Technology transfer and training in forest and natural resources education – a New Zealand case study

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Abstract

Education for Forest and Natural Resources has been evolving in the Taranaki Region of New Zealand through a local **Resource Group** formed in 1991. In the new education environment, **strategic alliances** are necessary with institutions and industry to make programmes work. Programmes that must be credible, audible, flexible and suit the end users involved. The tertiary programme described in this paper has been designed to address sustainability and the New Zealand Resource Management Act (1991) with a common link between research, technology, education, skills, people and the land. Adoption of **management systems** and application of appropriate technology to enable people and the community to provide for social and economic wellbeing is currently being instigated and developed. Technologies like **GPS/GIS/Remote Sensing, Internet and Interactive New Media** with decision support systems are now being trialled and integrated into a core Diploma Programme of Forest and Natural Resources. The programme is supported by "**model site**" land based farm forestry locations that provide exemplary forest practices and research opportunities for students and the community to participate in. These model sites feature in the 1999 New Zealand National Farm Forestry Conference in Taranaki.

1 Introduction

Effective training for the forest and natural resource industry is only possible through close co-operation between industry, education, landowners and students.

It is essential to develop structures from the ground up and build on community support that includes en-

vironmental issues suited to local conditions.

The combination of the above components can lead to the formation of practical demonstration areas (model sites). With the addition of distribution technology, plus Internet interactivity concepts, information can be shared on a national and international basis.

For New Zealand, Taranaki Polytechnic has developed the first truly integrated, yet practical learning experience to match and enhance sustainable forest and natural resource needs.

2 The programme

Within New Zealand there are seven Universities and 25 Polytechnics. Polytechnics are educational institutes that offer an increasingly wide range of vocational education programmes from skills training, pretrade, Diploma and more recently Degree Programmes.

In 1991 a small resource group of individuals and organisations came together to address the formation of a credible structure to support and maintain land based education, skills and research in the Taranaki region of New Zealand. The resource group approached the Taranaki Polytechnic to start a programme. The group could see a role for agroforestry as the traditional farming practices of raising sheep and beef cattle on marginal hill country were becoming less cost effective. Product values for sheep and cattle were decreasing and product costs were increasing. As well, environmental legislation to enforce sustainable land use such as soil loss and water quality, was being introduced. Historically, marginal land was inappropriately cleared for pastoral farming. As a result erosion control was increasingly required. Strategic afforestation of hill locations and riparian areas was needed.

The New Zealand Government's Forest Research Institute had developed a computer model (Agroforestry Estate Model "AEM") based on a local farm. The farm owner, Jeremy Thomson, is a member of a local resource management group (refer to Programme Infrastructure Illustration Link). He requested a model be developed to illustrate the consequences of varying regimes of livestock and trees on farmland. Another relevant development was a case study in the region co-ordinated by the Taranaki Regional Council (Local Government). The study aimed to apply results of recent research of pasture growth and soil erosion to existing farm systems. The project involved developing a sustainable land use classification system for the region. This system combined with the computer model (AEM) was used by the Regional Council to provide sustainable land management plans for farmers.

The Regional Council, having a role and interest in land conservation, provides the management plans free of charge. The plans incorporate agroforestry in a practical and sustainable way. By 1998, over 100 plans had been completed at the request of farmers. Implementing the plans is the responsibility of the farmer, not the government. A highly

skilled workforce was required. The Taranaki Polytechnic has a model site where the system has been implemented (Fig. 1, Fig. 2).

Thus the scene was set in 1991 with decision support systems and an environment where people wanted to develop the skills and knowledge to afforest land. The Taranaki Polytechnic hired me on the recommendation of the resource group. The group represents the local region through individuals, groups, trusts, forestry contractors, multinational companies, nurseries, sawmills, local government, conservation bodies and indigenous peoples. This group wanted to authentically address sustainability of the land for future generations and ensure the education of people to take care of it. The farmers felt the education system was failing to recognise their interests. They wanted practical and management skills to be taught – practical skills that included silviculture of special purpose tree species and management that included agroforestry and wider issues than traditional plantation forestry.

A vocational skills programme was started to address the afforestation of hill country land in the region. Members of the farm forest industry

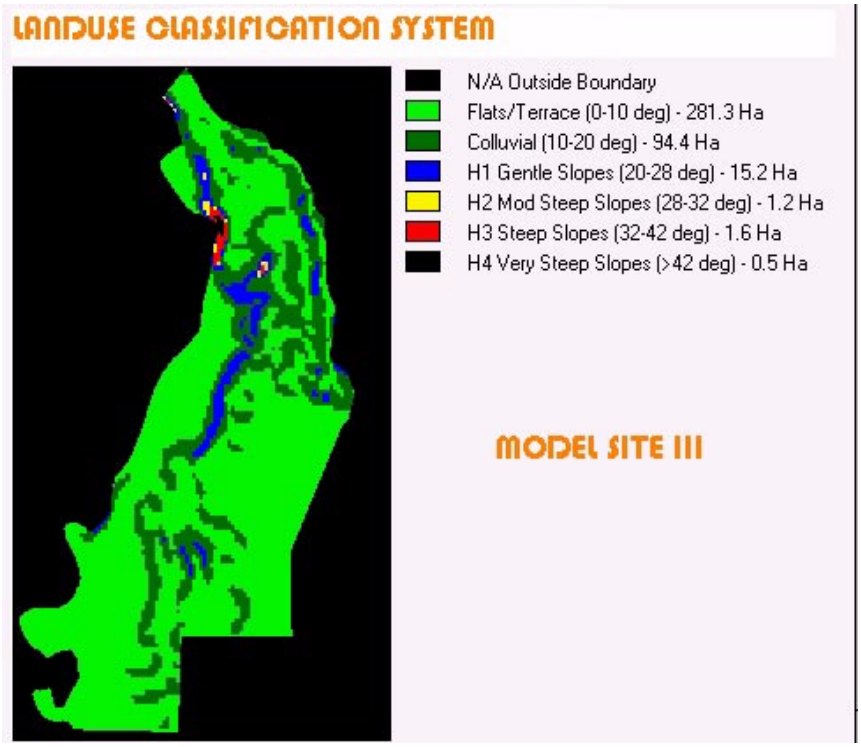

Fig. 1. Sustainable land management plan; a model site at Taranaki Polytechnic.

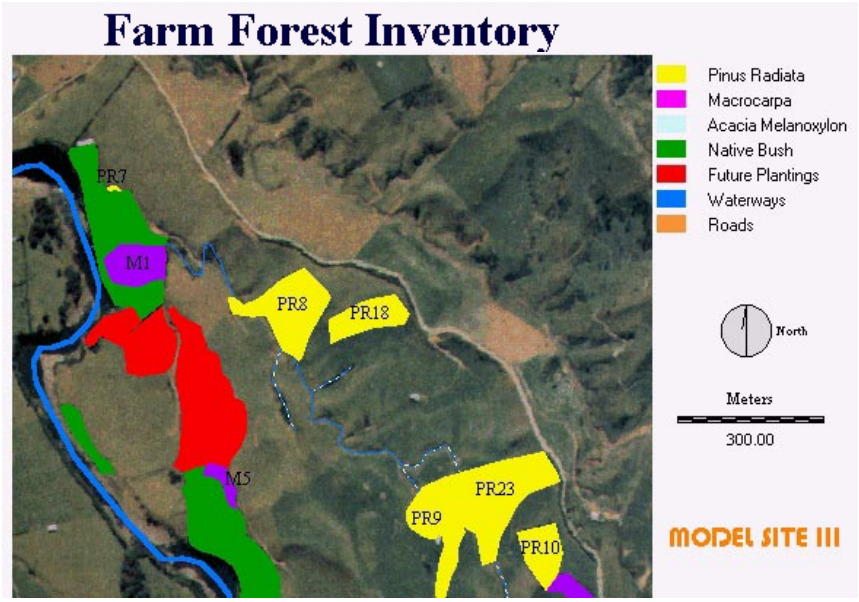

Fig. 2. Planting area's per classification system.

supplied the tools and plantation sites and the Taranaki Polytechnic provided the trainees, supervision and forest management. Upon completion of the skills programme, surveys showed that students were immediately employed by contractors.

As regions throughout New Zealand began to experience a planting boom on farm and hill country land (outside the traditional plantation industry forest land base) it became evident that people with supervisory and management skills were needed. As a response to this, the Taranaki Polytechnic developed and implemented a diploma programme to complement and extend the skills programme. The situation has evolved and continues to develop into a programme of national repute. The stakeholders are satisfied and student graduate surveys clearly show high employment outcomes. Strategic alliances with the scientific community, forest industry and technology providers have been achieved for the benefit of all. An Integrated Programme Infrastructure has evolved at the Taranaki Polytechnic.

Over the years the New Zealand Farm Forestry Association of it's own accord has become increasingly a professional organisation and respected lobby group. Estimates are Association members in the upcoming years may control up to 25 % of the exotic plantation base currently estimated at 1.5 million hectares. A more recent initiative by the Taranaki Association branch is The Tree Growers' Marketing Society. The Society is a co-operative formed and managed by farmers to collectively harvest and market timber.

3 Infrastructure highlights

3.1 **The Academic Programme (refer Reference 11)** encompasses a two year Diploma in Forest and Natural Resources. Practical forest tending skills, management principles, alongside ecological principles and GIS/RS are all part of the programme. Field training is carried out in model research and development forest and land locations throughout the region. A national certificate in Geographic Information Systems ("GIS") has recently been designed by an industry training organisation. This two year certificate may be developed by the Taranaki Polytechnic and linked with the current Diploma in Forest and Natural Resources.

3.2 **The Tuwharetoa Institute of Learning** is an Indigenous people (Iwi) managed organisation that is associated with the Taranaki Polytechnic. Together we have developed and run vocational skills programmes that suit not only their own Iwi but many other people who are involved in the contract forest industry. An objective of the Iwi is to be self sustaining in their education and business environment for future generations.

3.3 To date the **Research Programme** has established over 50 Permanent Sample Plots (PSP) of varying tree species on forest and farm plantation area's throughout the region (Fig. 3, Fig. 4). These provide a base for initiating growth models and further research opportunities for staff, students and interested parties.

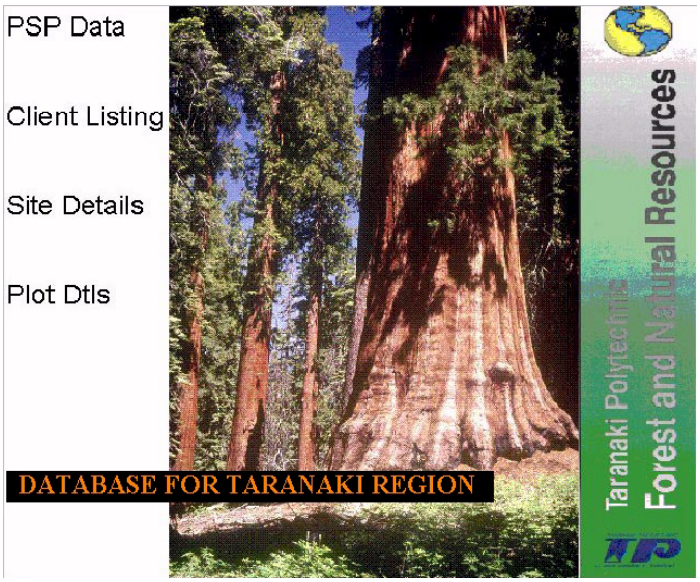

Fig. 3. Permanent sample plots: an overview.

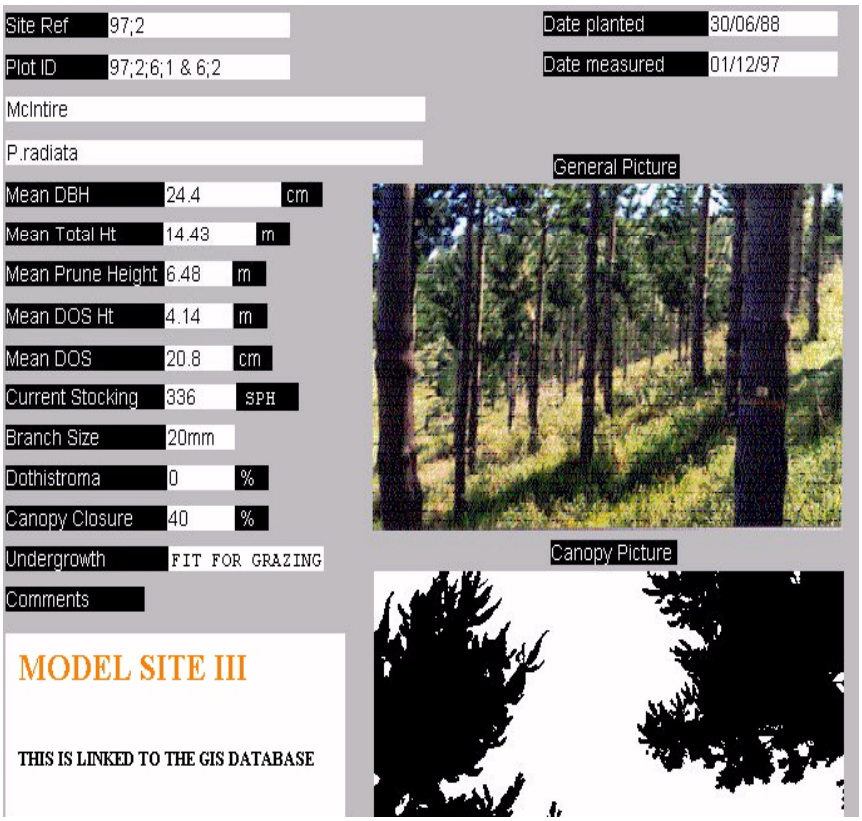

Fig. 4. PSP database; an example of plot details.

Tree root studies are also being researched on a model location (Fig. 5, Fig. 6, Fig. 7). Wind throw on fertile farmland has been a problem with *pinus radiata*. Preliminary results show direct set seed or direct set cuttings have the best root structures. The maintenance and economics of such results requires further investigation. Recently the Taranaki Polytechnic has been negotiating a research contract with Jiffy Canada to trial their nursery and field products for tree establishment.

Several GIS and Remote Sensing ("RS") Projects have been started with students using low level Idrisi software to capture and compile attributable data from model sites. For extended learning and industrial applications, this data will be imported into a higher level software package. This will form the basis for spatial technology application and extensions like monitoring or modelling.

3.4 **The Model Sites Programme** provides areas for the community and students to participate actively, as students complete all silviculture work on the sites. Income from the student work contributes to the pro-

A COMPARISON BETWEEN THE ROOT MORPHOLOGY OF YOUNG RADIATA PINE ESTABLISHED AS NURSERY GROWN TRANSPLANTS OR BY DIRECT PLANTING OR SEEDING

TRIAL SITE- McINTYRES PROPERTY

INGLEWOOD

TARANAKI POLYTECHNIC MODEL SITE II

Fig. 5. Tree root studies.

THE STABILTY OF TREES DEPENDS ON THE STRENGTH AND SHAPE OF THEIR ROOT SYSTEMS

TREES THAT ARE GROWN IN NURSERIES HAVE THEIR TAPROOTS REMOVED

TREES THAT ARE GROWN DIRECTLY IN THE FIELD DEVELOP TAP ROOTS AND AS A RESULT THEY ARE MORE STABLE

- Older literature and common sense link taproot development and stability
- Current research is directed at describing tree instability (toppling) and determining the likelyhood of this happening.
- Some research is being directed at repairing damage
- The forestry nursery industry is well established as part of current production systems
- Understandable reluctance to "look outside the square" at systems of direct planting without using nursery grown material.
- Possible cost benefits as well as improved stability.
- Current experiment compares a range of planting material which may develop individual root systems to direct seeded trees and direct set cuttings.

Fig. 6. Root documentation.

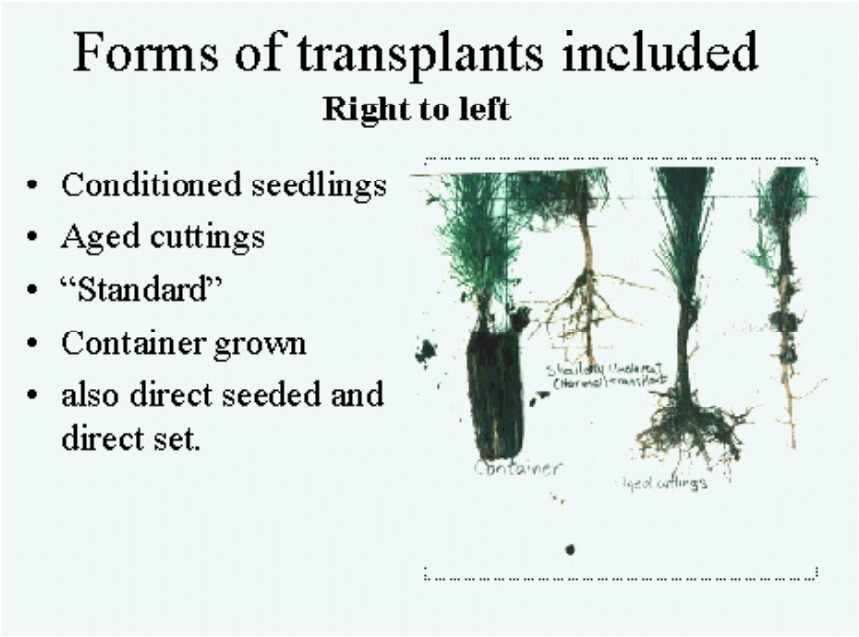

Fig. 7. Seedling roots.

gramme costs and resourcing. The criteria for model sites includes diverse locations of differing geographic, ecological and socio-economic circumstances. A mix of private land, trust farms (Fig. 8, Fig. 9), school and company locations are included. The landowners involved must be enthusiastic and in favour of education and research principles. In fact the programme is so successful we continually receive additional offers of sites. Landowner participants enjoy seeing people learn skills and apply the latest technology on their land (Fig. 10). They are perfectly willing to pay market value for the services provided as long as the workmanship is reasonably guaranteed. Several of the model sites were featured on the tour programme for the New Zealand Farm Forestry Association Conference in March 1999.

3.5 **The Resource Group** or Advisory Committee is a statutory requirement of the education system in New Zealand. It is an excellent vehicle whereby the community gets together and decides collectively on their educational needs. The Resource Group comprises the stakeholders referred to in the Programme section.

As Taranaki Polytechnic representative and Programme Manager it is one of my priorities to foster this group and ensure stakeholders are involved in objective setting and feedback.

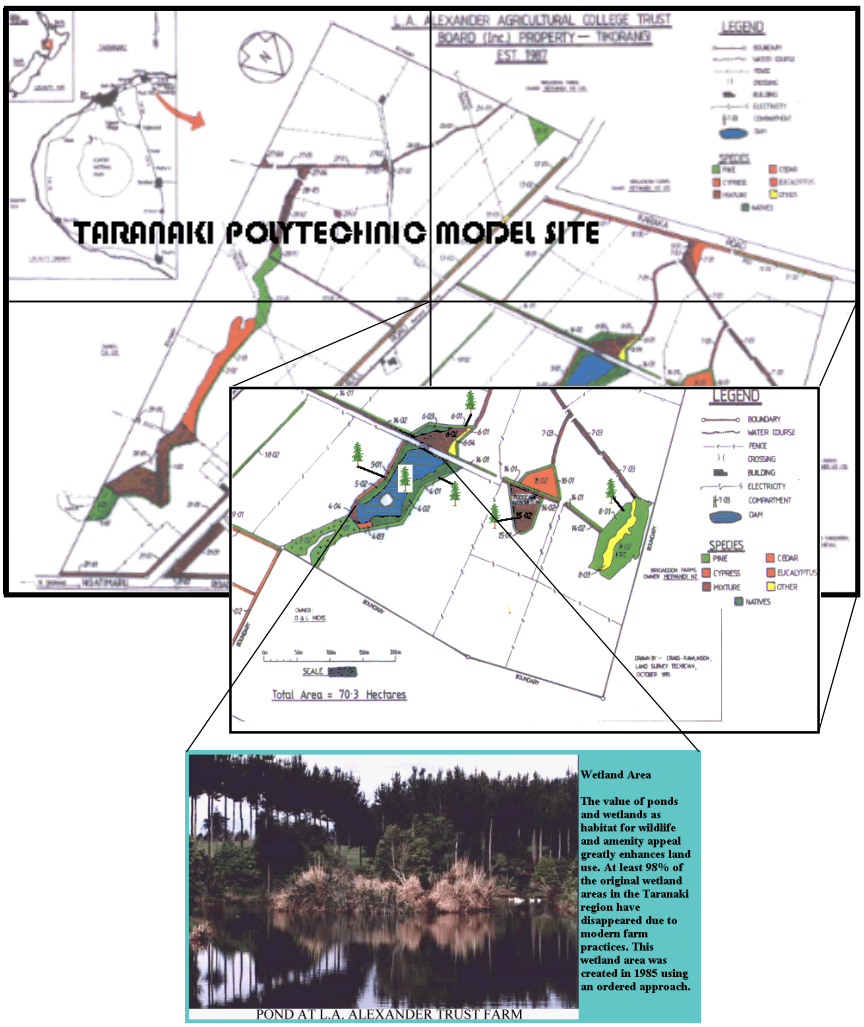

Fig. 8. A trust farm (model site).

3.6 **The Forest and Natural Resources Programme World Wide Web (WWW) Site** is currently being developed by students as a project. It will link directly with the existing Taranaki Polytechnic WWW site and possibly other associated educational or Forestry WWW sites. The basic format of the site is evolving from the Programme Infrastructure. (Refer to Taranaki Polytechnic Integrated Programme Infrastructure link). Appropriate data from the entire programme structure will be placed on the WWW.

Fig. 9. "Learning by doing"; students at field.

Fig. 10. A plantation at model site IV.

3.7 **The GIS/RS Co-operative** is modelled on the College of Geographic Sciences Programme. Industry specifies GIS/RS research projects they would like done by Diploma students during their course of studies. The Taranaki Polytechnic provides the research facilities, supervision and hardware. To date sponsorship of software is being negotiated with representatives of international companies including Autodesk Inc, ArcView, E.R.Mapper and Map Info. An Australian Software company Digital Mapping Systems has contributed orthorectification software for the co-operative to trial. The co-operative is an ideal environment for strategic alliances to occur for the good of all stakeholders.

3.8 **The GIS Extramural (Distance Learning) Programme** is a GIS Introductory Certificate offered by the Taranaki Polytechnic to suit people who have distance learning needs. An arrangement was made between the Taranaki Polytechnic and the College of Geographic Sciences, Canada, to import the Canadian Distance Learning Programme into New Zealand. Modification of the data sets to suit local conditions is currently being done. It is envisaged that this localised distance learning programme will be available on the Internet or through the interactive

new media in the future to service New Zealand needs.

3.9 **The Forestry Tending and Technical Services** have evolved from the active management of over 600 hectares of forest and farm plantation model sites. Taranaki Polytechnic students have planted over one million trees since programme inauguration (Fig. 10). Planting sites vary from farm locations and private investor type ventures to multinational company block locations like Carter Holt Harvey Limited.

This service creates opportunities for the Taranaki Polytechnic staff to practise their profession, students to gain practical skills and the greater community to benefit from work well done (Fig. 11). If the Taranaki Polytechnic can not immediately service the model sites then preferential contractors who hire students pick up the balance of tending work.

As an example of Taranaki Polytechnic training, a small local company that intensively manages and applies silviculture to 18,000 hectares of forest on ex farm land for 1600 investors recently hired two graduates to suit their companies expanding needs. They have since commented how pleased they were with the graduates who had a good combination of theoretical and practical skills.

3.10 **The Nature Tourism** component is a more recent element and opportunity in the programme to introduce multipurpose land use. Hundreds of people visit the model sites every year. The Australian Department of Conservation and Land Management stated in their nature tourism programme "People not only want to look at trees but they want to know something about them.". Nature Tourism is proving to be a mega dollar industry. Therefore, it seems opportune to introduce students working on model sites to Tourism (Fig. 12). Interested parties will be able to book their tours on the WWW site!

4 GIS / RS education at Taranaki Polytechnic

GIS/RS education was phased into the programme in 1997. This phase was introduced after core issues of

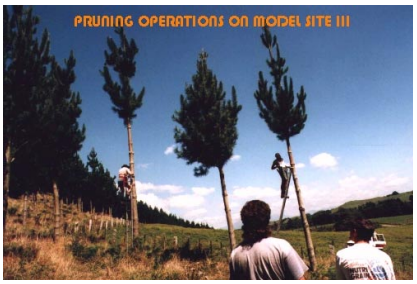

Fig. 11. Pruning on model site III.

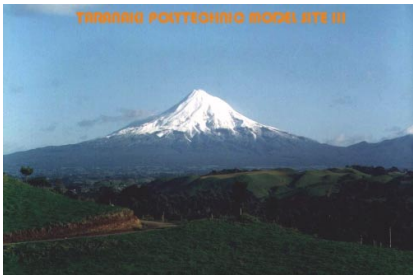

Fig. 12. Model site III; dealing with tourism.

vocational skills training (forest tending) and biological sciences had been established in the programme.

The emphasis on practical skills and experience combined with actual problem solving has produced some excellent students that satisfy industry demands. In the Diploma programme students plan, execute, compile and evaluate real projects. As an example, students are currently completing a forest compartment allocation project for a forest owner. The project is to determine the relationship between slope degrees and aspect to existing tree growth (Fig. 13). Given a relationship, then compartments will be allocated for forest operational purposes. Individual pruning operations are targetted per compartment depending on growth. In the project area trees were planted in 1994 and pruning will commence this year.

5 Technology use

To date, GIS in New Zealand has not been widely adopted. Computer World New Zealand (1997) stated "First and foremost is the perceived high cost of getting started". From our personal experience and contact with industry we would add the old adage "sworn to caution and suspicious of the untested".

For educational purposes GIS/RS technology products are widely available in the market place. The applications are extensive.

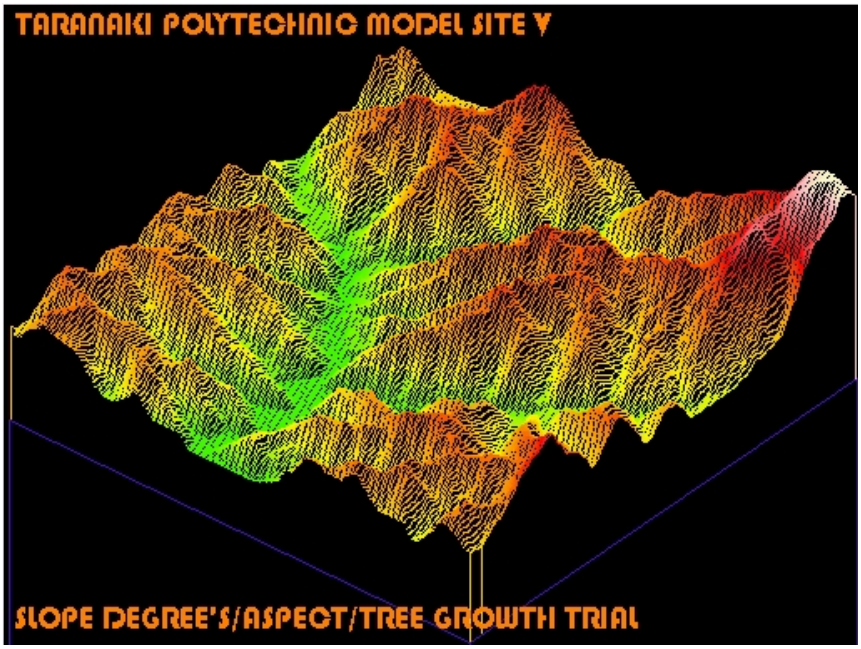

Fig.13. Altitude contour plot of a tree growth trial.

The Taranaki Polytechnic's strategy when adopting software is to ensure:

- It is easy to use
- It can be applied in a diverse range of industries
- It is able to be integrated and combined with other software and data types

Software packages the Taranaki Polytechnic is considering trialling for its programme include Autodesk, ArcView, E.R.Mapper and Map Info just to name a few. Again I emphasise that there is huge product availability from which to select but at the end of the day choices will be cost driven. Software companies have to offer reasonable circumstances for educational institutions to adopt and trial their products.

6 "Interactive New Media"

Established media channels and educational institutions are increasingly being challenged by new forms of distribution and learning. Through information technology, consumers have become aware of an increased range of choice. Developing components of the evolving Interactive New Media may be adopted as a strategy for educational institutes (Fig. 14, Fig. 15, Fig. 16, Fig. 17).

The Taranaki Polytechnic currently offers a Bachelor of Information Systems degree to groups in a interactive new media and internet situation. Recent survey results from the programme seem to indicate face to face contact between student and

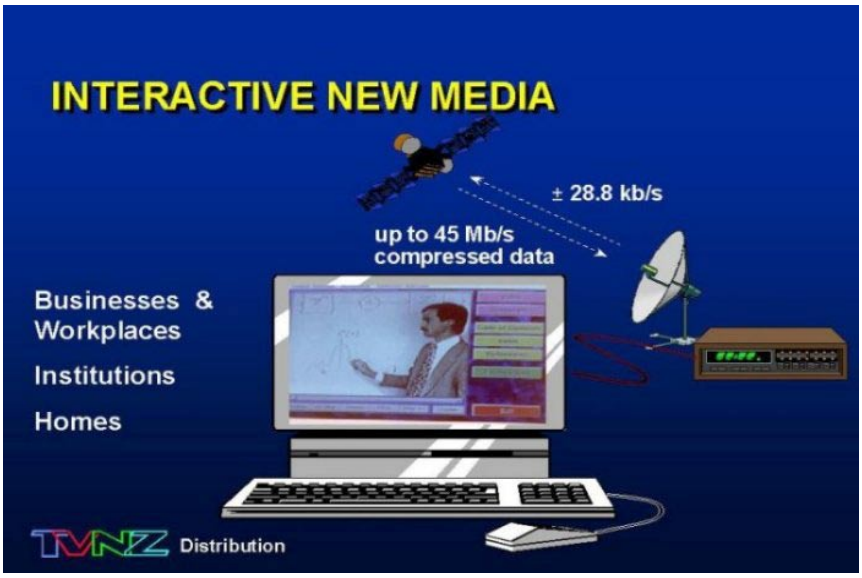

Fig. 14. Interactive new media.

Fig. 15. The global trends.

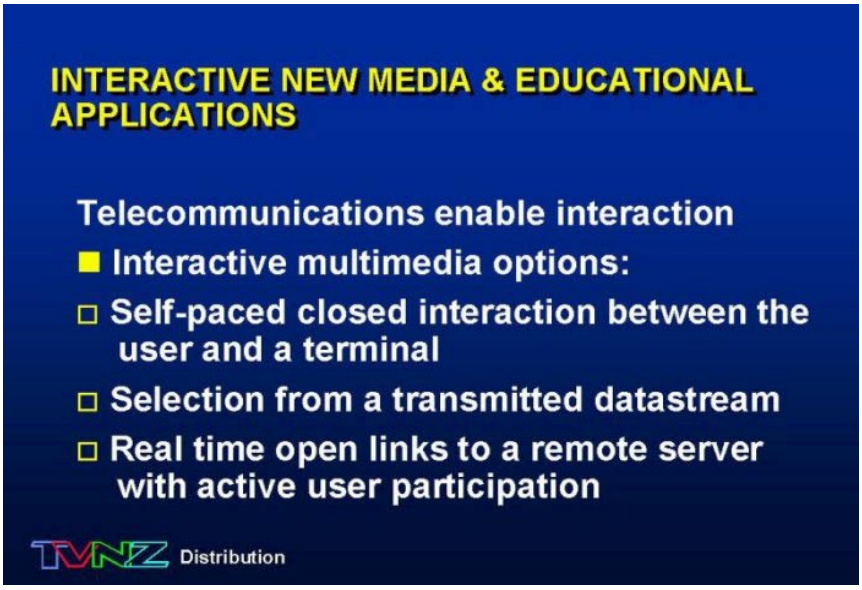

Fig. 16. Edicational applications.

Fig. 17. Business opportunities.

tutor is still the most desired learning means. As a result, the Taranaki Polytechnic's GIS Distance Learning Programme is being investigated. Strategies are currently being developed to include introductory sessions with a tutor in regional centres as well as follow up sessions part way through the year. This will provide opportunity for more face to face contact.

It is planned that databases developed to service the Distance Learning programme and existing Diploma programme will eventually be transferred to server software. Students will have access to this software via an intranet or Internet situation to complete interactive exercises. The server package will be constantly developed and maintained to service educational objectives or strategies using the interactive new media. Initially data will come from the Forest and Natural Resources programme including current research projects. Data could also come from other organisations that link with the programme.

The challenge for educational institutes will be to constantly update and evolve media products and services to meet the higher expectations of a more educated, better equipped, experienced and diverse customer base. The traditional lines between education and work seem to be diminishing as learning becomes a life long process. The interactive new media will play a crucial role in facilitating future learning.

To remain involved, educational institutions will have to develop professional centres that facilitate peoples' learning. These centres will have to be supported with capital and

skill to gathering and process information appropriate to peoples learning needs. The people component must not be overlooked. People make systems work. Educational institutes will have to invest yet further in the professional development of their staff. Keeping pace with new technology and associated learning is a strain on a system that already has financial limitations.

7 Discoveries

The government in New Zealand and no doubt other governments in the world are reducing educational funding. Further research is needed to conclude the positive and negative outcomes of this and the impending implications. People must address issues that affect our society and the environment in which we live. If our educational institutes reflect in part the health of our society, then collectively people must urgently prioritise what they want to achieve.

Developing and implementing an integrated education programme is a challenge. People from the education and industrial world in our society do not necessarily agree on everything. However, an entity and situation like the Resource Group involved with the Taranaki Polytechnic Forest and Natural Resources Programme, can effectively address educational and environmental issues for the benefit of all. People make programmes or systems work. Time and effort is required by many skilled and experienced people from different disciplines.

Strong structures have to be in place before people will invest their resources. Decision support systems (for example land classification schemes and computer models as used by Taranaki Polytechnic) applied in a practical way with integrity on demonstration (model sites) areas, give people confidence to address issues.

People enjoy and learn best by doing, from being involved in practical situations that suit their immediate and foreseeable needs.

8 Conclusion

Technology and information transfer to the education environment is happening in various forms and rates of progress throughout the world. Collectively, strategic alliances involving all the stakeholders can enhance education both locally and internationally.

The New Zealand Case Study presented in this paper with its evolving programme structure, highlights crucial links that can not be separated anymore. A teaching model can not be developed in isolation and the education system must respond to industrial demands. As a result of this approach, Taranaki Polytechnic now has an effective and multifaceted programme.

It is essential to “develop structures from the ground up” and build on community support and environmental issues suited to local conditions. In practice, the educational component must be credible, audible, flexible and suit the stakeholders

involved. For it is the stakeholders who will support and ultimately decide if positive outcomes are going to occur.

Acknowledgements

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