
- Varying reference points for indicators (e.g. may be aspirational or based on a scientific optimal or a national maximum);
- Consideration of, not only the current state of an indicator or group of indicators, but also the vulnerability context, which requires consideration of the Trends, Pressures on and Resilience of indicators;
- Consideration of the institutional context of sustainability and the effects of weak or strong institutions on sustainable well-being; and,
- Consideration of the cultural context of the assessment to allow the community's values to shape their picture of sustainable well-being.

A key drawback of the approach by Halpern, et al. (2012) is that it was conducted at a national and international level so regional and community level implications cannot be drawn from the final index. It also weights most components equally because there is not enough international data to allow cultural preferences to shape the index through various weightings. By focusing on a community in the Waiapu of New Zealand we can capitalise on local knowledge to provide a more in-depth index for one area. The usefulness of the index is therefore not to compare against other country's or region's indices but to test the impact of pressures, such as climate change and social pressures, on the index under different scenarios and to test the ability of different livelihood strategy's ability to improve the index.

The approach provides a holistic and systematic way to bring together various types of data, on current and future well-being of the community along with consideration of the vulnerability context. This is collected into a composite indicator of well-being of the community and can be used as a visual tool to express a complex problem, as well as a tool for assessing the composite well-being of the community under various climate change scenarios and resilience strategies.



### *Capitals and development of indicators to assess*

The capitals used to assess sustainable livelihoods in the Waiapu Catchment and a definition of each capital is outlined in Table A2.

Indicators are needed to measure each capital that is tailored to the local community with the ability to measure progress towards sustainable forest management. The indicators were developed through using the existing 95 Ngāti Porou aspirational indicators already developed for the Waiapu Catchment and its people (Porou, et al., 2012). The aspirational indicators were captured under an aspirational 10 point framework developed by Te Haeata, the sub-committee responsible for the supervision of the Ngāti Porou Treaty of Waitangi Settlement Negotiations with the Crown (Te Haeata reports to Te Runanga O Ngāti Porou Board of Trustees). Te Haeata described ten aspirations for Ngāti Porou as follows: Strong identity – whakapapa, Ngāti Poroutanga, Employment & wealth creation (economic), Te Reo & tikanga, Whanau, Mana Motuhake, Connectedness, Matauranga, Clean environment, and Infrastructure.

The 95 aspirational indicators were grouped into each of the capitals to support a summarised set of 25 indicators for each capital assessment (Table A4, in detail with aspirational indicators in A5). The summarised indicators aim to capture the detail in the aspirational indicators at a higher level in the livelihoods assessment framework within consideration that forestry will play a key role in the rehabilitation of the catchment. The Montréal Process (2009) monitoring framework for sustainable forest management was also used as a guide in the development of the 25 indicators.

**Table A4: The indicators used to measure each capital in the Waiapu Catchment and weighting contribution of each sub-capital to the respective capital.**

Capital	Sub-capital (weighting)	Indicator (weighting)
Cultural	Conservation of biological diversity (0.2)	1 – Status of species of utility or cultural value to Ngāti Porou. (0.2)
		2 – Area of native vegetation and forest cover in the catchment compared to reference condition. (0.2)
		3 – Area of forest available to the community for the collection non-wood forest products and firewood. (0.6)
	Cultural, social and spiritual needs and values (0.8)	4 – Number of sites formally/actively protected for their cultural and spiritual value. (0.6)
		5 – Number or area of water bodies, or stream length, or springs protected for their cultural and spiritual value. (0.2)
		6 – Number of Te Reo speakers in the community. (0.2)
Financial	Credit access (0.4)	7 – Number of incentive credit opportunities available to the community. (0.5)
		8 – Number of loan schemes available to groups with land in multiple-ownership. (0.5)
	Flow of revenues (0.2)	9 – Flow of revenue from land, forests, forest products and forest ecosystem services to the community. (1)
	Wages (0.2)	10 – Average wage rates in the catchment. (1)
	Security (0.2)	11 – Levels of home ownership amongst Ngāti Porou. (1)
Human/Political	Mana Motuhake (0.4)	12 – Extent of Ngāti Porou control or influence over key assets and resources. (1)
	Health (0.3)	13 – General health of community. (1)
	Knowledge, skills and education (0.3)	14 – Number of resident tertiary qualified Ngāti Porou. (1)
Natural	Protective function (0.4)	15 – Area of land whose designation or land management focus is the protection of soil or water resources. (1)
	Soil (0.3)	16 – Area of land with significant soil degradation. (1)
	Water (0.3)	17 – Area of water bodies, or stream length, with significant change in physical, chemical or biological properties from reference conditions. (1)
Physical	Transport infrastructure (0.25)	18 – Number days the roads are open per year. (1)
	Communications (0.25)	19 – Access to uninterrupted internet and mobile phone coverage. (1)
	Waste water infrastructure (0.25)	20 – Number of houses with septic tank waste water systems. (1)
	Water supply (0.25)	21 – Quality of water at tap and consistent water supply throughout the year. (1)
Social	Marae (0.33)	22 – Number of Marae based events per year. (1)
	Cohesion (0.33)	23 – Number of registered sports club. (0.5)
		24 – Number of volunteer days spent on Ngāti Porou events and activity. (0.5)
	Ngāti Poroutanga Whanau/Hapu (0.33)	25 – Number of Ngāti Porou living within the catchment. (1)

### *Quantification of indicators and capitals*

To enable quantification the capitals each indicator and sub-capital was given a weighting (Table A3).

Each indicator was assessed for its status, trend, pressure and resilience described following (Halpern et al., 2012), outlined below:

- **Status** – the current status of an indicator. Where data was unable to be sourced anecdotal evidence reported in Porou, et al. (2012) and from the sustainable livelihoods interviews were used to populate the indicator.
- **Trend** – an indication of the likely annual direction and change of an indicator to indicate a likely condition at future states. This can be based on the recent change in the current status of the indicator and requires at least one other recent data point in time from which to determine the slope of the indicator. The trend is assumed to be linear where information doesn't exist. A shorter time-frame is preferable for the trend to better predict a future condition, however because we are interested in climate change impacts, we will consider both the short, medium and the long term in our analysis. Where data was unable to be sourced anecdotal evidence reported in Porou, et al. (2012) and from the sustainable livelihoods interviews were used to populate the indicator.
- **Pressure** – the anthropogenic stressors that negatively affect the status of an indicator. Climate change pressures will be used to determine the ecological pressures facing the community capitals. The New Zealand deprivation index will be used for the social pressures within in the community.
- **Resilience** – refers the social, institutional, and ecological factors that positively affect the status of an indicator. The New Zealand deprivation index will be used for the social resilience within in the community. Institutional regulations, ECFP and LO3A, will be used to add to resilience. Applicable ecological factor will also be sort.

Following are tables for a detailed methodology on:

- 1) Indicator development;
- 2) Indicator description, data source and reference points; and,
- 3) Pressure and resilience description, data and calculation of sustainable livelihoods.

1) Sustainable livelihood capitals – a planning tool: Indicator development

**Table A5: Ngāti Porou aspirational indicators for the desired state grouped into capitals and the indicators used to measure each capital in the Waiapu Catchment.**

Indicators of the desired state of the catchment (Porou et al., 2012)		
Tuna and other kai is bountiful in the river and can easily regularly sustain Whanau and supply tribal events.		
There are several types of puha growing and harvested for whanau sustenance and tribal hui.		
Inanga can be harvested sustainably by the 'bucket full'.		
Kokopu are part of the staple diet of Ngāti Porou again.		
Watercress is plentiful and safe to eat.		
The four species of Pekapeka are commonly found in native forests in the Waiapu catchment.		
Kereru and Kaka are found at similar numbers as in 1936 in the Poroporo catchment and the Waiomatatini/Northern Waiapu area.		
Weka are found in the Waiapu catchment.		
Kapata kai areas are no longer negatively affected by erosion.		

Capital	Sub-capital	Indicator
Cultural	Conservation of biological diversity	1 – Status of species of utility or cultural value to Ngāti Porou.
		2 – Area of native vegetation and forest cover in the catchment compared to reference condition.
		3 – Area of forest available to the community for the collection non-wood forest products and firewood.

Table A5: Continued.

Indicators of the desired state of the catchment (Porou et al., 2012)
Cultural inventory of rongoa species found in the Waiapu catchment complete and monitored.
Areas of harvesting for rongoa are not negatively affected by erosion.
Traditionally recorded swimming areas used by Ngāti Porou Whanau again.
A broad range of non-cultivated foods are easily identifiable and part of the regular diet of Ngāti Porou in the catchment.
Ngāti Porou have retained and use mātāuranga Māori as it pertains to growing and maintaining traditional and non-traditional crops.
Records established and maintained to record mātāuranga Ngāti Porou and are accessible to Ngāti Porou
Kapata Kai knowledge is taught in wananga to Ngāti Porou.
Number of tohunga and people who know mātāuranga Māori are easily identified and growing annually.
Vehicles for the transfer of Mātāuranga Ngāti Porou are available to all Iwi members.
A definitive history of Ngāti Porou and the Waiapu is completed.
Karakia are revived through the identification and protection of natural springs.
Tikanga associated with kapata kai commonly understood and practised in Ngāti Porou.
Taniwha are identified and revered as kaitiaki.
Cultural inventory of freshwater environs of the Waiapu complete and monitored.
Kapata kai areas are clearly identified and managed by Ngāti Porou through traditional methods including rahui.
Cultural inventory of vegetation species found in the Waiapu catchment complete and monitored.
Cultural inventory of plants for raranga species found in the Waiapu catchment complete and monitored.
Cultural inventory of fauna species found in the Waiapu catchment complete and monitored.
Cultural health indicators are in place in the Waiapu based on an oral history project that recorded past uses and relationships between Ngāti Porou and the Waiapu.
Traditional names of Waahi Tipuna commonly known and sign posted.
Waahi tapu inventory completed.
Waahi tapu are not at risk from being negatively impacted by erosion.
Areas of land are reserved for wananga and other traditional practices.
Whakapapa research teams are established to assist Ngāti Porou to record and access their whakapapa and strengthen their relationships with each other and our natural environment.
Practitioners of Mātāuranga Ngāti Porou are promoted and honoured by ensuring they are engaged in all Waiapu Projects.
With the restoration of habitat and native species to the Waiapu, mātāuranga Ngāti Porou is commonly utilised across the community, as it connects to hunting, gathering, cultivations, preparation, storage and consumption of food.
Gathering practices from native forests for food are revived and part of the staple diet of Ngāti Porou.
Ngāti Porou understands the land use capability and land use currently of whenua in the Waiapu and develops according to Ngāti Porou tikanga.

Capital	Sub-capital	Indicator
Cultural	Cultural, social and spiritual needs and values	<p>4 – Number of sites formally/actively protected for their cultural and spiritual value.</p> <p>5 – Number or area of water bodies, or stream length, or springs protected for their cultural and spiritual value.</p> <p>6 – Number of Te Reo speakers in the community.</p>

Table A5: Continued.

Indicators of the desired state of the catchment (Porou et al., 2012)
Investment fund for Ngāti Porou small to medium businesses (SME's) established focused on sustainable land use established in the Waiapu catchment (note that the business case and implementation plan will be aligned with accepted business practice and Ngāti Porou tikanga).
Ngāti Porou are involved in leveraging the best finance options for its people for housing and looking at innovative ways to fund its home builds in the Waiapu catchment.
Ngāti Porou own their own homes in the Waiapu catchment.
Ngāti Porou awards, scholarships and internships for students in the areas of resource management particularly in erosion related fields established.
Afforestation schemes are expanded and paid in advance to enable more Ngāti Porou to uptake the programmes.
Poverty is eradicated in the Waiapu catchment.
Ngāti Porou are never hungry and can feed themselves and their whanau from the land.
Afforestation is a core business of Ngāti Porou with a range of species for wood, food and medicinal purposes being utilised.
Maara kai have grown to create opportunities for organic food export with Ngāti Porou branding.

Capital	Sub-capital	Indicator
Financial	Credit access	7 – Number of incentive credit opportunities available to the community. 8 – Number of loan schemes available to groups with land in multiple-ownership.
	Flow of revenues	9 – Flow of revenue from land, forests, forest products and forest ecosystem services to the community.
	Wages	10 – Average wage rates in the catchment.
	Security	11 – Levels of home ownership amongst Ngāti Porou

Table A5: Continued.

Indicators of the desired state of the catchment (Porou et al., 2012)
All advisors that are non-Ngāi Porou will have clear knowledge transfer requirements in their service agreements to Ngāi Porou to build internal capacity.
Effective Ngāi Porou succession programmes established in Marae, Hapu, Iwi, trusts and incorporations including associate trustee positions, Tuakana/Teina models and intern positions.
Ngāi Porou have decision making influence on where and how roads are situated and managed in the catchment.
Ngāi Porou are engaged in climate change adaptation activities to increase their resiliency to extreme weather events.
Nga Whenua Rahui and carbon agreements are widely established in the Waipatu catchment.
Afforestation is the core business of Ngāi Porou.
We are sustainably managing harvesting to avoid mass deforestation and have a managed system.
Ngāi Porou hapu own the bed of the Waipatu and the air column above it.
Ngāi Porou hapu are making decisions over erosion management policies and programmes for the Waipatu.
Ngāi Porou are the consenting authority over the Waipatu through a section 33 transferral of powers in the RMA 1991
Ngāi Porou have effectively created and implemented successful erosion policies that are driven by the people on land that they directly control.
Ngāi Porou hapu have co-management and co-governance arrangements with the Gisborne District Council that share planning responsibilities similar to those of the Waikato River Settlement.
Ngāi Porou hapu have a clear strategy to the management and protection of the Waipatu and is implementing this as an Iwi Management Plan under the RMA and other agreements.
Ngāi Porou are engaged with central government to ensure that national policies do not increase the degradation of the Waipatu.
Ngāi Porou have identified and are establishing alternative routes and transport options along the East Coast to improve roading options that will not be effected by erosion prone areas.
Tourism Ngāi Porou is a thriving business that is working on the Waipatu.
Ngāi Porou businesses progress sustainable development without environmental degradation to exercise kaitiakitanga and to reduce RMA compliance costs.
Ngāi Porou businesses operate under the Waipatu Environmental Strategy policies and are committed to its implementation.
Ngāi Porou are actively investing in erosion prevention and remedial action collectively on an annual basis to an agreed strategy.
Land use management tools are in place and influence erosion control policies in the Waipatu.

Capital	Sub-capital	Indicator
Human	Mana Motuhake	12 – Extent of Ngāi Porou control or influence over key assets and resources.

Table A5: Continued.

Indicators of the desired state of the catchment (Porou et al., 2012)
All Ngāi Porou have a job opportunity in the Waiapu catchment.
Poverty is eradicated in the Waiapu catchment.
Ngāi Porou have health statistics that exceed that of non-Māori in Aotearoa.
Numbers and age profiles of Ngāi Porou Whanau living in the Waiapu catchment.
Ngāi Porou knows who our people are and where they reside as well as their demographic status to inform planning.
Ngāi Porou has access to environmental and other land-use advice and information which supports the aspiration of Ngāi Porou for their land.
Ngāi Porou students currently studying with tertiary providers in areas relevant to the Waiapu catchment are identified and recruited to understand their skills and align these to restoration projects in the catchment.
Ngāi Porou who have specific skills pertaining to the Waiapu catchment and are currently in the workforce are identified and recruited to understand their skills and align these to restoration projects in the catchment.
Gaps are identified in skills and expertise for Ngāi Porou for the Waiapu and strategies in place to grow capability and capacity.
All Ngāi Porou are aware of the issues facing the Waiapu and its ahi ka and are engaged in its restoration.
Traditional climate indicators are widely understood by Ngāi Porou.
Ngāi Porou have developed IT opportunities and products in communications, erosion control and land management tools.
Ngāi Porou understand the alternative port options for transporting goods overseas.

Capital	Sub-capital	Indicator
Human	Health	13 – General health of community.
	Knowledge, skills and education	14 – Number of resident tertiary qualified Ngāi Porou.



**Table A5: Continued.**

Indicators of the desired state of the catchment (Porou et al., 2012)
Underground springs are used and protected.
Large expanses of Ngāi Porou lands are in reserves for native forestry.
The areas of Ngāi Porou land lost or seriously degraded over time by land use have substantially reduced from 1988 numbers.
No adverse health effects from swimming in the waters of the Waiapu catchment.
Water quantity is sufficient for both economic and cultural activities.

Capital	Sub-capital	Indicator
Natural	Protective function	15 – Area of land whose designation or land management focus is the protection of soil or water resources.
	Soil	16 – Area of land with significant soil degradation.
	Water	17 – Area of water bodies, or stream length, with significant change in physical, chemical or biological properties from reference conditions.

Indicators of the desired state of the catchment (Porou et al., 2012)
Ngāi Porou communities are no longer isolated due to land slips and/or road closures.
Ngāi Porou have efficient, safe and environmentally friendly waste disposal services within Ngāi Porou that do not negatively affect the Waiapu.
Underground springs are used and protected.
Water quality from the Waiapu is to a standard where it is clean enough to drink.
Water quantity is sufficient for both economic and cultural activities.

Capital	Sub-capital	Indicator
Physical	Transport infrastructure	18 – Number days the roads are open per year.
	Communications	19 – Access to uninterrupted internet and mobile phone coverage.
	Waste water infrastructure	20 – Number of houses with septic tank waste water systems.
	Water supply	21 – Quality of water at tap and consistent water supply throughout the year.

Table A5: Continued.

Indicators of the desired state of the catchment (Porou et al., 2012)
Ngāti Porou pae are full each time the marae is used.
Ngāti Porou Marae are welcoming, safe, vibrant and evolving sites to practice and 'be' Ngāti Porou.
Ngāti Porou Marae and hapu are the vehicles for sustainable development.
All schools are using the Waiapu for swimming and other recreational activities.
Surface water activities carried out by Ngāti Porou on the Waiapu regularly.
River crossings are common to meet with neighbours.
There are three Ngāti Porou events held on the Waiapu annually.
Whanau in Tikitiki can speak across the river to the whanau at Te Horo without yelling.
Maara kai are re-established in the Waiapu reconnecting whanau and the concept of manaakitanga.

Capital	Sub-capital	Indicator
Social	Marae	22 – Number of Marae based events per year.
	Cohesion	23 - Number of registered sports club.
		24 – Number of volunteer days spent on Ngāti Porou events and activity.
	Ngāti Poroutanga Whanau/Hapu	25 – Number of Ngāti Porou living within the catchment.

## 2) Sustainable livelihood capitals – a planning tool: Indicator description and data

The following tables outline the data used to quantify each indicator. It must be noted that the data source is limited to quantify some indicators. For all Statistics New Zealand Mesh block data the following mesh blocks were excluded from the analysis; within the BoP region (1334000, 1334300, 1335600) and percentage of Mesh Block in Waiapu that were 5% or less (1342000, 1343200, 1348100, 1348500, 1348700, 1351900).

**Table A6a: Indicator description and data cultural capital**

Indicator	Indicator description	Data used 1) data description, 2) source, 3) scale, 4) data variables, 5) data assumptions	Reference point 1) type, 2) limits and 3) description
1 – Status of species of utility or cultural value to Ngāti Porou.	Been able to utilise species for cultural value.  Status of species of utility or cultural value to Ngāti Porou.	1) Using an indicator species for utility and cultural value it is possible to have an understanding of the measure of this indicator. The indicator species selected was Weka. 2) <b>National Weka recovery plan</b> – Department of Conservation. 3) <b>National Weka recovery plan</b> – National (NZ), Regional. 4) Count of Weka; for 2012. 5) It is assumed that using an indicator species such as weka that an understanding of the species of utility or value are known.  <i>Ecological Integrity</i> – is applicable to this indicator and was measured by: • A measure of species abundance in the Waiapu Catchment – for Weka there are no populations of Weka present other than occasional vagrants. The ecological integrity is therefore low (given a score of 10%).	1) Temporally using an established benchmark. 2) A breeding population present within catchment. 3) This is linked to the aspirational indicators around the use of species for utility or cultural value to Ngāti Porou, Table A1.
2 – Area of native vegetation and forest cover in the catchment compared to reference condition.	Indigenous forest is of high significance to Ngāti Porou.  Area of native vegetation and forest cover in the catchment compared to reference condition (to be decided).	1) <b>Land Overlay 3A (LO3A)</b> – Targets the “worst of the worst” erosion areas within the Waiapu Catchment. It generally delineates a buffer around an area of actively eroding gullies and is based upon NZLRI LUC units. <b>LUCAS New Zealand land Use Map</b> – tracks and quantifies changes in New Zealand land use. The data is composed of land use classifications at the 1 <sup>st</sup> January 1990, 1 <sup>st</sup> January 2008 and 31 <sup>st</sup> December 2012. 2) <b>Land Overlay 3A</b> – Gisborne District Council. <b>LUCAS New Zealand Land Use Map 1990-2008(v011)</b> – The Ministry for the Environment. 3) <b>Land Overlay 3A</b> - Regional scale (Gisborne); Waiapu Catchment. <b>LUCAS New Zealand Land Use Map</b> – National (NZ); Waiapu Catchment. 4) Waiapu Catchment; Total area of LO3A; Total area of LO3A in native vegetation; 1990 & 2008. 5) It is assumed on highly erodible land that is currently under an afforestation scheme is the best land use.	1) Temporally using an established benchmark. 2) 100% of the LO3A layer afforested in catchment is native forest*. 3) This is linked to the aspirational indicators around indigenous forest within the catchment, Table A1.  *This reference point represents a starting point, and that an area larger than LO3A could be identified as the reference point in the future.

3 – Area of forest available to the community for the collection non-wood forest products and firewood.	<p>Been able to utilise the natural resources is of <b>cultural significance to Ngāti Porou</b>.</p> <p>Area of forest available to the community for the collection non-wood forest products and firewood.</p>	<ol style="list-style-type: none"> <li>1) <b>DOC Public Conservation Areas</b> – Public Conservation Areas spatial representation of DOC's management units (conservation units) defined by various acts of parliament and legislation.  <b>LUCAS New Zealand land Use Map</b> – tracks and quantifies changes in New Zealand land use. The data is composed of land use classifications at the 1st January 1990, 1st January 2008 and 31st December 2012.  <b>MPI Waiapu Land Tenure</b> – a land tenure spatial layer created by MPI Gisborne. Original data sourced from LINZ and Māori land court</li> <li>2) <b>LUCUS New Zealand Land Use Map</b> – Ministry for the Environment  <b>DOC Public Conservation Areas</b> – Department of Conservation  <b>MPI Waiapu land tenure</b> – Ministry for Primary Industry</li> <li>3) <b>DOC Public Conservation Areas</b> – National (NZ); Waiapu Catchment  <b>LUCUS New Zealand Land Use Map</b> – National (NZ); Waiapu Catchment.  <b>MPI Waiapu land tenure</b> – Catchment; Waiapu Catchment</li> <li>4) Total area of forest identified in the LUM spatial layer in the catchment under different land tenure – Department of Conservation, Crown, General title, and Māori title for 1969, 1990 and 2008. Data is classed as Access, restricted, no access and give a score of 0.5, 0.25 or 0, respectively. Data is then classed as collection allowed, no collection and given a score of 0.5 or 0, respectively.</li> <li>5) Assume that DoC land has restricted access, private land has no access, Crown land has no access, and Māori land has full access. Assume that Doc land, Crown land and private land has no collection, and Māori land collection.  We acknowledge that this is a simplistic view of access within the Waiapu Catchment, with DoC land having free access but only for walking not for food collection. Permits may be acquired for collection on some private and crown land and that not all Māori land is accessible to all residents of the catchment. (see interview for information on access issues).</li> </ol>	<ol style="list-style-type: none"> <li>1) Temporally using an established benchmark.</li> <li>2) 100% of forest area is available to the community for the collection of non-wood forest products and firewood (100% of last measurement).</li> <li>3) This is linked to the aspirational indicators around collection of food, Table A1.</li> </ol>
4 – Number of sites formally/actively protected for their cultural and spiritual value.	Area of land that has been protected to retain or restore its Mauri.	<ol style="list-style-type: none"> <li>1) The <b>Gisborne District Council</b> has mapped Heritage overlays, Heritage alert layer, archaeological sites and areas, waahi tapu and waahi tapu areas, and post European contact significance. These mapped areas are used in planning decisions by the Gisborne District Council.</li> <li>2) <b>Gisborne District Council</b> Combined Regional Land and District Plan - <a href="http://www.gdc.govt.nz/district-plan/">http://www.gdc.govt.nz/district-plan/</a></li> <li>3) <b>Heritage overlay maps</b> – Gisborne region, Waiapu Catchment: a) Overlay 1: Heritage Alert Layer; b) Overlay 2: Archaeological sites &amp; Areas (NZAA database, HPT sites and sites determined by private and Council commissioned surveys) c) Overlay 3: Gisborne District Council Waahi Tapu Schedule - places and areas identified by tangata whenua as being of cultural or spiritual significance and waahi tapu and waahi tapu areas registered by HPT; d) Overlay 4: Gisborne District Council Post European Contact Schedule, sites</li> </ol>	<ol style="list-style-type: none"> <li>1) Temporally using an established benchmark.</li> <li>2) 100% of sites of significance to <b>Ngāti Porou</b> are protected*.</li> <li>3) This is linked to the aspirational indicators around knowing about and protecting special sites of significance to Ngāti Porou, Table A1.</li> </ol> <p>* Assumed that not all sites have been identified to enable protection.</p>

		<p>identified by the community and tangata whenua being of post European contact significance.</p> <p>4) Number of sites of significance mapped; for 2013.</p> <p>5) Not all sites of significance are widely known or recorded and therefore cannot be identified for protection. The mapping by the Gisborne District Council holds numerous sites of significance that are protected through rules and regulation. It can, however, only be assumed that current mapped heritage sites are underestimated. We have not included site of significance already lost in the analysis.</p>	<p>It is difficult to make an assumption on sites not identified – we have used 20% of sites have not been identified for protection.</p>
<p>5 – Number or area of water bodies, or stream length, or springs protected for their cultural and spiritual value.</p>	<p>All water bodies are of <b>significance to Ngāti Porou</b>.</p> <p>Water (stream length) and number of springs that have been protected to retain or restore its Mauri.</p>	<p>1) <b>Land Overlay 3A</b> – Targets the “worst of the worst” erosion areas within the Waiapu Catchment. It generally delineates a buffer around an area of actively eroding gullies and is based upon NZLRI LUC units.</p> <p><b>DOC Public Conservation Areas</b> – Public Conservation Areas spatial representation of DOC’s management units (conservation units) defined by various acts of parliament and legislation.</p> <p><b>New Zealand mainland spring points</b> – A place where water issues from the ground naturally. Only significant springs either by their size or location are recorded. The data is taken NZ topo50 topographic mapping series.</p> <p><b>River Environment Classification New Zealand</b> - organises information about the physical characteristics of New Zealand’s rivers. This information is mapped for New Zealand’s entire river network.</p> <p><b>LUCAS New Zealand land Use Map</b> – tracks and quantifies changes in New Zealand land use. The data is composed of land use classifications at the 1<sup>st</sup> January 1990, 1<sup>st</sup> January 2008 and 31<sup>st</sup> December 2012.</p> <p>2) <b>Land Overlay 3A</b> – Gisborne District Council.</p> <p><b>DOC Public Conservation Areas</b> – Department of Conservation.</p> <p><b>New Zealand Spring Points</b> - Land Information New Zealand.</p> <p><b>River Environment Classification New Zealand</b> – The Ministry of the Environment &amp; National Institute of Water and Atmospheric Research (NIWA).</p> <p><b>LUCAS New Zealand Land Use Map 1990-2008(v011)</b> – The Ministry for the Environment.</p> <p>3) <b>Land Overlay 3A</b> – regional; Waiapu Catchment.</p> <p><b>DOC Public Conservation Areas</b> – National (NZ); Waiapu Catchment.</p> <p><b>New Zealand mainland spring points</b> – National (NZ); Waiapu Catchment.</p> <p><b>River Environment Classification New Zealand</b> – National (NZ); Waiapu Catchment.</p> <p><b>LUCAS New Zealand land Use map</b> – National (NZ); Waiapu catchment.</p> <p>4) Waiapu Catchment; Total stream length in the catchment; Total count of springs in the catchment; Length of stream and number of springs protected (i.e. within the LO3A layer, and within Doc land) for their cultural and spiritual value; for 1990 and 2008.</p> <p>5) It is assumed that all rivers and springs have been correctly identified and mapped and</p>	<p>1) Temporally using an established benchmark.</p> <p>2) 100% of known water places of significance are protected.</p> <p>3) This is linked to the aspirational indicators around knowing about and protecting water of significance to Ngāti Porou, Table A1.</p>

		that no other water bodies are present in the catchment. It is also assumed that through afforestation of the land the Mauri of the stream and springs is protected. Note: No mapped springs were mapped within the catchment; however, it is known that springs of cultural and spiritual value are present in the catchment.	
6 – Number of Te Reo speakers in the community.	Speaking Te Reo is cultural identity and allows for the cultural learning's to be taught, known and practiced, including begin able to describe places in traditional Māori names (Waahi Tipuna).	<ol style="list-style-type: none"> <li>1) <b>New Zealand census data</b> captures data on Te Reo speakers.</li> <li>2) <b>Statistics New Zealand</b> – <a href="http://www.stats.govt.nz/">http://www.stats.govt.nz/</a></li> <li>3) <b>Census data</b> – National (NZ); Meshblock (Waiapu Catchment).</li> <li>4) Waiapu Catchment meshblocks; Total population; Māori descent total population; Number of Te Reo speakers; for 2006, 2001, 1996.</li> <li>5) It is assumed that; The majority of the Waiapu Catchment Māori population is Ngāti Porou; If Te Reo is spoken a number of cultural learning's are also been taught.</li> </ol>	<ol style="list-style-type: none"> <li>1) Temporally using an established benchmark.</li> <li>2) 100% of Māori descent resident to the Waiapu Catchment speaking Te Reo.</li> <li>3) This is linked to the aspirational indicators around traditional ways learning's, Table A1.</li> </ol>

**Table A6b: Indicator description and data financial capital**

Indicator	Indicator description	Data used 1) data description, 2) source, 3) scale, 4) data variables, 5) data assumptions	Reference point 1) type, 2) limits and 3) description
7 – Number of incentive credit opportunities available to the community.	Number of incentive credit opportunities available to the community where there is a policy to change land use.	<ol style="list-style-type: none"> <li>1) Policy to change land use in the Waiapu Catchment is the afforestation of LO3A identified land.</li> <li>2) Ministry for Primary Industries.</li> <li>3) LO3A layer Gisborne region, Waiapu Catchment.</li> <li>4) Count of policies for land use change; percentage of up-front payment incentive; for 2012 and 2013.</li> <li>5) -</li> </ol>	<ol style="list-style-type: none"> <li>1) Temporally using an established benchmark.</li> <li>2) 100% up-front payment for policy induced land use change.</li> <li>3) This is linked to the aspirational indicators around access to credit, Table A1.</li> </ol>
8 – Number of loan schemes available to groups with land in multiple-ownership.	Number of loan schemes available to groups with land in multiple-ownership.	<ol style="list-style-type: none"> <li>1) Currently Kiwi bank and Mauri Trustie are available to lend for multiple-ownership.</li> <li>2) Anecdotal data from TRONPhui Runuga. <b>Register of New Zealand banks –</b> <a href="http://www.rbnz.govt.nz/regulation_and_supervision/banks/register/">http://www.rbnz.govt.nz/regulation_and_supervision/banks/register/</a></li> <li>3) <b>Anecdotal data:</b> Waiapu Catchment. <b>Register of New Zealand banks:</b> National (NZ).</li> <li>4) Count of lending institutes with appropriate schemes available; Count of all registered banks in New Zealand.</li> <li>5) -</li> </ol>	<ol style="list-style-type: none"> <li>1) Temporally using an established benchmark.</li> <li>2) Opportunities at all major lending institutes.</li> <li>3) This is linked to the aspirational indicators around access to credit, Table A1.</li> </ol>
9 – Flow of revenue from land, forests, forest products and forest ecosystem services to the community.	Flow of revenue from land, forests, forest products and forest ecosystem services to the community.	<ol style="list-style-type: none"> <li>1) <b>LUCAS New Zealand land Use Map</b> – tracks and quantifies changes in New Zealand land use. The data is composed of land use classifications at the 1<sup>st</sup> January 1990, 1<sup>st</sup> January 2008 and 31<sup>st</sup> December 2012. <b>Forest Investment Finder (FIF)</b> – identifies potential economic and environmental benefits from the afforestation. <b>New Zealand census data</b> captures data on median wage rates.</li> <li>2) <b>LUCAS New Zealand Land Use Map 1990-2008(v011)</b> – The Ministry for the Environment. <b>Forest Investment Finder (FIF)</b> – Scion (NZ forest research institute). <b>New Zealand census data</b> – Statistics New Zealand.</li> <li>3) <b>LUCAS New Zealand land Use Map</b> – national (NZ); Waiapu Catchment. <b>Forest Investment Finder</b> – national (NZ); Waiapu Catchment. <b>New Zealand census data</b> – national (NZ); Waiapu meshblock.</li> <li>4) Includes potential revenue from timber, carbon and avoided erosion for forest areas in 1990 and 2008. Medium wage rate data for the Waiapu Catchment from 2006, 2001 and 1996.</li> <li>5) It is assumed that; Medium wage data follows a similar percentage increase or decrease that is experienced in potential forest revenue. Direct year comparisons was not possible, therefore the slope of the data was compared for total revenue and medium wage over the data sets available. This doesn't take into consideration below average wage rates for</li> </ol>	<ol style="list-style-type: none"> <li>1) Temporally using an established benchmark.</li> <li>2) Revenue % gain returning to the community at the same rate.</li> <li>3) This is linked to the aspirational indicators around flow of revenues, Table A1.</li> </ol>

		the community.	
10 – Average wage rates in the catchment.	Average wage rates in the catchment giving an indication of income.	<ol style="list-style-type: none"> <li>1) <b>New Zealand census data</b> captures data on average wage rates.</li> <li>2) <b>Statistics New Zealand</b> – <a href="http://www.stats.govt.nz/">http://www.stats.govt.nz/</a></li> <li>3) <b>Census data</b> – National (NZ); Meshblock (Waiapu Catchment).</li> <li>4) Waiapu Catchment meshblocks; Total population; Median wage rates; National median wage rates; for 2006, 2001, 1996.</li> <li>5) It is assumed that; the available census data represents the Waiapu Catchment as the data for personal income in the waiapu Catchment was limited heavily from confidentiality.</li> </ol>	<ol style="list-style-type: none"> <li>1) Spatial Comparison (New Zealand average).</li> <li>2) Average wage rates are no less than the New Zealand average.</li> <li>3) This is linked to the aspirational indicators around having opportunities for employment in the catchment, Table A1.</li> </ol>
11 – Levels of home ownership amongst Ngāti Porou.	The level of home ownership amongst Ngāti Porou giving an indication of security.	<ol style="list-style-type: none"> <li>1) <b>New Zealand census data</b> captures data on home ownership.</li> <li>2) <b>Statistics New Zealand</b> – <a href="http://www.stats.govt.nz/">http://www.stats.govt.nz/</a></li> <li>3) <b>Census data</b> – National (NZ); Meshblock (Waiapu Catchment).</li> <li>4) Waiapu Catchment meshblocks; Total population, Māori descent total population; Number of homes owned; for 2006, 2001, 1996.</li> <li>5) It is assumed that; The majority of the Waiapu Catchment Māori population is Ngāti Porou; The Māori descent population in the Waiapu Catchment is high and that a count of home ownership of the total population is representing the Māori community.</li> </ol>	<ol style="list-style-type: none"> <li>1) Spatial Comparison (New Zealand average).</li> <li>2) Level of home ownership is no less than the New Zealand average.</li> <li>3) This is linked to the aspirational indicators around security, Table A1.</li> </ol>

Te Runanganui o Ngāti Porou (TRONPnui) – Ngāti Porou post Settlement tribal authority



**Table A6c: Indicator description and data human capital**

Indicator	Indicator description	Data used 1) data description, 2) source, 3) scale, 4) data variables, 5) data assumptions	Reference point 1) type, 2) limits and 3) description
12 – Extent of Ngāti Porou control or influence over key assets and resources.	Mana Motuhake: Control over the river and its catchment as kaitiaki and able to decide and influence the protection and sustainable use of the Waiapu and reduce the sources of pollution to the awa and use matauranga that was honoured, respected and relevant to restore the catchment.	<ol style="list-style-type: none"> <li>Control over key assets and resources include ownership of land and development of businesses.</li> <li><b>Māori land ownership</b> – Waiapu report by Scion (2012). <b>Registered businesses</b> – <a href="http://www.business.govt.nz">http://www.business.govt.nz</a></li> <li><b>Māori land ownership</b> – Waiapu Catchment. <b>Registered businesses</b> – Waiapu Catchment.</li> <li>Waiapu Catchment; Area Māori land (proportion 0.7); Total area of land to be place in Māori land title; Count of registered active businesses (proportion 0.3); Count of all registered businesses; for 2012.</li> <li>It is assumed that; Mana motuhake is represented by a measure of Māori land ownership and Ngāti Porou registered businesses in the catchment. Of the registered businesses it was not possible to divide out Ngāti Porou owned. The reference for point for businesses used was count of active businesses to be no less than 60% of all registered businesses.</li> </ol>	<ol style="list-style-type: none"> <li>Temporally using an established benchmark.</li> <li>100% of land returned under treaty claim, and 60% of registered businesses to be active.</li> <li>This is linked to the aspirational indicators around Mana Motuhake, Table A1.</li> </ol>
13 – General health of community.	The general health of the community.	<ol style="list-style-type: none"> <li><b>New Zealand statistics data</b> captures data on general health. We measure smoking because of its negative effects on health. Smoking is a major risk factor for many cancers and for respiratory and cardiovascular disease.</li> <li><b>Statistics New Zealand</b> – <a href="http://www.stats.govt.nz/">http://www.stats.govt.nz/</a></li> <li><b>Census data</b> – National (NZ); Meshblock (Waiapu Catchment).</li> <li>Waiapu Catchment meshblocks; Total population; Count of regular smokers; for 2006, 2001, 1996.</li> <li>It is assumed that; statistics around smoking are representative of community health.</li> </ol>	<ol style="list-style-type: none"> <li>Spatial Comparison (New Zealand average).</li> <li>Measured against New Zealand average health statistics.</li> <li>This is linked to the aspirational indicators around good health statistics for the people living the Waiapu catchment, Table A1.</li> </ol>
14 – Number of resident tertiary qualified Ngāti Porou.	The number of resident tertiary qualified Ngāti Porou.	<ol style="list-style-type: none"> <li><b>New Zealand census data</b> captures data on qualifications.</li> <li><b>Statistics New Zealand</b> – <a href="http://www.stats.govt.nz/">http://www.stats.govt.nz/</a></li> <li><b>Census data</b> – National (NZ); Meshblock (Waiapu Catchment).</li> <li>Waiapu Catchment meshblocks; Total population, Māori descent total population; Number of tertiary qualified; for 2006, 2001, 1996.</li> <li>It is assumed that; The majority of the Waiapu Catchment Māori population is Ngāti Porou; the Māori descent population in the Waiapu catchment is high and a count of tertiary qualifications of the total population is representing the Māori community; the available census data represents the Waiapu Catchment as the data for qualifications in the Waiapu Catchment was limited from confidentiality.</li> </ol>	<ol style="list-style-type: none"> <li>Spatial Comparison (New Zealand average).</li> <li>Tertiary qualified is no less than the New Zealand average.</li> <li>This is linked to the aspirational indicators around increasing the capability of Ngāti Porou in the catchment, Table A1.</li> </ol>

**Table A6d: Indicator description and data natural capital**

Indicator	Indicator description	Data used 1) data description, 2) source, 3) scale, 4) data variables, 5) data assumptions	Reference point 1) type, 2) limits and 3) description
15 – Area of land whose designation or land management focus is the protection of soil or water resources.	Land that has been protected through afforestation. It is assumed that through afforestation soil and water resources will be protected.	<p>1) <b>Land Overlay 3A</b> – Targets the “worst of the worst” erosion areas within the Waiparu Catchment. It generally delineates a buffer around an area of actively eroding gullies and is based upon NZLRI LUC units.</p> <p><b>LUCAS New Zealand land Use Map</b> – tracks and quantifies changes in New Zealand land use. The data is composed of land use classifications at the 1<sup>st</sup> January 1990, 1<sup>st</sup> January 2008 and 31<sup>st</sup> December 2012.</p> <p><b>DOC Public Conservation Areas</b> – Public Conservation Areas spatial representation of DOC's management units (conservation units) defined by various acts of parliament and legislation.</p> <p><b>New Zealand mainland spring points</b> – A place where water issues from the ground naturally. Only significant springs either by their size or location are recorded. The data is taken NZ topo50 topographic mapping series.</p> <p>2) <b>Land Overlay 3A</b> - Gisborne District Council.</p> <p><b>New Zealand mainland spring points</b> – Land Information New Zealand.</p> <p><b>River Environment Classification New Zealand</b> – The Ministry of the Environment &amp; National Institute of Water and Atmospheric Research (NIWA).</p> <p><b>LUCAS New Zealand land Use map</b> – the Ministry for the Environment.</p> <p><b>DOC Public Conservation Areas</b> – Department of Conservation.</p> <p>3) <b>Land Overlay 3A</b> – National (NZ); Waiparu Catchment.</p> <p><b>New Zealand mainland spring points</b> – National (NZ); Waiparu Catchment. <b>River Environment Classification New Zealand</b> – National (NZ); Waiparu Catchment.</p> <p><b>LUCAS New Zealand land Use map</b> – National (NZ); Waiparu Catchment. <b>DOC Public Conservation Areas</b> – National (NZ); Waiparu Catchment.</p> <p>4) Total area of Waiparu Catchment: total area of afforested LO3A and total area of DOC land within the catchment; for 2008, 1990.</p> <p>5) It is assumed that with afforestation of LO3A land that soil and water resources will be protected. DOC land it is assumed is managed to protect both soil and water resources</p>	<p>1) Temporally using an established benchmark.</p> <p>2) 100% of the LO3A layer area afforested*.</p> <p>3) This is linked to the aspirational indicators around protecting the land and water.</p> <p>*This reference point represents a starting point, and that an area larger than LO3A could be identified for protection of soil and water resources. It must also be noted that protection may include options other than afforestation.</p>
16 – Area of land with significant soil degradation.	Land that has been degraded from erosion.  This indicator is a negative indicator and in the sustainable livelihoods calculation the positive (area not eroded) was used.	<p>1) <b>Land Cover Data Base</b> – Thematic classification of land cover The polygon features contain a code and boundary representing the land cover type at each of three periods; summer 1996/97, summer 2001/02, and summer 2008/09</p> <p><b>Waiparu River Catchment Study (final report)</b> - Presents the work undertaken on the Waiparu River Catchment Study, the purpose of which was to investigate the geophysical, social, cultural, and economic dimensions of the erosion problem in the Waiparu River catchment</p> <p>2) <b>Land Cover Data Base V3.3</b> – Ministry of the Environment &amp; Landcare Research.</p> <p><b>Waiparu River Catchment Study (final report)</b> – Ministry for Primary Industries &amp; Scion.</p>	<p>1) Temporally using an established benchmark.</p> <p>2) A reduction in 1996 degraded land area by 25%*.</p> <p>3) This is linked to the aspirational indicators for a reduction in degraded land from erosion, Table A1.</p>

		<p>3) <b>Land Cover Data Base V3.3</b> – National (NZ); Waiapu Catchment.  <b>Waiapu River Catchment Study (final report)</b> – Waiapu Catchment.</p> <p>4) Total land area in the Waiapu Catchment; Total land area eroded; for 1957, 1997 and 2008.</p> <p>5) It is assumed that; The most significant land degradation is erosion.</p>	*This reference point is difficult to define.
17 – Area of water bodies, or stream length, with significant change in physical, chemical or biological properties from reference conditions.	<p>Water (stream length) that has been degraded by erosion.</p> <p>This indicator is a negative indicator and in the sustainable livelihoods calculation the positive (area not impacted by erosion) was used (i.e. when improving the trend is positive).</p>	<p>1) <b>River Environment Classification New Zealand</b> – organizes information about the physical characteristics of New Zealand's rivers. The data is mapped for New Zealand's entire river network.  <b>Land Cover Data Base</b> –Thematic classification of land cover. The polygon features contain a code and boundary representing the land cover type at each of three periods; summer 1996/97, summer 2001/02, and summer 2008/09.</p> <p>2) <b>River Environment Classification New Zealand</b> – The Ministry of the Environment &amp; National Institute of Water and Atmospheric Research (NIWA).  <b>Land Cover Data Base</b> – Ministry if the Environment &amp; Landcare Research.</p> <p>3) <b>River Environment Classification New Zealand</b> – National (NZ); Waiapu Catchment.  <b>Land Cover Data Base</b> – National (NZ); Waiapu Catchment.</p> <p>4) Waiapu Catchment; Total stream length in Waiapu River and stream network; Total stream length below erosion event; for 1996, 2001 and 2008.</p> <p>5) It is assumed that; A 20 m riparian zone is sufficient to protect water bodies and any spring fenced for conservation is protected; All areas downstream of a landslide event would be adversely affected by sedimentation released from the landslide; We acknowledge that it is very unlikely that all slope related erosion events in the Waiapu Catchment are captured by the LCDB data; The data could be improved by using the data used form Marden et al. (2011).</p>	<p>1) Temporally using an established benchmark.</p> <p>2) A reduction in 1996 degraded stream length by 25%*.</p> <p>4) This is linked to the indicator 19 above which is to reduce degraded land, Table A1.</p> <p>*This reference point is difficult to define.</p>

**Table A6e: Indicator description and data physical capital**

Indicator	Indicator description	Data used 1) data description, 2) source, 3) scale, 4) data variables, 5) data assumptions	Reference point 1) type, 2) limits and 3) description
18 – Number days the roads are open per year.	Roads are open for use and connecting to Gisborne and Opotiki, state highway 35.	<ol style="list-style-type: none"> <li><b>Traffic road Event Information System (TREIS)</b> - lets you access real time data on events/incidents that affect traffic conditions across the network of national highways in New Zealand.</li> <li><b>Traffic road Event Information System (TREIS)</b> - Opus &amp; NZTA</li> <li>Catchment and state highway 35 from Gisborne to Opotiki.</li> <li>Total number of days state highway 35 is open to Gisborne (proportion 0.9); and for state highway to Opotiki (proportion 0.1); for 2010, 2011, 2012 and 2013.</li> <li>Data was collected from Opus who carried out a data dump from the TRIES system for the year's mentioned above. Data is only available for Highways no data is available for minor roads. It is assumed that all road closers have been recorded.</li> </ol>	<ol style="list-style-type: none"> <li>Temporally using an established benchmark.</li> <li>0 days closed for state highway 35.</li> <li>This is linked to the aspirational indicator '<i>Ngāti Porou communities are no longer isolated due to land slips and/or road closures</i>', Table A1.</li> </ol>
19 – Access to uninterrupted internet and mobile phone coverage.	The internet and mobile phone coverage is working and accessible to the majority of people in the Waipapu Catchment.	<ol style="list-style-type: none"> <li> <b>Vodafone Cell Sites</b> – current Vodafone mobile phone transmitter locations across New Zealand  <b>Telecom Cell Sites</b> – current Telecom mobile phone transmitter locations across New Zealand  <b>2degrees Cell Sites</b> – current 2degrees mobile phone transmitter locations across New Zealand  <b>Rural Broadband Initiatives – Vodafone Wireless – Current</b> - Current coverage from Vodafone as part of the Rural Broadband Initiative (RBI)  <b>Rural Broadband Initiatives – Vodafone Wireless – Final coverage</b> - Final coverage from Vodafone as part of the Rural Broadband Initiative (RBI)  <b>Chorus New Zealand Broadband</b> – represents the previous Telecom Group fibre encompassing Chorus and its parent company Telecom New Zealand. </li> <li> <b>Vodafone Cell Site</b> – Register of Radio Frequencies <a href="#">vodafone-cell-sites</a>  <b>Telecom Cell Sites</b> – Register of Radio Frequencies <a href="#">telecom-cell-sites</a>  <b>2degrees Cell Sites</b> – Register of Radio Frequencies <a href="#">2degrees-cell-sites</a>  <b>Rural Broadband Initiatives – Vodafone Wireless – Current</b> – <a href="#">vodafone.co.nz</a>  <b>Rural Broadband Initiatives – Vodafone Wireless – Final coverage</b> – <a href="#">vodafone.co.nz</a>  <b>Chorus New Zealand Broadband</b> – National Broadband Map <a href="#">broadbandmap.govt.nz</a>. </li> <li> <b>Vodafone Cell Site</b> – National (NZ); Catchment.  <b>Telecom Cell Sites</b> – National (NZ); Catchment.  <b>2degrees Cell Sites</b> – National (NZ); Catchment  <b>Rural Broadband Initiatives – Vodafone Wireless – Current</b> – Na National (NZ); Catchment  <b>Rural Broadband Initiatives – Vodafone Wireless – Final coverage</b> – N National (NZ); Catchment  <b>Chorus New Zealand Broadband</b> – National (NZ); Catchment </li> </ol>	<ol style="list-style-type: none"> <li>Temporally using an established benchmark.</li> <li>Full access to both broadband and cell phone coverage.</li> <li>-</li> </ol>

		<p>4) Waiapu Catchment; Broadband coverage (proportion 0.5); Cell sites (proportion 0.5); for 2013.</p> <p>5) It is assumed that with cell sites in the catchment cell phone coverage is accessible in the main areas of the catchment.</p>	
20 –Number of houses with septic tank waste water systems.	The disposal of waste is up to standards and not impacting water bodies.	<p>1) <b>Gisborne District Council septic tank data</b> – lists all properties with or with compliant septic tank facilities</p> <p>2) <b>Gisborne District Council</b></p> <p>3) <b>Gisborne District Council</b> – regional; Catchment</p> <p>4) Number of houses within the catchment; Number of houses with septic tank waste water systems identified by the Gisborne District Council; for periods 2002 - 2011, 1998 – 2001, before 1998.</p> <p>5) Accurate detail of recorded septic tanks in the catchment is not known. The data presented is of the known data only – it does not necessarily mean that septic tanks are not present.</p>	<p>1) Temporally using an established benchmark.</p> <p>2) 100% of houses to have septic tank waste water systems.</p> <p>3) This is linked to the aspirational indicators on waste water infrastructure, Table A1.</p>
21 – Quality of water at tap and consistent water supply throughout the year.	The quality of water at the tap is of drinking water standards and is of a consistent supply throughout the year.	<p>1) <b>Drinking water for New Zealand</b> – records community drinking-water supplies#, water source and quality*.</p> <p>2) <b>Drinking water for New Zealand</b> – <a href="#">drinking water NZ</a></p> <p>3) National (NZ); Catchment.</p> <p>4) All registered water supply source (and score allocated) within the Waiapu Catchment, mains (5), bore (3), stream/river (2), spring (2), or roof (1); for 2012, 2010, 2011.</p> <p>5) Within the catchment all water is privately managed (i.e. no mains water supply). Water supplies are also of small scale and no water quality data was available due to small scale. The scoring allocation is based on a consistent water supply throughout the year.</p> <p>#"Community drinking-water supplies" means all drinking-water supplies serving more than 25 people for more than 60 days a year, Registration of smaller supplies is voluntary.</p> <p>* In order to compare water supplies and identify those which may not be delivering quality water, the Ministry of Health grades each supply. So far, only those with populations over 500 are graded, but those with as few as 25 users will be graded in the future.</p>	<p>1) Temporally using an established benchmark.</p> <p>2) A score of 4 or more to ensure consistency of water supply throughout the year.</p> <p>3) This is linked to the aspirational indicators on water quality and supply, Table A1.</p>

**Table A6f: Indicator description and data social capital**

Indicator	Indicator description	Data used 1) data description, 2) source, 3) scale, 4) data variables, 5) data assumptions	Reference point 1) type, 2) limits and 3) description
22 – Number of Marae based events per year.	Marae is a major part of life as it is a place to meet and connect with people. They are hugely important physical as well as social assets.	1) <b>The TRONPnui Runuga local knowledge</b> of the Waiapu Catchment has scored Marae based on activity. 2) <b>TRONPnui Runuga</b> local knowledge. 3) Catchment. 4) Number (definition and score) of Marae used less than once a year (not operational, 1), used once a year (functional, 2), used once or more a month (operational, 3), used once or more a week (active, 4); for 2013. 5) No data previous to the 2013 is known.	1) Temporally using an established benchmark. 2) 100% Marae are operational or active. 3) This is linked to the aspirational indicators around use of Marae, and Ngāti Porou events, Table A1.
23 - Number of registered sports club.	Rural sport is a major part of life as it is not just your club but also your wider family. Sports occasions & matches are important culturally and socially as it enhances one's mana that you can field a team. It brings families together.	1) Number of active Rugby Clubs in the Waiapu. 2) <b>Ngāti Porou East Coast Rugby Football Union.</b> Local knowledge (Pia Pohatu). 3) Regional, Catchment. 4) Total number of registered rugby clubs in the Waiapu Catchment; for 2013, 2011, 2010. 5) All rugby clubs are based in Waiapu (note some players come from outside the catchment). It is assumed that a count of registered rugby clubs is representing the major sport in the Waiapu Catchment.	1) Temporally using an established benchmark. 2) No decline in registered rugby clubs from 2013 value. 3) This is linked to the aspirational indicators for cohesion of the community, Table A1.
24 – Number of volunteer days spent on Ngāti Porou events and activity.	Key to the success of events and activity is volunteers. They drive the success of events and activity resulting in participation, connections and cohesion of the community.	1) <b>New Zealand census data</b> captures data on unpaid work days. 2) <b>Statistics New Zealand</b> – <a href="http://www.stats.govt.nz/">http://www.stats.govt.nz/</a> 3) <b>Census data</b> – National (NZ); Meshblock (Waiapu Catchment). 4) Waiapu Catchment meshblocks; Count of unpaid activities (other helping or voluntary work for or through any organisation, group or Marae); for 2006. 5) No data was available for previous years in the Waiapu Catchment. It is assumed that; all volunteer days are recorded through Statistics; all volunteer days are spent on Ngāti Porou events and activity.	1) Spatial Comparison (New Zealand average). 2) Volunteer days are no less than the New Zealand average. 3) This is linked to the aspirational indicators around use of Marae, and Ngāti Porou activities and events, Table A1.
25 – Number of Ngāti Porou living within the catchment.	Ngāti Porou living in the Waiapu catchment and retain the Whanau/Hapu connections.	1) <b>New Zealand census data</b> captures data on population numbers. 2) <b>Statistics New Zealand</b> – <a href="http://www.stats.govt.nz/">http://www.stats.govt.nz/</a> 3) <b>Census data</b> – National (NZ); Meshblock (Waiapu Catchment). 4) Waiapu Catchment meshblocks; Māori descent total population; for 2006, 2001, 1996. Total population of Ngāti Porou within each region of New Zealand; for 2006. 5) It is assumed that; The majority of the Waiapu Catchment Māori population is Ngāti Porou; That Ngāti Porou population living in the Gisborne region (not specifically the Waiapu Catchment) is used to produce the benchmark.	1) Temporally using an established benchmark. 2) 1% Ngāti Porou population outside of the Gisborne region returning to live in the Waiapu Catchment*. 3) This is linked to the aspirational indicators around Whanau/Hapu, Table A1. *This reference point represents a starting point, and that a higher percentage could be identified as the reference point in the future.

Te Runanganui o Ngāti Porou (TRONPnui) – Ngāti Porou post Settlement tribal authority

### *3) Sustainable livelihood capitals – a planning tool: Pressure and resilience description, data and calculation of sustainable livelihoods*

#### **Pressures**

Climatic pressures have been identified as 1) extreme rainfall, 2) major drought, and 3) warmer, drier, and windier, plus a small increase in sea level. Climate change pressures were applied at an indicator level where relevant to the indicator. Where climate change pressures were not relevant to the indicator the 'cell' was left blank and not included in the pressure analysis.

The climate change pressures were scored from 1 – 3 (low, medium, high). Both extreme climatic events (extreme rainfall and major drought) were scored at 3 as they cause significant pressures, or shocks, to the Waiapu and its people. The general climatic trend of warmer, drier, and windier, plus a small increase in sea level was scored low (value 1) as this is more of a gradual change over time that can be adapted to more easily compared to extreme events.

The scores were then weighted low to high (0 – 1) depending on a return period (if relevant), intensity of the event, and whether they had direct, indirect, or induced effects (Slootweg et al., 2001; See Porou et al., (2012) for discussion). For example, extreme rainfall will have a direct effect on natural capital, and either an indirect or induced effect on the social capital. Taken into consideration in the weighting is the return period for any climatic event, with shorter return periods given a higher weighting as they would be expected to occur more often. It was assumed that an indirect effect was 50% of the direct effect and an induced effect was 50% of the indirect effect as no other data was available to weight the effect.

The climate change pressure score was applied to all indicators and then weighted for each indicator for its importance to the indicator.

Social pressure was calculated using the New Zealand Index of Deprivation score presented for the Waiapu Catchment in Porou et al. (2012). An area weighted average of the Index of Deprivation was calculated for the Waiapu Catchment, equalling 9/10.

A summary from Porou et al. (2012) on the New Zealand, the Index of Deprivation follows: In New Zealand, the Index of Deprivation is used to summarise the relative socio-economic conditions in an area, and thus help target intervention programmes and policies. The index combines a selection of key variables from the Census of Population and Dwellings (see Table A6), and takes the form of a decile rating for a census mesh block, and for an area unit, an average score for the mesh blocks in that area unit. The index score ranges in value from 1 to 10, with "10" meaning the area is within the most deprived 10% (lowest decile). The deprivation scores derived from the 9 component variables are also available. These scores are adjusted to have a mean of 1000 and a standard deviation of 100. The most recent version of the Index is NZDep2006 (Salmond et al., 2007) and is constructed from the variables listed in Table A2.

The social pressure was scored low to high (0 – 1) with the Waiapu Catchment high at 0.9 (using 2007 census data). The score was applied to all indicators and then weighted for each indicator for its importance to the indicator.

For this analysis the soil pressures were not weighted. It could be possible to weight the scores (low to high, 0 – 1) depending on whether they have direct, indirect, or induced effects, respectively (Slootweg et al., 2001; See Porou et al., (2012) for discussion).

#### **Resilience's**

Goal Specific Regulation (rules and regulations) aimed at addressing ecological pressures. Were the goal specific regulation resilience's were not relevant to the indicator the 'cell' was left blank and not included in the resilience analysis. Selected for the Waiapu Catchment were the East Coast Forestry Project (ECFP) and the Land Overlay 3A (LO3A). Each regulation was scored low to high (0 – 1) against:

- Institutional structures that address the intended objective,
- A clear process for implementing the institution is in place,
- Whether the institution has been effective at meeting stated objectives.

To achieve the score each goal specific regulation was weighted low to high (1 – 3) based on the whether there was detailed information to assess if they would contribute to effect management and thus catchment resilience. More weight was given to the goal measures that had detailed information. In the case of the ECFP and LO3A layer a weighting of 2 (score of 0.5) was given to both.

Ecological Integrity is measured as relative condition of assessed species in a given location (i.e. food web integrity) and only relevant to the sub-capital conservation of biological diversity – specifically indicator 1 (Status of species of utility or cultural value to Ngāti Porou).

Social resilience was calculated as one minus the social pressure score. For this analysis the soil resilience was not weighted. It could be possible to weight the scores (low to high, 0 – 1) depending on whether they have direct, indirect, or induced effects, respectively (Slootweg et al., 2001; See Porou et al., (2012) for discussion).



## Calculation of livelihoods

Data range, equation and exceptions for the sustainable livelihoods calculation are described below (from; Halpen et al., 2013).

**Table A7a: The status, trend and likely near-term future status calculations, range in values and exceptions.**

	Capital (and sub-capital)	Indicator	Status	Trend	Likely near-term future status
Symbol	$I$	$I_i$	$X_i$	$T_i$	$\hat{X}_{i,F}$
Value range	0 – 1	0 – 1	0 – 1	-1 – 0 – 1	0 – 1
Equation	$I = \alpha_1 I_1 + \alpha_2 I_2 + \dots + \alpha_{10} I_{10} = \sum_{i=1}^N \alpha_i I_i$ <p>Where:  <math>I_1, I_2, I_3 \dots</math> = capitals 1, 2, 3...  <math>\alpha</math> = weighting</p> <ul style="list-style-type: none"> <li>We used individual weighting for the importance of each sub-capital to the overall capital based on findings from Porou et al. (2012).</li> <li>We used equal weighting between capitals 1/6. Options for weighting capitals are described in Halpen et al. (2013).</li> </ul>	$I_i = \frac{x_i + \hat{X}_{i,F}}{2}$ <p>Where:  <math>X_i</math> = status  <math>\hat{X}_{i,F}</math> = likely near-term future status</p>	$x_i = \frac{X_i}{X_{i,R}}$ <p>Where:  <math>X_i</math> = present status  <math>X_{i,R}</math> = reference point</p>	<p>Determined from the slope of a linear trend line between data points.</p>	$\hat{X}_{i,F} = (1 + \delta)^{-1} [1 + \beta T_i + (1 - \beta)(r_x - p_x)] x_i$ <p>Where:  <math>\delta</math> = Discount rate (set at 0)  <math>\beta</math> = assumed at 0.67 (this assumption makes Trend twice as important)</p>
Exceptions	-	-	IF: status = 1 then Trend = 0	-	IF: $\hat{X}_{i,F} > x_i^{MAX}$ : then set $\hat{X}_{i,F} = x_i^{MAX}$  $x_i^{MAX}$ = max attainable status given realistic conditions

Table A7b: The pressure calculations, range in values and exceptions.

	Pressure						
	Total pressures ( $p_x$ )	Climate Change Pressure				Social Pressure	
		Climate Change pressure ( $p_E$ )	General Change	Extreme Events		Total Social Pressure ( $P_s$ )	NZ Index of Deprivation
			Warmer, drier, winder, plus a small increase in sea level	Extreme rainfall	Major drought		
Symbol	$p_x$	$p_E$				$P_s$	
Value range	0 – 1	0 – 1	1 – 3	1 – 3	1 – 3	0 – 1	0 – 1
Equation	$p_x = \gamma * (p_E) + (1 - \gamma) * (p_S)$ <p>Where:  <math>p_E</math> = Climate change pressure  <math>p_S</math> = Social pressure  <math>\gamma</math> = relative weight for ecological vs. social (set at 0.5)</p>	$p_E = \frac{\sum_i^N (w_{i\_max} * p_i)}{\sum w_{i\_max}}$ <p>Where:  <math>w_{i\_max} = 3</math></p> $p_i = \frac{\sum_i^M (w_i s_i)}{3}$ <p>Where:  <math>w</math> = is the pressure score  <math>s_i</math> = weighting (value range 0-1)</p>	<p>Value determined by the score (1-3) multiplied by the weighting (<math>s_i</math>).</p> <p>Blank cell the data is not relevant.</p>	-	-	$p_s = \frac{\sum_i^N z_i}{N}$ <p>Where:  <math>z_i</math> = social pressure.  <math>N</math> = number of social pressures.</p>	Value determined by the score (1-3) multiplied by the weighting ( $s_i$ ). For this analysis weighting set at 1.
Exceptions	-	-	-	-	-	-	-

Table A7c: The resilience calculations, range in values and exceptions.

	Resilience						
	Total Resilience ( $r_x$ )	Goal Specific Regulation			Ecological Integrity	Social Resilience	
		Goal Specific Regulation (G)	ECFP	LO3A	Resilience - Ecological Integrity ( $Y_E$ )	Resilience - Social ( $Y_S$ )	1 - NZ Index of Deprivation
Symbol	$r_x$	G			$Y_E$	$Y_S$	
Equation	$r_x = \gamma * \left( \frac{Y_E + G}{2} \right) + (1 - \gamma) * Y_S$ <p>Where:  <math>\gamma = 0.5</math>  G = Goal specific regulation  <math>Y_S</math> = social resilience</p> <p>Where no <math>Y_E</math> use:  <math>r_x = (G + Y_S)/2</math></p>	$G = \frac{\sum w_i G_i}{\sum w_i}$ <p>Where:  <math>w_i</math> = weighting (value range 1-3)  <math>G_i</math> = Goal specific regulation.</p>	-	-	A measure of species abundance.	$Y_{S,x} = \frac{\sum_i^N Y_{S,i}}{N}$ <p>Where:  <math>Y_{S,i}</math> = social resilience.  N = number of social resilience's.</p>	Value determined by 1 minus the score (1-3) multiplied by the weighting (s). For this analysis weighting set at 1.
Value range	0 – 1	0 – 1	0 – 1	0 – 1	0 – 1	0 – 1	0 – 1
Exceptions	If no G = $Y_S$	-	-	-	-	-	-

## **Institutions and network analysis**

The methods and approaches adopted in this stream are based on systemic policy research. Key underpinning papers include 'The Adaptation Coalition Toolkit' (World-Bank, 2011) which explains the importance of shared agency and community agendas to support the development of resilience strategies and Wieczorek, et al. (2012) provide a range of tools to assess the ability of systems to stimulate innovation in response to economic and environmental challenges. A semi-structured questionnaire and coding framework was been developed and used to guide the interviews. Nine interviews were completed and analysed using NVivo.

The descriptions of systemic challenges facing the building of resilience within the catchment have been developed through a co-analysis of function and structure. This analysis has taken place against the backdrop of a rapidly evolving political and policy environment within the catchment.

## **Community dialogue and participation in community generated livelihood strategies**

A hui was held between officers of MPI, GDC and the members of the research team to align this stream of the research programme with the establishment of the Waiapu Restoration Partnership and launch of the Accord between Ngāti Porou and the Crown. The outcomes of this stream were derived from meetings held across all of the streams including a specifically targeted hui that took place on 5<sup>th</sup> May in Ruatoria. Programme participants were encouraged to share their thoughts on future land use, likely barriers and obstacles to uptake. They were also given data relating to climate change impacts and engaged in a discussion on the vulnerabilities the community faces (World Bank, 2011). Part of this process included a science presentation on developments elsewhere in New Zealand, particularly in Northland, and on the viability of alternative forestry options.

WAIAPU CATCHMENT PLANTED FORESTS CARBON VALUE

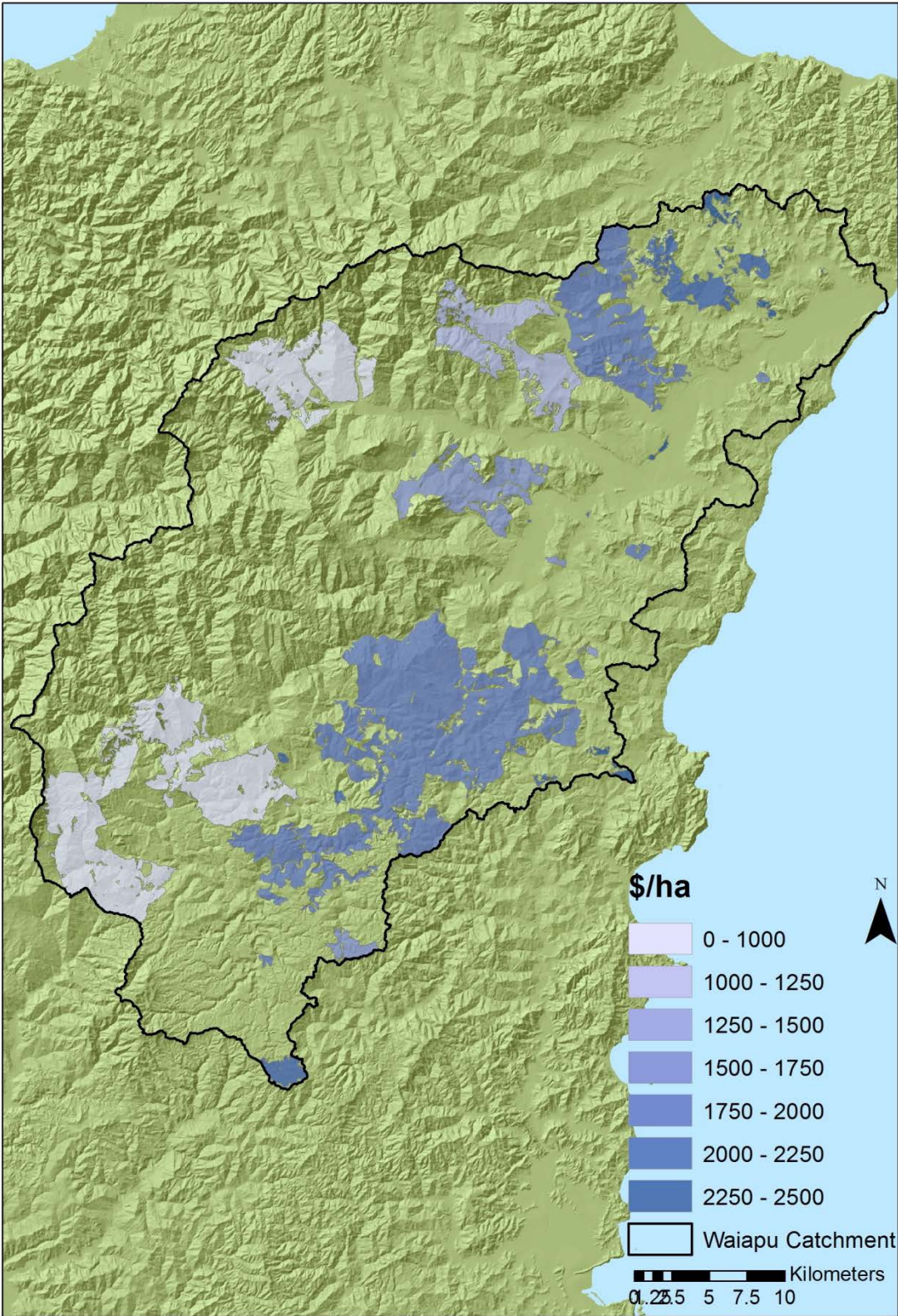


Figure A4: The Waiapu Catchment planted forests valued at a \$15 carbon price.

## GLOSSARY OF TERMS

Glossary of Māori and Ngāti Porou terms and explanations (He Kupu Māori) used in this report, adapted from Harmsworth and Warmenhoven (2002).

Apirana Ngata - esteemed politician and tribal leader of the East Coast tribes  
Awa - River or stream  
Hapu - Sub-tribe, organised kin group, extended families, pregnant, impregnated  
Hui – To gather, congregate, assemble, meet  
Iwi - Tribe, people, large socio-political grouping, bone  
Kaitiaki, Kaitieki - Agents to provide guardianship of the environment  
Kaitiakitanga - Concept of guardianship or stewardship of the environment  
Kai moana – food from the coast and ocean  
Kaumatua - Elder, respected elder  
Kawa – ceremony, open a new house, a ceremony to remove tapu from a new house or canoe  
Korowai – cloak ornamented with black twisted tags or thrums  
Mahinga kai - Areas for food cultivation or resource collection  
Mana - Prestige, authority, status  
Manaaki - Care for, host, hospitality, look after  
Mana Motuhake - Sovereignty, authority, autonomy  
Marae - Area at front of meeting house, social gathering place, social centre  
Matauranga - Traditional knowledge  
Mauri - A life force, permeates in all living things, sustains life  
Ngāti Poroutanga - Uniquely Ngāti Porou tikanga, institutions, processes and culture  
Oranga - Wellbeing, Health  
Pakeke – Learned elders  
Papakainga – Ngāti Porou community housing  
Papatuanuku - The earth mother  
Raranga - Traditional weaving  
Reo - Voice, language  
Rohe – boundary, district, region, territory, area, border (of land)  
Rongoa - Traditional medicinal practice, medicines from plants  
Runanga - Assembly/assembled  
Runanganui - Great Assembly  
Tairāwhiti – The East Coast region of New Zealand  
Tangata - Man, person; plural tangata: people  
Tangata whenua - People of the land, or people from the land  
Taniko – border for cloaks, etc. made by finger weaving  
Tapu - Sacred, under divine protection  
Te Puni Kokiri – Ministry of Māori Development  
Tiaki - Guard, protect  
Tipuna - Ancestor  
Tikanga - Protocol, values, etiquette, custom, unspoken rules, truth, plan, correct way  
Tukutuku – to decorate with lattice-work, make tukutuku panels  
Tūrāngawaewae – a place one has a right to stand through their whakapapa, Ngāti Porou homeland  
Wāhi tapu - Sacred place  
Wai - Water  
Waiata - Song  
Whanau - Family, birth, extended family  
Whanaungatanga - Family, collectively, kinship  
Whakapapa - Genealogy, decendency, links to all living things  
Whakairo – carved, carving, to carve, ornament with a pattern, sculpt  
Whaikorero – oratory, oration, formal speech-making  
Whenua - Land, placenta, afterbirth