THE RELEVANCE AND APPLICABILITY OF PARTICIPATORY GEOGRAPHIC INFORMATION FOR MĀORI DEVELOPMENT

A CASE STUDY OF TE ROOPU TAIAO O UTAKURA.

ABDUL NISHAR
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by

Abdul Nishar

A thesis submitted in fulfilment of the requirements for the degree of Masters of Arts

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DECLARATION

Statement by Author

I, Abdul Nishar, declare that this thesis is my own work and that, to the best of my knowledge, it contains no material previously published, or substantially overlapping with material submitted for the award of any other degree at any institution, except where due acknowledgment is made in the text.

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Statement by Supervisor

The research in this thesis was performed under my supervision and to my knowledge is the sole work of Mr. Abdul Nishar.

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Dedication

To my Amma and Abba.

Who always gave me hope, strength and support:

Who taught me to aim for the highest.

Who were there for me all the way.
Acknowledgement

This thesis was accomplished with the support and inspiration of many people. Firstly I would like to thanks the almighty Allah for making this dream come true and giving me the confidence and strength to start and complete this journey with ease.

A big thanks to my Wife – Zaira for making me endless cups of coffee, unflagging love and support. This journey would have been very hard without you. Thanks to my mum for her words of encouragement and comfort conversations. Amma, thanks for listening patiently.

Thanks to my supervisor, John Lowry and my mentor Tim McCreanor. I thank you both for the time and support you have given to me in achieving this goal. Tim, I owe you for taking time out of your very busy schedules for reading my work and it is fully appreciated.

This thesis was only made possible with the assistance of Te Roopu Taiao o Utakura, my extended family. Thanks heaps for giving me this opportunity to work with the Roopu and contribute my bit to Utakura Valley. Thanks for the continuous guidance, support, love and care. Thanks for being in this journey together.
Abstract

With the deadline for the submission of Waitangi claims coming closer, GIS has become popular amongst Māori. Through a better understanding of the technology, Māori have started to implement GIS, and Participatory GIS in particular.

Participatory GIS has been used by other indigenous communities. A lot of debate has been held about whether Participatory GIS is as user-oriented as it should be. Another dilemma has been how Participatory GIS a tool used by the modern societies can be implemented in Māori communities by Māori’s. Much of the debate has been about the relevance and applicability of Participatory GIS in the Māori context more than anything else. Taking this into account, there is a serious need to comprehend the methodology of Participatory GIS and investigate if it has any relevance and applicability to Māori development.

The overall objective of the study is to assess the relevance and applicability of Participatory GIS using the good governance dimensions and assess its relevance and applicability in a Māori context. Additionally, the study also looked at the Participatory GIS process, the level of Māori participation and the similarities of Participatory GIS to Kaupapa Māori Research. Te Roopu Taiao o Utakura was used as case study.

The research followed the guidelines of the Participation Action Research (PAR) with a major emphasis on community participation. Using the good governance dimensions, and specially developed indicators for each dimension, Participatory GIS process was assessed. The Participatory GIS process adopted the Participatory Rural Appraisal (PRA) tool in combination with GIS tools.

The study found that the Participatory GIS Process consisted of Preparatory phase, Assessment phase and Action phase and the reaction of the Utakura community to Participatory GIS was rather good. Participatory GIS Process fulfilled the criteria’s of the Good Governance Dimensions and proved to be relevant and applicable for Māori. Participatory GIS works in an equivalent way as Kaupapa Māori theory for Māori.

The conclusion of this study highlighted on how well the members of Te Roopu Taiao o Utakura responded to GIS. In addition, it illustrated that Participatory GIS was relevant for
Māori development which was assessed based on Good Governance Dimensions and that the participatory process assisted in providing data for the coming generation. It also demonstrated the applicability of Participatory GIS in Māori development context defined by Economic, Political, Institutional, Social factors. Furthermore, it stated that besides being developed to cater for different conditions, Kaupapa Māori Research principles and Participatory GIS principles are very similar.
List of Abbreviations and Acronyms

ESCMAP                    Exploratory Strategy for Collaboration, Management, Allocation, and Planning
GIS            Geographic Information System
GPS Global Positioning System
NGO non-governmental organization
PGIS Participatory Geographic Information System
PPGIS Public participation geographic information systems
PRA Participatory Rural Appraisal

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1.0 Participatory GIS in Māori Context

The reaction of an elderly woman to a GIS map at a community gathering motivated this research. As the map was projected on the screen, she recognised the area and started to describe how she remembered the local environment to be, who used to live where and own what. The map awakened her memories bringing forward information that could have been lost. The stories she told enlighten everyone in the meeting house. The effects of involving the community in setting up a geographic information system (GIS) were very fascinating and encouraged this research.

1.1 Background: Participatory GIS Concepts and its application to Māori.

Māori, indigenous to New Zealand, have a special relationship with the land and the environment. Firth (1973) stated that the entire Māori culture has been centred around issues related to land and the environment. From their ancestral land, Māori find their place to stand.

For a Māori, a purposeful life is conceptualised around Whanau\(^1\), tikanga Māori\(^2\) and their whenua\(^3\); Participatory GIS assures to consider all of these. Whanau is one extended family but with the simple deem that all Māori are interrelated; Whanau is defined however preferred. Whanau is a Māori family unit which is a source of support, strength, security and identity. Tikanga Māori is set of guidelines and values for a Māori way of life that are practised from generation to generation. It is based on logic and common sense associated with a Māori world view (korero Māori, 2011).Whenua refers to land, land that has been inherited. To Māori, whenua is not only important due its social values but also because of the connection it symbolises to their genealogy.

Similar to indigenous people of any country, Māori have always been concerned with their environment and natural resources. This concern increased with colonisation as the Māori felt the threat of losing their customary rights to what is theirs, GIS has widely been recognised as a development and a planning tool. Pacey (2005) states that “GIS has been recommended as a cost effective technique for spatial research for Waitangi Tribunal claims”. GIS has

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1 Extended family  
2 Māori values  
3 Land
supported complex textual and oral evidence and has also been used to aid arbitration and empowerment at both central and local government level.

The Treaty of Waitangi was signed in 1840 to bind Māori and European settlers but to the contrary, the new colony’s charter created an entirely European governing body that surveyed the land, divided it up into districts and towns, and gave uncultivated Māori land to settlers (Sherman, 2006). Like other indigenous populations colonised by Europeans in the nineteenth century, Māori in New Zealand have been subject to research and research-based policies with long-lasting negative consequences (Smith, 1999).

Due to the failure on the part of the Crown to honour the treaty of Waitangi, Māori were given the opportunity to claim historical injustice, known as “Treaty settlement process”. Many things happened to the Māori that should not have happened. There were injustices, and the treaty process is an attempt to acknowledge that, and to make a gesture at recompense (Brash, 2004).

Spatial information has been vital during settlement negotiations hence brought GIS into action. Using inherent functionality of GIS, claimants have been able to challenge the Crown’s assumptions about land loss in their region by showing that a proportionately larger amount of land was confiscated (McDowall, 1999). To better understand what is theirs and how to claim its existence, Māori have applied GIS.

Geographic Information System is a useful technology but like any other tool applied to an indigenous society, the tool is best applied using indigenous methodologies, hence the adoption of Participatory Geographic Information System (PGIS). “Participatory GIS is a generic designation for the use of geo-spatial tools and methods oriented to represent people’s spatial knowledge, using physical or virtual media, to help in the learning, discussion and exchange of information, in the analysis and decision-making process or in the promotion of human rights” (Rambaldi, Kwaku Kyem, Mbile, & et al, 2005).

PGIS combines a range of methods such as sketch maps, problem trees and transect walk with GIS to represent the spatial knowledge of the local people in visual forms such as maps which is used by the people for discussion and decision making. Participatory GIS implies
making GIS available to disadvantaged groups in society in order to enhance their capacity in
generating, managing, analysing and communicating spatial information (CTA, 2011).

Māori development is about acknowledging, recognising and protecting cultural values that
confirm and enhance an intergenerational obligation to the ancestors and the generations to
come, both biophysical and metaphysical resources (Pacey, 2005). Participatory GIS
methodologies do not regard the values and beliefs, practices and customs of communities as
barriers. Rather PGIS encourages the involvement of cultural protocols and values as a
significant part of the methodology.

Kaupapa Māori Research methodology which has been developed within a Māori paradigm,
gives full recognition of Māori culture and values system (Smith & Reid, 2000) is based on a
growing consensus that research involving Māori knowledge and people needs to be
conducted in a culturally validating ways (Bishop, 1996). These Māori obliging principles are
also accommodated by Participatory GIS. Kaupapa Māori Research objectives are similar to
Participatory Action Research (Pacey, 2005), which is a limb of Participatory GIS.

Participatory GIS has the potential to empower Māori communities by representing
community knowledge held by the community members and elders about natural resources
and traditional values in forms that can be digitally stored, visualized, and distributed. PGIS
are well suited to extracting people’s ‘lay’ local indigenous knowledge (McCall, 2004).
Participatory GIS also allows Māori when participating to gain access to data which they can
use to manage their own resources and contribute to development more independently.
1.2 The Study Area with Te Roopu Taiaro o Utakura.

Te Roopu Taiaro o Utakura is a Māori community environmental group that has focused on the condition of the local lake (Lake Omapere) and the local river (Utakura River). Te Roopu Taiaro o Utakura was organised to address the declining health of these aquatic environments. The broad mission of the group is to restore, protect and sustain the freshwater environment, for the whole catchment, lake, river, tributaries and wetlands.

The Utakura Valley is a 30 km x 5km catchment situated to the west of Okaihau and north east of Hokianga harbour, encompassing a number of small rural Māori communities (Figure 3). The waterways of the valley including the lake, the river and its tributaries which have suffered major degradation of water quality over a number of decades and especially in recent years. The health of the people is also a cause for concern.

The Utakura River is a treasure in every sense to the families that live along its course. “It is their pride and joy; it provides their food and drink, water for stock and gardens, a playground and a classroom for the children and a place for contemplation and relaxation. It has nurtured the locals for many generations and has been the constant site and backdrop to their lives, the dramas, the victories and tragedies. Its life force is crucial to the health and the wellbeing of the people. Now as it suffers, the people suffer, and it is their plain duty, to battle to make it well again” (Henwood & Henwood, 2010).

Utakura Valley is home to not only Māori. According to the 2006 census, European is the largest ethnic group residing in the catchment. Although, the Te Roopu Taiaro o Utakura group’s mission is centred on Māori; their actions and efforts will benefit the whole area at large. Due to the potential benefit to the whole community by means of the initiative of Te Roopu Taiaro o Utakura, most local European farmers have given their support to the environmental group and assisted however they could. The pie chart (Figure 1) below shows the percentage of different ethnic groups living in the valley.
Figure 1: Ethnic groups residing in Utakura Valley

(Source: New Zealand 2006 Census)

Figure 2: Population increase from 1996 to 2006 in the Utakura Valley

(Source: New Zealand 2006 Census)
The valley has seen a gradual increase in population over the last few centuries. Figure 2 above shows the increase in Population from 1996 to 2006. As widely understood, an increase in population increases the pressure on natural resources. Because all things in this valley are interconnected, pressure on one natural element starts a chain effect on all resources, with the waterways being the component affected the most.

Wells & Champion (2008) reported on 80 Northland lakes and ranked the status of Lake Omapere as “low”, a ranking attributed to lakes that were either de-vegetated with poor water quality, or severely impacted by exotic pest species. The waterways of Utakura, the lake, river and the tributaries have suffered for a long time and now it has started to show its impact on the health of local residence.

Te Roopu Taiao o Utakura is trying to preserve the environment for the coming generation. If the role of a river were not respected, or if people assumed to assert some dominance over it, it would lose its vitality and force, and its kindred people, and those who depend on it, would ultimately suffer (Waitangi Tribunal, 1998). Members of Te Roopu Taiao o Utakura have always engaged in activities that assist the recovery of Lake Omapere and subsequently Utakura River. Ministry of Environment (2010) reported that since 2000 Lake Omapere had improved significantly.

A primary goal of Te Roopu Taiao o Utakura is to determine the impacts of water quality in the Utakura River on the health and wellbeing of local people. This study use PGIS to help Te Roopu Taiao o Utakura in this goal. With the use of GIS and PGIS in particular this project will provide an opportunity for the group to create comprehensive local knowledge, build skills and expertise, involve other groups and individuals that support the project, and strengthen knowledge, capacity and capability.
Figure 3: Site Map of Utakura Valley.
1.3 Overview of This Study

1.3.1 Concepts and Terms

Because some of the terms used in this study have different meaning in different contexts, below is a description of the key terms used in this study providing a clear understanding of what is meant by these concepts and terms.

PGIS

PGIS refers to Participatory Geographical Information Systems (also known as Public Participation GIS, Community integrated GIS or Community based GIS). PGIS requires and facilitates the involvement of identified public members or local community in the design, development, and implementation of GIS projects in community settings.

Relevance

In this study relevance or appropriateness of PGIS for Māori development will be assessed based on a criteria identified subsequently.

Applicability

Applicability in this study will look at the opportunities to apply PGIS in a Māori context.

Participatory rural appraisal tool

A methodology applied at the rural level to interact and understand the needs of local communities by involving them in the problem-solving process.

Good Governance Dimensions

In the context of PGIS, Good Governance with a set of definition looks is the process of decision making and implementation.

Kaupapa Māori research

Kaupapa Māori is a methodological framework that incorporates cultural understanding as a way of conduct research; it fully accommodates Māori cultural norms, protocols, customs, values, and knowledge.
1.4 Conceptual Framework

Figure 4: Conceptual framework for the PGIS Process
The Conceptual framework shown in figure 4 gives an idea of how the PGIS process flows and the areas of the major emphasis in this study. It starts from the point of understanding the needs for Te Roopu Taiao o Utakura; recognising problems and the application of PGIS tools which leads to the outcomes addressing the needs identified. The experience and lesson gained during the PGIS process with the assistance of good governance dimensions will give insights about PGIS’s relevance, applicability and contribution to Māori development.

1.5 The Structure of this Thesis

Chapter 2 presents the research conceptual problems upon which an overall objectives are formed and justified.

Chapter 3 provides a literature review that relates to and supports the analysis and the argument in the research.

Chapter 4 describes the methods of the study, including the research strategy, the particular tools applied and the entire research process.

In Chapter 5, the results are brought forward, explained and analysed. This chapter includes in-depth and detailed explanations and solid discussions on the finding.

In Chapter 6, principles of PGIS are compared to the Kaupapa Māori research framework and the similarities between them are identified.

Finally in Chapter 7, conclusions and recommendation from the study are stated
2.0 Research Problem and Objectives

2.1 Research Conceptual Problems

Many methodological approaches used in setting up and implementing GIS, particularly among indigenous peoples, do not take the role of indigenous people into consideration. This leads to poorly planned implementation and discourages the involvement of the very people GIS is supposed to help.

Because the PGIS approach is focused on community empowerment through measured, demand-driven, user-friendly and integrated applications of geo-spatial technologies (Rambaldi et al., 2006), the use of PGIS is presumed to be applicable and relevant to Maori community development.

The Kaupapa research framework has been specifically developed by Māori to meet the needs of the Māori, and emphasises (amongst other things) the use of appropriate research methods (Cram, 2001, Smith, 1999). It would therefore be an advantage to explore the similarities and synergies between Kaupapa research framework and PGIS.

2.2 Research Objectives and Questions

This section describes the overall objectives. In order to achieve this overall objective, several specific and sub-objectives are identified.

2.2.1 Overall Goal

The overall aim of this research is to assess the relevance and applicability of PGIS to Māori Development through a case study on Te Taiaro o Utakura and to examine the similarities between PGIS and Kaupapa Māori Research.

2.2.2 Justification

First, Tripathi & Bhattarya (2004) have briefly mentioned the application of PGIS in developmental studies of the Māori but have not investigated the suitability of PGIS to Māori and Māori development in general. This research seeks to answer questions about the suitability of PGIS in Māori developmental studies.
Second, the Kaupapa Māori research framework is an accepted and effective approach for Māori development studies (Cram, Smith & Johnstone, 2003). It is useful to investigate the similarities between PGIS and Kaupapa Māori Research Framework and to ascertain whether PGIS contradicts the principles of Kaupapa Māori Research Framework.

2.2.3 Specific objectives and research questions

1. To carry out a PGIS project as a case study in the field of Māori development, and to document how the Māori progressed in the development of the PGIS project.
   - What were the steps in the PGIS project?
   - How well did Māori People interact with GIS?

2. Assessment of Participatory GIS process using good governance dimensions.
   - Based on good governance dimensions such as participation and legitimacy, ownership, empowerment, equity, responsiveness, effectiveness and efficiency, how was the PGIS project carried out?

3. To assess the relevance and applicability of PGIS in Māori development and understand the concept of PGIS in relation to Māori development.
   - What are the factors/components of the development context that define PGIS applicability and relevance?

4. To compare the principles of PGIS to the characteristics of Kaupapa Māori Research
   - What are similarities between the principles of PGIS and Kaupapa Māori Research?
   - Is PGIS as Māori ‘friendly’ as Kaupapa Māori Research?
3.0 PGIS for Māori – a Literature Review

This chapter provides a review of literature available on PGIS concepts and principles focusing on Māori and indigenous communities at large. Due to a lack of relevant material on PGIS for Māori, material based on other indigenous communities were also referred to. It was very easy to match Māori issues to that of other indigenous communities, and examining PGIS application in other Indigenous communities is enlightening to the Māori context.

3.1 The Emergence of Participatory GIS

Beginning in the early 1990s, critics from both inside and outside the discipline of geography began identifying what they saw as serious shortcomings in GIS technology and its distribution among users (Schuurman, 2000). Part of the criticism focused on how GIS was not as beneficial to those without financial or technical skills, as compared to those already empowered with the means and skills to use the technology. The debate was at times contentious and there was fear that such strong criticism could frustrate the ongoing evolution of GIS technologies (Elwood, 2006).

One of the most useful outcomes of the debate was the promotion of Participatory Geographic Information System (PGIS), and the closely related Public Participation GIS (PPGIS) (Frenierre, 2007). Participatory GIS is now common in community development, local land-use management, and cultural heritage preservation. In 1991 there was so much enthusiasm for PGIS that Heit and Shortried (1991) considered it the “magic tool” natural resource management was looking for.

The origins of PGIS/PPGIS are found in the Participatory Rural Appraisal (PRA) methods that development practitioners began employing in the 1970s and 1980s (Rambaldi et al., 2006a). Similar to Participatory Rural Appraisal, sketch mapping, mental mapping etc are used as part PGIS to obtain important spatial information from community members.

Participatory GIS (PGIS) and Public Participation GIS (PPGIS) are closely related practices that seek the democratization of information and mapping long promised by proponents of GIS. Public Participation GIS is generally considered to be a formal, institutionalized process that is most common in the developed world, while Participatory GIS is typically a much less
formal, bottom-up exercise usually undertaken in the rural developing world (Smith and Kingston, 2007).

PGIS has been able to address the weaknesses identified in traditional GIS by making GIS an impartial and empowering technology. In particular, PGIS’s consideration of the potential of the project and attempting to understand, and involve multiple actors of the organisation differentiates it from the traditional GIS (Weiner, et al., 2001).

Although PGIS was launched as specific discipline not long ago, the essence of PGIS has always been around. Participatory mapping in communities existed way before the social criticism of GIS, this was due to advancement in technology and market trends that occurred without being influenced from those criticism (Elwood, 2007).

PGIS gives clear direction to consider areas of research that have not been previously considered. A list of guiding principles for PGIS/PPGIS activities developed in 2002 explicitly addresses many of the issues raised during the critical GIS debate (Aberley and Seiber, 2002). PGIS integrates several tools and methods whilst often relying on the combination of ‘expert’ skills with socially differentiated local knowledge. It promotes interactive participation of stakeholders in generating and managing spatial information and it uses information about specific landscapes to facilitate broadly-based decision making processes that support effective communication and community advocacy (Rambaldi et al., 2005).

3.2 Participatory GIS Concept and Application

As GIS becomes widely used in spatial decision-making, there is concern that top-down development planning will be reinforced (Abbot et al, 1998). Consequently, Participatory GIS is an attempt to make use of GIS technology to address the needs of the communities that will be involved and affected by the development projects and programmes.

Participatory GIS can be defined as the merging of community development with geospatial technologies for the empowerment of less privileged communities and is an emergent practice developed out of participatory approaches in planning and spatial information and communication management (Rambaldi and Weiner 2004). Participatory GIS draws on the
diversity of experiences associated with ‘participatory development’ and involves communities in the production of GIS data and spatial decision making (Abbot et al., 1999).

A careful consideration of the ethical consequences of participatory mapping has been a central component of PGIS/PPGIS practice since at least the late 1990s (Abbott et al., 1999). The concept of community-integrated GIS or neighbourhood GIS is part of a wider discussion on the development of Participatory GIS (Schroder, 1997; Talen, 1999; Harris & Weiner, 1998; Pickles, 1995; Craig et al., 2002).

In recent years GIS technology has become much easier to use, so the challenges today are not so much with the getting the technology to work, but to get the community to work with the technology and/or use of geographic information (Dunn, 2007). Participatory techniques have been the primary tool for obtaining community and resource information, and participation, empowerment and facilitation (Jordan, 2002).

One of the main motivations for PGIS projects is the empowerment of community through access to information (Ghose, 2001). Such empowerment is based on effective use of the information in the ways that help the local community achieve their goals (Haklay & Harrison, 2011). For example PGIS can be useful for negotiation situations in which spatial conflicts are involved (Rambaldi, Bugna et al. 2002) such as with the treaty of Waitangi wherein Māori used GIS to prove their cultural ownership of land.

A key motivation for PGIS is to provide a voice to under-represented communities by allowing them to communicate their spatial knowledge in the same technical language being spoken by government and business (Frenierre, 2007). By involving community participation in natural resources planning activities such as water catchment management, cultural heritage administration, and conflict resolution, using PGIS/PPGIS empowers people to govern resources crucial to their economic well-being.

3.2.1 Brief summary of PGIS and its application for indigenous community development: Experience and lessons learned

There are now hundreds of PGIS case studies which demonstrate the success with which the power of maps has been directed to benefit people traditionally lacking a strong political voice (Frenierre, 2007). This section reviews studies and research where PGIS has been used.
in an indigenous context. In each of these cases, PGIS has been used for the explicit benefit of Indigenous communities that would not otherwise have had any involvement or influence in the decision-making that would affect them.

**Community-Integrated GIS for Land Reform in South Africa** (Weiner and Harris, 1999)

In this study, Weiner and Harris highlight the on-going land struggles in South Africa. With people’s expectations of greater access to land and other economic and environmental resources high, the GIS industry stood out during the transition from apartheid, as a variety of GIS applications surfaced during this period. President Mbeki acceded to a land reform program, obligating community participation, engagement and empowerment. The intention of Weiner and Harris was to investigate how the implementations of PGIS come about with the application of Community integrated GIS. Via a case study on the Mpumalanga Province, several community workshops were organised and locals were interviewed. The knowledge gained from this was integrated into a GIS database. The participatory aspect brought forward the knowledge reserved with the elders.

Weiner and Harris, in their study demonstrated how the use of PGIS publicised the views of local people in relation of their environment. The importance and the role of participation of the local community is also highlighted together with the emphasis on the continuous community involvement in the future.

**Participatory GIS in a sustainable use reserve in Brazilian Amazonia: Implications for management and conservation** (Bernard, Barbosa, and Carvalho, 2011)

Brazil has 51 million hectares of strictly protected areas and 109 million hectares of land allocated to sustainable use, most of which located in Amazonia. Amazonia is an area with traditional communities that are highly dependent on the natural resources. A lot of components of the traditional communities should be considered, such as how the human population use the natural resources; their demographic densities, spatial distributions, migratory paths and areas already impacted and the area necessary to maintain these traditional ways of life.

However, due to the lack of a properly established technical guidelines or protocols on how to create these protected areas the Brazilian branch of the NGO Conservation International
applied PGIS protocols in three reserves. Community member were invited to get involved in performing participatory mapping of the areas they used. Community meetings were also organised to discuss the purpose and the goal of the research together with a question and answer session.

Semi-structured interviews conducted with the people providing specific data, requesting them to define the diversity of plant species, the animals raised, the diversity and range of species hunted, and fished and their extractive practices. During the interviews, residents also had the opportunity to point to other important data not covered earlier in the survey. Information such as trails frequently used, sites of specific interest or points of conflict with commercial fishermen or loggers were put forward.

Once the information-gathering phase was completed, the collected data were used to develop a GIS. PGIS allowed the visualization of hotspots, areas and resources under stronger pressures, and confirmed the dependence of the Amazonian people on natural resources. With the help of PGIS, it was estimated that nearly 30% of the reserve was under direct use by its residents hence disputed with their way of life. This study strongly recommends that the local and the indigenous people in Amazonia should be consulted and their socio-economic demands should be considered before the establishment of any sustainable use reserves.

Promoting Local Community Participation in Forest Management through the Application of a Geographic Information System: a PPGIS experience from Southern Ghana (Kyem, 2002)

Anti-conservation activities have taken a huge toll on the forests in parts of Sub-Saharan Africa. Local collaborative forest management organizations have been formed to help forestry official’s work with local community groups. The intention in many of such participatory programs has been to integrate traditional resource management practice into modern planning methods. Knowing its potential, Forest Department officials introduced GIS into the collaborative forest management process.

Motivated by the need, a Public Participatory GIS (PPGIS) method termed ESCMAP (Exploratory Strategy for Collaboration, Management, Allocation, and Planning) was
developed. ESCMAP was developed around decision support procedures and integrated the concerns, experiences, and customs of local groups into official forest management practice. By means of the PPGIS methodology foresters and representatives of local communities met in workshop to get a common understanding.

A database was created holding information on selected Forest Reserves upon which a discussion of their uses, protection, and rehabilitation were made and assessed. The project was implemented in three rural communities in the Ashanti Region of Ghana. PPGIS helped ensure that power was shared among all parties. Due to customary practices and religious beliefs women are usually not included in any decision making, because of their reluctance PPGIS attentive efforts had to be made to attract them to participate.

One of the major reason for the implementation of the PPGIS project in rural Ghana was to get the local community involved in forest management, as they were dependent on the forests and new policies would affect them the most. In rural Ghana tradition and custom still influence people’s lives and the PPGIS project incorporated customary interpretations and rituals together with facts. The adoption of PPGIS assisted enormously by bring together both the forestry departments and local communities and endorsing a combined effort towards forest management which would be respected and followed as it had incorporated and address the customary believes to keep the locals happy and rational needs to keep forest department happy.

**Monitoring and Evaluating Land use/Land Cover change Using Participatory Geographic Information System tools: A Case study of Begasheka Watershed, Tigray, Ethiopia.** (Aynekulu, et al. 2006)

In Ethiopia, farmers use agricultural lands in a traditional way without any logical organisation of the land leading to soil degradation. It would be more productive to use land according to their agricultural potentials.

Centralised knowledge has failed to recognise the traditional knowledge that the rural people possess about the natural resources. Participatory Rural Appraisal (PRA) was used to better understand social-economic status of the affected sites. PRA included not only local and centralised knowledge but also historical situations into the management process. Looking at
the environmental and the participatory aspect of the project, PGIS application was considered as a tool for assisting with the land degradation problem.

The use of PGIS was aimed at avoiding the drawbacks due to the obvious preconception obligations to the key stakeholders of the community. PGIS would also strengthen the prospective of local knowledge with in the participatory environment where more than one stakeholder is involved. The visual emphasis of PGIS had gained the farmer support as they also believed that maps and flow charts were easy to remember and show change.

PGIS provided a good opportunity for land problem analysis and decision making. PGIS was found very useful as it was simple to apply and involved everyone, making everyone feel better and promoting balanced representation. Good representation and intra community interaction convinced the land management board that the land experience mentioned in the participatory planning process were true in the locality.

**Conflict Resolution by Participatory Management: Remote Sensing and GIS as Tools for Communicating Land-use Needs for Reindeer Herding in Northern Sweden**
(Sandstrom, et al. 2003)

This paper illustrated how GIS was used via a participatory approach to collect and compile information regarding the land use among reindeer herders and other land users in Northern Sweden. To resolve natural resource conflicts, the projects aimed to close the gap in knowledge and understanding between reindeer husbandry and other land users.

Forestry activities such as harvesting trees and ground treatment methods influence the amount of lichen available as food for reindeers which is also vital for reindeer habitat. The villages were concerned about the food shortage for reindeer and the land owners were apprehensive for their forest activities. There was a need for a plan that would improve conditions for the reindeer herders without affecting the timber industry.

The participatory planning and mapping process highlighted huge areas of overlaps between the grazing land and areas of interest to forestry and tourism authorities. Delineation of important grazing lands was a vital part of the project and included maps of existing grazing areas and potential grazing areas. Most importantly, during this process the reindeer herders
and landowners got to know about each other’s reliance on the forest and got a better understanding of each other’s needs.

The resulting land-use plans provide information that could be used to facilitate future land use consultation between the reindeer herders and other stakeholders, maintaining communication and building a partnership between them. This project could not have been completed without the contribution of the villages that possess the traditional knowledge of the reindeer habitat and grazing areas and the support of the land owners. The involvement of the two parties via PGIS defined land use plan that suited both.

**Spatial Information Tools for Land Use Management Networks in Montane Mainland Southeast Asia** (Saipothong and Thomas, 2007)

In the past most of the natives in Montane Mainland Southeast Asia used their natural resources only for subsistence. However, as populations grew and lifestyles changed there has been a shift from subsistence-oriented to market-oriented agriculture. Due to the increasing need for land there are conflicts among communities regarding the use of natural resources and land.

The exploitation of land has alarmed the downstream populations who have major environmental concerns. To address their concern there needed to be a good communication and transparent procedures on how to use land. To make sure that the limited resources were shared equally with environmental issues, both traditional land use practices and market-oriented agriculture need to be modified to address the situation. To facilitate discussion and analyse the issue at hand, a GIS based participatory mapping processes was used to obtain detailed spatial information from communities and other stakeholders to produce a standard map recognized both by the communities and by other stakeholders.

### 3.3 PGIS for Māori

The Māori, the indigenous people of New Zealand, have a very strong connection and a sense of belonging to their land and natural resources and regard these as gifts. Land, water, and air are central to Māori life and values, and they regard themselves as kaitiaki, or guardians of all natural resources (Harmsworth, 1998).
With the signing of the Treaty of Waitangi in 1840, land confiscation and resettlements through the Native Land Court removed land and places for gathering food out of tribal control. Furthermore, government regulations intruded into all aspects of tribal life. Similarly Māori tribes were excluded from participating in the management of environmental resources (Waddel, 1998). However, Māori never abrogated their fundamental guardian responsibility. Even with little or no control over the maintenance of their cultural heritage and ‘ownership’ of the land, the guardian responsibilities and duties to the people, environment and each resource within it remained (Pacey, 2005).

Māori have a wealth of knowledge regarding their natural resources which is safeguarded by the elders. As most of the traditional knowledge is still in oral form, it is very important to record these as a voice for the future generations. Harmsworth, (1998) comments that GIS complement the indigenous knowledge systems traditionally used to store and transfer knowledge and information. Use of GIS as a tool to collect Māori knowledge, preserving and protecting it (Hakopa, 1998), would suit Māori.

According to Hakopa (1998), Māori can benefit immensely from the integration of GIS technology and the like as demonstrated by other indigenous peoples without compromising their values that make them unique. The primary reasons are the preservation of their traditional knowledge, the continuity and link to the generations that follow, that is, the reacquisition, retention and management of their land, their resources, and their customs and traditions.

The challenge is in combining indigenous knowledge with western technology to devise alternative strategies that may be more efficient as well as being culturally sensitive (Laituri, 1999). This gap is filled by the introduction of Participatory GIS. It is absolutely essential, that GIS is created by Māori for Māori needs (Hakopa, 1998).

If appropriately utilized, the PGIS practice could exert a profound impact on community empowerment, innovation and social change. More importantly, by placing control of access and use of culturally sensitive spatial information in the hands of those who generated them, PGIS practice could protect traditional knowledge and wisdom from external exploitation (Rambaldi, 2005).
Jackson (1997) found that GIS facilitated understanding and enhanced presentation of complex textual and oral evidence. This proved another reason for Māori to use and implement as most of their history is oral, passed on through songs and stories. With Treaty of Waitangi on the verge of settlement, local knowledge has a very important part to play in the negotiation. Payne’s (1991) identified decision making issues and spatial information problems affecting the parties’ efficiency and ability to conduct rigorous claims hearings and negotiations during Waitangi Tribunal claims.

3.4 Kaupapa Māori Research and PGIS

Research of Māori has been carried out with “traditional” methods in the production of western knowledge. According to Smith (1999) such practices have continued to privilege western ways of knowing, while denying the validity for Māori of Māori knowledge, language and culture. Most western research methods do not regard Māori philosophy, creating a need for a more Māori friendly research approach, which is now known as Kaupapa Māori research.

Methodologies that have been developed from within the Māori inquiry paradigm and are therefore distinctly Māori are commonly referred to as Kaupapa Māori research (Powick, 2002).

Kaupapa Māori theory is based on Kaupapa Māori including Māori customs and procedures. According to Jefferies and Kennedy (2009) a critical element of Kaupapa Māori theory is the positioning of a Māori view as normal, rather than it being taken for granted that a white world view is normal and any other perspective is different or unusual. An important part of Kaupapa Māori research is that it should be organised, developed, and carried out by Māori, benefitting Māori.

Kaupapa Māori research aims to make sure that Māori are not only consulted but also heard knowing that Māori capacity to participate in resource management processes is generally low (Tutua-Nathan, 2003) and Māori only participate in a small percentage of processes (Bachurst et al., 2002).
Kaupapa Māori research in general is an attempt to make sure that Māori are heard and their views are considered, refraining from research where communication is only for show. Indigenous people and their communities and other local communities have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognise and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development (UNEP, 1992).

The Kaupapa Māori framework is intended to assist in addressing and providing both Māori and decision-makers with a framework and methods with which they can assess strategy and their implementation. It includes measures for the extent to which Māori values are provided for in decision making. Smith (1997) described a set of principles for Kaupapa Māori research. These principles represent key elements that sum up Māori values and knowledge and act as a guideline for the research. They can be used to ensure that the ethics relevant to research in a Māori environment are being considered (Cram, 2001).

Kaupapa Māori principles defined by Smith (1997) are similar to the principles of Participatory GIS. The first Kaupapa Māori principals, Aroha ki te tangata meaning respect for people is about allowing people to define and meet their own terms. Similarly, one of the key principles of Participatory GIS is to focus on the people, the participants (Tripathi & Bhattarya 2004).

The second principle He Kanohi kita mean presenting you face to face; emphasis on the important of meeting people face to face. Wall (2001) describes face to face meeting and interacting as a vital aspect of Participatory GIS methodology. Meeting face to face is similarly putting face to the name if not anything else. Meeting in person gives the opportunity to make connection and building a relationship with participant and other researchers.

The third principle, Titiro, whakarongo...Korero –means “look, listen...then speak”, states the importance of observing and listening to the participant in order to get a good understanding of the situation before speaking. Participatory GIS also accustom researchers to listen to participant, to get a better perceptive of the circumstance. Rodgers (2004) mentions that listening is best research tactic for Public Participatory GIS.
The forth principle, *Manaaki kit e tangata* – means “share and host people, be generous”, is all about the collaborative approach to research. Participatory GIS attempts to embed GIS in a more collaborative research and decision making processes (Elwood, 2006).

The fifth principle *Kia tupato* - means “to be cautious”, or to be culturally understanding and wise with the participants. PPGIS contextualise the users’ settings, language, and culture (Kempton 1995) in the research.

The last two principles, *kaua e takahia te mana o te tangata* – do not trample over the influence of people and *kaua e mahaki* – don’t flaunt your knowledge; both involve sharing ideas and findings together with researchers, participants and the community and using the finding for their benefit. Complimenting these principles, one of the central goals of Participatory GIS research is to increase the power of grassroots groups and marginalized social groups in social and spatial decision making, and enhancing their efforts to improve their social and physical environments (Craig et al, 2002).

### 3.5 Participatory Rural Appraisal and PGIS

Rural policy is often poorly developed and fails to integrate the different development impacts of various sectors in rural areas as well as the various forms of state intervention (Hall, 2008). Typical text book methods are simply applied to rural development which often fail to appreciate the skills, perceptions, knowledge and aspirations of those whom the programmes are designed to assist. Failure to understand and accept the input of the people being served sometimes rise through the utilization of methodologies that are not suited (Hill, 1986).

One of the key reasons for the failure of rural development schemes is simply due to the application of inappropriate methodologies which have failed to fully understand the rural setting. In Particular, such methodologies fail to understand the complexities of the social and cultural context that rule indigenous livelihood (Binn at al., 1997).

Māori communities dominating rural livelihood have become target for many research projects, but how much of their interests were included in the research is debatable. In recent
years there has seen a notable shift in rural indigenous development strategies—strategies that are more inclined toward involvement and interaction than the dictatorial approaches. One of the key reasons for this change is due to the development of new, more enlightened and sensitive rural research methodologies, particularly an array of methods known collectively as ‘Participatory Rural Appraisal’ (PRA) (Chambers, 1994).

PRA is “a growing family of approaches and methods to enable local people to share, enhance and analyse their knowledge of life and conditions, to plan and to act” (Chambers, 1994). PRA is holistic approach to analyse local problems and formulation of possible solution with the involvement of local stakeholders. It makes use of a wide range of visual and practical group based methods of research. PRA recognises and incorporates the local community into planning or project design and provides a sense of ownership towards the project.

As Participatory GIS is typically a much less formal, bottom-up exercise usually undertaken in the rural developing world (Smith and Kingston, 2007), it is comparable and parallel to the principles of PRA. The origins of PGIS actually predate the social consequences of GIS debate, and are found in the Participatory Rural Appraisal (PRA) methods that development practitioners began employing in the 1970s and 1980s (Rambaldi et al., 2006).

According to Hassan (2005) PPGIS/PGIS has recently been developed in combination with PRA and GIS methodologies to utilise GIS in the context of the needs of communities that are involved with, and affected by development programmes. Application of PGIS is very similar to PRA, the difference lies mostly in the use of technology. PGIS uses GPS handheld, laptops and projectors while PRA being a pioneer is limited to paper and blackboard

The integration of PRA and GIS is valuable in generating awareness and interest in communal issues at hand and involving both the community and the different concerned groups. GIS data used collectively with PRA techniques has proven to be very effective for project design, planning and implementation. Participatory rural appraisal techniques aim to be a voice for the poor and the disadvantaged, recognising and accepting their input at the same time legitimising the production of maps and data by the people themselves (Jain & Polman, 2003)
PRA techniques encourage people to take part and express information and their views as they see it and discuss issues amongst themselves in their language and terminology, adding to the information pool. When people have made the diagram or map it provides a useful basis for questions and discussion (Jain & Polman, 2003). Where researchers are interested in getting a general overview of a topic or a resource that is not specific to each household, ‘visual PRA tools’ can provide a sound qualitative picture relatively quickly (Conray, 2002). Other formal methods are likely to take longer and have a very rigid outline that could be obstructive for community work.

PRA methods serve multiple purposes. They provide information to outsiders who wish to understand how the community uses and manages its resources and they provide information for the collective community to evaluate its resource management practices (Asia Forest Network, 2002). Mercado (2006) suggested that there are 35 PRA techniques or methods. According to CDI (2010) there is no single way to do PRA, although there are core principles and over 30 methods available to guide teamwork, to carry out sampling, structure discussions and visualise analysis. In this study a range of Appropriate PRA techniques will be applied and have been selected based on the needs of the research.

PRA is a general approach whose effectiveness depends heavily on the attitude of its practitioners, it will only work well if they listen to and respect the views of the local people with whom they are working (Chambers, 1994). PRA will only work if the research genuinely wants to seek the views of the indigenous/rural community.

In a PRA research the practitioner is regarded as a person with specialized knowledge and is a committed participant and also a learner. As such, the researchers ‘assume a facilitating role rather than being predominantly data collectors and analyzers in charge of the research project’ (van Vlaenderen and Nkwinti, 1993). PRA being a Participatory methodology also provides researchers with a valuable opportunity of learning from the community.

3.6 Good Governance Dimensions and PGIS

Community-based resource management or community-based conservation is not just about communities. It is about governance that starts from the ground up and involves multi-level interactions (Berkes, 2004). Good governance creates a strong future for an organisation by
continuously steering towards a vision and making sure that day-to-day management is always lined up with the organisation's goals (TPK, 2011).

McCall (2002) describes governance as “a set of measures of the relationships between the public (civil society/citizens) and its government, and private sector capital. Exercising power and decision-making for a group of people is called governance (TIG, 2010). In addition, UNESACP (2011) describe governance as how public institutions conduct public affairs and manage public resources in order to guarantee the realization of human rights. The characterization of governance above has been defined by different organization with different perspectives but they all have one common element present—the people.

A review by Nzongola-Ntalaja (2002) confirms that The Human Development Report issued in 2002 contends on good governance as a democratic exigency, in order to “[rid] societies of corruption, [give] people the rights, the means, and the capacity to participate in the decisions that affect their lives”. TIG (2010) also articulate that the views of all oppressed groups, including women, youth and the poor, must be heard and considered by governing bodies because they will be the ones most negatively affected if good governance is not achieved.

Good governance sets out a very clear view to once goal and it dimensions or principals set out a solid guideline to support the goal. Good governance is a means to address issues and challenges in terms of development whether it be at international, national or community level. The World leaders at the 2005 World Summit concluded that good governance is integral to economic growth, the eradication of poverty and hunger, and sustainable development. UNECAP (2001) also consent that good governance is an imperative for development.

There is an implicit, sometimes explicit, assumption that GIS at the local level is both efficient and effective, in that it is believed to simultaneously meet the contents needs, answer the questions asked of the geo-information, and address and satisfy the local stakeholders underlying interests. As such there are assumptions that PGIS is a tool for better governance (McCall, 2002). This view has also been expressed by Alcorn (2000) and Carver (2001).

Given that PGIS is a tool for good governance, good governance dimensions can be used to assess PGIS. Mccall and Minang (2005) utilized the good governance dimensions together
with PGIS to derive indicators to assess PGIS for community-based natural resource management as well as employing key good governance dimensions or criteria’s relevant to the study and derived associate indicators to assess PGIS.

UNDP, (1997) defines the core characteristics of good governance as: Participation, Rule of law, Transparency, Accountability, Legitimacy, Responsiveness, Consensus-orientation, Equity, Effectiveness and efficiency, Resource Prudence, Strategic Vision, Ecological Soundness, Partnership, Empowering and Enabling. On the contrary, Asian Development Bank (1995) identifies four basic elements of good governance which McCawley (2004) calls democratic governance such as accountability, participation, predictability and transparency. Although good governance principles and practice are also universal, no two organisations are ever the same. In Māori organisations, the objectives of governance will take into account the way in which Māori relate to the assets and what they are used for. (TPK, 2005) There are particular characteristics of Māori organisation which bring extra dimensions to the practice of governance (TPK, 2005).
4.0 Participatory GIS Application – Methodology

This chapter describes the methods and strategies used in this research and explain the rationale behind it, then an overview of the entire research events are presented in the research methods framework as shown in Figure 5.

Figure 5: Overview of the research method
4.1 Research Approach

This research uses a case study approach. Te Roopu Taiao o Utakura was selected as a case study site, based on its location, level of Māori involvement and a need for GIS to assist them with environmental planning and safeguarding the information for the generations to come. Utakura, in the Far North District of New Zealand, has always had a higher Māori population relative to those of European descent. It was important to select a case site where a good level of Māori participation could be expected, while at the same time having a significant level of non-Māori involvement. This allowed the study to be more practical and relevant to other situations in New Zealand where there are larger Māori population.

Te Roopu Taiao o Utakura covers an area with high Māori population yet had a significant level of non-Māori population. This makes the research comparable to larger scale Māori ownership and entrepreneurship issues experiencing non-Māori influence.

The research was conducted using mainly two sets of tools or approaches. Participatory Rural Appraisal (PRA) which focuses on the research on participatory actions, and GIS. The combination of PRA and GIS complement one another and fulfil the requirements of PGIS. The relevance and applicability of PGIS for Māori was assessed based on indicators derived by linking and establishing relationship between good governance dimensions with PGIS variables.
4.2 The Social Situation

4.2.1 The Case Study Area

Utakura Valley, which is 184 miles from Auckland, is situated to the west of Okaihau on the main Kawakawa and Horeke road.

Figure 6: Location of Utakura in relation to Northland

(Source: Sail Te kaihau, 2000)
According to The Cyclopaedia of New Zealand (2011) as far back as 1883 blocks of land were opened in the Utakura valley for settlement on the system of deferred payments. This is a good indication of the time frame when Utakura might have started to attract outsiders for settlement. The valley contains good agricultural and pastoral land. Farming and cattle grazing were the major income earners but due to urbanization, residences have found jobs at local forestry and other local industries. Okaihau Township has a, general store, post office and medical centre which serves the Utakura, Kaikohe is the nearest commercial centre.

With increase in population density over time, pressure on the environment has also increased. To keep up with local crop demands small subsistence farmers have had to produce more crops. With no control on farming practice, environmental degradation became evident, figure 7 shows the high level of weeds in Lake Omapere fuelled by the nutrient runoffs from the farms in the catchment. The issue of increasing environmental awareness is hampered by the health of the communities affected. The reduction in soil fertility and hence the productivity has resulted in reduced yields and increased production costs, resulting in more supermarket reliance and fast food culture.

**Figure 7: Surface reaching Egeria densa weeds at Lake Omapere**

Furthermore, Lake Ompere is also affected by poor farming practices. Lake Omapere lies in a basin midway between the Bay of Islands and the Hokianga harbour, north of Kaikohe. The surface of the lake covers an area of around 1200 hectares with a depth of only a couple of
metres. According to a report by the Waitangi Tribunal (1998) the lake is fed by runoff from adjacent lands causing extensive weed (Northland Regional Council, 2002) issues at Lake Omapere.

For centuries, Lake Omapere was an important source of fisheries for Māori; this has been seriously affected by the degradation of the lake. The conditions of the lake subsequently started affecting the Utakura River as it flows from the lake 15 kilometres west and merges into Hokianga Harbour. Utakura River and the tributes has been backyard eel reserve and recreational avenue for generations but it has changed with the effects of eutrophication⁴.

As a result, there was a need for environmental stewardship, which would enhance community awareness to environment conservation and in many cases is perceived to hamper community actions towards environmental issues as urgent action must be taken to arrest the continued degradation of the watershed.

4.2.1 The Case study Group – Te Roopu Taioa o Utakura

Te Roopu Taiao o Utakura was established as stewards to manage and address the declining state of the environment of Utakura Valley. Their territory or boundaries includes the Utakura River and its tributaries from the outflow of Lake Omapere to Paremata near the entrance of the Hokianga Harbour. The groups aims to “restore, protect and enhance their freshwater environment and fisheries - ma uta ki tai” (Henwood & Henwood, 2010:2).

Te Roopu Taiao o Utakura is made of Utakura residence as well as community members from nearby areas, there are also those members who have moved away from the area but are still dedicated to the Roopu. The Roopu consists of member from all walks of life, from students to farmer to professional and specialists.

Over the years, the Roopu has made numerous efforts at the community level to promote environmental interest and awareness. With most members being from the local community itself, the approach adopted is informal and significantly ‘bottom up’. With this approach the communities help themselves hence making the initiative personal and meaningful.

⁴ The process by which a body of water acquires a high concentration of nutrients, its a natural, slow-aging process for a water body, but human activity greatly speeds up the process.” (Art, 1993)
Figure 8: Eel monitoring exercise conducted by Te Roopu Taiao o Utakura

Figure 9: Planting day around Lake Omapere organised by Te Roopu Taiao o Utakura
The project undertaken by Te Roopu Taiao o Utakura was funded by the Health Research Council of New Zealand allowed the Roopu to be ambitious and cover different possibilities, using sophisticated technology and specialists. GIS is one of the sophisticated technologies used in the project to capture and store and output spatial information for the Roopu’s benefit. Figures 8-11 demonstrate some of the activities the Roopu and the community were involved in during this project.
4.3 The Framework for Conducting Participatory GIS.

The combination of Participatory Rural Appraisal Tools and GIS technology was utilised by Te Roopu Taiao o Utakura to attain a well-supported GIS database.

4.3.1 Participatory Rural Appraisal Tools

Participatory Rural Appraisal (PRA) facilitated the implementation of GIS for Te Roopu Taiao o Utakura. As PRA emphasizes local knowledge and community involvement, setting up the GIS database for Te Roopu Taiao o Utakura members had great level of input in planning, designing and application phases. Furthermore, as a collaborative process, PRA empowered the Roopu members without any emphasise on hierarchy or status.

Facilitating PRA was a time consuming exercise. Developing strategy for community discussion and participation in general was very carefully conducted considering the characteristic of the Roopu members. PRA tools were used in steps. After each exercise, the outcomes were analysed and documented. In this way information could not be misplaced or misrepresented, eliminating any confusion with the data. This is an unquestionable resolution to the issue of information loss with the passing away of the older generation.

The entire process of collecting PRA information was seen as important as the data itself, it prompted effective discussions among the parties involved, regarding existing practices, problems, conflicts, and opportunities. The discussions at times diverted from the central topic but this was not seen as a problem as it brought forward a lot of related information which might not be used in this project but could become beneficial later, as it has come to light and is now shared with everyone.

PRA comes with a variety tools and techniques. PRA is ‘a growing family of approaches and methods to enable local people to share, enhance and analyse their knowledge of life and conditions, to plan and to act’ (Chambers, 1994: 1). In general, how one carries out PRA depends on the type of information required, and the particular research question.
4.3.2 Participatory Rural Appraisal Process

4.3.2.1 Sketch mapping

Sketching was the entry phase and the essential core for the GIS project indorsed by Te Roopu Taiao o Utakura. It started off as a tool for initial conversation with informants and core group members. The question that was being asked with the sketch mapping was; what is our physical area of concern and research boundary?

Sketch mapping is a method for collecting and plotting information on the occurrence, distribution, access and use of resources within the economic and cultural domain of a specific community (IAPAD, 2010). Te Roopu Taiao o Utakura using a terrain map marked all the monitoring sites, sites of significance such as the meeting houses, cemetery, mountains, the Utakura River and it major tributaries. Sketch mapping helped the Roopu members in picturing resources and features that they wanted documented for future reference.

This process was conducted very informally sitting on the floor in a group member’s study room with only a few key members. As the basic starting point, sketching mapping allowed for a general conversation regarding the data of interest and its use. The features added on the map by the Roopu members present were all from memory and observation, drawn not to any scale, without any structured legend.

This activity took place as the conversation went on, with no standard structure. To make the map, one participant took lead and sketched a mental map of their perceptions on the paper. The participants visualised place-related topographies such as, the physical features on the terrain map to assist in the mapping process.

The sketch mapping exercise began by giving an overview of the Te Roopu Taiao o Utakura’s context, understanding and elucidating the issues to be addressed through the project at hand. One of the vital aspects of the sketch mapping exercise was assembling and confirming the adequacy of the mapping materials, familiarising the participants with the geography of Utakura valley and endorsing the mapping extent.
Figure 12 shows sketch map product; using numbers the participants depict all the sites they considered significant and highlighted the Utakura River and all the major tributaries. The sketch map was kept simple by limiting the variables to a minimal number of sites.

![Figure 12: Outcome of the sketch mapping exercise](image)

Data and information obtaine from Sketch-mapped exercise was transferred to the GIS database. However, this was done using GPS rather than from the sketch map. In other words, the 1: 40000 scale terrain map was not used to accommodate accuracy but was used as a base map to facilitate the GPS data collection, which was the next PRA activity.

### 4.3.2.2 GPS Based field mapping

GPS field mapping was the collective approach by the Roopu members to gather accurate positions of the significant sites identified during sketch mapping. During the sketch mapping, nine Utakura Cultural Health Index Monitoring sites, five meeting house, four cemeteries and one mountain were identified.
The locations of these sites were collected using GPS, with the exception of the mountain. The mountain was identified as an area of significance that would be easily identified on the aerial photograph and digitised.

For GPS mapping, a general purpose recreational, hand-held GPS device was used. They are readily available, reasonably priced and their accuracy is adequate. To make sure that the GPS data collected was efficient and achieved the expected result, the following measures were taken.

- Priority locations were identified after a group discussion. Priority was given to those locations that were known by all group members present. Second priority was given to points nearest the location of the group at the time they started the exercise.

- The information and notes on each of the positions was collected using the GPS. The data collecting group decided that together with GPS points the site name would be entered at the time from the default attribute list of the GPS software. All other information about the site was well known and would be added to the attribute list at a later stage.

- Photos of the sites visited were also taken at the same time of the GPS data collection.

- To avoid any confusion, the ID of all the GPS point collected was included with the notes on a datasheet together with the site name. This provided a way to check if all the sites have been covered by the data collection team. This process also encouraged team members to stay at the sites longer allowing all members to carefully observe the sites. While in the field, any extra notes were taken on the same data sheet and were cross-referenced to the GPS locations ID’s for later use.

Each site was visited and GPS positions were captured following measures outlined in figure 12. After the GPS data collection, the data were converted to shape files ready for import into the GIS database.
4.3.2.3 Strategy planning

A weekend long stay at the Mokonuiarangi Marae\(^5\) was organised by Te Roopu Taiao o Utakura. The main reason for the stay was for the Roopu to come together and discuss the progress of the research, and at the same time conduct strategic planning for all different aspects of the Project. This included GIS setup and application in addressing the declining health of the aquatic environments in the Utakura Valley.

As far as GIS setup was concerned, the stay over at the Marae was used as a platform to get Roopu’s views and suggestions on types of data to be collected or requested and imported into the GIS database. Although addressing the declining health of these aquatic environments was the mission of Te Roopu Taiao o Utakura, using GIS properly was given very special consideration as it was responsible for bringing all the aspects of the project and assisting in formulation of outcomes.

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\(^5\) Meeting house.
As part of GIS strategy planning, the Roopu focused on three questions. *Where are we now? Where would we like to be and how do we get there?*

![Diagram](image.png)

**Figure 14: Focus of the Strategy Planning**

*Where are we now? -* The Roopu discussed what they had done and the progress made to date. The Roopu elaborated on the compilation and the outcomes of the sketch map together with the GPS field mapping. The reason for this discussion was simply to keep everyone updated—not only the Roopu members but also other community representatives present. This exercise provided an opportunity to raise any concerns and resolve them.

The community members were very keen to know if their land was included in this project and, if so, how it would benefit the land. The community members were very concerned about who the information would be shared with. They wanted assurance that the data submitted to the project would not be shared with just anyone. The community members noticed during the discussion that as the benefits would not be monetary but environmental wellbeing. It was made clear that the information collected would only be used for the purpose of this study and would not be given out without consultation.
Where would we like to be? This step of the strategy planning proved to be very popular. Even though the idea of GIS was very foreign to the Roopu, members were very curious about it functions and limitations. Potential uses of GIS were discussed. The first item on the Roopu’s wish list was a site map of the valley. The site map would contain all basic information such as land, vegetation and political data, and would be used a reference for the Roopu and the wider community.

The importance of the identification of the catchment of the Utakura River was also identified. Knowing the catchment boundary will assist in delineating areas prone to floods and understanding the effects of land pollution on the aquatic environment. In addition, growing population and its pressure on the local environment was also discussed.

How do we get there? The Roopu decided that the best way to gather the data for different areas of the study would be by grouping Roopu members based on their interest and areas of speciality. The groups focused on particular areas of interest to them resulting full commitment and better results.

Te Roopu Taiao o Utakura provided everyone an equal opportunity to contribute to the setup of the GIS database and give their views on areas to focus on. This was called “Strategy planning Hui.” By obtaining a participatory view the initiative received full support. This involvement also assured that the plan maintained its focus on what was needed by the Te Roopu Taiao o Utakura.

4.3.2.4 GIS Participatory Mapping and On-Screen Digitizing

One of the outcomes of the Strategy Planning meeting was to produce a GIS base map. This was achieved through participatory on-screen digitizing. Traditional participatory mapping combined with GIS technology was highly supportive in advancing the knowledge of the Roopu members and the rural community at large regarding Utakura valley. The base map was projected on a screen and the participants set around discussing issues at hand. GIS Participatory mapping increased the user capacity to voice issues and concerns regarding the mapped area. It also empowered the Roopu members, giving them confidence to take part in amending GIS in front of an audience. Using the GIS gave the Roopu a sense of control.
and management of the application technology reinforcing power distribution and the relationship.

This activity was conducted during the overnight stay at the Marae, after a relationship with all Roopu members including all the consultants and community present was established. This is because the community may consider resource distribution, use and access as a sensitive issue and not openly discuss this with strangers. Orthophotos covering broader Utakura and it surrounds was used as a back drop or a base map for GIS. Orthophotos are geometrically corrected aerial photographs. Orthophoto are accurate and economical for mapping large scale maps.

The objective of using the orthophotos in GIS Participatory mapping and on screen digitizing was to enable the community to understand aspects of their land resources which are of important to them. In this process, the community delineated their views and notes that were drawn or digitized on the orthophoto base map. The information digitized was noted, georeferenced and added to the site map. Involving local stakeholders with their extensive field experiences, improved the accuracy and precision of obtained data.

**Figure 15: Roopu members during on-screen digitizing exercise**

4.3.2.5 Catchment - Brainstorming/ Variable Brainstorming

Brainstorming is a common tool that helps generate innovative solutions to a problem (Carlson & Manktelow, 2012). Brainstorming, assisted by established patterns of thinking,
develops new ways of looking at things. For example, the initial catchment that was formulated using the GIS did not look right to some members. Following a brainstorming session the catchment area was finalized to everyone’s satisfaction. Brainstorming helped bring the diverse views of all team members into play during problem solving.

**Figure 16: Initial session of brainstorming during the Hui**

Brainstorming was a relaxed, informal approach to problem-solving with lateral thinking. It started during the meeting at the Marae and continued even after that. The communication was maintained using Skype and emails. The final catchment was forwarded to the Roopu for comments before finalising.

### 4.3.2.6 Population mesh block - Semi structured discussions

To work out the population of the catchment, it was vital to decide which population meshblock\(^7\) used for New Zealand census to select. To do this, it was decided that a semi-structured discussion seemed to be the best approach.

Semi-structured discussion was conducted with a fairly open framework which allows focused, conversational, two-way communication. Semi-structured discussion facilitated giving and receiving information. Semi-structured discussion started with more general

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\(^7\) Mesh blocks are the smallest geographic units used for census by Statistics New Zealand.
questions, slowing progressing to the main topic. Relevant topics were initially identified and the possible relationship between these topics and the issues such as availability, relevance and effectiveness became the basis for more specific questions. The interview questions allowed both the questioner and the discussion group the flexibility to probe for details or discuss issues.

The mesh block covering Utakura area was loaded on the GIS and projected on the wall to be used as a guide for the discussion. Through the discussion the mesh blocks that fully covered the catchment were selected first, and the discussion proceeded with identifying other relevant mesh blocks. Semi-structured discussion was very informal which allowed Roopu member to speak up at any time.

Semi-structured discussion confirmed what was already known but together with that it provided the opportunity for learning. Semi-structured discussion provided the answers with justification and the support of the Roopu.

Figure 17: Roopu members in the middle of a semi structured discussion
4.3.3 GIS Tools used

Software

One of the initial decisions was the choice of GIS software to use. The choice of which GIS software package selected for the project was considered based on the cost, functionality and system requirements, and ability to exchange data with other systems.

ArcGIS desktop was the selected GIS software. ArcGIS desktop was very cost effective not only because of the licence cost but with its various functionalities no other secondary software had to be purchased or applied.

ArcGIS was very flexible in terms of data exchange, a substantial amount of data was obtained from external sources and with ArcGIS it was simply imported into the database without any complicated processing.

We felt confident that ArcGIS Desktop was a good choice after finding that other Māori organisations use ArcGIS Desktop for similar purposes. Raukawa Trust Board had setup a GIS database using ArcGIS desktop to record all resources and other assets within their land. They experienced no issues using ArcGIS Desktop. Ngati Awa 8 also created a GIS database using ArcGIS Desktop for the purpose of consenting planning, digital data record, land details, and other referencing data.

Hardware

Due to the spatial nature of the data capture a handheld GPS unit was used. The Global Positioning System (GPS) has become the most common mapping tool for participatory scale mapping (CTA, 2011). Also used was the Garmin GPS unit with a built-in physical map and a default data dictionary. Since very basic attributes were collected during data capture, there was no need to customise data dictionary.

8 A Māori tribe situated in the eastern Bay of Plenty Region of New Zealand.
As Te Roopu Taiao o Utakura is very remote, using GPS for GIS data capture was very important. The GPS not only allowed accurate and efficient recording of location but also made it possible to conduct attribution and validation of data. This spot visit method also provided the opportunity to take photographs of sites that could be used for comparison later.

The GPS data were exported directly into the GIS Database without any manual data entry, eliminating redundancy of data and reducing the likelihood of data capture errors. Furthermore, the GPS unit required very little training to use allowing all interested member to work it.

Laptops and a screen projector were also used. The screen projector was used to display GIS maps on a bigger screen allowing other group members to input their views and comments. It was also a very good method to get everyone’s attention and demand their contribution. A lot of data verification and confirmation was done this way. The projector was especially vital during the Participatory Rural Appraisal. Laptops were used for data and GIS processing.

4.4 The Framework for Assessing Participatory GIS.

In order to assess PGIS for Te Roopu Taiao o Utakura, a framework was developed. The assessment framework is based on certain criteria and indicators. It was vital to develop a criteria and indicators for the assessment of Participatory GIS. Structure and proper organisation was needed for the assessment and to identify the indicators which would decide to whether or not Participatory GIS was relevant and applicable for Te Roopu Taiao o Utakura and in what ways and extends.

4.4.1 Selection of Good Governance Dimensions

Good governance has many characteristics outlined by the United Nations (TIG,2011). These characteristics of good governance, however, are not new and have been used in numerous contexts other than governances.

For the purpose of this project only six dimensions of good governance were used to assess the outcome of the PGIS effort. The six dimensions were selected based on their appropriateness to the study. The selected dimensions were: legitimacy, participation, empowering, equity, responsiveness, effectiveness and efficiency.
**Legitimacy and Participation**

As an assessment dimension for this study, Legitimacy and Participation are combined and used as one dimension. Legitimacy in the context of this study means the right people have to contribute to the set up and implementation of GIS, the right to participate and get involved. Due to close definition in the current context, the dimensions are used to assess the contribution of Te Roopu Taiao o Utakura. The Participation and the involvement of the Roopu members will indicate their level of input and acceptance of the GIS. Participation could be either direct or via representatives, requested or voluntary. The whole idea of participation is to promote input by the Roopu and aim to increase their ownership on resources and directions and influence the execution of a GIS set up and implementation project.

The use of the selected PRA technique adopted in the research brought through the essence of the Legitimacy and Participation. All PRA process had participation as the focus. Each of the techniques used provoked participation. The sketching mapping exercise gave the involved participants an opportunity to share what they know about Utakura and get the information collection process started. The GPS field mapping gave a perfect opportunity for the community and the participants in general to obtain data collectively, giving a sense of ownership and pride. The semi structured discussions which was a more selective group out of the community, assembled together due to a common interest address specific issues in isolation aiming to reach a solution efficiently.

**Empowering**

One of the aims of the project is to give the Roopu members and the community at large the opportunity to make decisions on issues that matter to them the most. Empowerment is the process which enables communities and social networks such as Te Roopu Taiao o Utakura to fully administer authority and influence development. To clarify, Empowerment is not about giving people power, people already have power and motivation. Empowerment encourages people to overcome any fear or shyness and develop within themselves and come out in the society.

The success of PGIS is dependent on the open interference of the Roopu which is assured by the empowerment principles. Empowerment promotes the access of information and resources for decision making by the Roopu, gives the Roopu a ranges of options from which
to choose from and directs assertiveness in collective decision making. Open discussions also increased the participant’s moral via exchange of ideas, education and engagement consequently assisting them overcomes any stigma.

During the PRA Process the GIS Participatory mapping and on screen digitizing; the participants commented on the geography of Utakura and their comment were given effect. With each spatial reference made the participant could see that the base map being amended and altered; this was the indication of empowerment. The participants could see that they were in charge, stirring and driving the project.

**Equity**

Equity is another aspect of good governance. The equity arm of good governance ensures that the needs of all participants and Roopu members were heard without any discrimination related to gender, age, size and level of education. To make sure that there was a comfortable atmosphere to allow free and open communication it was very important throughout the project to treat everyone equally. This promoted the idea that everyone’s views were given the same level of reception and it was just as significant as the other persons.

**Responsiveness**

Responsiveness means that issues mentioned by the participants should be responded to and not causally dismissed. Responsiveness ensures that there was no pretension of any kind, rather fairness (Jagadesan, 2008). Responsiveness to the participants was seen as one of the outcomes of the PRA Process. During the Semi-structured discussion; a lot of questions were asked, which was unexpected. The main objective of the Semi structured discussion was to come up with a unique population meshblock of Utakura valley. Although this lead to a lot of gratuitous questions, every possible effort was made to answer all the questions and queries that arose from the community.
**Effectiveness and efficiency**

Time was of essence to the project and due to its participatory nature, it was vital to manage time to complete the project according to schedule without compromising the quality of the project. The aim behind using effectiveness and efficiency as PGIS assessment criteria was to make sure that participatory nature of the project did not delay progress or divert the project from its goal.

### 4.4.2 Development of Participatory GIS Indicators

Table 1 shows the dimensions of governance used in the assessment of Participatory GIS and the specific indicators for each of the dimensions. The assessment for each of these dimensions was done independently with respect to all the circumstances. The level of involvement by the Roopu members was used to demonstrate whether the PRA process which is part of the overall PGIS scheme motivated participation.

Indicators that assess Participation and Legitimacy attempt to evaluate the level of involvement at each of PRA process. Indicators assessing Empowerment attempt to understand how motivated the Roopu members were to get involvement and contribute to the PGIS process. Indicators of Equity investigate if every member got an equal say in the mapping, data collection and GIS implementation process. Indicators of Responsiveness examine if the use PRA technique addressed and countered all the participants’ queries and interest equally and timely. The indicators of Effectiveness and Efficiency weigh if the Participatory process affected the timeframe and budget of the project.

Each of the indicators of the associated dimensions were used to assess the relevance and applicability of participatory GIS. For each of the dimensions the indicators seek answers that would better determine and assess the appropriateness of participatory GIS to the context of the Māori development. To evaluate the appropriateness of participatory GIS, the indicators revealed that the qualities of the dimensions that would indicate the relevance and applicability of participatory GIS.
Table 1: Good Governance Dimensions and indicators used to assess PGIS

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators</th>
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<tr>
<td>Legitimacy and</td>
<td>1. Roopu’s involvement in the initial environmental related discussion?</td>
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<tr>
<td>Participation</td>
<td>2. Representation of the Roopu in the mapping and data collection processes?</td>
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<td></td>
<td>a) Was there representation during the sketch mapping? \</td>
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<td></td>
<td>b) Was there representation during the GPS field data collection? \</td>
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<td>c) Was there representation during the Strategy Planning? \</td>
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<td>d) Was there representation during the Brain storming? \</td>
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<td></td>
<td>e) Was there representation during the GIS participatory mapping and online</td>
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<td>screen digitizing? \</td>
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<td></td>
<td>f) Was there representation during the semi structured discussion? \</td>
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<td></td>
<td>3. What was the level of voluntary Participation during the entire process?</td>
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<tr>
<td>Empowering</td>
<td>1. What was the level of attendance by Roopu members? \</td>
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<td></td>
<td>2. What was the level of voluntary input in entire process including</td>
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<tr>
<td></td>
<td>decision making? \</td>
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<tr>
<td></td>
<td>3. Was there evidence of delegation and acceptance of new responsibilities?</td>
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<td></td>
<td>4. What level of GIS access was there for Roopu’s use by individuals?</td>
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</tbody>
</table>
| Equity               | 1. Did all the Roopu members get an equal opportunity to participate in the:
|                      | a) Mapping Process? \                                                   |
|                      | b) Data collection Process? \                                           |
|                      | c) Decision making Process? \                                          |
|                      | 2. Were any Participatory tools found to be partial to gender or          |
|                      |   particulars?                                                          |
| Responsiveness       | 1. Coverage of all areas to everyone interest during discussion?       |
|                      | 2. Any partiality in Priority given while responding to queries and       |
|                      |   question?                                                             |
|                      | 3. Mechanisms to listen and address Roopu’s views and comments?         |
| Effectiveness and    | 1. Did the Participation process affect the time frame if the Project?  |
| efficiency           | 2. Did the Participation process affect the productivity during the      |
|                      |   mapping and data collecting process?                                  |
|                      | 3. Did the Participation process have any decadent effect on the project |
|                      |   outcomes?                                                            |
5.0 Results

This chapter presents the research findings of this study. First the description of the Participatory GIS as experienced by Te Roopu Taiao o Utakura is illustrated. This is followed by the list of outputs in relation to the assessment criteria. The third step is the assessment of the Participatory GIS process used by Te Roopu Taiao o Utakura of its relevance and applicability with the assistance of good governance dimensions.

5.1 Describing the Te Roopu Taiao o Utakura Participatory GIS Process (Objective 1).

The objective 1 of the study was to carry out a Participatory GIS project as a case study in the field of Māori development, and to document how the Māori progressed in the development of the Participatory GIS project. The focus of this part of the research was to carry out the Participatory GIS process.

5.1.1 What were the steps in the Participatory GIS project?

The Participatory GIS process was carried out in three major phases: the preparatory phase, assessment phase and action phase.

5.1.1.1 Preparatory phase

The preparatory phase was aimed at getting to know the issues that needed to be addressed. This involved meeting the Utakura community and exploring the issues mutually with their assistance. The second aim was to carry out preliminary analysis of the targeted research areas.

Getting the local Te Roopu members together was a very easy and quick task. A meeting at the Marae was organised around a convenient date avoiding public holidays and locally organised activities. The invitation was sent via word of mouth and the Te Roopu Taiao o Utakura members also invited the Utakura Valley residence personally.

The meeting at Marae followed the proper Māori protocols and resulted in an accepted and a well contributed event. The issues of importance to the Te Roopu Taiao o Utakura was discussed and in most cases were seen to be the same issues that the residence of the Utakura Valley had noted. Starting with such harmony was a great achievement.
The Preliminary analysis of the targeted research areas highlighted were basic and were intended to make sure that the Te Roopu Taiao o Utakura had enough in-house resources in terms of skilled labour and volunteers and to estimate a figure to apply for funding. All the areas of the research were generally talked about to give everyone an idea of the research scope.

5.1.1.2 Assessment phase

The initial step in this phase was person-to-person introduction with a bit of a background on each phase. The use of GIS and Participatory approach was explained by the session coordinator. GIS was a new field to many, it was difficult to explain and make a few understand its concepts but this was archived at last. During this step interactive discussion and an orthophoto of the Utakura valley was interpretation.

The aim of this introductory step was that by the end of this session everyone participating should be clear as to what needs be to achieved by the end of the research with a very clear outline of activities. The challenge during this step was knowing how to address the people and getting to know them. With the familiarisation with the Māori culture and protocol, it was not very difficult to mingle and get to know each other and starting to build associations.

Next was a problem – solution analysis step. This step was designed for Utakura residence and the external parties to come together. With the use of using a Participatory GIS the parties looked at the problems at hand and work out a solution. This exercise was seen to be focus on issues concerning natural resources such as land use and forest/cattle management rather than issues of social problems.

The step was carried out by using PRA techniques on issues highlighted, problems and opportunities. Sketch mapping was used as an entry phase methods to mark all the areas of interest and visualise the geography of the valley. GPS Based field mapping was used to ground truth several sites before recording them digitally.

Strategy planning was held over a weekend to focus on progress of the research work and to out the best possible ways to achieving those goals not yet managed. GIS Participatory mapping and on screen digitizing was used to produce a well-recognised site map. Brain storming was employed to agree on a catchment area of the Utakura valley, this was noticed
to be a difficult part as it involved a lot of science as well as local understanding. Semi structured discussions assisted in forming an local meshblock out of the New Zealand population meshblock system for the Utakura valley.

All the issues highlighted were addressed using appropriate PRA techniques. During each of the activities that took place in the study and as mentioned above, it was noticed that the participant said that they learned a lot about their own area, that the PRA techniques had assisted them bring out all the information that collectively have a lot value. It was observed that the PRA techniques together with Participatory GIS combined both advantages of spatial analysis and local knowledge.

5.1.1.3 Action phase

This phase looked at the outputs of Participatory GIS and used it during decision making. This step will assist in filtering out solutions to focus on the needs of the local Māori. Participatory GIS achieved the mission of the research with outputs relative to the current situation of Utakura valley.

The outputs were mostly maps and facilitated discussion during decision making. The advantage of these outputs was that they were results of the work of the participants themselves. The Participatory GIS also assisted with priority ranking. With all information highlighted with the use of GIS it was very easy to identify the issue that need attention before other to.

5.1.3 How well did the Māori People respond to Participatory GIS?

The reaction of the Utakura community to Participatory GIS was good; this was hoped for but not fully expected. The high level of acceptance and interaction was noted due to that fact how flexible and accommodated Participatory GIS was towards such community initiatives. Participatory GIS allowed flexibility in the research to consider the values and behaviour of Māori which made it a success. Discussed below are some of the characteristic of the Participatory GIS process noted during the research activities that encouraged the Māori to interact and get involved.
The Māori community participated on their own time hence the venue and time of the research meeting suited them. A central venue, the Marae was chosen for the meeting to ensure their time is best used assisting decision-making and not wasted on commuting. Participatory GIS encouraged a development of a partnership with Māori right from the planning stage. With Participatory GIS the purpose for engaging with Māori was also clearly stated. Being explicit about the purpose, the aims were met from the exercise, and participants felt satisfied when their contribution was reflected in the outcome.

In addition, Participatory GIS did not make promises or give false hope. Everyone was engaged in discussions that were realistic and relevant. Most importantly, when engaging with Māori the Participatory GIS process respected the kawa (protocols) and tikanga (customs). The relationship of mutual goodwill and co-operation.

Furthermore, the success with Participatory GIS interaction was also very much due to it being a face-to-face communication which the Māori community preferred. Participatory GIS accommodated for the holistic view of life and the world around which Māori culture is based. Using Participatory GIS process the practitioners were prepared to listen and consider these issues without directing the research to the particular area of focus. This showed respect yet regard for the input despite being of less significance.

Māori could see that the Participatory GIS process was worthwhile when they saw that their contribution has affected the overall outcome of the research. This was conveyed by the continuous feedback to the participants on the information received, issues unresolved and addressed and how they influenced the final decision.

### 5.2 Assessment of Participatory GIS Process Using Good Governance Dimensions (Objective 2).

This section presents the results of the evaluation of the Participatory GIS Process based on good governance dimensions including participation and legitimacy, empowerment, equity, responsiveness, effectiveness and efficiency.
5.2.1 Participation and Legitimacy

During the study it was noticed that ownership and participation combined supported legitimacy rather than participation and legitimacy being a dimension on its own. Participation and ownership focused on particular issues; participation looked into the level of Māori involvement in research activities and decision making. Ownership looked into access to GIS and control of GIS during the participatory GIS process. Although ownership was not initially a dimension included into the study, it became apparent it was an important dimension with which to measure the outcome of the study. The results of the dimension for both Participation-Legitimacy and Ownership-Legitimacy are summarised below.

5.2.1.1. Participation-Legitimacy

Participation is made up of representation or involvement in research activities and decision-making. They will thus be assessed in the cases of Te Roopu Taiao o Utakura.

Table 2: Indicators of Participation and Legitimacy

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<td>f) During the semi structured discussion?</td>
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<tr>
<td></td>
<td>3. What was the level of voluntary Participation during the entire process?</td>
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</table>

A good representation of Māori men, women, elders and young adults participated in all the activities. The initial environmental related discussions included the key Roopu members together with external the consultants to give their views and comments. Due to inadequate planned only a few members took part in the sketch mapping exercise, otherwise the attendance would have been greater. In all other activities which took place during the research meetings representatives from the Roopu as well as the Utakura Valley community attended.
The GIS data processing and mapping was done by the consultant only, with input from others. During the GIS data processing and mapping, the Utakura Valley community members could not get involved as most of it was done away and not at the time of the research meetings. This was not seen to be a problem as the community articulated what to focus on and outputs of the GIS data processing were shared with all once completed. The entire participation was voluntary; the invitation went out giving enough preparation time to organise their attendance.

The open debate enabled those present to take part in major decision-making. Participation influenced decision-making by clearly giving the community the opportunity to understand the situation and come to a joint decision. In unison each of the issues at hand were discussed and the GIS consultant brought it in to the maps.

5.2.1.2 Ownership-Legitimacy

Ownership as a governance dimension in this study has been assessed on two main aspects, Which are access to GIS and the use of GIS. From the legitimacy point of view GIS should be accessible to all in the community in principle. Representation functions of GIS were used during Participatory GIS process. GIS maps and raster data used throughout the research and GIS maps were produced representing spatial information.

Strategically, the process of mapping enabled the Roopu and the Utakura community to look at resources in perspective and to make decisions on resource use; maps were used as discussion aids for decision-making, locating place during discussions and activities such as picking applicable population meshblocks and for the collection of information for general benefit. It also helped members and guests living outside the community to know the area better and to understand the concerns.

The GIS data that was collected and derived during the research was kept within the Roopu for use by the community. Anyone with a reason to use could access it. The data was kept in digital form for direct access as well as paper copy for everyday reference. As part of this research Te Roopu Taiao o Utakura is looking at running GIS training, and in particular give youths the skills to make use of this technology and the data for school project as well as everyday task such as resource mapping.
Based on the dimensions of participation-legitimacy and ownership-legitimacy, the study was seen to be a success. The representation and the involvement of the community were solid throughout. In addition, all the outcomes and the products of the discussions both maps and data were made available to the community at large to support both communal efforts and individual interests.

5.2.2 Empowerment

The participation provoked by the Participatory GIS during the research activities allowed the communities to share knowledge of the area. Most of the Participants mentioned that they learnt something new about their area where they have been living for ages. Specifically the young adults said that during the Participatory GIS process they also got to know the valley better and the extent of their land and other natural resources.

Table 3: Indicators of Empowerment

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empowering</td>
<td>1. Level of attendance by Roopu members?</td>
</tr>
<tr>
<td></td>
<td>2. Level of voluntary input in entire process including decision making?</td>
</tr>
<tr>
<td></td>
<td>3. Evidence of delegation and acceptance of new responsibilities?</td>
</tr>
<tr>
<td></td>
<td>4. Level of GIS access for Roopu’s use by individuals?</td>
</tr>
</tbody>
</table>

Looking at the Indicators of Empowerment, the attendance of the Roopu members as well the community was almost 100 %. This high level of attendance was due to the content of the research which looked at the community’s natural resources, which was an interesting topic for the community. With the use of paper maps and GIS projected on the screen the input during the discussions as well decision making was voluntary as by now the participant had gain confidence to give input without much probing.

From time to time during the discussions a bit more time was spent on outstanding matters. For this the Roopu instigated that the best way to attend to the areas highlighted would be by grouping Roopu members based on their interest and areas of speciality into groups to work together. The groups focused on particular areas, not only allowing full commitment but also assuring a better result. Given this decision, those interested volunteered and handled the responsibility well.
The access to GIS was still possible even after the research meeting. On request GIS specialist could address any question and produce maps for their use. Based on the dimensions of empowerment and its indicators, the study was a success. The attendance, acceptance of delegated roles and level of on-going input was a positive sign that the community wanted to be part of the activity and have a say. The GIS access and request for on-going access in future revealed that the community had faith in what they had accomplished and will apply the outcomes and lessons learnt in the future.

5.2.3 Equity

In this governance dimension the main element of focus is whether the Participatory GIS process influenced power relations. This equity indicator emphasised that all participants and Roopu members without any discrimination related to gender, age, size and level of education should be allowed an input in the Participatory GIS process.

During the course of the research, all participants could freely express their views and give remarks and comments. Knowing this everyone spoke and commented when they wanted to provide vital data and fascinating stories. As expected not all participants were familiar with all aspects of the study. Therefore participants contributed when it was appropriate for them to do so.

Table 4: Indicators of Equity

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Did all the roopu members get an equal opportunity to participate in the:</td>
</tr>
<tr>
<td></td>
<td>a) Mapping Process?</td>
</tr>
<tr>
<td></td>
<td>b) Data collection Process?</td>
</tr>
<tr>
<td></td>
<td>c) Decision making Process?</td>
</tr>
<tr>
<td></td>
<td>2. Were any Participatory tools found to be partial to gender or particulars?</td>
</tr>
</tbody>
</table>

All research process was found to be accommodative except GPS data capture. Due to the physical nature of the GPS data capture requiring walking on uneven surface, older and unwell Roopu and community members could not participate. The equity dimension was applied to see if everyone had an equal opportunity and with the assistance of the indicator it was seen that everyone had the freedom to participate with no limiting circumstances.
5.2.4 Responsiveness

This indicator was employed to assess members responsiveness to all issues raised. All areas that were highlighted as part Te Roopu Taiao o Utakura’s mission were addressed. Minor issues or concerns that were highlighted during Participatory GIS process were also included in the discussions. At the end of the project, participants mentioned that they had all their doubts cleared and questions answered.

Table 5: Indicators of Responsiveness

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness</td>
<td>1. Coverage of all areas to everyone interest during discussion?</td>
</tr>
<tr>
<td></td>
<td>2. Any partiality in Priority given while responding to queries and question?</td>
</tr>
<tr>
<td></td>
<td>3. Mechanisms to listen and address Roopu’s views and comments?</td>
</tr>
</tbody>
</table>

Of course, there were those situations when an unrelated topic would arise; in such cases it would be discussed very briefly without spending a lot of time on it. Greater priority was given to issues in the agenda. Participatory GIS process being quite informal, there was no order adopted to ask or answer questions. It was impromptu yet without any collisions. Participants waited for their chance which provided others with opportunity to raise issues as well. Furthermore, all areas of interests were covered without any urgency, gauging from this the project was a success.

5.2.5. Effectiveness and Efficiency

The aim behind using the effectiveness and efficiency dimension was to make sure that participatory nature of the project did not waste time and money or caused the project to divert from its goals.
Table 6: Indicators of Effectiveness and Efficiency

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness and efficiency</td>
<td>1. Did the Participation process affect the timeframe if the Project?</td>
</tr>
<tr>
<td></td>
<td>2. Did the Participation process affect the productivity during the mapping and data collecting process?</td>
</tr>
<tr>
<td></td>
<td>3. Did the Participation process have any decadent effect on the project outcomes?</td>
</tr>
</tbody>
</table>

The Participatory GIS process did not cause any delays in the timeframe and all the outcomes were met on time. As the participants noticed that the research process was very accommodating and flexible, it required more patience due to which the process did take more time but the extra time taken was not significant to cause any delays as such. As seen, Participatory GIS process was very productive; it addressed issue after issue and dealt with any related concerns instantly and then moved to the next. By doing this there was no going back and forth around the same issues. There were no adverse effects on outcomes. In fact with the Participatory GIS the outcomes were better supported and agreed upon.

5.3 Assessment of the Relevance and Applicability of Participatory GIS in Māori development (Objective 3).

The third objective if the study was to assess the relevance and applicability of Participatory GIS for Māori. The sections below deliberate the assessment for both factors.

5.3.1 Assessing the relevance of Participatory GIS in Māori development?

Relevance is seen as a direct connection of something; in this case Participatory GIS to a subject of concern which in the current context is Māori. This connection can be seen from different perspectives such as connection by process/time, connection by nature, connection by necessity, and connection by impact and effectiveness (Trang, 2004). Relevance of PGIS will be assessed on the level of participation in this study.

5.3.1.1 Assessing the participatory level of Participatory GIS

At each of the research meetings, all the expected participants were present and in many cases the participants brought other community members who showed interest. There was
always a good representation from men, women, elders and children. Participants attending the research meetings showed up with full motivation and enthusiasm coming from their interest as there was no monetary compensation for their time.

The level of participation was stable in all the meetings as Utakura was not a big area and everyone was constantly reminded about the meeting and this kept everyone alert. Emails and text messaging also helped to alert people. In addition, from the start the community was fully advised of the content of the research and once they discovered that it was their environment; freshwater in particular, they remained motivated to attend.

The fact that during the gathering there was simply no waste of time in waiting for enough participants to make sure there was no biasness as enough participant were present to begin with, this made it very easy to get right to the point and start the participatory process. With good use of time, participants were assured that their attendance was utilised well.

Furthermore, the number of participants did not alone assure or add to the success of the level of Participation. The level of Participation was dependent on how actively the participants contributed to the Participation which was by giving their opinions, views, feedback and even criticism. The discussion and Participatory activities were spread amongst all, giving all a chance to join in and take control when given the opportunity. The overall level of active participation during the participatory process was really good.

The level of participation was also identified by the passion and intensity of the participation. The level of information sharing either by storytelling or data distribution, consultation amongst the participants and joint decision making portrayed a successful level of participation.

5.3.1.2 Assessing the contribution of participation to Participatory GIS

The study was not focused on data exploration but it was very interesting to see how the Utakura community members brought forward knowledge and revealed it to all present by participating. As part of the process all the data that surfaced has been documented and stored for future use.
It was very interesting to see how all the participants joined in unity and worked on issues that affected them all without any major disagreements. There was no concern about favouritism or those with social power gaining more than the rest. The transparency in Participatory GIS gave the participants total confidence to openly share their knowledge. Therefore this was a good example of how relevant PGIS approach was to Māori.

The sketch map exercise was such an achievement especially with the excellent contribution from the community members. It was also good to see that the Te Roopu Taiao o Utakura and community members knew the area quite well their excellent spatial perception of the land features. The on screen digitizing which had more participants was an eye opener; the map projected had helped bring forward rich knowledge that seemed as irrelevant or archaic. The same level of data input was seen with variable brainstorming and semi structured discussion.

The contributions by the participants were not just limited to the data collection process; they also had a huge input in the design and setup of the GIS Database. Based on their need they were able to direct the design of the system to their favour. The type of data to include and generic map documents to produce was all suggested by the participants. The attribute tables for each of the features digitised or imported were populated with the help of the participants. They helped decide what the tables should contain but also provided most of the information and assisted in finding out the missing data. Although the contributions from the participants were provoked with the use of Participatory GIS process, once the participants were in the process, it was very easy to maintain the level of input and keep it continuous.

5.3.2 Review on the applicability of Participatory GIS in Māori development?

This section is an analysis based on reviewing Participatory GIS experiences of researchers and the participants. The focus of this review is how applicable Participatory GIS can be for Māori development in general. The case study of Te Roopu Taiao o Utakura was used as an example for this analysis. In this research, the analysis was determined in the direction of Participatory GIS applicability to Māori context in economical, social, institutional, and political aspects.
5.3.2.1 Economic applicability (Effectiveness and Efficiency)

With very little emphasis on cost, Participatory GIS does not disregard this as being important. Very few studies on cost-benefit in Participatory GIS were found. This was probably due to the complexity of PGIS socio-political factors (Trang, 2004). According to (Rhind 2000), invested costs for a system of geospatial data infrastructure includes:

- Cost of raw data capture and data collection,
- Cost of equipment,
- Cost of human resources,
- Cost for training people who can use GIS and maintain its use.

However, Berry (2001) articulates that the cost for data collection, maintenance and human resource training is much greater than the cost for hardware and software. According to McCall (2003) the cost of time-consumed in Participatory GIS is unavoidable. On the contrary, it should be noted that these costs have not been quoted out of mainstream projects. In saying this, these cost have to be met be it an indigenous, Māori Participatory GIS or a mainstream project.

In the case of Te Roopu Taiao o Utakura, GIS was a minor focus of huge freshwater project which was fully funded by The Health Research Council of New Zealand. The Health Research Council of New Zealand funding provides an opportunity for the community groups to investigate a well-defined community identified area of Māori health. This targeted groups who have not had any significant research funding but want to build their capability in this area. Similarly, other funding by central or local government is made available for community efforts. Local communities, town and district council are very supportive of this type of community organisation as the data and knowledge again will be fed back to them.

Small Māori organisation using Participatory GIS is aimed mainly to serve their problem solving process and their non-profit nature get a lot of support from other companies and organisation that hold data and other needed resources. The data, orthophotos and the GIS software which would account for a major portion of the overall cost were donated by organisation with interest and see a benefit in community empowerment. In terms of time, Participatory GIS does account for the special research techniques that are directed by the Participatory GIS methodology hence it is not anything unexpected during the project. Given
this, such special research techniques are not time intense just better structures to provoke participation and involvement. In terms of the cost of human resources, with the community emphasis that Participatory GIS promotes local human resources is mostly voluntary yet very committed.

Though future training of local human resources is an added cost in the short term but for long term of GIS use, data management and maintenance, this would help to reduce cost and dependence on paid consultants. The most significant benefits of Participatory GIS is legitimacy, which leads to higher chances of funding approval. Participatory GIS being a participatory learning process through which knowledge of Māori spreading to the outside world both during Participatory GIS application and via Participatory GIS outcomes.

Te Roopu Taiao o Utakura by doing this research with proper organisation and publishing the outcome and compiling it into a development strategic plan make them more comprehensible and recognised by authorities and other funding agencies increasing their chances for future funding approval even higher. With such a path any Māori community organisation for their development can prove Participatory GIS applicable and appeal funding. PGIS is economically applicable due the fact the cost of its implementation is easily justified with its benefits and is shared by external organisation that support such community programmes.

5.3.2.2 Political applicability (Empowerment)

Participatory GIS intends to involve Māori and the Utakura community at large and expose them to hidden and unknown information which otherwise would not be shared. This might have been an issue if there were dominating stakeholders involved but as this was not the case in this case study, the Empowerment to the community upheld by Participatory GIS was much appreciated by all.

Mosedale (2003) states that empowerment is “a sense of people making decisions on matters which are important in their lives and being able to carry them out”. Participatory GIS emphasis on empowerment as it aims to help, support and enlighten those community members at the glass root level; those at this level often get left out. As a result of this everyone is accessible to the knowhow of the environment in this case and can fully participate in discussions and give their input toward decisions made.
If for some reason Participatory GIS is applied to a society where an obvious power differential is seen, Participatory GIS lessens the power differential and bring them information to the less powerful, empowering them at the same time taking away power from the other party. The change in power system could cause administrative issues in the community and lead to future restriction to Participatory GIS implementation.

For Te Roopu Taiao o Utakura empowering the Utakura community was a one of the major reason for using Participatory GIS. The idea was to involve the community and enlighten them with the state of the freshwater environment and get their feedback and come up with possible solution and management plans. With Participatory GIS implementation, it was very easy to engage and revile the issues with the help of visual aid and continuous dialogues.

Participatory GIS was also noticed to have maintained the interest of the community throughout the process which is vital for effective information transfer. Most importantly, Participatory GIS was transparent yet empowering.

5.3.2.3 Institutional applicability (Legitimacy)

Legitimacy and the participation in PGIS are linked. The accuracy and collectiveness of the data collection producing maps reflects how the real world sees and accepts the effort or in other words, makes the participant’s work legitimate. Furthermore it promotes the ownership of local communities to PGIS and provokes interest for further use, giving an equal opportunity to people at the grass root level to pass their views to the higher level authorities. In the participation seen with Te Roopu Taiao o Utakura, each party or individual contributed some valued information to the process which is than given a chance to be validated and appreciated among all participants. This is what brings legitimacy.

Carrying out such participation for legitimacy was more complicated than anticipated. Time to gather all parties required for research and discussion had to be well planned. The meeting atmosphere had to be ceremonial due to the spiritual beliefs of Māori, but this was a positive factor as it maintained everyone’s respect for the reason of the meetings. Since the participants were either from Utakura Valley and members of Te Roopu Taiao o Utakura, it was very easy to get the process going. Without official visitors there was no need to be formal.
The fact that Participation GIS maps and data produced projected the true shape of the valley and the relative information on the use and evidence of environmental degradation. This was not only useful for the learning process of local people but also provides better understanding to external authorities. The data produces will make decision making easier and prove that Te Roopu Taiao o Utakura know what they are doing, giving them better recognition when applying for future funding.

Working within community on issues of concern is great but if the work done can be acknowledged by external organisation and support future programmes than it’s even better. This is what Participation GIS helped achieve, it did not only bring issues of concern to light, but by seeking participation, put together scattered information that was validated by the community for internal and external use.

5.3.2.4 Social applicability (Equality and Responsiveness)

Participation GIS just like any other process is strongly influenced by many social factors. The most significant social elements affecting Participation GIS in the case of Te Roopu Taiao o Utakura were equity and responsiveness.

To be accepted in the society, it is very important for any research or study methodology to be fair to the participant, respecting and deliberating with everyone equally. In no community will one be able to implement any system as in this case Participatory GIS with a stigma of being bias.

To avoid any disappointment or discouragement, Participation GIS treated all participant the same. No preference was given to any particular group of participant; all had the same opportunity to get involved. Special attention was given to the elderly, who required more time to understand and speak out but it was not regarded as being bias but respectful. In addition, the data or maps produced from this activity were available for all to use. This was very quickly realised by all participants as they requested to see and have paper copies, which was consented.

With the signing of the treaty of Waitangi, which many Māori feel was unfair and revoke against any practice that would treat Māori as being inferior. Equality being promoted by Participatory GIS also strength learning attitudes amongst the participant at the same time
encourage those to get involved who were reluctant. Knowledge sharing was also empowered as participants realised that they all will from this exercise.

Responsiveness to Māori in the context of Participatory GIS refers to the obligation and flexibility to accommodate all participants’ requests and consideration of their ideas and views. Participatory GIS being a promoter of open communication and dialogue made the atmosphere very comfortable to allow the community members and the participants to speak out and request answers.

Participatory GIS allows for such interruptions to address the issues arising during the research processes. There were times when the issues raised were out of topic or context; they were briefly addressed without making the participant who asked feel imprudent and quickly clarified any points that could have caused any confusions leading to off topic discussions.

Responding to everyone present or the participants simply made all feel that they are important to the research and their input is of some value and that it is in fact about them and their environment and resources. Although such community researches is setup around the community needs, it is sometimes very difficult to convey this to the community and get their corporation but with Participatory GIS this was made simple.

5.4 Participatory GIS and its relation to Kaupapa Māori Research (Objective 4).

Objective 4 of the research goal was to look Kaupapa Māori research approaches and Participatory GIS, to compare them and investigate if Participatory GIS is as acceptable as Kaupapa Māori research principles are to Māori.

5.4.1 What similarities are there between Participatory GIS and the principles of Kaupapa Māori Research?

The Kaupapa Māori methodology has been initially used in the context of education and research before dispersing to all aspects of Māoridom. From the time of colonialism Māori views and interests have been interpreted by researchers reflecting their own points rather than the Māori views. One reason for this could have been due to no regard and recognition for Māori values and philosophy.
Consequently Research with Māori must consider their values and protocols in addition to any recognised ethical standards. Kaupapa Māori methodology has inherited Māori ethics explicitly directed at Māori. According to Cram, Pihama and Barabara (2000), operating in a Kaupapa Māori framework necessitates a research process that affirmed Kaupapa Māori ethics. These ethics are informed by Māori values and demand that negotiation with participants be undertaken” (Hudson, 2009).

Beyond doubt not all methodologies are based on this level of Māori or indigenous emphasis for that matter. Without this emphasis it would be very difficult to carry the views of Māori through the research to reach Māori favourable outcomes. Consequently it is very important that any researcher whether Māori or European undertaking research with Māori to take into consideration the cultural implications and include that in their methodology, research tools and approaches.

Looking the at the PGIS methodology applied in the study it would to interesting to see what similarities PGIS has with Kaupapa Māori framework and how accommodative it can be to Māori values. As part of assessing the relevance and applicability of Participatory GIS for Māori development it is very important to see if Participatory GIS principles line up with the Principles of Kaupapa Māori and not contradict it.

Graham Hingangaroa Smith (1997) in his PhD thesis highlights six broad-spectrum elements that have become an integral part underpinning Kaupapa Māori. These six elements have been drawn out of successful initiatives of Te Kōhanga Reo, and Kura Kaupapa Māori. These Kaupapa Māori elements are:

- Tino Rangatiratanga (the ‘self-determination’ principle)
- taonga tuku iho (the ‘cultural aspirations’ principle)
- ako Māori (the ‘culturally preferred pedagogy’ principle)
- kia piki ake i nga raruraru o te kainga (the ‘socio-economic’ mediation principle)
- whanau (the extended family structure principle)
- kaupapa (the ‘collective philosophy’ principle)

This section looks at each of the elements of Kaupapa Māori mentioned above and compare to the application of Participatory GIS by of Te Roopu Taiao o Utakura.
Tino rangatiratanga ‘self-determination’ principle
Tino Rangatiratanga relates to sovereignty, autonomy, control, self-determination and independence (Smith 1997). The idea of Tino Rangatiratanga is to reinforce that Māori are competent and should be allowed to manage issues concerning them by themselves. These issues could be cultural, political, social, economical or environmental. Participatory GIS agrees and promotes this Māori empowerment through its research and study principles. Participatory GIS is built on the foundation of giving the communities and in this case the Māori community a fair opportunity to get involved and control the study and stir it in any direction that suits and benefits them.

With the flexibility with research setting such as the research meeting held at the local Marae, Participatory GIS encouraged the community to attend and get involved in any way they felt comfortable. The research meeting also made it possible for the elders and children to attend and take part. Furthermore, Participatory GIS has versatile and unique research tools with an emphasis on provoking input and have a good handle in making sure that the Māori community and the Roopu controlled the research sessions; giving all participants an equal opportunity to give their opinions and discuss their views, unconditional to any dynamic.

The Participatory GIS process clearly abides by the principle that Māori should be making their own decision and lays out an applicable set of research and study conditions. Implementing Participatory GIS Māori can be content that they are maintaining Tino Rangatiratanga.

Taonga tuku iho the ‘cultural aspirations’ principle
This principle emphasizes on legitimate use of Māori paradigm such as Māori language and values within developments. Taonga tuku iho principle recognizes the strong emotional and spiritual believe of Māori, and combines it in any work involving Māori to support their commitment, understand their ways of doing things and creates awareness and not taking them for granted.

With respect to how Māori think and what influences the way they think, Participatory GIS process implemented by Te Roopu Taiao o Utakura fully acknowledged Māori paradigm through the project. In fact the project upheld Te Roopu Taiao o Utakura by was based on
Māori principal. Consequently there was no way that the Participatory GIS process would undermine Māori ways.

Additionally, Participatory GIS commands the research approaches preferred and known to the participant should be applied, allowing Māori to maintain emphasis on their belief. Participatory GIS implementation in the case Te Roopu Taiao o Utakura Māori custom and values were accommodated throughout the process.

**Ako Māori the ‘culturally preferred pedagogy’ principle**

This principle promotes teaching and learning practices that accommodates Māori and incorporates Māori values. This principle is about Māori being able to choose their own pace in carrying out studies that include them. Ako Māori if not anything else states the common sense by emphasising on the fact that it is imperative to understand and consider the party in question when drafting research plan and approach.

The Participatory GIS process that was applied for the purpose of Te Roopu Taiao o Utakura made every attempt to incorporate Māori and get their option on the know-how of the research. The Participatory GIS Process allowed the flexibility with the hosting of the project. Māori enforce such flexibility to make sure that men, women, children and the elders are included, with this understanding flexibility with time, venue and research approaches were maintained throughout the research.

The Participatory GIS Process also acknowledged the protocols of the Marae during the research meeting. The Marae was not just as a convenient venue but used for hosting due to the research having a cultural significance. The research meeting started with a welcome prayer, prayer before eating and after waking up in the morning are the usual protocols of the Marae. Appropriate dressing and personal conduct were observed throughout the Participatory GIS gathering.

The Participatory GIS Process achieved the research goals at the same time made sure that Māori values were fully respected and maintained. This allowance of Participatory GIS links it to the Ako Māori principle which promotes Māori principles during research and studies including Māori.
**Kia piki ake i nga raruraru o te kainga the ‘socio-economic’ mediation principle**

Kia piki ake i nga raruraru o te kainga acknowledges the economic disadvantages that Māori face by practices extend family living and other traditional norms. This principal of Kaupapa Māori brings the collective act of the whanau and the Māori community to the focus of initiatives involving them.

This principle asserts the need to mediate and assist in the alleviation of negative pressures and disadvantages experienced by Māori communities. This principle stresses a need for Kaupapa Māori research to be of positive benefit to Māori communities. It also acknowledges the relevance and success that Māori derived initiatives have as intervention systems for addressing socio-economic disadvantage that currently exist.

Realising that access is one the major socio–economic deprivation for Māori, the Participatory exercise worked for the benefit of Māori. Māori Participation and involvement were major parts of the PGIS process, attention to every aspect of information, data and decision was transparent and fully socialised with all the community members. In any account, access to information empowers community against any dispossession from the society. Contentedly, Participatory GIS principles underpinning community association and contribution are a step in the right direction.

In addition to access, locality and isolation are some of the other socio–economic disadvantage for Māori. The location of the Roopu was not a barrier for Participatory GIS. The tools and principals have been predominantly derived to suit the rural communities. These tools respect the slow pace of life and ensure approaches to assist community to participate and overcome holdbacks and participate.

The research meeting was a major part of the Participatory GIS process and it was a very smart approach to get the Māori community under the same roof to be a part of the project. Despite the isolation of Māori household in Utakura, the Roopu’s research meeting at the Marae attracted the locals to attend. Participatory GIS has all tools suited to assist all included those who need socio-economic mediation.
**Whanau the extended family structure principle**

Whanau, is at the core of Māori life hence is a major focus of Kaupapa Māori. Māori still practice traditional family structure organised around the Whanau interest and wellbeing. This Whanau ideology is quite foreign in this fast paced life but it is one that Māori exercise and should be acknowledged. Furthermore, with this outlook towards Whanau it is a must to include the Whanau principle in all Māori related study or research. Participatory GIS very simply adopted the Whanau principle in the research by Te Roopu Taiao o Utakura.

The setting of the Participatory GIS process which was conducted in the Marae near the field and area of concern and gave the Whanua an opportunity to watch over the entire research process if not anything else. The Whanua was able to see how the project will benefit them as well as the causes of the environmental issues. Participatory GIS with an emphasis on communal setting not only served the Utakura Whanau but formed a small Whanua of the Roopu members who treated the research very personally as it would have an overall effect on their extended Whanau.

The visual aspect of research accommodated for the Whanau’s value. The use and outputs such as map, charts and plans were very useful for the Whanua. In a few words it displayed the research ideas and results. The major function of the Participatory GIS promoted outcomes that will benefit the entire Whanau equally. Participatory GIS process made every attempt to involve the Whanau in the research and the data collected and processed together with the outcomes will be used to assist make decisions that will benefit not only Utakura Valley Whanua but have a chain effect on the surrounding Whanua’s.

**Kaupapa the ‘collective philosophy’ principle**

The 'Kaupapa' refers to the collective vision, aspiration and purpose of Māori communities (Ranahui, 2011). This vision connects Māori aspirations to political, social, economic and cultural wellbeing (Smith, 1997). The Kaupapa principle stresses on the strength that Māori see in working together on issues of interest for maximum benefit. Similar to Kaupapa, Participatory GIS promotes involvement and association. In fact Participatory GIS research approaches prompt Kaupapa by assisting Māori to collectively participate and agree on conclusions that benefit them exclusively.
Given that the key asset for Māori is their knowledge, the land and customs, an approach is needed to ensure that this collective Kaupapa will influence their capacity for planning and managing natural resources. The Participatory aspect which is the core of Participatory GIS emphasis on being organised with supplementary processes involving the Māori community assisting in decision making on issues that affect them the most. Participatory GIS demonstrates that benefits of communal empowerment producing collective views is more recognised and has more impact on political and economic decision makers.

Kaupapa Māori theory lays a very concrete foundation to protect Māori interest and maintain their influence on decision that is bound to have an effect on their livelihoods. Kaupapa Māori theory has been cautiously designed to suit Māori and if success is desired from any Māori initiative than the implementation process will have to align with Kaupapa Māori theory. Participatory GIS implementation by Te Roopu Taiao o Utakura to assist them make informed decisions regarding the environmental sustainability of Utakura Valley fully accommodated and worked along the guidelines of Kaupapa Māori theory.

Participatory GIS gave Māori the control and independence over issues of concern, abided by the way Māori do things and traditional Māori practice, address social and economic challenges faced by Māori, involving and benefitting all.

**5.4.2 Is Participatory GIS is as Māori ‘friendly’ as Kaupapa Māori theory?**

Kaupapa Māori theory is all about understanding, respecting, accommodating and promoting Māori values and practices without any picking and choosing or eliminating the undesired ones. Throughout this project, Participatory GIS also demonstrated that it is as responsive toward Māori as Kaupapa Māori research theory. The discussion below illustrates how Participatory GIS is understanding, respectful, accommodating and promotes Māori values and practices.

Participatory GIS utilises tool that attempts to seek and understand the views, opinion and bulk of knowledge that Māori have inherited from their ancestors about the land and its resources. Participatory GIS techniques such as semi structured discussion and on screen digitising are agents that facilitate a forum where Māori openly shared their interpretations with other. Participatory GIS implements such appropriate techniques to understand Māori approaches and rational.
Furthermore, Participatory GIS also demonstrated respect towards Māori by requesting and taking into account their views. The techniques adopted by Participatory GIS treats all the participants the same, without any prejudgements. With these techniques, every time a participant comments it was recorded and considered during decision making. The respect for everyone and their opinions encourages further communication. Looking at the social deprivation that Māori have faced over the years, Participatory GIS demonstrates that Māori matters and their views are important.

For research to benefit Māori, any research method must accommodate Māori holistically. Participatory GIS research accommodates and is flexible towards Māori values. Participatory GIS incorporates flexibility in meeting time, location and research methods. To involve Māori Participatory GIS consented to organise the study around the routine of the community rather than dictating a time and venue and expecting everyone to turn up. Participatory GIS welcomes collective input from men, women, children and elders, making the process a family orientated one.

In addition, Participatory GIS further promotes Māori values than just emphasis on Māori input in the methodology. The Māori focus that starts during the research is maintained and addressed in decision making where issues that has been highlighted by the Māori community is given priority. The success with each project encourages other project with Māori focus to apply Participatory GIS allowing better Māori involvement in decision making in future as well.

Judging from all the flexibility and openness of the Participatory GIS one can conclude that Participatory GIS is equally accommodative toward Māori as Kaupapa Māori theory. Kaupapa Māori theory was specially developed for Māori hence in that sense will always be significant. As a foreign tool, Participatory GIS does not undermine Māori ways yet understands and incorporates them.
6.0 Discussion

This chapter discusses issues associated with the implementation of Participatory GIS for Te Roopu Taiao o Utakura. The first section talks about some of the positive and negative aspects of the project within the general outline and the framework of Participatory GIS for Te Roopu Taiao o Utakura. The second section identifies factors that influenced Participatory GIS implemented by Te Roopu Taiao o Utakura.

6.1 Participatory GIS for Te Roopu Taiao o Utakura

After the Participatory GIS experience with Te Roopu Taiao o Utakura; the Participatory GIS process was better understood. This was an aspect not fully perceived in the literature review. It was noticed that Participatory GIS was not just a simple use of GIS in a participatory manner. It was more complicated than that. Participatory GIS required a great deal of understanding and flexibly to accommodate the Māori values and principles. This varied from day to day with regards to needs, application and participant engagements.

Due to Participatory GIS handling digital and physical information with the Māori community members, the participation process required more attention and detailed planning than a usual or normal GIS application. The level and focus of participation changed all the time in terms of number of community and Roopu member attending, the skills and understanding level and even emotions and the mood of participants. It also happened on many incidents where the topic drifted to other concerns. All of these deviations during the processes required Participatory GIS to be more understanding, adaptive and flexible.

As expected, Participatory GIS was highly demanding and required a continuous involvement from all participants. The implementation went ahead in stages and for each stage the Participatory GIS tool was considered carefully for the purpose. The great advantage with Participatory GIS was that it was not technology driven hence did not scare away those who are not computer savvy. Participatory GIS was the starting point in many context and facilitated further discussion strengthening and serving the common problem addressing the needs of the Roopu.

The products of Participatory GIS facilitated discussions and assisted in decision making to address the needs of the community. For future use and reference the products will be
accessible and owned by the Roopu and the Utakura community. If the community did not have full and open access to the outputs or benefited from them, then the entire process would have been a normal GIS application and not Participatory GIS.

Figure 18: Participatory GIS Framework for Te Roopu Taiao o Utakura

The figure above shows the direction of Participatory GIS for Te Roopu Taiao o Utakura. Participatory GIS as a process stated the community’s needs and using appropriate tools outputting products such as maps and data sets that could be used during discussion etc. to come up with solution addressing those needs.
The interaction, participation, involvement and the different tools incorporated in Participatory GIS demonstrated a very positive and communal impacted on Te Roopu Taiaro o Utakura.

### 6.1.1 Positive Impacts

- Being unique and a new field of research for some, Participatory GIS with its collective tools attracted great interest and participation, Participatory GIS drew curiosity and a desire to know more amongst the Utakura community.

- The noticeable feature of Participatory GIS was its ability to maintain interaction of the participants as it provided visualisation tools for communication and discussion. Through this process the community were enlightened on the issues at hand, gained better understanding and engaged in dialogue which assisted in achieving a consented solution. Such informed sessions enabled Utakura community members to express their views and opinions which ended up in the sketch maps or discussion boarding showing the community that their views had been taken into account.

- The remote support with GPS technology was an efficient crowd pleasing feature of Participatory GIS. With this compatibility, the length of PRA time was better used as GPS was a time saving method of collecting precise location data.

- The primary advantage of Participatory GIS was that it produced maps and other outputs that were properly defined in terms of location and projection as well as being based on orthophotos. With such high level of detail, the Roopu felt confident using it for decision making as well as distributing it to other authorities.

### 6.1.1 Negative Impacts

The only issue that was seen is the use of the desktop and GIS software, not all community members had good computer skills hence were dependent on others to assist them from time to time. The Roopu did consider running training over a weekend to assist those that lacked computer skills.

The Roopu realised that if community member do not learn to use the computer then the data and GIS setup could be underutilised. The community are looking at options for training.
This did not comprise the outcome in anyway but did hinder the discussion and demonstrations by causing delays as it took longer to explain the logic to those who lacked computer skills.

The pros and cons listed above are a good indication of the limitation of Participatory GIS and can assist in considering Participatory GIS for other Māori initiatives. While each project setting and requirements are different, the core characteristics of Participatory GIS will suit in any situation.

### 6.2 Identification and Description of factors influencing Participatory GIS

With Participatory GIS in practice for the purpose of Te Roopu Taiao o Utakura, a few factors were noticed to have an influence on the Participatory GIS Process. The factors that had an influence were recognised during activities held with the Roopu as certain decisions were made. The factors presented are only those that had a high level of influence.

![Diagram](image.png)

**Figure 19: An Illustration of factors that influenced the Participatory GIS**

#### 6.2.1 Resource availability and Participatory GIS Process

The major factors influencing the Participatory GIS process was the availability of resources. This included availability of human, financial and material resources. A range of Te Roopu Taiao o Utakura and Utakura community resources were crucial to the Participatory GIS
Process. Alternative accommodation for the research meeting had to be arranged when the Marae was unavailable. The Marae provided a bigger room hence was better for catering large number of people. Having a larger area would make is easier to conduct group activities.

To make sure that everyone who needed to be consulted and involved were present, it was vital to arrange a meeting date and time that was suitable for all members, without discouraging anyone. Since Participatory GIS is all about involvement it was very important to maximise attendance for everyone. Very early in the project a budget was set for the GIS aspect, this administrated the content of the Participatory GIS. Funding was needed to cater food for the participant and cover the cost of travel and external consultations. A reasonable budget was necessary to run the Participatory GIS fully.

6.2.2 Interest of Te Roopu Taiao o Utakura

A very strong benefit of Participatory GIS was recognised was the Roopu from the start of the project. With the Roopu having a good understanding and use of GIS, the focus of the Participatory GIS process was applied to all disciplines of the project. Participatory GIS was incorporated in areas of the research where possible. Where there was interest and a need, Participatory GIS was applied.

6.2.3 Interest of other External Organisations

Involving external Māori responsive research organisations had an important influence on the Participatory GIS process. Whariki, Māori research arm of Massey University was one of the external organisations assisting Te Roopu Taiao o Utakura where possible. These organisations assisted by providing material and technical support throughout and accompanied the Roopu. As these organisations understood the Roopu’s concerns and supported their motive, the Roopu trusted these organisations and appreciated and accepted their views and suggestions.

In this way these organisations influenced the Participatory GIS as well as the entire research. In the case of Te Roopu Taiao o Utakura, the external organisations strengthened Participatory GIS by emphasising participation and Roopu empowerment. The suggestions regarding the area of GIS application by the external organisation were also taken on board.
by the Roopu. With the value of GIS known, Participatory GIS application was stirred by the external organisation to focus on the area of significant benefit the Roopu as well as accomplishing the role of Participatory GIS.

Although not shown in Figure 19 the factors that influence Participatory GIS are inter-linked and mutually affected each other. This inter-relation brought further complexity to the Participatory GIS implementation by Te Roopu Taiao o Utakura, such as when funding restricted the application of Participatory GIS. This complexity due to the inter-relation did not have a negative impact on the outcome but it did cause delays along the way. The delays were cause to address new concerns arising with inter-relationship of factors that influenced Participatory GIS. The freshly raised concerns were seen as an affirmative effect; it brought forward any issues and concerns that were not dealt with previously, leaving no room for protest afterwards.

**6.3 Limitation in this study**

Given the objectives of the study, the major limitation was time. Due to inadequate time, the focus of the Participatory Rural Appraisal Process was done only on a few applications of GIS. It would have been ideal to show the application of Participatory GIS fully. Time also restricted the full use of the Participatory Rural Appraisal tool, from the wide range of Participatory Rural Appraisal tool only a handful was utilised. Lack of time also required selecting only a few good governance dimensions. The use of more dimensions for assessing Participatory GIS would have added more value.

Another limitation with this study was lack of research conducted around assessing Participatory GIS. This deprived this study of opportunity of being benchmarked. It would have been valuable to comprehend the assessment condition of Participatory GIS with other tools apart from Good Governance dimensions.
7.0 Conclusions and Recommendations

7.1 Conclusions

Objective 1 - Participatory GIS for Māori development.

- The process of Participatory GIS for Te Roopu Taiao o Utakura was based on the selected steps of the Participatory Rural Appraisal process. The six steps employed for the case study were selected due to its appropriateness to the problem being studied.

- The GIS software, the GPS unit and the computer hardware including a wall projector were used. The tools used as mentioned above were found suitable for the purpose without causing any major challenges.

- The Utakura residence and the members of Te Roopu Taiao o Utakura responded to GIS extremely well. The use of GIS was well known and everyone was looking forward to implementing it in the project. Technology being quite accessible, with some training GIS was not difficult to follow.

Objective 2 – Assessment of Participatory GIS process using good governance dimensions.

- The criteria to assess Participatory GIS were based on good governance dimensions. Special indicators where developed that assisted with assessing if the characteristics of the Participatory GIS experience match up with the associated dimensions.

Objective 3 – Applicability and relevance of Participatory GIS in Māori development.

- Relevance of Participatory GIS in Māori development context is defined by the level of and contribution of Participation. Participation contributed heavily to the project hence proved the relevance of Participatory GIS.

- Suitable to economic, political, institutional, social factors demonstrated the applicability of Participatory GIS in Māori development context. Each of the factors mentioned had directives in a Māori context, fulfilling those indicated the applicability of Participatory GIS.
Objective 4 – Comparison between the principals of PGIS to the characteristics of Kaupapa Māori Research

- Kaupapa Māori Research principles are developed around Māori protocols ensuring the teachings of the virtues passed on by the ancestors. Subsequently, Participatory GIS also touches on those principles rather exclusively compared to Kaupapa Māori Research principles. Kaupapa Māori Research principles were designed particularly for Māori; catering specifically for Māori. On the contrary, Participatory GIS principal are extensive principles proper for a wider audience.

- Kaupapa Māori Research creates a conformable atmosphere for Māori to open up to and be heard. Participatory GIS prompting open and fair discussions, ultimate flexibility together with no favouritism or biasness is equally welcoming.

7.2 Recommendations - for future research

After processing the results, compiling the discussion and the conclusion of this study, I would like to suggest some areas of further study and research on participatory GIS as follows:

- Participation is a very important part of participatory GIS. However, in this study its measure was absolutely qualitative. The qualitative nature of participatory GIS makes it very challenging and complex to measure. Further research looking into quantifying participation will be valuable.

- The use of good governance dimensions in this study was very useful. Further research to develop dimensions to assess participatory GIS would be of great significance. Particular aspects of participatory GIS could be focused on to make the assessment more appropriate given the Maori context.

- This study did not look at the actual cost and benefit of using participatory GIS in monetary terms. Further research showing the monetary cost of applying participatory GIS and its benefits will show a better picture of participatory GIS.
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