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Indigenous Research Ethics and Agro-ecological Development: Raising the IRE in Biotechnology Transfer

Abstract
Although biotechnology has been an integral component of human history, contemporary research now operates with a precision and level of expertise that marks a significant break from previous understanding. By enabling the manipulation of the basic 'building blocks' of life, biotechnology sciences have had profound impacts in the humanities, including challenges to property rights, economic strategy, research and development policy, and – not least - ethics. In this context, previously isolated eco-social groups have experienced increasing contact and exchange as both purposeful and accidental transfers of biotic components occurs, and the potential for 'recombination' (of DNA, agricultural landscapes, political economies and ecosystems) has dramatically increased.

These new technologies and methods have provoked wide concern as well as hope and excitement. This last point is driven by the coincidence of two developments - advanced biotechnologies and the completion of a 'sociotechnosphere' in which novelty is a commodity. These developments infer two fundamental resources upon indigenous peoples, revolving around biotic and cultural concepts of capital. This paper examines the interplay of agro-ecological and cultural development as it effects the participation of Maori in local and global genetic information networks, and seeks to extend our ethical participation. It does this by locating significant sites in the utilisation of genetic information, thereby identifying the relevant 'ecosocial' institutions to which Maori belong and with whom we should engage.

Key words: biotechnology, ethics, agri-business, Maori development, Plant Genetic Resources.

Introduction
While the reliance of humankind on biotic resources is axiomatic, their actual utilisation is the focus of disputes within and between societies. In this regard, New Zealand shares a common history with a small group of countries characterised by extensive 19th century white-settler small farm agro-ecology (Fairweather, 1985). This beginning has seen an ongoing commitment to a generic assemblage of crops and an associated array of cultivation methods, supplied to increasingly environmentally conscious markets. The phylogenic basis of New Zealand's land-based industries is around 50 species, with just 28 accounting for 99% of cultivated land by area (Halloy, 1994).

Maori participation in this 'biopolitical-economy' of New Zealand has been problematic from the outset of post-contact experiences. By occupying a multiplicity of niches within

European thought and capitalist production, Maori have struggled to regain the initiative in self-determination. The Maori economic base is heavily dependent on biotic resources, predominantly agricultural commodities (see Table 1). Much of this is committed to export, resulting in many iwi and hapu ventures being overly exposed to market volatility and environmental change (Te Puni Kokiri, 2002; NZIER, 2003).

Table 1: Maori Commercial Asset Base (c. 2000-2002) :

Sector	value (1)	%	% Maori prod.(2)
Agriculture	$3,074m	59%	36% ($700m)
Fisheries	$671m	13%	16% ($299m)
Forestry	$501m	10%	2% ($43m)
Business	$945m	18%	
	$5,191m	100%	

1. Although returns were improved for the financial year 2000, much of this is attributable to favourable climatic conditions and the depreciation of the New Zealand currency (Te Puni Kokiri, 2002: 18).
2. NZIER (2003: 9). NB: this table is based on two separate sources and is indicative only.

State-induced research (via government and industry-backed institutes such as the recently established Centres' for Research Excellence) explicitly acknowledges two things. The first is that a vibrant future for New Zealand's economy requires adopting and innovating new technologies. Much of this still focuses on the country's biotic resources, although with the now ubiquitous proviso that it be 'sustainable'. The second is that Maori have a role in processes by which this is to be achieved, explicitly in calls for research and development to be responsive to Maori.

Implicit in this is that Maori be responsive to research. This paper argues that if a robust ethical framework is desired, then the potential(s) of modern biotechnology and their fundamental elements must be identified. To summarise, New Zealand's economy - and Maori disproportionately so - is increasingly dependent on sustainable agricultural and horticultural production and the novel marketing of the resulting produce in a global market. Maori must be able to recognise the implications of research that utilises the genetic information implicit in biotic resources. While some attention has been given to *indigenous* flora (culminating in the Wai 262 Claim, see Harris and Kapoor, 1990; McLean and Smith, 2001; Williams, 2001), the reliance on *introduced* species is rarely noted (see however Roskruge, 2001, and Halloy, 1994). The ethical implications of the reliance of agri-biotechnology research and development processes on Plant Genetic Resources have now reached the fullest global reach that was first 'promised' in 1492 by the great Colombian exchange (Crosby, 1986).

Biotechnology, Ecosociality, and Aotearoa/New Zealand

Technology is a broad term, the defining characteristic of which is that it is never really complete. Ferré (1988: 1) refers to the 'technosphere' - the space touched or reached by human artifacts that stretches from several miles below the earth's surface or sea-level to many hundreds of thousands of kilometers above the atmosphere. This technosphere is comprised of many interrelated sociotechnical systems that enable 'the linkage of

techniques and material culture to the socio-coordination of labour' (Pfaffenberger, 1992: 497). This is best understood as an activity system that involves a wide range of decision-making processes and various communities, both professional and lay.

Looking into Pfaffenberger's 'sociotechnosphere' we observe a mass of biotic and components whose interaction can be said to form a 'genosphere'. This phenomenon has a history that increasingly revolves around manipulation by a highly advanced genotype – *Homo sapiens*. In this world, as David Harvey reminds us, any ecological debate is always a commentary on political-economic organisation (Harvey, 1996). Kloppenburg (1988) and Lyson (2002), among others, have argued that the advanced techniques now available to agricultural researchers are analogous to the reductionist nature of neoclassical economics and provide the framework for turning the traits of plants and livestock into property. As perhaps the most rapidly advancing technology, biology is drawn into the political arena as biodiversity fractures into variously valued resources while remaining a fundamental component of sustainability.

Criticism of modern biotechnology has two main planks. The first stems from the inherent reductionism alluded to above that sees researchers accused of ignoring or seriously underestimating the actual complexities of its subject matter. This criticism extends the analogy of frontier science - a complex research area that is subject to rapid changes in understanding – to 'cowboy' scientists that dismiss or ignore the possibilities of negative environmental impacts (Ho, 1998). The second criticism concerns its relevance, with accusations that this technology seeks to provide answers 'to a false set of questions' (Campbell, 2000: 32). In many respects this echoes the first criticism by drawing attention to the obscurity of processes by which genetic engineering (GE) or modification (GM) is to deliver on (the originally hyperbolic) promises. These concerns have coalesced into an array of political movements that are vociferously opposed to such techniques, particularly in the food chain and in the area of human reproduction where advances now challenge what it means to be human (Mauron, 2001; McKibben, 2003). The domain of 'ecosociality' (that is those institutions that explicitly exist to coordinate the manipulation of living organisms) is facing unique challenges that call for creative debate. In this context, genetic reductionism can be subverted, exposing moral and ethical choices within a political-economic framework: who gets what?

These observations highlight the unique position of Maori in the literature on indigenous peoples and technology which is dominated by case studies that examine the often extreme disparities of knowledge and power evident in technology transfer in developing countries where indigenous groups maintain (not necessarily through choice) a much more separate existence. The research arena has thrown up a number of subdisciplines that include access to Appropriate Technology (AT), the role of Indigenous Knowledge (TK) and Traditional Ecological Knowledge (TEK) and the political alliances between indigenous communities and environmentalists (see Willoughby, 1990; Berkes *et al*., 1995; Gillespie, 1998).

Briefly then, technology can be defined as a process (incorporating political economic and socio-cultural elements as well as scientific institutions) that crystallizes into things,

but only with effort. The point of this paper is that the most valuable of these 'things' - the material outcomes of large-scale, interdisciplinary research and development projects - are increasingly biotic in character, challenging assumptions within those networks that New Zealand's economy (and with it Maori) operates. The survival of eco-social institutions in this context is perhaps more remarkable than their initial establishment. In what ways could advancing biotechnologies force change on the ecosocial institutional context within which hapu and iwi ventures exist? Although the potential of modern biotechnologies has yet to be clearly characterised, it is increasingly clear that the 'public' or lay communities hold a nuanced position (Marris *et al*. 2001). In order to identify where such challenges might originate for Maori, two models are presented as attempts to describe the arena in which conflicting interests interact.

Model I: Tracking Genetic Information.

The first model presents the utilisation of genetic information as a number of stages involving various specialties, not all of which necessarily use or require the presence of genetic material. These stages provide a useful analytical tool as shown in Figure 1. Such a framework needs also to be situated within the macro agro-ecological context of Aotearoa/New Zealand: what ecosocial groupings to Maori belong to and engage with? From this we can identify relevant biotic resources and their threats, and (because biodiversity *is* genetic diversity) begin understanding the extended networks of genetic information to which we belong and utilise.

Although space precludes in-depth analysis, the following attempts to reflect the current situation in New Zealand, a situation that is primarily a consequence of the white-settler farming history alluded to earlier. For example, the pastoral history initiated by colonisation means that forage plants are the single most important Plant Genetic Resource (PGR) for the New Zealand economy. Although some native species do contribute to pastures in areas of low fertility, preferred species are exotic (Warmington *et al*., 1996). Their value lies with their fundamental contribution to the livestock industry, again a range of exotic species (primarily Eurasian in origin, see Diamond, 1997) that have been bred for various qualities revolving around meat and fibre.

Fig. 1. The utilisation of genetic material

Stage	Disciplines	Examples
Identification and Collection	fieldwork, taxonomy, GIS, bioinformatics, ethnobotany, medical research	Te Kete a Tini Rauhanga (1) gastric cancer research (2)
Storage and Maintenance	*ex situ* conservation, engineering, public sector management, *in situ* preservation	Lake Waikaremoana Hapu Restoration Trust (3) Rene Orchiston collection(4)
Trade and Transfer	corporate affairs, trade negotiations, biosecurity	Te Hikoi mai o te kumara(5)
Research and Development	genomics, proteomics, traditional breeding, software design, marketing	ornamental development (6) eg *Hebe* & *Phormium* spp.

1. A research project in collaboration with Crop and Food, funded by FRST ($960,000) to investigate rongoa Maori (native medicinal plants), headed by Dr Meto Leach and Hohepa Kereopa (Ngai Tuhoe).
2. Research lead by Dr. Parry Guilford into the relevant genes for a type of gastric cancer was conducted using a Maori family (see Guilford, *et al*., 1998).
3. A 10-year project investigating the decline of kiwi at Waikaremoana, a collaboration between Manaaki Whenua, DoC and tangata whenua.
4. Held by Manaaki Whenua and originating with 50 cultivars of harakeke/*Phormium*. Now known as the National New Zealand Flax Collection.
5. A hikoi by kaumatua to Japan in 1988, led by Del Wihongi, to seek the return of 9 varieties of kumara 'delivered' to Japanese researchers in 1969 following concerns of maintaining the collection in New Zealand.
6. Extensive collections are in private ownership, both overseas and domestically.

Securing these industries, let alone actually advancing them, will require ongoing experimentation with genetic recombination, driven by both the need for market novelty and sustainability in an increasingly changeable environment. Although valuable collections of globally important PGR exist in New Zealand (particularly of apple and kiwifruit germplasm), international collaboration must continue in what has been described as the Red Queen race, after that character in *Alice in Wonderland* who must run to stand still (Swanson, 1998). Maori are members of the very same ecosocial interactions as non-Maori, both in Aotearoa/New Zealand and overseas, that engage in the utilisation of similar genetic parcels of flora and fauna.

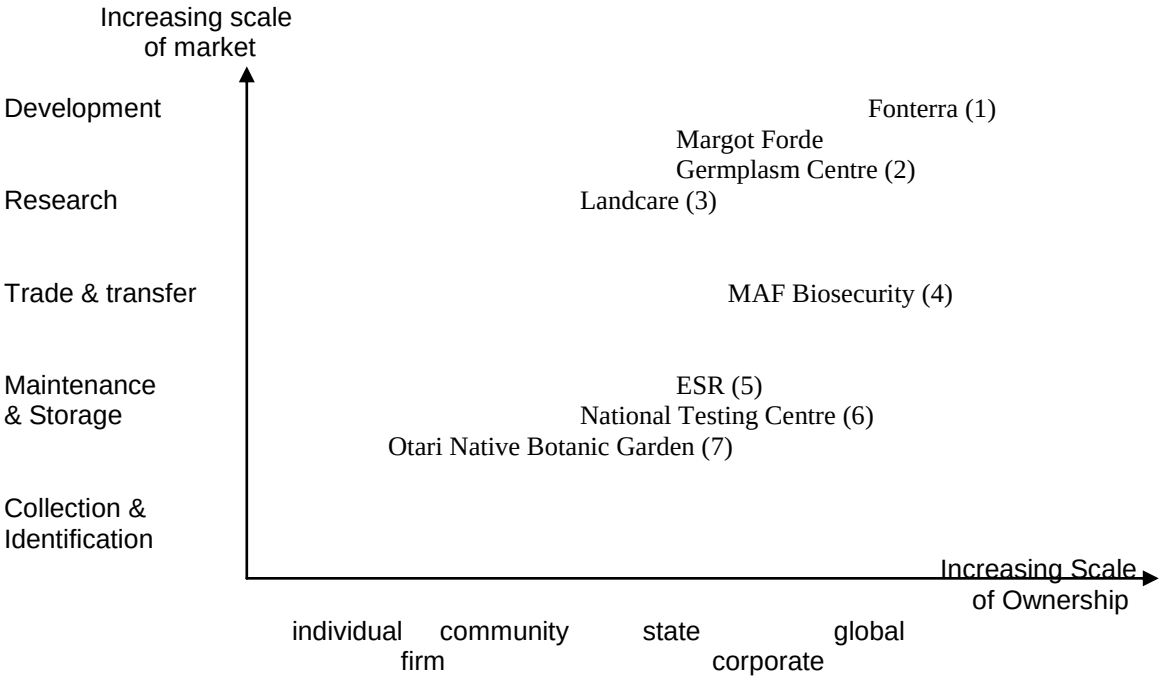
Model II: Mapping Genetic Resources

The following diagram attempts to broadly reflect the theorised markets of relevance to iwi and hapu ventures, by which I mean not so much the place (although physical locations certainly exist) but the *scale* of management, the nature and extent of networks within which genetic information could be expected to travel (Fig. 2). Such 'business' does not necessarily rely on the actual presence of genetic material but may revolve around the legal *right* to claim royalties from use of historical germlines or patented techniques. No deeper analysis is attempted here although there is an ever-expanding range of complex interests acting to secure or utilise genetic information. Some institutions may act to support private biotic interests in order to secure indirect economic benefits, e.g. the provision of publicly funded biosecurity for industry or sectoral interests by government agencies. Further, there could be great emotional security provided to the individual by the provision of relatively simple DNA identification.

This second model highlights the difficulty that any disempowered community would face in engaging on an equal footing those institutions that control aspects of development needed for self-determination. First there are the usual disparities, in knowledge, power, support. Secondly, there is now global extent of control and influence over an increasingly strategic resource, variously declared a global commons or the property of nation-states, corporations or indigenous peoples. Access to PGR have been blocked before (to 'the usual suspects', enemies of the 'West', see Querol, 1993; Frankel, 1988: 29), local communities continue to experience biopiracy, and the illicit trade in rare organisms continues (Gower, 2004). This model describes a genosphere where access to

and benefits from genetic information is dominated by nation-states over sub-national communities, multinational corporations over local businesses, or supranational organisations over democratically elected legislative bodies.

Fig 2. Market scales



1. Fonterra is engaged in a number of projects that involve genetic information although thus far they have disavowed genetic modification in their research (Dann, 2004).
2. Est. 1930s, based in Palmerston North and maintained by AgResearch. Holds approx. 60,000 seed samples (mainly grasses and legumes). 1,500 spp/58 plant families including 18,000 varieties of white clover. An important genebank for New Zealand land-based industries.
3. Landcare maintain the largest herbarium in New Zealand, containing over 500,000 specimens, representing NZ and the South Pacific.
4. The Ministry of Agriculture and Forests administers the Hazardous Substance and New Organisms Act (1996) and is the lead government agency in the implementation of Biosecurity strategy.
5. Environmental Science Research hold approx. 40,000 human DNA samples for criminal profiling (Source: Courtney, 2004: A15)
6. Stores the majority of human DNA samples collected in NZ (from newborns), numbering around two million samples. Owned and managed by the Auckland District Health Board (Source: Courtney, 2004: A15).
7. A significant reserve dedicated to NZ native plants. Established in 1906, it covers 75 hectares and is implicated in two (now amalgamated) Waitangi Tribunal claims, no.'s 145 and 474.

Discussion

Like other agri-business participants, Maori are committed to a global network whose purpose is to effect the development and implementation of a range of strategies involving the utilisation of genetic information. This immediately locates us with other beneficiaries of global trade in PGR, a trade that has been criticised as theft by many indigenous groups. While Maori can effectively avoid blame, this paper presents a case for acknowledging where we have benefit from inherited genetic information, and

including those dissenting ecosocial institutions within our network of participants.

The sources of vulnerability and the means to attain resilience are multi-scalar, involving linkages to new locations (and therefore previously unknown ecosocial institutions) as well as altering the relationship with historically connected locations (via advancing technologies) and challenging existing ecosocial institutions. Conceptually, significant locations could be mapped by tracing the relevant genetic information, its origins, threats to access or even the survival of viable germplasm, and contradictory interests in its actual or perceived properties, and so on. The ethical and moral issues attendant on the identification, collection, storage, maintenance, trade, transfer, research and (all going well!) socially just development must also be acknowledged. Model I presents a template for tracking where such obligations might exist, which can be only the first step in truly successful development; Model II describes nothing more than the obvious, that as a resource (in this case genetic information) increases in value, its control will be sought and amalgamated by more powerful players.

Conclusion

Marx claimed that 'the tradition of the dead generations weighs like a nightmare on the minds of the living'. By this he meant the constraints of previously solid institutions that were neither willing nor able to aid the 'revolutionary transformation' of people and their environments in 'the creation of something which does not yet exist.' (cited in Harvey, 1996: 94). Challenges to existing ecosocial institutions, whether Maori or non-Maori, local, national or global, result from and contribute to change and that is evident in the utilisation of genetic information. The 'best practice' (i.e. ethical) ecosocial arrangements *cannot yet exist*, and their development will require broader sources of input than has been apparent so far.

Notwithstanding the cultural heritage and emotional connections to indigenous flora and fauna (an aspect of Aotearoa/New Zealand that is also claimed by pakeha) the resilient development of Maori agri-business is increasingly dependent on advanced technology and improved marketing that is global in extent. Like *pakeha*, Maori are entwined within the neoliberal-ordered exchange of commodities and must be cognisant of supranational regulations concerning, among other things, production methods, marketing labels and intellectual property that explicitly uses 'culture-tags'. International traders must also be aware of their target market's idiosyncrasies that will include moral and ethical judgements. By engaging in modern agri-food business, Maori are complicit in the appropriation and manipulation of genetic information that is generally held (*ex situ* or *in situ*), maintained and disseminated according to rational, capitalist demands. Let Maori be proactive in defining the debate. Our complicity needs to be acknowledged, if for no other reason than to raise the IRE in future agri-biotechnology research.

References

Berkes, F., Folke, C. and Gadgil, M. 'Traditional Ecological Knowledge, Biodiversity, Resilience and Sustainability' pp 281-299 in Perrings, C., Maler, K.G., Folke, C., Holling, C.H. and Jansson, B.O. (eds) *Biological Diversity*, Kluwer.

Brown, D. 2004 ‘The Whare as Exhibition’ pp 65-79 in Smith, A. and Wevers, L. (eds) *On Display: New Essays in Cultural Studies*, Victoria University Press.

Campbell, H. 2000 'Between Abstract Promise and Concrete Reality: Will GM Feed the Third World?', pp 32-43 in Davis, R. (ed) *Will the ENZ Justify the Genes* Proceedings from the Symposium on the Ethics of Genetic Engineering, August 2000, Capital City Forum, Joint Methodist Presbyterian Public Questions Committee: Wellington.

Courtney, D. 2004 ‘Who’s in charge of the DNA bank?’ *The Press*, April 28th, 2004, A15.

Crosby, A.W. 1986 *Ecological Imperialism: The Biological Expansion of Europe, 900-1900*, Cambridge University Press: Cambridge, xiv; 368 pp.

Dann, L. 2004 ‘Putting a toe in the GM pool’ *NZ Herald*, May 14th, 2004.

Diamond, J. 1997 *Guns, Germs and Steel: The Fates of Human Societies*, New York: W.W. Norton & Co.

Fairweather, J. R. 1985 ‘White-Settler Colonial Development: Early New Zealand Pastoralism and the Formation of Estates’ *The Australian Journal of Sociology*, Vol. 21(2): 237-257.

Ferre, F. 1988 *The Philosophy of Technology*, Prentice Hall: Eaglewood Cliff, New Jersey, x, 147 pp.

Frankel, O.H. 1988 ‘Genetic resources: Evolutionary and Social Responsibilities’ Chapter 1 of Kloppenburg, J. (ed) *Seeds and Sovereignty: The Use of Control of Plant Genetic Resources*, Durham: Duke University Press.

Gillespie, A. 1998 'Environmental Politics in New Zealand/Aotearoa: Clashes and Commonality Between Maoridom and Environmentalists' *New Zealand Geographer*, Vol. 54 (1): 19-25.

Gower, P. 2004 ‘Czech politician questions case after meeting orchid smugglers for a beer’ *NZ Herald*, February 16th, 2004.

Guildford, P., Hopkins, J., Harraway, J., McLeod, M., McLeod, N., Harawire, P., Taite, H., Scoular, R., Miller, A. and Reeve, A.E. 1998 ‘E-cadherin germline mutations in familial gastric cancer’ *Nature*, Vol 392 (6674): 402-405.

Halloy, S. 1994 ‘Long term trends in the relative abundance of New Zealand agricultural plants’, pp 125-142 in Fletcher, D.J. and Manly, B.F.J. (eds) *Statistics in Ecology and Environmental Monitoring*, Otago Conference Series 2, Dunedin: University of Otago Press, vii, 269 pp.

Hancock, J.F. 2004 *Plant Evolution and the Origin of Crop Species*, 2nd edition, Wallingford: CABI Publishers.

Harris, W. and Kapoor, P. (eds) 1990 *Nga Mahi Maori o te Wao Nui a Tane: Contributions to an International Workshop on Ethnobotany*, Botany Division, DSIR: Christchurch.

Harvey, D. 1996 *Justice, Nature and the Geography of Difference,* Blackwell Publishers.

Ho, M. 1998 *Genetic Engineering: Dream or Nightmare?*, Gateway.

Kloppenburg, J.R. (ed) 1988 *Seeds and Sovereignty: The Use and Control of Plant Genetic Resources* Duke University Press: Durham, 368 pp.

Lyson, T.A. 2002 'Advanced agricultural biotechnologies and sustainable agriculture' *Trends in Biotechnology* Vol 20(5): 193-196.

Marris, C., Brian Wynne, B., Peter Simmons, P., Weldon, S., Cárceres. J., De Marchi, B., Klinke, A., Lemkow, L., Pellizzoni, L., Pfenning, U., Renn, O., and Sentmartí, R., 2001 *Public Perceptions of Agricultural Biotechnologies in Europe*. Also known as the PABE Report, Dec. 2001, Commission of European Communities.

Massey News 2003 'Hui unearths taewa potential', *Massey News*, Issue 11, http://masseynews.massey.ac.nz/2003/at_massey/National/issue11.html

Mauron, A. 2001 'Is the Genome the secular equivalent of the soul?' *Science*, Vol. 291: 831-832.

McLean, R.A. and Smith, T 2001 *The Crown and Flora and Fauna: Legislation policies and practices, 1983-98* Waitangi Tribunal, 760 pp.

McKibben, B. 2003 *Enough: Staying Human in an Engineered Age*, Times Books, Henry Holt and Co.; New York, xiii; 271 pp.

New Zealand Institute of Economic Research (Inc.) 2003 *Maori Economic Development/Te Ohanga Whaneketanga Maori*, Wellington (A Report prepared for Te Puni Kokiri).

Posey, D.A. and Dutfield, G. 1996 *Beyond Intellectual Property: Toward Traditional Resource Rights for Indigenous peoples and Local Communities*, International Development Resource Centre: Ottawa.

Querol, D. 1993 *Genetic resources: a practical guide to their conservation* [Other title *Recursos geneticos*] London; New Jersey: Zed Books; Penang, Malaysia: Third World Network.

Roskruge, N. 2001 'Taewa Maori: Their Management and Commercial Viability' in

Howard, M. L. & H. Moller (eds.) *He Minenga Whakatü Hua o Te Ao, Murihiku Marae* 25 – 27 August 2000. Online at <http://www.otago.ac.nz/Zoology/hui>

Swanson, T. 1998 'The source of Genetic Resource Values and the reasons for their management' pp 67-81 ion Evenson, R.E., Gollin, D. and Sananiello, V. *Agricultural Values of Plant Genetic Resources*,

Te Puni Kokiri 2002 *Maori in the New Zealand Economy* 3rd edition June 2002, Wellington.

Warmington, B., Cole, G. and King, G. 1996 C*onservation and Use of Plant Genetic Resources: National Report for New Zealand June 1996* Wellington: Ministry of Agriculture.

Williams, D.V. 2001 *Matauranga Maori and Taonga: The Nature and Extent of Treaty Rights held by Iwi and Hapu (regarding) Indigenous Flora and Fauna, Cultural Heritage Objects, Valued Traditional Knowledge*, Waitangi Tribunal Report.

Willoughby, K.W. 1990 *Technology Choice: A Critique of the Appropriate Technology Movement*, Westview Press: Boulder & San Francisco, xii, 350 pp.