The Diffusion of Sustainable Technologies to Māori Land: A Case Study of Participation by Māori in Agri-Food Networks

Simon Lambert

Abstract: Within innovation diffusion literature, indigenous peoples have historically been described as 'laggards': slow to adopt new technologies. While accepted as the originators of acceptably 'quaint' traditions, Māori, like other indigenous peoples, are targeted as passive adopters of new, and theoretically, beneficial innovations. However within sustainability discourse, indigenous peoples are considered to possess innovations in the form of traditional knowledge that is conducive to sustainability. For Māori, this assumption has converged with niche marketing strategies in agri-food networks and Māori initiatives to participate in research programmes. This paper details the diffusion of innovative objects in the form of taewa or 'Māori potatoes' within sustainability research programmes. Knowledge sourced from Māori in their role as kai tiaki of taewa have seen attempts by research institutions to accommodate Māori growers within collaborative programmes. However, the intended diffusion of collaborative research with Māori outwards from 'core' research institutions is paradoxically reliant on a counter-diffusion of 'Mātauranga Māori' from Māori growers. This counter-diffusion is subject to validation from Māori collectives: if cooperation is withdrawn by these collectives, diffusion is not possible. Rather than the non-adoption of sustainable technologies by Māori, such withdrawal is interpreted as non-participation in unsustainable networks.

Keywords: agri-food networks, innovation diffusion, Māori horticulture, potatoes.

Introduction: Innovation, Diffusion and Diffusionism

The return of Māori land to a productive role in a market economy occurs in a context of innovation and diffusion relevant to the sustainable development of this land. Sustainable development will require substantive innovation to current land and resource use to mitigate environmental degradation, and contribute to ecological and sociological resilience. This paper takes concerns for *cultural* diversity (World Commission on Culture and Development, 1995) and investigates how Māori participate within agri-food networks in ways that contribute to their resilience, defined as development that sustainably links ecosystems and communities in ways specific to Māori discourse. In agro-ecological management, this development is reliant on non-Māori inventions, necessitating Māori participation in the relevant innovation and diffusion networks.

However, any form of development involves innovation that is identifiable as change. Because change and difference are integral to innovation, innovation is considered to struggle against 'traditions' that constrain, and against conservatism that interprets these so-called traditions as both static and integral to the 'proper' functioning of culture. But Māori, like other indigenous societies, have never rejected innovation. Indeed from 'First Contact' with Europeans, the adoption of radically new ideas, objects and activities were included in the strategic and tactical decisions of Māori individuals and groups. The adoption of non-Māori inventions has continued *and accelerated* with contemporary Māori development (Lambert 2005) from a realisation that sustainable development requires new ways of 'doing things'.

The importance of innovation can be observed in the agro-ecological systems in which Māori seek participation. In the associated agri-food networks, innovations - particularly of research, science and technology (RS&T) outputs - are fundamental processes with which engagement is sought. But the 'change' implicit in innovation is not automatically accepted by Māori communities but is examined through the lens of cultural logics to protect or enhance aspects of Māori resilience. This paper treats innovation as any idea, practice, or object that is perceived as new. Innovation can, therefore, involve the rediscovery of an idea, practice or object. Adoption is the singular decision - whether by an individual, institution, firm or other 'adoptive unit' - to take up an innovation. Diffusion is the process whereby the adoption of an innovation is transferred through certain channels over time among the members of a social system. Social diffusion is associated with spatial diffusion as community members implement adopted innovations in their communities, on their land and in the use of surrounding ecosystems. Embedding sustainable development on Māori land will therefore include the timely adoption of relevant innovations to a degree of diffusion such that Māori resilience is increased or its decline arrested.

The historical observation of diffusion led to a body of scholarship in which certain places and peoples were ascribed the status of originators and others as passive recipients. Blaut (1987) argues the accumulative effect of diffusion discourse – diffusionism - influenced many disciplines in the Western academy. Diffusionism posits change within communities is produced by diffusion rather than by invention, and that certain places are permanent centres of invention (ibid.). Blaut relates six arguments that describe the properties of each 'location' and the transactions between them. The arguments are:

1. The 'core' is the location of autonomous and progressive cultural change.
2. This innovativeness in the core stems from psychological or spiritual factors that include rationality, technological inventiveness, 'imaginativeness' and so on.
3. The 'periphery' is considered 'traditional' meaning a low level of civilisation and slow change.
4. The predominant form of transfer between core and periphery is the outward diffusion of "…progressive ideas, intangible intellectual and moral products" that reflect the core's aforementioned rationality and inventiveness.
5. A 'counter-diffusion' takes place from periphery to core comprised of raw materials, art objects, and labour.
6. A second type of counter-diffusion occurs, "Consisting of precisely the opposite of civilisation". Following the above arguments, the periphery is by definition 'archaic', therefore "…it is the locus of atavistic traits that seep back into the core according to the principle of ideological contagion" (Blaut, 1987, pp. 32-33).

Blaut's critique shows the history of diffusionism is coeval with European imperial expansion and an explicit and implicit expression of Eurocentrism. The assumptions recognised by Blaut are also integral to the colonisation history of Māori (Lambert, 2005). Modern development is realised through the purposeful use and control of knowledge, providing a valuable mapping tool in the diffusion of ideas, objects and activities between the traditional institutions of indigenous peoples and the RS&T institutions that are intended to drive sustainable development.

Agri-food Networks

The literature within agri-food research is replete with the modelling of 'networks', 'chains', and 'linkages' from the farm to the household, from 'paddock to plate'. Agri-food marketing seeks to promote 'quality' through market attributes, principally health, taste, novelty, and sustainability. This trend is exemplified by the rise of 'alternative' food networks as a response to consumer concerns about food safety, and linked to the promotion of localised and regional food products (Bessiere, 1998). The emphasis in these studies is on the manner

in which the ultimate product, food, is influenced by the changing relationship between participants along the chain. Contemporary agri-food research shows greater interest in the production and consumption of *meanings*, reflected in the construction of narratives around food. In the wealthy markets of the developed world, New Zealand's main export destination, most food is sold with a 'story' (Freidberg, 2003).

Where indigenous communities engage with modern agri-food networks, food 'stories' often draw upon indigenous traditions while debate concerns access to the means of modern development and the innovations integral to such development. The contemporary agri-food sector is dominated by multinational corporations undertaking industrial production in the pursuit of profit through productivity gains and through post-production strategies that seek 'added-value'. Navigating the innovation and diffusion networks necessary to improve indigenous development is difficult from a position that is in many ways subversive to state and corporate organisations from the outset. What are the implications for Māori institutions in protecting and developing iwi and hapü biotic resources where these resources are not 'native' but were introduced as a result of colonisation? What are the options for Māori growers in their attempts to 'add value' in their ventures when relevant research programmes are extensive and complex? Given that the criteria for food quality are now re-embedded within local ecosystems and informed by nutritional research, in what ways do 'process and place' contribute value to New Zealand agri-food systems?

Case Study: The Māori Potato

The issues identified above will be discussed through the participation of Māori in modern agri-food networks. The case study is presented from three perspectives: an overview of two institutions engaging with Māori horticulture; an examination of the biotic character of an innovative crop ('Māori' potatoes); and a synthesis the first two approaches that examines selected research programmes that seek to 'enrol' Māori and Māori potatoes.

The Role of Institutions in Diffusion

Three empirical patterns have been identified in the diffusion of innovations: the cumulative adoption of innovations in the temporal context; the 'neighbourhood' or 'contagious' effect in the spatial context; and hierarchical flows and institutional agency (Brown & Cox, 1971). It is this last pattern that is examined next through the 'hierarchic' diffusion of innovations via a regular sequence, generally described as 'downward' from larger or more 'important' centres, to smaller ('less' important) places, correlating to Blaut's core and periphery.

In the late 1990s, a number of small research projects were taking place involving the growing of taewa or Māori potatoes, also known as peruperu, riwai and mahetau (Harris & Niha, 1999; Roskruge, 2004). Taewa are considered a taonga, a treasured possession whose care and conservation is a matter of historical record and contemporary pride and interest for Māori. Some of the research projects led to formal agronomy trials with a view to contributing to Māori horticulture with inaugural crops planted in October 1998 at Massey University under the direction of Nick Roskruge. Research was initiated and supported by a collective of Māori researchers and growers. Growers were mostly small-scale commercial horticulturalists, 'emergent' growers bringing small parcels of whānau and hapü land back into production, and 'interest' gardeners. The networking engaged in by participants involved hui and wānanga and took place within specifically Māori spaces, primarily marae where Māori cultural values and knowledge are legitimate and valued. A constant topic was the desire of participants to develop their land but not at the expense of Māori cultural values.

Constraints are evident in the development of Māori horticulture, many of which are repeated within wider Māori development attempts. They include difficulties in raising capital, due to restrictions on Māori land as collateral, and a lack of the appropriate governance structures and management skills (Te Puni Kōkiri, 2002). Successful development of the primary

industries is increasingly dependent on advanced technology and improved marketing. The networks through which information and resources relevant to this engagement are transferred are international, as they were in the 19th Century. Perversely the networks now seem *harder* for Māori to access.

Tahuri Whenua, as this group became known, was incorporated in 2004 as the National Māori Vegetable Growers Collective to "…support Māori growers in this rapidly changing business" of modern horticulture (Tahuri Whenua Incorporated Society, 2005, p. 2). This required a formal constitution, the election of officers, the establishment of a committee, and the publication of several strategy documents. The 'Strategic Aim' of Tahuri Whenua is "To establish a grower entity with the appropriate structures to ensure continuity through strategic and operational management" (ibid., p. 5). Members were engaged in their own whānau and hapü development efforts. One marae trust sought "…the promotion, tuition and marketing of the various craft skills of the people that reside in our rural area" Their horticultural venture was intended to "…feed our families first", the excess sold commercially to benefit the Māori community" (Hokianga Tui Tuia Trust, 2005, no page number).

By all 'standard' variables, Tahuri Whenua is a peripheral institution. Not only are its members relatively poor, their lands often marginal, fragmented and small, their capitalisation – including human resources and specialised knowledge - is minimal. As indigenous growers they also enact cultural economic logics that are ascribed traditional status, correlating to the pejoratively-framed passiveness of the periphery.

However, Tahuri Whenua and its members possess two characteristics that situate the institution as an innovation 'core'. First, as indigenous growers they enable product differentiation through the construction of cultural attributes that contribute to products' 'sustainability' through *assumptions* of cultural diversity and vibrancy. Second, Māori combine traditional and contemporary methods in innovative ways to sustainably develop their land and resources in *expressions* of cultural diversity and vibrancy (World Commission on Culture and Development, 1995). This historical evolution has converged with state RS&T institutions that have been directed towards 'Responsiveness-to-Māori' strategies for the benefit of Māori development (Simpson & Meha, 2004).

The innovative potentialities of Māori growers brought Tahuri Whenua to the attention of a well-financed RS&T institution, the National Centre for Advanced Bioprotection Technologies (NCABT). Initiated with Centre of Research Excellence (CoRE) funding in 2003, the NCABT was based at Lincoln University. The terms of reference for CoRE funding were broadly focused on 'excellence' in research, economic and social development, environmental sustainability; fulfilling the obligations of the Treaty of Waitangi was also an objective (Ministry of Education, 2005). CoREs are interdisciplinary, and though hosted by a single tertiary institution, draw upon multiple collaborators, including Crown Research Institutes (CRIs) and industry to be 'innovative and entrepreneurial' (Williamson and Samuel, 2002). The NCABT entered into 'partnerships' with several with other RS&T institutions in New Zealand, including Massey University, AgResearch Ltd., and Crop and Food. Collaborative relationships were ultimately entered into with eight other RS&T institutions, including Te Whare Wānanga o te Awanuiarangi, a wānanga based in Opōtiki (National Centre for Advanced Bioprotection Technologies, 2006). Any development by a CoRE is to be 'sustainable', and the transfer of resulting knowledge is to be an integral function of CoREs.

Four research programmes were established by the Lincoln 'CoRE': agri-biotechnology, biocontrol, biosecurity and mātauranga Māori. The 'Mātauranga Māori' theme shows all the rhetorical characteristics sought by the government's various directives to 'respond' to Māori, and to seek innovation from resulting collaboration. The project was titled "Indigenous Knowledge and Agri-development" and explicitly sought innovation emanating from 'the

border' between four apparently distinct disciplines: Māori science, mātauranga Māori, traditional ecological knowledge and Western science. The relevant section of the proposal is reproduced below:

> In Māori terms, social development must be built on economical development that is environmentally sustainable and cognisant of tikanga Māori values such as kaitiakitanga, manaakitanga, and rangatiratanga. However, this development must also be informed by innovative bio-protection technologies that originate from Westernised science. Fulfilling obligations under the Treaty of Waitangi requires moving beyond the rhetoric of the Treaty, consultation with Māori, and the mantra of increasing Māori research capacity. This will only occur if opportunities for collaboration are created and Western and Māori science is taken as complementary rather than conflicting. Research at the border between Māori science, mātauranga Māori, traditional ecological knowledge and Western science will lead to innovation, the creation of new knowledge and a new paradigm – one that is better equipped to deal with many of the issues confronting agricultural and horticultural development in NZ.
> (CoRE Fund Application Number 02-LIN-501, p. 22; emphasis in the original).

Tahuri Whenua and the NCABT began to discuss collaboration through the auspices of the mātauranga Māori research team. The 'Mātauranga Māori Bioprotection' programme was relatively non-specific, seeking to enable sustainable development of Māori horticulture and 'innovate' for the economic development of Māori and New Zealand. The research projects which were subsequently developed were to form the basis of two PhD's for Māori students. A central goal was the construction of a database of mātauranga Māori as it applied to horticulture. Collaboration and funding were sought from a variety of research and grower organisations, including extra-mural education programmes, archaeological researchers, CRI's, fellow NCABT research teams, and other indigenous (Pacific) peoples. Through meetings, hui, and research proposals, a picture can be built of the research programmes considered by participants as relevant to Māori and the professional goals of researchers. Before these research programmes are discussed, however, an examination of an integral research subject, the Māori potato itself, is required.

Taewa as a Biotic Innovation: Indigenous Commodification of Nature

Innovation can also be identified within living organisms that have resulted from intense interactions with humanity. Charles Darwin articulated the control exhibited in domestication of highly-selected plants (crops) and animals (livestock). The potato, *Solanum tuberosum*, is one such example, being domesticated in the Andean region of South America circa 8-7,000 before present (Hawkes, 1992), and the subject of continuing breeding and research programmes. The tangible representations of this important food source are complemented by an intangible but extensive mythology that together comprise the 'Traditional Ecological Knowledge' inherent to indigenous communities (Lambert, 2004). It has become a staple crop, fourth in importance in food production (ranking after wheat, maize and rice), and easily the most important root crop (followed by cassava, sweet potatoes and yams, Hawkes 1990, p. 1).

The original varieties, being of tropical origin, were adapted to equatorial short-day conditions by selective breeding. In northwest Europe, these varieties were inclined to set tubers early in the season, a reaction of "…a short-day plant doing its best to survive in a long-day environment" (Salaman, 1987, p. 67). Other adaptations *by the plant* to European climes were very small tubers that developed at the end of long stolons, numerous flowers, and occasional shoots growing above ground from the stolons (Hawkes, 1990, p. 39). However, selective breeding by human actants led to a day-neutral, higher yielding European variety by mid-18th Century, when Linné described the *S. tuberosum* subsp. *tuberosum* (MacKay, 1997). The 'Modern Ecological Knowledge' of Europe had been applied to the Andean 'import'.

The reputation of the potato as a staple food in Europe was established by the time of large-scale European exploration and it was a deliberate and valued selection of the explorers' cargo. The first introductions of the potato to New Zealand have been variously credited to de Surville, 1769; Cook, 1769 and 1773; du Fresne 1772 and Lt. Governor King, 1793. A 'European' garden was established by Crozet on the 1772 voyage of du Fresne, on Moturua Island (Leach, 1984). A garden was also established during Cook's second voyage in Queen Charlotte Sound; the potatoes were sourced en route from South Africa and were originally of Dutch origin.

The arrival of potatoes into the eco-social systems of Māori was as a significant development for Māori (Best, 1925; Yen, 1990; Harris & Niha, 1999). Ron Crosby (1999) notes the use of the newly introduced potatoes by Hongi Hika as food supplies on his extended musket campaign 1818-25. Graham Harris considers the contribution of the potato to Māori nutrition so significant as to be evidence against a pre-European introduction, for if this had been the case "…Tasman and Cook would have found the country more heavily and widely populated, and the course of the history of New Zealand would have been very different" (Harris, 1999). Some confusion over the preparation of potatoes may have limited their early adoption into the Māori diet; one commentator noted Māori eating the tubers raw, and some potato harvests were initially reserved for the all-important trade with Europeans. However, by the mid 18th Century, the potato - so much hardier than the 'traditional' kumara - was widely, and productively, grown.

Once the potato was adopted and diffused around New Zealand by Māori, it was enrolled by Māori in extensive trading enterprises, and within Māori nutrition. The introduced crop quickly became a key component in the evolving 'resource economy' of New Zealand (McAloon, 2002). From a focus on indigenous species (principally timber and flax), Māori supplied ships' crews, settler communities and even Sydney with potatoes and pork. Māori newspapers of the day made regular mention of their value as a crop for Māori, and for horticulture and agriculture in general, publishing growing tips, market information, and international experimental results (ibid., see also Petrie 2006). Extensive fields were noted by many early European travellers and officials. Like Europeans before them, Māori Traditional Ecological Knowledge incorporated the new actor as a commodity, and with this innovation, Māori began to engage with global ecological knowledge.

Modern ecological knowledge is reliant on advances in RS&T as societies grapple with dynamic environmental and social worlds. Within horticulture can be seen the research activities of RS&T institutions as they seek to commercialise innovations via the production and management of living organisms. The drive to innovate for profit can be observed through the evolution of research programmes that have sought to enrol both Māori and Māori potatoes.

Research Programmes: Commodifying Taonga?

Research programmes are complex assemblages of people, technology, knowledge and, in this case, biotic 'actants' (see, e.g., Callon, 1986). From the outset of the NCABT's Mātauranga Māori theme, Māori growers were sought to a) provide case studies for subsequent research, and b) provide 'raw' data for the mātauranga Māori database. Various hui and conferences were attended by researchers, and approaches made to possible case studies that included offers of 'services' such as soil testing, growing advice, and formal education (Harris, 2003). A corollary to this enrolment of people was the attempt to enrol Māori potatoes into research projects. Research by Lincoln-based CRI researchers identified the variety Māori potato known as urenika or tutaekuri as possessing antioxidant activity several times greater than that commonly observed (Lister, 2001). This property of taewa subsequently featured in presentations and proposals by the mātauranga Māori researchers as attempts were made to secure additional funding (Harris, 2004).

Other micro-scale actants have also been enrolled by researchers. A programme undertaken by researchers at Massey University and supported by contestable state funds has sought to strip accumulated viruses within taewa to produce virus-free seed tubers (McCarthy, 2006). Late Potato Blight, caused by the fungal agent *Phytophthera infestans*, is a significant disease within the potato industry, and has featured in collaboration between by the NCABT and a project supervised by the chairman of Tahuri Whenua. The project examined the natural resistance of four taewa cultivars to Blight and formed the basis a 'Summer Scholarship' by a Māori student (Lincoln University, 2006).

Equivalent attempts were made by members and supporters of Tahuri Whenua to establish and engage with various research programmes. At the most simple were marketing efforts that attempted to leverage sales of the 'heritage' characteristics of potatoes labelled 'Māori' through local supermarkets, regional farmers markets, supplies of seed tubers (Lambert, 2005). These niche marketing opportunities occurred in tandem with media attention, in mainstream and Māori print and television outlets, as well as various events and promotions at which Māori growers participated.

Collaboration through joint research projects between the NCABT and Māori growers initially struggled to progress despite attempts at mediation by Tahuri Whenua representatives. Whereas researchers within the other three NCABT themes were continuing within their relatively established research fields, the 'Mātauranga Māori' Theme was a new initiative, relying on collaboration between people with no research background in horticulture. The 'enrolment' of growers was to be achieved through the personal and professional networks of project members but the requisite trust was either not established, or was quickly abused by NCABT researchers, ultimately leading to the withdrawal of many Māori growers from collaboration. At the end of its initial three-year funding period, with over $1 million dollars spent, research outputs were not achieved, and neither of the two PhD scholarships listed in the proposal resulted in the retention of students or completion of doctorates.

However, the Mātauranga Māori programme received continued funding (much reduced), as a result of new enrolments of both humans and non-humans. New Māori research staff at Lincoln continued aspects of the collaboration with Massey researchers, focusing on agronomy trials of selected taewa varieties (funded $30,000). Another project is investigating 'pathways' for the restoration of native plants on land utilised for production, and the associated Māori knowledge and practice ($170,000) (National Centre for Advanced Bioprotection Technologies, 2006).

This section has not attempted anything more than a very brief discussion of just some of the human and non-human participants within the agri-food research programmes that have sought indeed were reliant on the 'cooperation' of Māori growers, Māori potatoes, and micro-scale actants associated with those potatoes. Actants are assembled within projects by programmes that result from RS&T partnerships and collaboration. For Māori, the programmes and projects described have significant roles in marketing strategies as horticultural innovation includes the conceptually simple differentiation of produce by the indigeneity of growers, as well as the more problematic association of metabolic outputs of these crops and health benefits to the consumer, and methods for mitigating a serious disease of the potato sector.

Discussion

The preceding examination of Māori horticulture shows that Māori institutions continue to evolve both autonomously and in interaction with non-Māori institutions. In an expression of convergence between Māori and Pākehā societies, components of RS&T institutions have

likewise 'evolved' in interaction with Māori. As Māori have attempted to increase their individual and collective resiliencies through the development of Māori land and resources, greater contact with RS&T is sought and offered. Various prospective innovations are, along with their innovators, the 'human handlers' of RS&T processes, *interrogated* by Māori to ascertain their value in contributing to Māori resilience.

The establishment aims and activities of Tahuri Whenua show that contact with 'Western' research is not seen to threaten Māori culture. Not only does culture remain a lived experience but is discussed and even codified to continue the logics with which Māori distinguish themselves. The diffusion interface is comprised of research staff (Māori and non-Māori), Māori growers and their supporters, and the personnel of an array of institutions. Through regular hui, held according to tikanga, the establishment of trust and cooperation is enabled, fundamental requirements for the completion of planned research projects and overriding research programmes.

Māori culture features, albeit amorphously, in the use of cultural attributes in product differentiation. Here there is something of a divergence between Māori and non-Māori. Commercial concerns (including Māori) seek 'added value' through a cultural industry in which references to Māori culture act as tropes in niche marketing. Māori, on the other hand, whilst seeking access to commercial markets simultaneously participate in a broader cultural economy in which cultural concerns and practices unique to Māori may *change*, but are not sacrificed as they have historically defined Māori resilience. The withdrawal of Māori growers from collaboration is better understood as 'non-participation': growers chose *not* to adopt the particular and potential innovations on offer from the NCABT, and consequently diffusion outwards from the 'core' was hindered. However, the causal factor in this non-diffusion was the loss of the hoped for 'counter-diffusion' of mātauranga Māori from Māori growers to CoRE research. Such decisions are based on cultural logics – ways in which societal change is perceived and undertaken - that structure Māori economic functioning in which contact with any industry, including that which commodifies cultural attributes, is interrogated.

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Author Notes

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Simon Lambert (Ngāti Ruapani ki Waikaremoana) is a PhD candidate at Lincoln University, Christchurch, New Zealand.

E-mail: lamberts@lincoln.ac.nz