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Implementation of environmental regulations on-farm

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ABSTRACT

A case study of the consultative process concerning water clarity in Lake Taupo was used to identify the key elements required to reach consensus between land-owners, users and regulatory authorities. These elements included: the identification of all stakeholders; impacts at the farm level where individual behaviour change must occur; the scientific validity of data used and the decision support models available to assess biological and economic impacts. The importance of the consultative ‘process’ itself and the need for sufficient time for this process to occur were other key elements. The Lake Taupo case study was then compared with the larger scale issue of greenhouse gas emissions (GHG) from New Zealand agriculture. We concluded that a much greater level of scientific uncertainty existed for the effect of GHG emissions on climate change than for Lake Taupo water clarity. This fact, coupled with the potentially much greater economic impacts on agriculture and individual farmers helped explain farmer reluctance to accept proposed solutions. Findings from the Lake Taupo study suggest the way forward in the GHG emission debate requires a major improvement in the underpinning science and a clearer understanding of the implications of GHG emission control at the farm scale. Mitigation options must consider both physical and financial inputs and outputs. The consultative process must involve farmers at policy, economic and science levels and be long enough to cover all issues.

Keywords: environment; greenhouse gases; Lake Taupo; nitrate; ruminants; sustainability.

INTRODUCTION

Implementation of changes to farming practice to improve environmental performance will be at the farm level. Changed practice does not necessarily result from promulgation of policy and regulation, particularly where assessment of an individual farmer’s level of compliance is difficult. Waikato farmers wanted sustainability to be considered in terms of effects on farm profitability and lifestyle, as well as on natural resource conditions (Parminter *et al.*, 1994). Furthermore, management practices that have a beneficial effect on resource conditions may be difficult to promote if they do not support profitability and lifestyle goals (Parminter *et al.*, 1996).

Although ecologically sustainable practices might conflict with short-term economic sustainability, long-term economic performance must be related to conservation of the resource base (Ikard, 1990). This is most obvious to land managers when considering on-site effects (e.g., soil erosion), as in the longer term, depreciation of physical resources will reduce the ability to continue farming and so the alignment between economic and environmental sustainability is obvious. However, when considering off-site effects this convergence over time of economic and environmental goals is less obvious. In a biophysical sense, pollution of water or emission of greenhouse gases (GHG) does not directly impact on the ability to farm into the future. Hence the logic of modifying practices to improve environmental performance will be less obvious to farmers.

The implications of regulations concerning GHG emissions from ruminants are as yet not clear at the individual farm level. However, there is currently a somewhat similar environmental issue that is in the process of being resolved. This issue is a regional one, and concerns the leaching of nitrate from grazed pasture

in the Lake Taupo catchment into ground water and thence into the Lake (Vant & Huser, 2000). The factors associated with farmer acknowledgement of this issue and of the need for changed practice, and of the way the policy makers have interacted with farmers, provide some lessons as to how on-farm practices might be aligned with policies on greenhouse gas emissions in the future.

A CASE STUDY

Context

Things were looking up for the farmers in the Lake Taupo catchment early in the new millennium. A monitor farm (Sheath *et al.*, 1999) had run its course within the catchment and demonstrated the potential for increased financial performance; farming systems on many of the properties were being intensified; product returns were strong, the dollar was low and profitability was rising; and farmer equity in many properties was increasing as land values appreciated and debt was retired. Farmers were more optimistic than they had been since the economic reforms of the 1980’s.

During 2000, press releases and public meetings instigated by Environment Waikato (EW) caused the farmers to temper their optimism. Recent public surveys had revealed that weeds and slime near the lakeshore were an issue for lake users (Stewart *et al.*, 2000) and small decreases in lake clarity were observed. The water clarity effects in particular were being ascribed to an increase in nitrogen concentration in the Lake. Reductions in the amounts of nitrate leached below the root zone in pastoral land (considered to originate mainly from the urine patches of the grazing animals) were targeted by Environment Waikato as the most-effective way of halting the predicted decline in lake water clarity.

The farmers thought they had been doing a good job. Taupo was regarded as a “well-managed” catchment. Water quality issues apparent in the 1970’s were resolved

by extensive stream bank retirement and planting, and provision of treatment facilities for urban sewage (Thorrold *et al.*, 2001). About 22% (46,000 ha) of the catchment is in pasture, more than half (55%) is alpine area or remains in indigenous vegetation, and 22% is in pine forest. Shoreline scrublands have not been developed, and most of the farms run sheep and beef, and increasing numbers of deer - dairy conversion has been very limited. The majority of the pastoral land (58%) is Maori-owned, with the remainder split between private (24%) and Crown (18%) ownership. Most of this land was developed by Government Departments (Maori Affairs and Lands & Survey) for subsequent settlement.

One possible future scenario had a variation to the regional plan being notified as early as September 2001, requiring an across the board reduction in nitrate emissions from pastoral land, likely followed by protracted and expensive Environment Court action.

The farmers' response

The farmers believe the Lake is a national icon and its qualities should be preserved; however they felt they were being unfairly singled out for attention. They questioned the validity of the explanations for changes in lake water quality. They were aware at the outset that whatever rules were imposed on them would be hard to monitor and enforce, and for some farmers a policy of non-engagement and eventual non-compliance was seen as the probable outcome.

Following their initial response of disbelief, they formed a group called Taupo Lake Care (TLC). They met with local regional councilors, and then with EW policy staff. They stated their business viability would be threatened by land management options that halted further intensification or worse still forced reductions in farming intensity. It would be fair to say that initially there was an element of disbelief on both sides of the table.

The “Facts”

Environment Waikato, assisted by outside experts, documented current understanding of the issues, of the processes contributing to the problem (including a N balance for the Lake and the effects of substantial time lags between the nitrate leaching from the root zone, entering the streams and thence the Lake, and becoming biologically active in the Lake).

Algal growth in Lake Taupo is nitrogen limited (Vant & Huser, 2000), and the current aim is to maintain concentrations at about 0.1 mg/L, which is a very low concentration compared with the world health organisation recommended maximum for drinking water of 11.3 mg/L. Environment Waikato has targeted a 20% reduction in nitrate emissions from pasture land in the catchment as being required to maintain lake clarity at current levels. So we have the situation where public opinion regarding water quality, and monitoring of water quality by EW, has led to a perceived need for changed land management. Likely ways of reducing nitrate emissions from sheep and beef farms include reducing stocking rate, increasing sheep to cattle ratio, decreasing

N concentration in the feed e.g. by feeding maize silage, and grazing stock out of the catchment, or containing them on a feed pad, when potential for leaching losses is high e.g., in winter (Ledgard *et al.*, 2001). The most dramatic reductions would come where pastoral land was converted to forestry.

Implications for farmers

AgResearch staff acting as a neutral third-party, worked with the farmers to examine the impact of possible changed management scenarios on farm performance and nitrate emissions. The farmers identified their primary goals as maintaining economic viability and flexibility of farming options into the future, and maintaining the quality of the Lake. The nutrient balance model OVERSEER, and the farm system models Stockpol and UDDER were crucial to carrying out this work. The results suggested that farm capital value would be severely eroded as a result of potential legislation, profitability would decline, and in some cases businesses would not be viable (Thorrold *et al.*, 2001).

Consultation

Taupo Lake Care and EW agreed to hold a series of consultative meetings. Two AgResearch staff (including one of the authors) were invited to attend. The group met approximately three-weekly over a year. The underlying driver for the meetings was identified early-on; i.e., the likelihood that structured, interactive consultation between the policy makers (EW) and the people who would have to change their land management (TLC) would result in an earlier successful resolution and a better outcome for the stakeholders and the Lake. It was hoped this approach would increase the likelihood of timely compliance to the potential regulations.

Mutual understanding of TLC and EW points of view occurred, and the relationships that have been built should survive the difficult times that will continue as the variation is put in place and the farmers are asked to implement it. Vigorous debate occurred regarding “the facts”, and acceptance of many of the underlying fundamentals was achieved. Taupo Lake Care questioned the validity of the scientific explanations for changes in lake water quality. They were not confident that the relatively limited water quality data being used to demonstrate there was a problem were adequate. Variability in the estimates of various nitrogen pools and fluxes disturbed them. How can you create precise rules from imprecise data? Differences of opinion still exist, but they were identified and the consultation moved on.

Agreement was reached that other sectors also affected the Lake and that “the pain” would need to be shared by a range of stakeholders. There was acceptance that farmers would be severely disadvantaged if the proposed regulations were put in place, and it was acknowledged that there was a need for an assistance package that would involve very substantial sums of money. Local, Regional and Central Government have been identified as 3 agencies that should contribute to this package.

It became obvious that the 3 major groupings of landowners (and individuals within the groupings) would

TABLE 1: A comparison of key issues for the Lake Taupo catchment nitrogen emissions and greenhouse gas emissions from New Zealand ruminants.

Major contributors Issue	Lake Taupo farmers Nitrogen	New Zealand farmers GHG Emissions
Spatial scale	Local	National-Global
Temporal scale	Short-Medium	Medium-long
Scientific consensus on impacts	Good	Poor
Public concern	High	Low
National impact of action -costs	Minor	Major
National impact of action -benefits	Clear	Unclear
Trade implications	Minimal	Major
Feasible control options	Yes	No
Player and beneficiary alignment	Partial	Very poor

be affected differently, and the policies and assistance packages would need to accommodate this. Also, other substantial landowners (owners of forests and of currently undeveloped land) would be adversely affected in terms of future flexibility, and the impacts of the policies on them would need to be considered.

Environment Waikato offered to move the date of the proposed variation back in time, and then subsequently to not issue a proposed variation, but rather a draft variation. This would have no legal status and would be a consultative document. The variation would not be locked in place until details of an assistance package were finalised.

The consultation process widened to include other stakeholders who would be less severely, or indirectly, influenced as the TLC-EW consultation proceeded.

Taupo Lake Care represents almost all the non-Crown pastoral farmers in the catchment. It has credibility with both Maori and non-Maori interests. Throughout the process the TLC consultative team has maintained ongoing contact with the wider group through newsletters and meetings. There has been awareness within TLC that maintenance of farmer solidarity will be important. Particular care has been taken to make sure that the implications for farmers at each stage of the process are clear. This has involved open communication of all relevant details to the TLC members. The consultative team have at all stages measured the joint understandings arrived at during consultation against the probable reaction of the wider group, and have themselves reacted accordingly.

There is general agreement that this consultative route has been preferable to one of regulation and confrontation. Of course this approval is tempered with caution because of awareness that as more stakeholders become involved, and the political processes of governmental agencies impact on the process, the outcomes may not be satisfactory for one or both of the parties. Also, there has been an understanding throughout that the goals of TLC and EW differ, because of the different roles they have within the community.

What were the key elements?

- Scientific underpinning - understanding of the processes operating in the Lake and the catchment area.
- Identification of the stakeholders most likely to be affected, and consideration of the impacts (including

economic) at that scale i.e., at the farm level.

- Availability of decision-support models that enable impacts to be assessed at the farm scale.
- Willingness to acknowledge others' points of view, to engage in ongoing interactive consultation, to compromise and to learn.
- Provision of time for consultation and understanding to occur, impacts and options to be identified and explored, for assistance package possibilities to be discussed, and for changes in on-farm practice to be made.

Implications for management of greenhouse gases

In this section we examine some common features between the Lake Taupo catchment problem and management of greenhouse gas (GHG) emission in New Zealand agriculture. Table 1 compares some of the key issues that are involved in the economics of environmental pollution.

Spatial scale

The Lake Taupo nitrate problem is a local one and therefore a range of instruments is available to planners, these include: regulation, tradeable permits, voluntary restrictions or combinations of these. In contrast, GHG emissions are a national-global problem that can only be solved by voluntary international cooperation because there is no 'higher power' (that we currently have access to) to enforce reduced emissions. The Kyoto Protocol is an example of voluntary international cooperation.

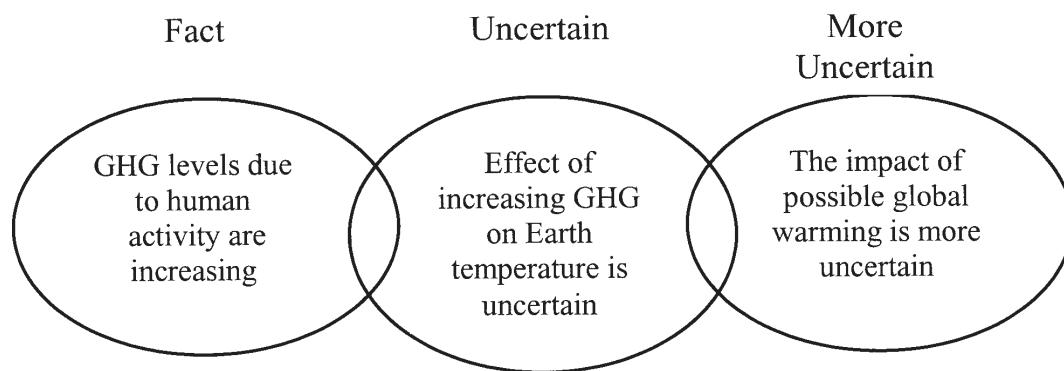
Temporal scale

Both Lake Taupo and global GHG emissions represent situations where costs are proposed now in the hope of medium to long term benefits. These costs and benefits are uncertain. In the light of uncertainty 'optimists' might prefer to defer action until cheaper, better options of emission control are developed. 'Pessimists' might opt for a precautionary approach that incurs high short-term costs but avoids the possibility of disastrous consequences. The fact that all parties in the Lake Taupo situation were able to take a fairly long-term view is encouraging in relation to GHG issues.

Scientific consensus on impacts

At Taupo farmers were initially very sceptical of the science and science models that EW and scientists used. It was only during a lengthy consultation process that

FIGURE 1. The chain of uncertainty linking greenhouse gas levels with the impacts of possible global warming.



farmers came to a partial acceptance of key concepts and models. Without this process and subsequent acceptance it would have been impossible to proceed with consultation and develop ‘what if’ scenarios from the models. Without sound underpinning science further consultation and acceptance would have been impossible.

Unfortunately the global climate change concepts and models in relation to GHG emissions are cloaked in uncertainty. Figure 1 shows that the level of uncertainty increases as we move from the effect of human activities on GHG concentrations in the atmosphere, to the impacts of possible global warming at a national, regional and farm level.

There is not a complete consensus on issues regarding global warming and global climate change. The science models have insufficient precision to predict national and regional effects. Drivers of change in one GHG may well have an effect on concentrations of another (Clark *et al.*, 2001) and to date insufficient attention has been paid to this in discussion of potential mitigation techniques. The variability of estimates for gas emission is large e.g., for nitrous oxide as reported by Carran *et al.* (1993). In our experience variability in estimates causes distinct unease in non-scientists, and extreme variability corresponding unease. Climate change will likely bring some benefits (e.g. higher winter pasture growth rates) and some disadvantages, even disasters (e.g. inundation of low-lying regions). Also, satisfactory models do not presently exist to predict the effects of changed practice on GHG emission at the farm scale. Given that this is the level at which mitigation techniques will have to be applied this is a serious shortcoming.

Public concern

New Zealanders, and Taupo residents in particular, consider Lake Taupo to be an important part of our heritage. This attitude led to a willingness to find a solution to any problems that threaten the lake’s current status. Given this willingness, the problem moves to one of finding a ‘fair’ solution. The chance of reaching a solution is increased because the object of attention (the Lake) is highly apparent visually, and also interested parties are often multiple users of Lake Taupo. Farmers “use” Lake Taupo for nitrogen emissions but they want the benefits of a pristine lake for lifestyle and recreational

use, as well as they have a strong sense of social and cultural responsibility. In reality, the situation is much more complex than the diagram and this complexity encourages trade-offs for both emitters and those suffering from emissions.

Greenhouse gas emissions are a global concern but they have yet to generate a groundswell of individual concern. This may be because of scientific uncertainty, and lack of evidence of immediate impacts on living standards of increases in atmospheric GHG concentrations, or if GHG emission controls were introduced.

Costs

The costs of reducing nitrogen emissions to Lake Taupo are quite low at a national level, but the benefits are quite clear and large because deteriorating Lake quality would constrain development of regional tourism (McDermott Fairgray, 2000). Potential costs to individual farmers in the short term may be large e.g. loss of income from a current enterprise, or inability to convert to a more profitable, but higher N emitting operation.

The likely scenarios for New Zealand livestock farmers who reduce GHG emissions are discouraging. Reduced stocking rates will lead to reduced incomes in many, but not all cases. The options of grain feeding, purchasing emission permits or the use of ‘magic bullets’ to reduce methane and nitrous oxide emissions will all increase farm variable costs. In addition, some of these options will lead to increased labour requirements in industries that are currently struggling to find suitable labour.

Table 2 shows that if a high carbon tax was imposed it would make economic sense for dairy farmers to reduce stocking rates by up to 30%. This would lead to a 25% reduction in methane output per ha. It would also lead to important spill-over benefits for nitrous oxide and nitrate leaching. However, individual farmers would lose \$311/ha per year in economic farm surplus. If applied across the 1.3 million ha in dairy farming this equates to \$400 million per year lost income.

Benefits

In the Lake Taupo catchment the tangible benefit to farmers of a pristine lake is likely to be large because of

TABLE 2. The effect of stocking rate on milk yield, economic farm surplus with and without a carbon tax and estimated methane output (from Macdonald *et al.*, 2001).

Stocking rate (cows/ha)	2.2	3.2	4.3
Milk (kg/ha/y)	12100	13800	14600
Methane (kg/ha/y)	233	309	385
EFS* (\$/ha/y)	2661	2741	2325
EFS** (\$/ha/y)	2430	2430	1940

Methane calculated from Clark (2001)

*Economic farm surplus - details of calculation in LIC (2001)

**Net economic farm surplus - calculated as EFS - cost of carbon dioxide tax (assumed at \$43.70 per tonne) to give break even for optimum stocking rate for EFS (3.2 cows/ha) and the lowest stocking rate (2.2 cows/ha)

the increase in real estate values, plus there will be an intangible benefit of meeting social and cultural goals. However, farming in an area with increasing emphasis on tourism and lifestyle will bring further challenges in the form of increased rates and the impact of agricultural operations on lifestyle block owners.

The benefits to farmers of reduced methane emission, for example, are difficult to quantify. Achievement of this goal would allow more energy to be captured from the rumen for production of milk, meat or wool (2-15% of gross energy is lost as methane, (Johnson & Ward, 1996). However, the marginal value of this production must exceed the marginal cost if a net benefit is to be extracted. There is an urgent need to quantify the costs and benefits of the options suggested.

Trade implications

The small, local nature of the Lake Taupo catchment means that it will have a negligible effect on international trade and the national economy. However, there are major potential issues for New Zealand farmers in relation to GHG emissions. Specifically, taxes, permits or regulations will increase the cost of farming. If only developed countries ratify the Kyoto Protocol it will mean that their costs will increase and developing countries will have a competitive advantage in the production of meat, wool and milk.

Feasible Options

As mentioned earlier realistic options exist for Lake Taupo catchment farmers to reduce their N emissions. The economic impact is not zero but it appears that if adequate assistance is provided for land-use change, farmers are prepared to accept restrictions on their farming activities in return for benefits to the wider community.

An absolutely key point here is that the 'process' by which this mutual agreement is being reached is far more important than the particular 'solution'. Can a similar "process" work for New Zealand livestock farmers and GHG emissions? The different nature and scale of the two problems, as outlined in Table 1, suggest that the way forward will be difficult. The nature of the GHG emissions problem meant that only an inter-governmental approach was appropriate in setting the overall framework for consideration of the issue; farmers were not directly involved. Once the Kyoto Protocol was advanced New Zealand Government agencies became involved in the details; again farmers were not involved. Economic

assessments (NZIER, 2001) have been done largely at a national scale; again with little apparent farmer involvement. The platform of GHG science both nationally and internationally has not involved farmers.

It has to be acknowledged that attempts have been made to engage stakeholders in discussions on the issue. The recent negative statements regarding Kyoto in the media from representatives of the pastoral, forestry and business communities, from Iwi, and also from politicians, suggests that the consultation process has been less than perfect. In the Lake Taupo consultations agreement was reached that discussion by media would be destructive, and that issues should be sorted out face-to-face. Also, TLC has regularly informed its farmer members regarding the state of the consultation process, and current points of agreement and disagreement. This does not appear to have been the case with GHG consultation.

Communication is a two-way process, involving sending and receiving. It would appear effective communication has not been occurring. Effective consultation involves honesty and trust, and full disclosure of relevant information. Has this been occurring?

All of the above means that individual farmers have not accepted that this is a problem that they need to solve through behavioural change. Without a spirit of cooperation, farmers will likely inflate the costs and difficulties of reducing GHG emissions, planners and pollution sufferers will exaggerate the costs of GHG emissions, and the outcome will be poor policy and regulation, and low compliance by those required to modify their behaviour.

Payer and beneficiary alignment

In the Lake Taupo catchment the cost will potentially be borne by farmers, local, regional and central Government, and also other stakeholders through increased user charges. The farmers' actions will determine the level of success and they will receive some benefits as part of the wider community and perhaps some individual long term benefits through increased land value.

For GHG emissions either the New Zealand livestock farmer and/or the New Zealand tax-payer will pay. Neither is likely to be financial beneficiaries in the short term, and long term benefits due to better climate outcomes or realizing the value of carbon credits are very uncertain. There will of course be various social and political outcomes that will meet the goals of parts of the community, but these goals will not necessarily align with those of the landowners affected. If New Zealand farmers have to pay the cost there is likely to be a major mismatch between payer and beneficiary. Further, New Zealand farmers are price-takers on the international market, therefore they cannot recover costs, which means that the consumer will pay none of the increased costs.

CONCLUSIONS

Based on the Lake Taupo case study and an analysis of the similarities and contrasts with the GHG emission issue the following conclusions are drawn:

There is need for much better underpinning science in relation to: climate change science and models and

GHG inventory and mitigation; international coordination with emphasis on global health rather than IP rights. The science and models need to be applicable, robust and credible at the scale of implementation i.e., the individual farm. The major New Zealand stakeholders need to clearly understand the implications for themselves and their sector. It is likely that scenarios involving “trust me, I know what I am doing” will be unacceptable to the pastoral industry. Any analysis of mitigation options needs to consider both physical and financial inputs and outputs. There is a need for immediate action on ‘process’ that involves individual farmers at policy, economic and science levels, with sufficient time to explore issues thoroughly.

REFERENCES

- Caran, R.A.; Willoughby, E.J.; Giltap, D.J.; Newsome, P.F.J. 1993: Nitrous oxide inventory information for New Zealand. Report to Ministry for the Environment, April 1993
- Clark, H. 2001: Ruminant methane emissions: a review of the methodology used for national inventory estimations. Report prepared for the Ministry of Agriculture and Forestry. June 2001
- Clark, H.; deKlein, C.; Newton, P. 2001: Potential management strategies and technologies to reduce nitrous oxide, methane and carbon dioxide emissions from New Zealand agriculture. Report to the Ministry of Agriculture and Forestry, September 2001. p 81
- Ikerd, J.E. 1990: Agriculture's search for sustainability and profit. *Journal of soil and water conservation* 45: 18-23
- Johnson, D.E.; Ward, G.M. 1996: Estimates of animal methane emissions. *Environmental monitoring and assessment* 42: 133-141
- Ledgard, S.F.; Thorrold, B.S.; Petch, R.A.; Young, J. 2001: Use of OVERSEER as a tool to identify management strategies for reducing nitrate leaching from farms around Lake Taupo. Pp187-194. In Precision Tools for Improving Land Management. Ed. L.D. Currie. Occasional report No. 14, Fertiliser and Lime Research Centre, Massey University, Palmerston North
- LIC 2001. Dairy Statistics 200/01: Livestock Improvement Corporation, Hamilton, New Zealand
- Macdonald, K.A.; Penno, J.W.; Nicholas, P.K.; Lile, J.A.; Coulter, M.; Lancaster, J.A.S. 2001: Farm Systems - Impact of stocking rate on dairy farm efficiency. *Proceedings of the New Zealand Grassland Association* 63: 223-227
- McDermott Fairgray 2000: The economic impact of alternative land uses in Taupo catchment. A Report to Environment Waikato. p 46
- New Zealand Institute of Economic Research 2001: The economic effects of greenhouse gas emission policies - a quantitative evaluation. In Report to the Greenhouse Policy Coalition and the Petroleum Exploration Association of NZ
- Parminter, T.G.; Wedderburn, M.E.; Carter, J.C.; Paine, M.S. 1994: Attitudes and beliefs of Waikato farmers to sustainable agriculture. New Zealand Conference on Sustainable Land Management. Lincoln University
- Parminter, T.G.; Wedderburn, M.E.; Spijkerbosch, P.J. 1996: The importance of a participatory approach to resolving issues of sustainable agriculture. *Proceedings of the New Zealand Grassland Association* 57: 15-19
- Sheath, G.W.; Webby, R.W.; Keeling, P.; Thomson, R.D.; Page, C.R.; Burton, G.T. 1999: The results and success factors of nine group farm monitoring programmes. *Proceedings of the New Zealand Society of Animal Production* 59: 87-90
- Stewart, C.; Johnston, D.; Rosen, M.; Boyce, W. 2000: Public involvement in environmental management of Lake Taupo: preliminary results of the 1999 survey. Institute of Geological and Nuclear Sciences Limited science report 2000/7. p 16
- Thorrold, B.; Finlayson, J.; Lambert, G.; Ledgard, S.; Smyth, D.; Tarbotton, I.; Smeaton, D.; Webby, R. 2001: Land use, farm businesses and environmental policy in the Lake Taupo catchment. *Proceedings of the New Zealand Grassland Association* 63: 63-67
- Vant, B.; Huser, B. 2000: Effects of intensifying catchment land-use on the water quality of Lake Taupo. *Proceedings of the New Zealand Society of Animal Production* 60: 261-264