Population and Scenario Modelling for Education and Te Reo Maori Investment

C. Iremonger and F. Scrimgeour

Department of Economics, University of Waikato, Hamilton, New Zealand (CATH10@mngt.waikato.ac.nz)

Abstract: Planning and capacity building by indigenous peoples requires insight into potential problem situations that they may face. Population and scenario planning is used in this paper to help indigenous people of New Zealand (the Maori) to make decisions about investment in education and Te Reo Maori that are consistent with changes in population growth. An interactive Microsoft Excel based simulation model was developed, to calculate population growth, numbers in different age cohorts, crude natural increase, child dependency ratios, elderly dependency ratios, and median ages, for 5 yearly intervals up until 2051. Nine scenarios were created based on high, medium, and low crude birth and death rates based on initial Maori demographic datasets from Statistic New Zealand, and the Ministry of Education. Migration and ethnic class jumping was not considered in this model because of the cultural custom of "Whanaunatanga" relating to kinship. Investments in education and the Maori language can be made at different points for each age cohort. Costs are based on Effective Full Time Student (EFTS) costings for early childhood, primary, secondary, tertiary, and community based education. Education and language reports are displayed in tabular form. The model produces three graphical reports, of which two are projections of age distribution at different times under the nine scenarios. These graphs plot the changes in population through time, and have potential use for other types of tribal planning and investment decision-making.

Keywords: Maori; Investment; Education; Te Reo; Language

1. INTRODUCTION

Sustainable human development of indigenous cultures requires that social, human, and cultural capital does not decline unacceptably. The processes of assimilation and urbanisation affects communal traditions and human rights, leading to unsustainability.

A project was initiated to determine possible scenarios for Maori tribes (indigenous to New Zealand) if different investments were made under different population scenarios. The population scenario planning model (PopulationMOD) includes Maori customs in relations to tribal membership or kinship based on genealogy called "Whanaunatanga". Whanaunatanga is the Maori design for social integration, and transcends geographical boundaries.

Marginalisation of Maori people occurred during successive periods of "under-education" policy. This policy impeded additional investment into Maori education and language. Low State investment in education and language was compounded by low Maori investment as a consequence of land alienation.

The result was migration into the labour market, as any capital remaining was used to pay for life-supporting services after the New Zealand Land Wars.

Indirectly, land alienation and urbanisation has had major intergenerational effects that persist today. Maori tend to be ill prepared financially, socially, and education wise for a market economy, limiting their participation and attainment in higher learning.

This paper describes challenges to Maori investment in education and language. It outlines a prototype population scenario model that can be used by Maori tribal planners to guide education and language investment.

2. MAORI EDUCATION

Traditional Maori education involved the use of song, games, stories, practice, and group learning activities. Education and language investment was spread amongst the tribal members at very low effort and hence cost (Hemera, 2000).

Talented individuals were selected at a young age to study natural sciences, medicines, art, and philosophies in traditional learning places called "Whare wananga" (a house of learning) [Hemara, 2000].

Currently, Maori education involves two streams, the New Zealand Education Curriculum and the Maori curriculum (Te Whaariki) taught in preschool language nests called "Kohanga Reo". Ahuru Mowai is the name given to the Maori dimension of "Parents as First Teachers" program to for infants by the Early Childhood Development Unit and is based on Te Whaariki principles [Ministry of Education, 1996]. Primary and secondary language immersion schools (Kura Kaupapa) teach under a curriculum specifically catering for their age group and language learning and were establishes in 1985 after the obvious success of Kohanga reo. Maori tertiary institutes (Whare wananga) specialise in different aspects of Maori culture such as crafts, medicines, performance, development, and management. Alternatively bilingual educational units may exist within mainstream education providers, kindergarten, schools, and institutes. Immersion schools teach 100% of the time in the Maori language, whereas Bilingual units teach in between 0-80% of the time in Maori and the rest of the time in English [Ministry of Education, 2000].

Studies on Maori immersion education show that students under this form of education tend to have more confidence, have more leadership, have better cognitive and linguistic skills compared to Maori students in mainstream schools. Also, family participation in a child's learning is higher and children have better access to resources compared to their mainstream counterparts where resources are more barriers to resource use and education attainment for Maori [Carkeek, et. al., 1994]. This is important because attainment levels for Maori have been low (in comparison to other New Zealanders) due to institutional barriers, cultural barriers, and costs of entry (although some grants and scholarships are available for people on low income) [Chapple, 2000].

Beyond secondary school Maori youth have four tertiary education options: university, polytechnic, teachers college, and whare wananga. Alternatively, community based education through private training, government funded courses, TV programs, or apprenticeships are also an option. Graduates will then contribute to the knowledge level of the tribe and be able to be used in increasing the productivity and wealth creation.

3. METHODOLOGY

This study uses a mixture of qualitative and quantitative information to determine various scenarios .

3.1 Data Collection

Statistical data was collected from Statistics New Zealand's Census 1996 on tribal groups. Information was also obtained from the Ministry of Education, and the Ministry of Maori Affairs.

3.2 Issues Collecting Data

In most part information was not comparable due to changes or differences in collection practice and definition of statistical indicators. There is also difficulty in getting tribal specific data because many surveys have homogenised people into a single Maori ethnic grouping and not individual iwi (tribal) groups. As a consequence information from Census 1996 regarding the percentage of each tribal group in relation to the total Maori population will be used to adjust the single Maori ethnic data to get a estimated proportion for that particular tribe until the results of the 2001 New Zealand Census are published. Over time individual Maori tribes will be undertaking their own census.

3.3 Cohort Analysis

Cohort Analysis method is used in studies to describe an aggregate of individuals having a significant common event in their life histories, such as year of birth (birth cohort). The concept of cohort is useful because occurrence rates of various forms of behaviour are often influenced by the length of time elapsed since the event defining the cohort--*e.g.*, the rate of fertility is influenced by the event of marriage and other economic, environmental and social circumstances.

Cohort Analysis is used to identify significant trends and possible policy needs to address future outcomes . This will be done through:

- Identifying significant age intervals and their populations, and establishing age dependency ratios for youth and elderly.
- Identifying inequities through Lorenz curves, Gini index, and intergenerational trends through regression analysis, and integrating this information into the overall model. This has yet to be done for each tribe in the study.

3.4 Population Modelling

Population models are based on measuring a number of parameters including initial population size, time, birth rate, expected age, death rates and identifying the relationships between them.

Population size can be measured at any point in time, where population growth is a function of the existing population size, the number of births, deaths, migrants and emigrants (Ehrlich and Erlich, 1972).

$$P_{t+1}=P_t+B-D+I-E \quad (1)$$

Where
P_t=*population size in time t*
B=number of births
D=number of deaths
I=number of people immigrating
E= number of people emigrating

The use of equation (1) has been modified to incorporate the Maori value of Whanaunatanga (Equation 2) and initial population size. Even though a family a tribal member has moved to another area, they are still part of the tribal group, and hence still included in the tribal population.

$$P_{t+1} = P_t + B - D \quad (2)$$

For the purpose of this model the natural increase will equal population growth rate r per time interval t (Equation 3).

$$R = B_t - D_t \quad (3)$$

An age specific death rate (Lx) was used as a transfer co-efficient between different age cohorts and age intervals. This is calculated as the difference between the numbers of individuals in cohort x and cohort x+1 (or $Lx= l_x - l_{x+1}$).

Age dependency ratios are used to determine "retirement" and "youth effects" that occur in a population. This can identify where policy needs to be prioritised.

Three age dependency ratios were calculated:

- *Rangitahi (youth) dependency= (% of individuals aged 0-15)/(% of working age population aged 15-64)*
- *Kaumatua (elderly) dependency=(% of individuals aged 65+)/(% of working age population aged 15-64)*
- *Katoa (total) dependency={(% of individuals aged 0-15)+(% of individuals aged 65+)+(%unemployed)}/(% of working age population aged 15-64)*

Further population models relating to enrolment in education are discussed later.

3.5 Casual Looping And Modelling

Although Excel was used for modelling the population, there is difficulty in showing the complete relationships in a spreadsheet. Hence the authors have used casual loop modelling to identify the key variables and to structure influences that affect education and language investment. Key leveraging points are identified and expressed mathematically instead. The casual loop model is a image embedded in the Excel program and has no other functional roles except to identify relationships, systems, feedbacks, and drivers.

Any significant historic events that have affected any cohort are noted and interventions points developed through dynamic modelling. Sensitivity tests are used to gauge the sensitivity of model parameters and the initial value, and to identify areas of greatest improvement (key leverage points) in the system.

The possible future needs for the cohort and any possible policy outcomes are developed through scenario planning.

A computer simulation model based on the casual loop (influence) diagram (Figure 1) has been constructed. It identifies stocks, and the structural relationships.

The model can be simulated over time and tested for model stability. The model's behaviour can be compared with historic trends or hypothesised references. Sensitivity tests will be performed to gauge the sensitivity of model parameters and initial values.

The model will be used to design and test policies, to address issues of concern to management and to look for system improvement. Later, test strategies will be used to identify where other improvements can occur in the model.

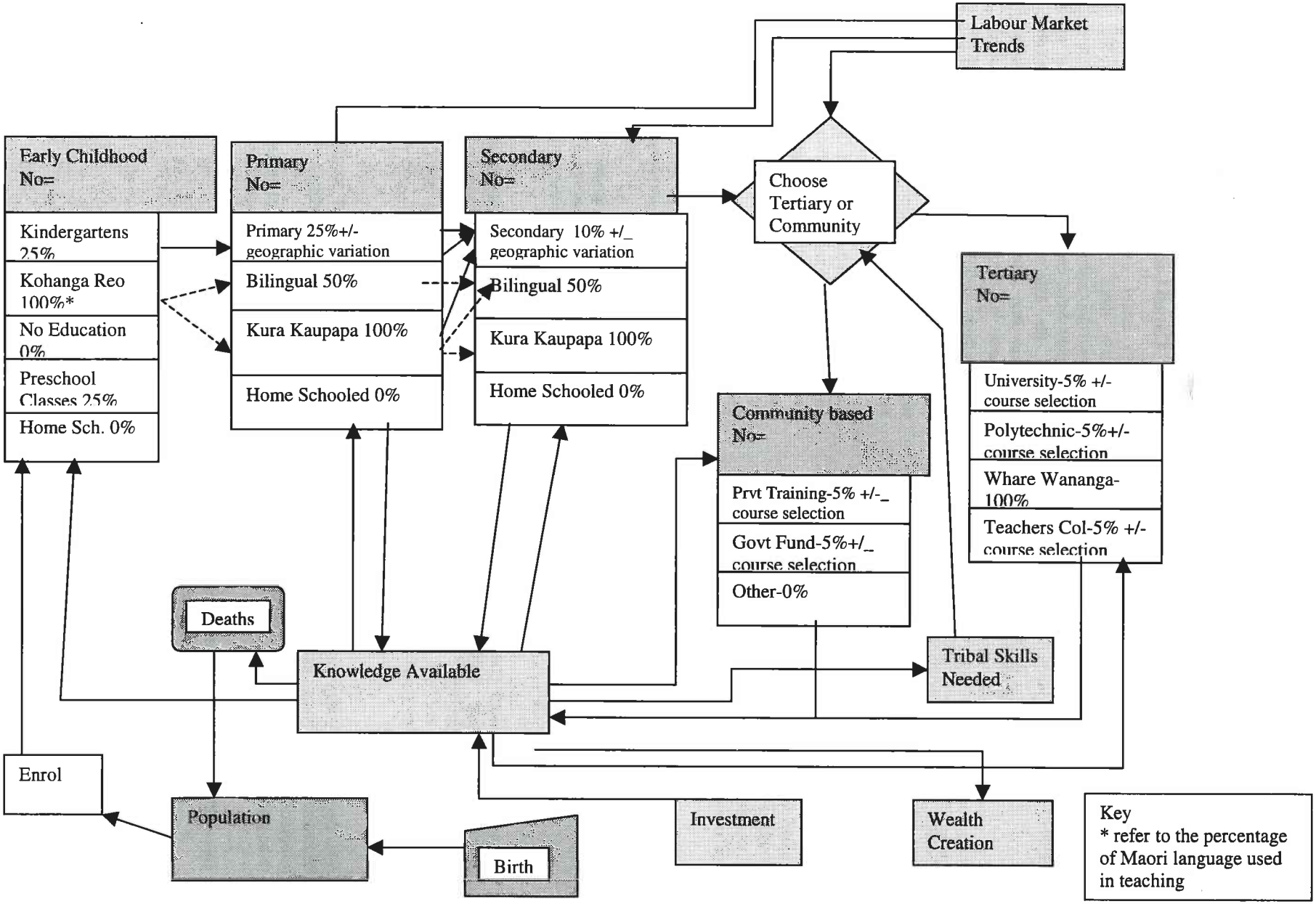

Figure 1: Maori Education and Language Casual Loop Model

4. EDUCATION FUNDING REGIMES

Generally education is paid for via the Ministry of Educations budget (Eb) or through investments from private funds from Maori (Mi). Management of Maori education occurs via the Ministry of Education controlling the Maori curriculum in the Mainstream. Due to low performance of Maori in mainstream education, the Kohanga reo (language nests) movement was initiated in 1982 to foster Maori education and language [Else, 1997].

Kohanga reo is managed by an incorporated society and currently has over 600 language nests catering for around 48% of Maori preschool children each year. Until recent times. Kohanga reo was funded mostly by parents of the children attending. Currently, Kohanga reo is funded similarly to other kindergardens and preschools.

Kura Kaupapa was established to cater for the Kohanga reo children reaching primary school age. Kura Kaupapa also have their own council that oversee the management of the Maori immersion curriculum, and are also accountable to the Ministry of Education.

In 1992 the New Zealand government increased the cost of tertiary fees for individuals and introduced student loans [Maani, 1997]. Tertiary funding for providers is based on student enrolments in courses leading to quality assured qualifications and is designed to subsidise the cost of tuition for each domestic student studying at that provider. It is based on the EFTS funding formula. The EFTS subsidy is up to 95% of course fees but this varies between institutions and courses. In the model, Maori tribes can determine a level of subsidy based on a percentage of the EFTS value.

Government Departments also provide funding for public education and communication to enlighten people about proposed policy changes and access to information. These are often provided in the form of a contract arrangement.

Alternative funding can be sourced through Maori trust funds that were set up by government to collect interest off Maori owned assets. Although the rents off Maori assets are minimal, and there are issues surrounding distribution, education scholarships are seen as an equitable way of distributing rents and hopefully provide for successful future development of Maori people.

An important issue is the relationship between private and social cost and benefits between a Maori student and the Maori tribe to which they belong. It also plays a part in the future of tribal survival.

For example there maybe benefit in teaching youngsters language skills in order to communicate and pass knowledge that is not communicable, understandable, or translatable in English, when the individuals earning potential is low. Older individuals may have larger costs because they may have to give up employment and higher net returns for education investment are over a shorter time period [Maani, 1997].

For the individual private investments in education relate to time, forgone income while studying, tuition costs, and education related costs. The pay-off for the individual is higher economic productivity, and higher earning potential for in the future for themselves.

There may be social benefit if a tribe subsidizes an individual a grant or scholarship in order to aid future development, and bring new skills back to the tribe.

If the individual has incurred large education costs through student loans, then they are likely to seek work from the highest bidder. In most cases means out of the tribal region and indirectly "short changes" the tribe, unless direct employment is offered within the tribe is agreed upon under a contract.

5. SCENARIO PLANNING

The Population Scenario Planning model (PopulationMOD) produces graphical and tabular output for the base case of the model, and for different scenarios. Showing age distribution profiles, age dependency profiles, and population growth under nine population scenarios based on changes in birth and death rates, showing changes in population growth from year 2001 to 2051.

Scenario development concepts from Cavana and Maani [2000] and Ringwood [1998] have been used within the model.

Key drivers for change, uncertainties, and factors that could have significant impact on the decisions policies and strategies will need to be identified and evaluated.

Optimistic scenario and pessimistic scenarios can then be developed, checked for internal consistency and used as learning scenarios for the tribes to trial. Alternatively, tribes will then create their own scenarios to see how they fair with the model. The model will then be redesigned if necessary to ensure that model outcomes are consistent with assumptions and data pertaining to various attributes, variables, and parameters obtained from historical base examples.

These scenarios are then used to identify possible implications concerning demand for education and language at different time periods, and what would be needed to leverage investment so that Maori education and language attainment goals are reached. The model can be used to evaluate the performance of iwi policies and strategies.

6. CONCLUSIONS

The PopulationMOD model provides an opportunity to explore possible futures for Maori tribes. This prototype model can be enhanced to address more complex investment questions.

It is hoped that this model is used for designing management strategies, policies, and in tribal investment decisions. Scenarios are extremely flexible making them particularly suited to explore the social, economic, cultural, and environmental changes, which give, rise to changes in Maori Sustainable Development.

7. ACKNOWLEDGEMENTS

This work has been supported by the New Zealand Foundation for Research, Science, and Technology.

8. REFERENCES

Carkeek, L., L. Davies, and K. Irwin. *What happens to Maori girls at School?* Victoria University, Wellington, 1994.

Cavana, R.Y. and K.E. Maani. *Thinking and Modeling; Understanding change and complexity*, Pearson Education New Zealand Limited, New Zealand, 2000.

Chapple, S. *Maori socio-economic disparity ; Paper for the Ministry of Social Policy Seminar*, Labour Market Policy Group, Department of Labour, Wellington, New Zealand, 2000.

Coyle, R.G. *System Dynamic Modelling: A practical approach*, Chapman and Hall, Glasgow, U.K., 1996.

Ehrlich, P.R. and Ehrlich A.H. *Population Resources Environment; Issues in Human Ecology*, (2nd Editions), W.H. Freeman and Company, San Francisco, 1970.

Else, A. *Maori Participation & Performance in Education: A Literature Review and Research Programme*, Ministry of Education, Wellington. Web Document http://www.minedu.govt.nz/web/document/document_page.cfm?id=4258&p=1063, 1997.

Hemara, W. *Maori Pedagogies: a view from the literature*, New Zealand Council for Education Research, Wellington, New Zealand, 2000.

Maani, S.A. *Investing in minds ; the economics of higher education in New Zealand,* Institute of Policy Studies, Victoria University, Wellington, New Zealand., 1997.

Ministry of Education *Early Childhood Education-Te Whaariki*, Ministry of Education, Wellington. Web Document http://www.minedu.govt.nz/web/document/document_page.cfm?id=3567, 1996.

Ministry of Education *Making Education work for Maori, Ministry of Education*, Wellington. Web document http://www.minedu.govt.nz/web/document/document_page.cfm?id=3879&p=1063, 1997.

Ministry of Education *Contents of A Guide to Tertiary Education Funding,* Wellington, New Zealand. Web document http://www.minedu.govt.nz/web/document/document_page.cfm?id=4974, 2000.

Pollard, J.H. *Mathematical models for the growth of human populations*, Cambridge University Press, Great Britain, 1973.

Ringwood, G. (1998): *Scenario Planning: Managing for the Future,* Wiley, New York, 1998.