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Maori land utilisation

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Abstract

The Maoti land **resource** in the Bay of Plenty district is variously defined as to area and undefined as to land use. A general resumé of Maoti land title and tenure is given and procedures on succession commented on. Two statutory avenues which may assist utilisation, the establishment of trusts under section 438 **of** the Maori Affairs Act, and the establishment of Maori Incorporations, are discussed. Lending for development on the security of Maori land was largely the preserve of the now defunct Maori Affairs Department. No commercial organisation has emerged to undertake this role and development of Maori land on any appreciable scale is now likely to cease.

Keywords Maori land, legislation, succession, utilisation, mortgages.

Introduction

There is a common and mistakenly held view that undeveloped or partially developed Maori land held in multiple ownership reflects a lack of will on the part of the owners to bring such land into productive use. To the extent that a percentage of ***all*** land owners neglect good husbandry this may be true; the view, however, is in the main a reflection of a lack of knowledge of, and acceptance of the misconception surrounding, Maori land tenure and use. Effective utilisation of Maori land by Maori owners has not been the prime object of the successive statutes within whose framework the Maori have been required to deal with their land.

Maori land resource

In the Bay of Plenty central plateau district this is not yet defined. In the example area chosen, the Opotiki County, it is defined only partially. Much of the information does lie in the Maori Land Courts records but has not been collated. It should be a first priority to define the resource in terms of area and land classification.

Maori land title and tenure

There exists two separate records of freehold land ownership in this country, the Maori Land Court Registry and the General Registry.

All general land for which there is a certificate of title or which is provisionally registered under the Land Transfer Act appears in the District Registry. Some Maori Freehold Land with various numbers of owners may also appear in the District Land Registry of General Land. These will be blocks the survey of which has been completed and where application for registration has been made and the District Land Registrar's requirements satisfied. All Maori Freehold Land is recorded in the Maori Land Court Registry, of which there are seven districts. Crown Land is a third category which appears in neither registry; equally, the few remnants of Maori customary land are not recorded in either registry.

The Maori Land Court district that includes most of the Bay of Plenty area is the Waiariki District, which ecompasses a roughly triangular area between Cape Runaway in the east, Taupo in the south and near Te Puke in the west.

Maori Land was originally held in common by tribal or subtribal groups and chiefs who, though exercising influence by virtue of theirmana orprestige and their ancestry, had no absolute right over tribal or subtribal lands. Early Native Land Acts aimed to establish that specific persons or groups of persons owned specified areas of land. It is generally now accepted that the purpose of these acts was to facilitate the alienation of Maori Land.

By the 1940s, investigation of title had not been undertaken in only a few remote areas.

Today a title will: recite the area of land and, where it is surveyed, have a plan appended; indicate whether the title was pursuant to the investigation of title of customary land, or pursuant to one or other of various Land Court order procedures such as partition, consolidation ***or*** vesting. The title will also show the beneficial owners of the land and the shares which each has in the land.

Upon the death of the owner, those entitled in the estate may apply to the Court to succeed to the land interest in question. If there is a will, that will determine who succeeds and in what proportion of the deceased shareholding. If there is no will, succession is according to Maori custom, as specified in the Maori Affairs Act.

Where there are children they normally succeed equally to shares in land both from their father and mother. Increasingly, however, family arrangements are made for some successors to succeed in one block and some in another.

Provided the evidence of such arrangements is before the Court, the Court will usually give effect to these arrangements.

If there are no children, the land interest follows back to the path through which it has come to the owner just deceased. Thus if an interest in a block of land had come to an owner, who himself was an only child, through his mother or father, also an only child, the interest would go back to the grand-parents' generation and then could be succeeded to by the descendants of brothers or sisters of a grandparent. In rare cases this procedure could mean going right back to the title issued upon the original investigation of title. This general pattern of succession on intestacy has been modified by Section 76 of the Maori Affairs Amendment Act to give surviving spouses a life interest unless they choose to forego this.

In the past, when there were large blocks of undivided tribal land, subtribal groups (hapu) and extended family groups (whanau) often recognised their own rights to certain areas. The Court had and has the power to cut out these interests down to individual interests by a process know as partition. Many partitions were unsurveyed but described by the Court by approximate area and physical dimensions such that a surveyor with a copy of the Court order could complete the title by survey.

In some court jurisdictions in earlier years, partitions were ordered from cadastral plans with very little regard to topography or any effects upon subsequent land utilisation.

Some notorious partitions resulted where blocks that enjoyed, say, a lake frontage, but ran to high ground somehat back from the lake were cut into long thin strips sometimes only one or two chains wide to give every applicant for partition a share of lake frontage without thought to the use of the hinterland area.

More recently than these events, the Land Courts appointed Land Utilisation Officers -usually surveyors - who advised the Court on the practicalities of boundaries. Later still these Land Utilisation Officers called in Field Supervisors of the Department of Maori Affairs and moved to present to the Court proposals which took account, at last, of use in its wider sense.

Some remedial measures have been applied by the Court toearlier Court decisions. Some partitions where survey and Land Registration had not been effected were cancelled and reamalgamated into lake frontage areas laid out as subdivisions with proper roading, reserves, etc, and the hinterland areas retained as one block.

In other areas 'Consolidation Officers', usually Maori and Maori speaking, worked in with the owners in. mainly, centres of rural population to amalgamate and rationalise family holdings into blocks of workable area for what was, in general, subsistence agriculture.

Section 438 Trusts

This section of the Maori Affairs Act (originally the 1953 Act but amended by the 1967 Amendment Act) enables groups of owners to vest their interest in a block of land in Trustees who are appointed by the Maori Land Court after consultation with the owners. This section has the object of facilitating the "the use, management, oralienationof any Maori freehold land, or any customary land or General land owned by Maoris." Such trustees have specific limits set upon their trusteeship by their Trust order but, taking account of this qualification, have the authority of Trustees in general and are bound by the Trustee Act.

This provision has received impetus both from groups of concerned owners and from Maori Land Court Judges in recent years. Of a sample of 71 Section 438 Trusts of 10 ha or more in area, only 8 have Trust orders dated prior to 1980. The appearance is that the Court has more actively concerned itself with effective utilisation, since that time. In Opotiki County there are some 1063 Trusts comprising approximately 70 165 ha.

The formation of a Trust and the definition of its powers by the trust order is only the first step to more effective utilisation. The most common outcome of trust formation is:

(a) A period of discussion and assessment by the trustees of their land resource and enquiry into avenues of utilisation.
(b) The arrangement of a lease - either formal or informal - of the land in question.

There is no record held of current land utilisation of Section 438 Trusts, nor is there an assessment of what factors may be inhibiting their productive use. It is clearly difficult to address undefined problems. Anecdotal evidence suggests that the first problem demanding attention is the provision of information to trustees as to appropriate uses for their land and sources of finance and expertise to enable such uses to be achieved.

During a review of the Land Managment Division of the Department of Maori Affairs commissioned by the State Services Commission in 1983, a principal recommendation was that funds be made available from the then Maori Affairs vote to institute and implement training courses for trustees and members of committees ofmanagement of Maori incorporations. This recommendation was not acted upon.

Leases of Section 438 Trusts range from annual cropping arrangements, generally of an informal nature, to 99-year leases to forest companies. Short-term leasing arrangements are often expedited by rating demands. The expectation may be that several years of maize or squash or tomato growing will yield a capital sum sufficient to enable owners toundertake acropping programme for themselves and gain the perceived benefits of windfall profits from market fluctuations in these crops while having sufficient funds to hedge against cyclical losses. If, however, there is a demand on the trustees by the beneficiaries of the trust for income, such hopes may not be realised. In fact some blocks have been cropped to maize during periods of good maize prices and left to lie fallow when prices were low.

The potential for pastoral use of the Trusts as at present constituted is limited by size. Of the 1063 Trusts in the Opotiki County, 738 are of less than 10 ha. Clearly a pastoral use presupposes fencing and water supply of at least some minimum standard. A lessee might might put up capital for such improvements if surface water were available. A lease of at least 5 years would probably be required on terms adequate to offset the capital outlay. This presumes, of course, that the area is initially in fair pasture. Dry stock from Opotiki dairy herds are grazed on a semi-permanent basis as far away as Te Kaha (60 km from Opotiki), but the demand is finite and the land owners or trustees need to be able to supply some livestock management as the Coast Riding (where most of the Maori land lies) in notoriously bad for facial eczema.

Expectations of future profits in horticultural and market garden crops are sometimes unwarrented. Strong promotion over the years by well-meaning politicians and others of the value of flat land in a favourable climatic area have led to the belief by some owners and trustees that the main prerequisite to high, andrelatively risk-free, returns is ownership of the land per se. The importance of the other two classical economic inputs to land-based enterprises of labour and capital have often been played down.

Many small pastoral holdings held as family trusts appear destined to be retained as adjuncts to residential properties running a few head of stock as killers and providing ares for subsistence cropping, and this may well be their best use.

At the other end of the scale some 8 Section 438 Trusts totalling 16 619 ha are under lease to forest companies. One of these Trusts also has a 20 ha kiwifruit orchard and a dairy operation. Another has bought the lease of and redeveloped a run-down dairy unit next door

Incorporations

A further important means available to Maori land owners for the effective utilisation of their land is that of the Maori Incorporation.

Rules for the establishment and the running of the incorporations occupy a complete section of the Maori Affairs' Amendment Act 1967. Suffice to say that Sir Apirana Ngata is credited with the initiation of these schemes and that they are essentially private land-owning companies governed by elected 'committees of management'. Liability of shareholders is limited but shares are not tradable on the open market.

The aims and object of incorporations are set out by the Land Court and are not now generally restricted to land-based activities, although the genesis is, by statute, land-based.

Incorporations tend to be tribally or subtribally based, and there are a number of strong incoporations throughout the country. Those that are most successful have good financial and technical advisors and operate with a clearly defined chain of responsibility between their staff and their committees of management.

Some committees of management have difficulties with the view that the best obtainable management and advice will generally give the best return to the shareholders, and have placed family members in management positions without sufficient regard to competence or impartiality as between different groups of shareholders. This point of view, I believe, is diminishing.

Incorporation funds have calls upon them not only for further land development but also for community projects, educational grants and, not least, dividends to the owners.

Regrettably, the training of agriculturalists, engineers and foresters has not been given high priority by Maori organisations with funds available. Much greater standing seems to have been accorded to the legal profession. The secondary school careers officer must take some of the blame; some parents also equate 'forester' with 'bushman' and 'agriculturalist' with 'subsistence farmer'.

The six incorporations in the Opotiki county total about 24 500 ha. Two are leased for forestry. One is leased as a pastoral lease. One combines a forest lease with a 400 ha sheep and cattle operation. One, the Orete Incorporation at Waihau Bay, has a 1755 ha

forest lease about 6 years from felling, has two dairy farms milking between them 600 cows and also owns the Waihau Bay Lodge. One, the Tunapahore B2A Incorporation, has 205 ha for forestry and a 325 cow dairy unit. In all, some 10 250 ha are forest lease. Both the last two incorporations mentioned have leased undeveloped blocks that adjoin them and that are constituted as Section 438 Trusts. The trustees have granted rent-free periods of several years to the incorporation on the understanding that certain minimum areas will be developed with that time. The incorporations concerned have loans from the Rural Bank secured on their freehold properties and the leasehold is not mortgaged.

Lending on the security of Maori land

Historically, the lending on Maori lands has been the preserve of the Maori Affairs Department and the Maori Trustee. The Maori Affairs Act has had specific sections tailored to the channeling of government funds into Maori land development and has provided the administrative structure both for this development and subsequent farming and settlement of the land.

With the demise of the Department, the administration of existing rural mortgages has fallen to the Iwi Transition Agency (ITA). This organisation aims to quit mortgages to commercial lenders, at a discount where necessary. It is not lending on Maori rural land for any purpose. Its field officers - a very much reduced strength carried over from the Department of Maori Affairs -now have little of their earlier advisory and educational functions and are primarily administrators facilitating the winding down of erstwhile departmental operations.

A whole structure is being withdrawn and it is fondly expected that the 'market' will fill the void.

Banks and stock and station agents have from time to time lent money both to individual Maori land owners and to Maori organisations. These have in the main been seasonal advances and not advances secured against interests inland forlongertermdevelopmentprogrammes.

State lending agencies were accorded some special provisions in relation to lending on Maori land. No such agencies now exist. The Rural Bank, when it was a state agency, did lend where there was no land transfer title but only on specific conditions. The continuity afforded by senior staff has meant that since 1981 this bank has lent in excess of $2 million to Maori mortgagors in the Coast Riding of the Opotiki County alone. Large advances, however, have been limited to those blocks where land transter title existed; small development loans have been made on the security of stock and plant.

The Maori Development Corporation (a private Auckland-based agency) has not emerged as a major rural lender as was once hoped. The three trading banks in Opotiki are providing seasonal finance only and cite the complexity of Maori land title as an important reason for not lending on longer terms against that securtiy.

The position is that lending on a security of Maori freehold land for its development and subsequent farming operations need not be inhibited by the fact that title may, for the moment, be held in the Maori Land Court registry rather than on the general registry.

Mortgagees of Maori freehold land have the same rights as mortgagees of general land, provided that the mortgage has been produced to the Registrar of the Maori Land Court and noted in the records of the court.

The staff of whichever organisations pick up rural lending on largely multiply-owned Maori land will need not only to be technically competent but also to have knowledge of the underlying problems, an empathy with the people, and some sympathy with their hopes and aspirations.

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Utilisation of wastes as fertilisers with particular emphasis on the Bay of Plenty region

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Abstract

Estimates of the wastes produced in the Bay of Plenty region indicate that 22 million m^3 (tonnes) is produced annually. The main contributors to waste production are the dairy industry (shed, factory), municipal sewage, pig, poultry, meatworks, kiwifruit, fishing and pulp and paper industries. In fertiliser terms these wastes are valued at $7.7 million. In addition the timber industry produces > 1 million tonnes of timber residues (sawdust, bark, woodchips) approximately 20% of which is currently dumped. Wastes, when recycled back on to the land, offer a potential source of nutrients to enhance pasture and crop production. In addition organic wastes provide a source of organic matter which may have beneficial effects on the physical properties of soils.

Research results indicate that pumice soils are well suited to the application of wastes. Some general recommendations are given for the use of wastes in dairying, orcharding and cropping situations. Three factors are considered important for the successful utilisation of wastes (a) applicationrates need to be balanced to the nutrient needs of the soil-plant system (b) safeguards in the form of regularchemical monitoring of theeffluent, soil, plant and animal need to be implemented, and(c) the economics of using the waste materials must be favourable to the farmer and orchardist. The principle of the producer of the waste paying for its safe disposal or utilisation needs to be adopted in New Zealand as i t has in many overseas countries.

Keywords nutrients, organic matter, waste recycling, pumice soils, fertiliser value

Introduction

European farmers have traditionally cycled large quantities of animal and human wastes back onto the land, In the more intensively farmed countries like the Netherlands increasing quantities of wastes together with inputs of 400 kg per hectare or more of N fertiliser has put pressure on the environment (nitrate in water, ammonia volatilisation), so much so that strict legislation on the quantities of wastes to be. returned to the land are being enforced (Mason 1991)

New Zealand farmers, on the other hand, because of all-year-round outdoor grazing have not been concerned with accumulations of animal manures nor has there been pressure to recycle wastes back on to the land. But increasingly in New Zealand there are environmental concerns particularly in relation to water quality and the need to keep wastes out of our waterways. In recent years there has also been a major downturn in fertiliser use *on* farms (MWBES 1991). Waste materials recycled back onto the land could be of assistance in both these areas. Hence we need to be in a position to critically assess (a) the range of waste materials available (b) their value in fertiliser terms for pasture and crop production and (c) any harmful components and possible long-termdetrimental effects of using wastes. This paper will address these issues with particular emphasis on waste materials available in the Bay of Plenty region.

Types of wastes, quantities and fertiliser value

The wastes produced in the BOP region have been estimated (Table 1). The main contributors to waste production are the dairy industry (dairy shed, dairy factory) municipal sewage wastes and poultry and pig industries. Others including meatworks, kiwifruit, fishing and pulp and paper industries are also important contributors. In total 22 million m^3 (tonnes) of waste materials is produced annually (excluding forestry), all of which could be considered a potential nutrient source to enhance pasture and crop production. Considered in fertiliser terms some 6580 tonnes of urea, 14 900 tonnes of superphosphate and 4320 tonnes of muriate of potash is produced annually in the BOP region. Together this is valued at $7.7 million. Relative to the sales of BOP Fertiliser Company on a proportional basis for the BOP region (R. Clark pers. comm.) this amounts to approximately 92% of the urea sold, 25% of the superphosphate and 34% of the muriate of potash. These are not trivial amounts.

Table 1 Estimates of the waste materials available in the Bay of Plenty.

Source		Quantity (m^3/year) (millions)	Fertitiser equivalents ('000 t) Urea	Superphosphate	Potash	Fertitiser value ($'000)
Agricultural						
Dairy Shed'		2.386	1.04	1.06	1.43	1.171
Dairy Factory		0.200	0.57	0.89	0.52	862
Poultry		0.015	0.49	1.25	0.19	537
Piggery'		0.110	0.41	0.61	0.18	370
Meatworks'		1.450	0.38	0.21	0.29	318
Other - kiwifruit, fish, horse		0.044	0.28	0.33	0.27	306
Municipal						
Sewage	- sludge[4]	0.140	1.61	8.09	0.25	2,397
	- effluent'	17.500	0.76	1.37	0.35	742
	- compost[6]	0.028	1.04	1.09	0.84	984
	TOTAL	21.873	6.58	14.90	4.32	7,687
Forestry						
Pulp & Paper	- effluent	72.800	0.02	0.08	1.60	541
	- lime sludge'	0.002				

1 50 l/cow/day
2 13.5 l/pig/day
3 1000 l/Stock Unit
4 800 kg/person/year
5 300 l/person/day
6 based on 50% of the compostible organic waste available
7 70% lime equivalent

Table 2 Timber residues in the Bay of Plenty region'

Product	Annual production (t)	Quantity dumped (t)
Sawdust	240,000	120,000
Woodchips	640,000	Nil
Bark	175,000	60,000
Fibrous waste (Pulp 8 Paper)	18,000	18,000

1 from van Wyke (1990) and pers. comm.

The timber industry is a large supplier of waste particularly in the form of sawdust, woodchips and bark (Table 2). Although significant use is being made of some of these products, e.g. woodchips, large quantities of the others are currently dumped. Such products would be useful as sources of organic matter for composts made from a range of waste materials.

Research results with wastes in the BOP

Whey

Two trials in the Reporoaregion between 1987 and 1989 compared whey with solid fertiliser. Treatments included whey at 45 000 litres/ha and solid fertiliser applied at equivalent P and K levels to that in whey. A basal S application was made to all the solid fertiliser plots. Trials were on ryegrass-white clover pastures under dairy grazing with measurement by pasture probe on a before andaftergrazing basis (pers. comm. B. Thorrold). Results for the final 12 month period of the 3 year trial are shown in Table 3. Whey gave a similar yield to solid fertiliser at the Reporoa site and although slightly higher at the Whenuaroa site this difference was non-significant. The presence of N in the whey inevitably provides a short-term benefit to that treatment. Overall, whey provided an excellent substitute for potassic super-phosphate. Soil and herbage chemical analyses (data not presented) over the 3-year period supported this view. No problems with soil wetness or surface soil stability were evident.

Table 3 Pasture production (kg DM/ha) for whey and solid fertiliser at 2 sites - 1989/90[1]

	Whenuaroa (kg DM/ha)	Reporoa
Control	5,000	5,100
Whey (45,000 M/ha)	6,200	5,700
Solid fertiliser (NPK)[2]	5,600	5,700
LSD (5%)	1,010	680

1 Pasture production underestimated
2 Equivalent to the PK in whey

Sewage effluent

Effluent discharge onto land can be viewed both as a means of treating effluent and obtaining increased production from that land. Pumice soils are highly regarded in their ability to treat effluent (Childs *et al.* 1977). Experiments conducted in the late 1970s at the MAF Wairakei Research Station on a free-draining Atiamuri sand indicated the importance of selecting the correct plant species for effluent irrigation. Lucerne *(Medicago sativa)* treated with 85mm effluent on a fortnightly basis gave an annual yield increase of 11% due to both an irrigation and anutrient effect (O'Connor 1979). However, lack of winter growth resulted in poor N removal (average 47%) resulting in increased nitrate levels in drainage waters (Stevenson & Wilcock 1979). Subsequent work (O'Connor 1981; Stevenson & Fellows 1984) suggested tall fescue *(Festuca arundinacea) was* superior to Nui ryegrass (Lolium perenne) and prairie grass *(Bromus cartharticus)* in both production and N removal particularly in the second year(Table4). Marked production increases *were* observed due to both an irrigation and nutrient effect. For example, the NPK applied at the effluent application rate of 85 mm every fortnight was 480.98 and 26 kg/ha/annum respectively.

Table 4 Pasture production (kg DM/ha/annum) and recovery for 3 pasture species with and without secondary treated sewage effluent'

	1978-79			1979-80		
	No. Eff.	Elf.	% N removal	No. Elf.	Eff.	% N removal
Tall Fescue	3960	13,410	76	4530	16,330	91
Nui ryegrass	3210	11,490	40	2870	12,250	60
Prairie grass	4720	10,310	51	3900	12.200	67

1 from Taupo Municipal Sewage

, Pumice soils, then, are seen as being ideal for sewage effluent treatment. The additional pasture production with effluent could be utilised in situ by grazing animals using appropriate withholding periods (Collins 1984). be cut and carried to feeding lots, or be made into hay or silage. The last two options provide the best in terms of N removal from the effluent. Utilisation of sewage effluent in forests is another option currently being practiced in the region (Rotorua District Council 1991).

Pulp and paper effluent

Trials conducted in conjunction with the Tasman Pulp and Paper Company at Kawerau indicated that effluent application to pasture at rates up to 80 mm/week was beneficial to pasture growth particularly over the summer period (Figure 1). This effect was considered mainly an irrigation effect as the effluent is low in N and P (Table 1). Associated soil and herbage chemical analyses (data not presented) indicated marked increases in K, S, Mg and Na supporting the contention that pumice soils and vigorous pasture growth are excellent at 'stripping' nutrients from effluents. However, possible long-term detrimental effects such as increased soil pH and Na saturation would need careful monitoring with such a waste material.

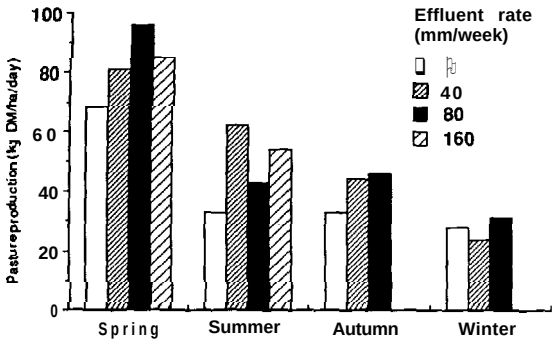

Figure 1 Pasture production (kg DM/ha/day) in 1987/88 to various rates of pulp and paper effluent (data supplied by Tasman Pulp and Paper Company, Kawerau). Note: high rate (160 mm/week) discontinued after summer season.

Other effluents

Effluent studies in *other* regions with dairy-shed wastes (Goold 1980) and meat works effluent (Russell 1986) indicate positive effects on pasture production and N removal.

Safeguards

Wastes can contain harmful elements such as heavy metals in sewage sludges or animal diseases in animal wastes. Heavy *metals* come from industrial sources and are therefore high in sewages from the larger cities like Auckland and Christchurch. Small towns generally have very low heavy metal contents in sewage (Quin 1979). Nevertheless, strict Health Department regulations are in place for the use of these materials (Collins 1984).

Likewise, with good husbandry practices, wastes from pigs, poultry and dairy cows should be free of major diseases, and if applied correctly with suitable withholding periods prior to grazing (allowing maximum exposure to sunlight) no health problems should occur.

Practical implications

A knowledge of the nutrient content of various wastes plus thenutrientrequirementsformaximisingpastureor crop production allows recommendations to be made on rates of application together with any solid fertiliser which might be required (Table 5).

Dairy farms

In general, effluents are ideally suited for application to pastures (Table 5). All contain nitrogen which gives a rapid response in the grasses. Generally they need to be supplemented with phosphorus and/or potassium to maintain maximum pasture production. The dilute nature of some of the effluents means that to be effective large quantities are needed (e.g. dairy shed effluent). Nevertheless they are a useful resource for farmers to utilise. Poultry manure is the major solid waste material forpas ture topdressing containing good levels of nitrogen and phosphorus.

Orchards, e.g. kiwifruit

Orchards offer a good opportunity to utilise waste materials. Organic wastes, in particular, offer both a nutrient and a soil conditioning effect. Table 5 shows the nutrient contribution from poultry manure and compost applied at 7 - 10 t/ha and sewage sludge applied at 5000 l/ha (approximately 1 t/ha on a dry weight basis). Additions of organic wastes can also have very beneficial effects on the physical characteristics of soils leading to better soil water-holding capacity and possibly better conditions for root growth (Marsh & Rixon 1991). This could have important implications for a permanent crop like kiwifruit subjected to the continued compacting effects of machinery.

Cropping, e.g. maize

Cropping land in the BOP is used mainly for maize growing. Maize will benefit from the addition of large quantities of nutrients (Table 5). This can be achieved by the addition of heavy quantities of organic waste (Table 5) worked into the topsoil. No further fertiliser additions would berequired. Such additions of organic matter would be considered beneficial to soil physical conditions particularly where continuous cropping was practised.

Special purpose effluent disposal

Wastes such as sewage effluent are probably best applied to specific areas planted to special-purpose species such as tall fescue. Evidencesuggests excellent

Table 5 Recommended waste applications' for dairy farms, orchards and crop land.

Waste	Application rate (litres or tonnes/ha)	Nutrients applied (kg/ha) N	P	K	Additional fertiliser required (kg/ha)*
(1) Dairy Farm					
Whey	40,000 l	52	35	66	Nil
Dairy[3] - shed	115,000 l	23	5	35	350 15% K Super
- pond	30,000 l	24	3	6	400 30% K Super
Pig slurry	15,000 l	30	30	4	150 KCl
Poultry manure	3t	45	21	18	200 50% K Super
(2) Orchard (e.g. Kiwifruit)					
Poultry manure	7t	105	49	42	90 Urea, 320 KCl
Sewage sludge	5000 l/1t	55	54	9	200 Urea, 380 KCl
Compost[4]	10t	170	35	150	375 30% K Super
(3) Crop land (e.g. make)					
Sewage sludge	25,000 l 5t	270	270	45	Nil
Compost	10-20t	170-340	35-70	150-300	Nil

1 average analyses. All wastes should be analysed prior to usage.

2 Maintenance requirements (kg/ha/annum):

	N	P	K
Dairy	-	30	70
Kiwifruit	150	50	200
Maize	100	40	50

3 100 cow herd. Effluent applied to 10 ha/annum.

4 Analysis based on Auckland Municipal Compost.

nutrient 'stripping' together with high levels of plant productivity can be achieved with relatively high application rates of effluent.

Economic considerations

In order to encourage widespread utilisation of wastes by farmers and orchardists, it will be necessary for New Zealand to adopt the principle of the waste producer paying for the safe disposal or utilisation of these materials. This principle has been adopted in many overseas countries. Where the waste producer carries the cost, the economic viability of waste utilisation becomes much more attractive. For particular waste materials (e.g. sewage sludge) a subsidy for its use may be appropriate. In West Germany, for instance, farmers are paid $200/ha to use sewage sludge on their land.

Conclusions

Numerous waste materials are produced in New Zealand which could be used effectively in agriculture and horticulture. Estimates for the Bay of Plenty region suggest a valuable resource, in excess of $7.5 million annually, is available. Three factors are important for the successful utilisation of these materials:

1. applicationrates need to be balanced to the nutrient needs of the soil-plant system.

2. safeguards in the formofregularchemical analyses of the effluent, the soil, the plant, and the animal need to be present.

3. the economics of using the materials must be favourable to the farmer and orchardist.

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