

**MAF SUSTAINABLE
FARMING FUND PROJECT**
PUGGING GROUP

FINAL REPORT

**NORTHLAND BEEF
FARMING GROUP**

*Managing Soils on Beef Farms
in Northland*

Prepared by:

*Gavin Ussher
Project Consultant
August 2004*

CONTENTS

- 1. Administration Detail**
- 2. Introduction**
- 3. Objectives of the Project**
- 4. Approach taken to this Project**
- 5. Outcomes**
 - 5.1 Technical Result**
 - 5.2 Extension Activities**
 - 5.3 Social Results**
 - 5.4 Financial Results**
 - 5.5 Future Actions**
- 6. Financial Statement**

1. ADMINISTRATION DETAILS

Grant Number: 01/148

Name of Applicant Group: Northland Beef Farming Group

Project Title: Managing Soils on Beef Farms in Northland

2. INTRODUCTION

Over recent years beef cattle farmers have become very concerned about the damage to their soils and pastures through pugging damage during the wet winter and spring period. This concern has extended into how much physical production they are losing through this pugging damage and the resultant financial cost.

Subjective estimates of pugging damage occurring on farm were made during other projects, eg Clover 300, through the late 1990's. With AgResearch's development of the Treading Test farmers now had an objective measurement of the damage to soils by pugging.

3. OBJECTIVES

- To achieve an increase in meat production of 8-10% by reducing pugging damage to pastures.
 - A combination of more feed, higher quality feed (more clover) and improved utilisation.
- To increase awareness by Northland beef farmers of the potential financial gains from a major reduction in pugging damage.
 - A 10% improvement in meat production for a typical farm of 300 ha would give a \$17,500 increase in farm income at a schedule price of \$3.85 per kilogram.

4. APPROACH TAKEN TO THIS PROJECT

The key activities undertaken during this project were:

- AgResearch suggestions and project farmers adopting a farm soil mapping activity. This to highlight, within any one farm, areas that were more or less sensitive to pugging damage.
- AgResearch undertaking on farm sampling:
 - Soils for the Treading Test
 - Soil moisture and temperature
 - Pasture clover population

This sampling was undertaken in the same season over a three year period.

- Farmers discussing what activities they would be adopting to minimise pugging damage. Then the adoption of these activities.
- A field day was hosted by each farmer member of this group, once over the three year period. This field day covered the presentation and discussion of the monitoring results, eg Treading Test, and also discussion regarding the various changes to on farm management by each project farmer.
- Other project activities included sampling for soil testing to measure soil fertility on the various paddocks nominated for the Treading Test monitoring. Overseer programme for soil nutrient budgeting plus Stockpol programme for stock policy change analysis were used.
- This project was completed with a very well attended and successful final open field day on Geff Cookson's property. During this field day, the overall results of this project were presented.

5. OUTCOMES

5.1 Technical Results

Macroporosity- Treading Test

Treading by grazing animals can have a significant adverse effect on soil properties and on plant growth under wet soil conditions. At one end of the scale there is a shallow pressing by cattle hooves without much visual impact. This is soil compaction. At the other, most severe end, soil and pasture plants are reduced to a visual muddy mess with a lot of pugging damage. This is what we observe on many of our Northland heavy clay soils.

On and off-site effects of treading/pugging damage

Pasture - reduced yield

- poor soil aeration
- nutrient loss
- shallow rooting
- reduced nutrient accessibility

Soil physical and chemical processes

- compaction
- loss of structure
- decreased oxygen supply
- increase in some less desirable elements eg molybdenum

Soil fauna

- reduced earthworms
- changes in microbial populations

Environment

- increased runoff of water, nutrients and faecal coliforms

Macroporosity

- gives the % of soil volume occupied by the important larger pores
- an ideal soil has a macroporosity of 16-20% in the surface 0-5cm layer and will produce the highest pasture production
- trials have shown that for every 1% increase in macroporosity there is a 1.8% increase in relative pasture yield
- in Southland studies a macroporosity of 8% was associated with a relative yield of 81%. That is, a pasture producing 11,000 kg DM/ha/annum at 20 % macroporosity would produce 8910 kg at 8% macroporosity.

Our Northland Project Results

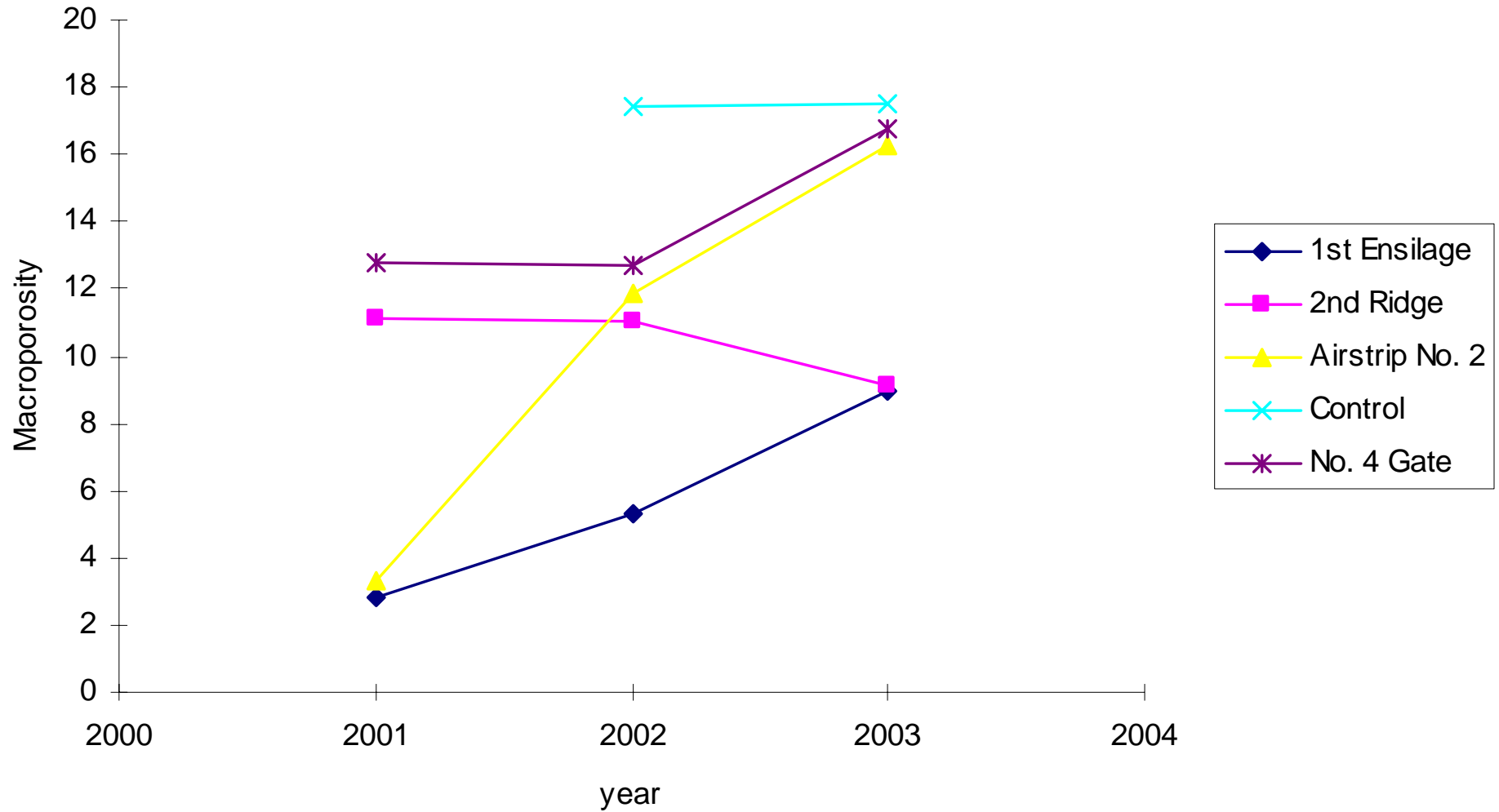
We have 3 years of data from 4 paddocks on each of 8 properties plus a "control" area from under the fence line on each farm. Although there have been some inconsistencies in results often because we are unable to distinguish between soil damage done in recent times versus long term damage. Nevertheless by considering all sites over 3 years (see "average over all farms" graph) we have been able to see a definite trend in the data.

Average macroporosity for all farms

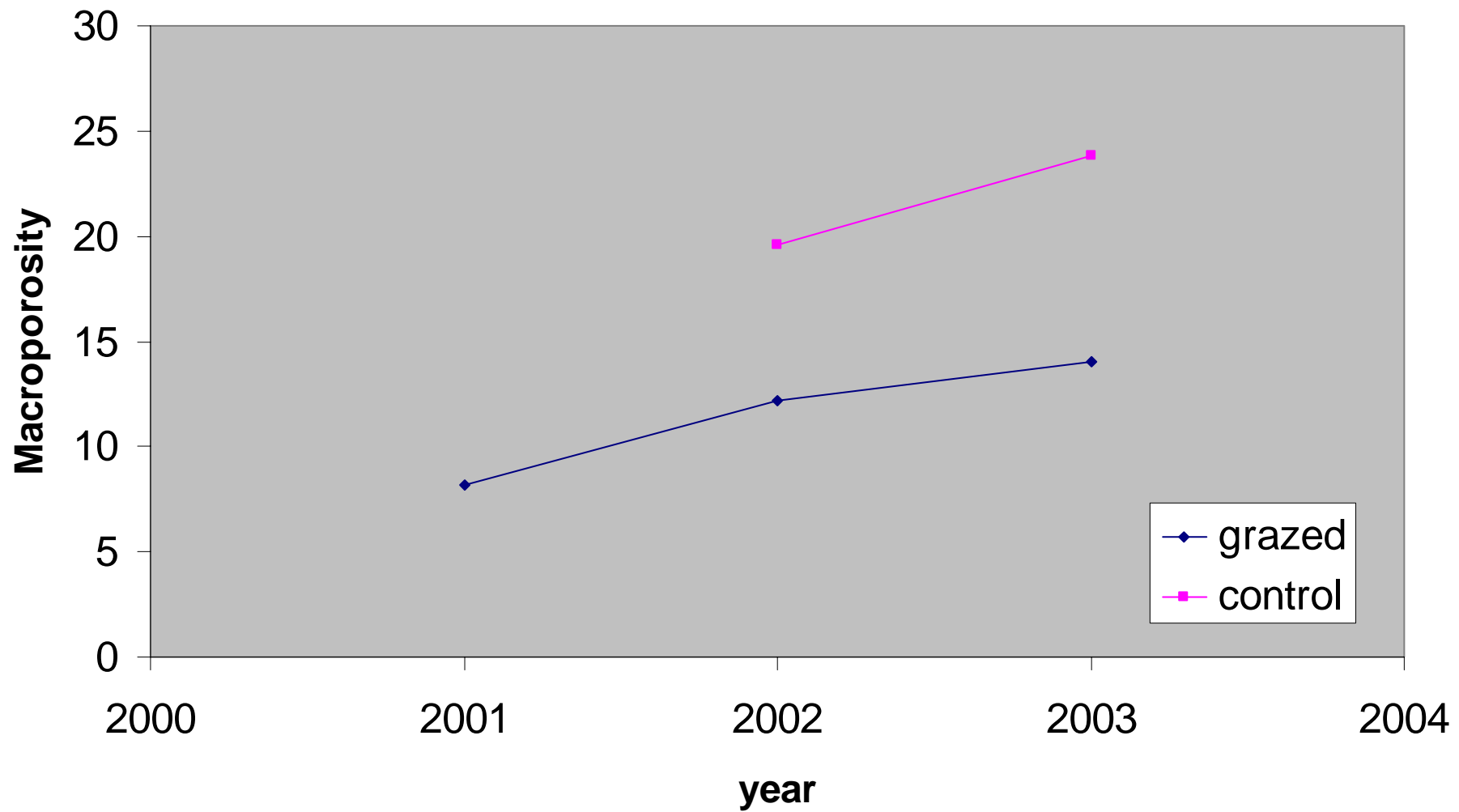
2001	8.23%
2002	12.23%
2003	14.15%

- The difference from 2001 to 2002 was statistically significant but not between 2002 and 2003. Year 2003 was the worst winter of the 3 and to even hold its own was considered an achievement!
- In effect the macroporosity has moved 6% over the 3 years which is equivalent to a 10.8% (1.8% x 6) increase in potential pasture production
- The potential macroporosity of all farms is shown as 19.6 to 23.8% (2002 and 2003) as indicated by the control samples
- Geff Cookson's graph indicates that 3 of the 4 paddocks have shown an increasing trend in macroporosity over the 3 years and 2 are approaching the potential value for the farm.

Cookson



Average over all farms



NORTHLAND BEEF FARMING GROUP

Paddock Mean Macroporosity Test figures for the Project Period

Farmer	Paddock ID	2001	2002	2003
Cookson	1 st ensilage	2.8	5.4	9.0
	2 nd ridge	11.1	11.0	9.1
	No. 4 gate	12.7	12.7	16.8
	Airstrip No. 2	3.3	11.9	16.3
	Control		17.5	17.5
Messham	27	8.0	12.3	10.5
	13	12.0	11.0	17.6
	9	6.5	9.6	15.3
	11	9.4	13.6	12.5
	31	14.1	7.7	8.6
	Control		18.3	21.1
Beazley	13	6.0	10.9	5.3
	E	7.1	15.1	11.9
	C	11.3	17.2	5.4
	A	11.6	14.5	5.1
	B (5)	6.6	12.6	5.1
	Control		32.8	17.7
Omapere	Papakauri	11.9	12.3	10.9
	Toia	2.4	6.9	4.0
	Lake Flats	7.3	9.8	9.4
	Te Pua	6.3	9.9	7.4
	Control		19.7	11.7
Linssen	Hay	9.5	12.5	11.7
	House	5.9	10.0	9.5
	Big Dam	7.7	13.6	15.2
	Airstrip	8.0	15.5	24.0
	Wally	12.8	10.7	16.8
	Control		15.1	16.3
Brown	Old Grass	9.9	18.4	21.8
	Direct Drill	6.4	13.4	16.4
	2 year old	4.9	8.4	10.7
	Silage	3.3	10.0	13.2
	Mikes	2.2	6.0	16.6
	Control		20.9	33.6
Wigley	North	14.2	12.0	27.0
	Air Strip	15.6	16.7	20.3
	30 acres	8.4	13.4	22.9
	Mushroom	8.4	17.3	20.9
	Control	16.4	20.7	37.1
Price	Quarry 2	19.0	13.9	18.1
	26	6.1	14.3	20.8
	23	9.6	9.5	17.5
	11	6.7	19.0	19.2
	Control		15.6	35.3

ADDITIONAL RESULTS

Soil moisture levels, clover percentage of the pastures and soil temperature were recorded for all paddocks that had the Treading Test sampling.

Shown below are the results:

SOIL MOISTURE RESULTS – Whole Farm

	2001	2002	November 2003
Cookson	49	35	40
Messham	82	50	50
Beazley	48	36	43
Omapere	68	41	44
Linssen	56	50	43
Brown	62	47	30
Wigley	72	61	38
Price	49	56	27
All Farm Mean Result	62	47	40

Brown, Wigley and Price showed soil moisture at substantially lower levels in the current 2003 year, compared to either 2002 or 2001. Other farms were similar to the 2002 year: Beazley being quite a bit damper in 2003 compared to 2002.

CLOVER PERCENTAGE RESULTS

	2001	2002	2003	Average of the 3 years
Cookson	17.5	19.3	2.3	13
Messham	4.0	7.8	5.2	5
Beazley	8.6	15.6	14.4	13
Omapere	9.5	16.3	5.5	10
Linssen	7.0	10.4	11.4	9
Brown	19.4	19.0	9.0	15
Wigley	7.3	9.8	10.3	9
Price	18.3	15.0	13.3	15
All Farm Mean Result	11.5	14.2	13.4	11
All Farm Mean excluding Cookson	10.6	13.4	9.9	11

The overall clover population result over all farms for the three years is just 11.3%.

The 2002 year showing a small increase on the first year, but the 2003 year showing a decrease. A sizable 26% decrease between 2002 and 2003.

This decrease excludes Cookson's result because virtually all of this huge decrease in clover population has been caused by the presence of clover root weevil.

Brown also showing a huge drop in clover population at the time of sampling: part of the reason will be the farm coming out of a major regrassing programme but the biggest reason is the soil moisture: ie. lack of good soil moisture restricting the clover plants. The 2003 year at just 30% soil moisture compared to 47 in 2002 and 62% in 2001.

All other farms are showing similar clover populations for the last year being 2003 compared to 2002 and/or 2001.

SOIL TEMPERATURE

All farm average of 16.5 C in 2001 and 14.6 C in 2002 and 16.9 C in 2003: a drop of almost 2 C in 2002 compared to 2001 which largely explains why that spring was a bad one. A later sampling for 2003 compared to both 2001 and 2002, which is the main cause of the soil temperature for 2003 being supposedly that much better 2002

5.2 EXTENSION ACTIVITIES

- The extension of the project results centered on:
 - Presentation and discussion of these results, especially pertaining to Omapere Station during the period up to November 2003, while Omapere Station was the Monitor Farm for the Far North district for Meat and Wool NZ. These results presented at field days, community group days and included in the newsletter and/or Annual Report.
 - Results commented on within the occasional newspaper articles published as part of the Omapere Station Monitor programme.
 - Pugging damage covered during a series of seminars held through Northland in 2002 and clover seminars in 2004.
 - A “open to the public” field day held on 24th June on Geff Cookson’s property to highlight the problem and also the potential activities to adopt to minimise pugging damage.
- A very worthwhile extension activity that was part of this project, was each farmer hosting a field day for other project farmers plus other project personnel. During these field days results were presented and discussed. Also discussed were farmers nominated activities that they were going to adopt as means of reducing pugging damage. These activities are summarised below:

PROJECT FARMERS – ACTIVITIES

Undertaken to reduce pugging damage.

Farmer 1

Farming smaller animals; eg dry dairy cows replaced by dairy weaners.

- Any older/heavier animals are moved more quickly – grazing management.

Farmer 2

- Improve subdivision
- Reduce number of older bulls before the wet winter sets in.
- Improving kikuyu control by breeding cows.

Farmer 3

- Farming young cattle through the winter.
- Carrying lambs through the winter on the wet country.
- Subdivision has increased: target being improved young cattle growth rates.

Farmer 4

- Not carrying two year bulls into/through the winter.
- Improving growth rates in younger cattle through subdivision and regrassing.
- Drainage coil used to tap very wet areas.
- Too “look after” the best pastures as much as possible.

Farmer 5

- Use of short rotation ryegrass to improve winter growth rates of younger cattle.
- Use of groundhog for sub surface drainage/aeration.
- Selling older cattle before July.
- Future: considering a feed pad.

Farmer 6

- Subdivision.
- Grazing management to focus on daily shifts?
- Farming lighter cattle: bigger cattle (over 450 kg) sold by end of June.

Farmer 7

- Use of a feeding/loafing pad in a dairy situation.
- Use of sub soiler for aeration work in the spring.

Farmer 8

- Move to wintering lighter stock.
- More break feeding.
- Mapping of the farm.

The principals discussed by the group can be summarised as shown below:

- Small cattle cause less pugging damage compared to bigger cattle.
- Quieter cattle cause less damage than wild or aggressive cattle.
- Well fed cattle cause less damage than hungry cattle.
- Sheep cause less damage than cattle.
- Lambs cause less damage than breeding ewes.

5.3 SOCIAL RESULTS

The social contact, the interaction of all group members was a very strong and positive result of this project. At the final project farmer hosted field day, attendees were asked to respond to the questioning, "what have you gained from this project?"

The replies to this question were:

Person 1

- Interaction of the group has been very positive.
- Networking with farmers.
- Seeing the changes on the farms with increased inputs, eg Omapere Station.

Person 2

- Learning from the group: it is good to hear and see what activities are happening on other farms.

Person 3

- A lot of helpful hints eg subdivision, grazing management.

Person 4

- Awareness of the pugging damage.
- Visiting a different farm for each field day has been excellent.

Person 5

- The group discussion.

Person 6

- Awareness of the damage to pasture; to say why we have to act. In some cases this action has been a whole farm policy.

Person 7

- Awareness: a lot more people are talking about reducing pugging damage; they are looking more closely at their soils, are their different areas on farm.
- More aware of damage to clovers by pugging.

Person 8

- Awareness – of how bad pugging really is and of how long lasting the damage is.

Person 9

- A positive experience.
- Have been able to introduce a few new ideas.
- While the macroporosity test may be giving some variable results, it has been very good increasing the awareness of pugging damage.
- Use of farm maps has been good and should continue to be encouraged.

Person 10

- Have learnt a lot from the group: both in the pugging damage areas and also in pasture management in general.
- Assisted in considering future plans eg: subdivision programme.

Person 11

- Knowledge of damage to soil structure.
- Impact of pugging on decreasing spring pasture growth.
- Smaller animals are better.
- Increased frustration levels; ie having the increased knowledge but still having major restrictions with soil types, climate and contour.

Person 12

- The discussion, interaction of the group has been very positive for the whole period of the project: this to me has been the most positive feature of the programme.
- Secondly, while I have murmured some unkind comments regarding the accuracy of the Treading Test, I totally agree with Mike O'Connor, in that it has been excellent to have this test, to put some actual figures on the damage we are doing to our soils and pastures.

5.4 FINANCIAL RESULTS

There was no attempt to measure financial changes for project farmers through his project period. The reasons for this were:

- It was outside the scope of this project.
- Other onfarm factors can affect final results tremendously eg extremely poor winter and spring pasture growth due to the weather rather than only due to pugging damage.
- Off farm factors such as cattle prices either store or prime prices which can have an overriding affect on the financial result and to a large extent they are outside the control of farmers.

Comparisons were carried out on farms to analysis the improvement in financial and physical results through a change in stock policy to one that was far more likely to reduce pugging damage. Stockpol, a farm management decision support computer programme was used to undertake this analysis.

The results shown below indicate the likely benefits from adopting a major change in stock policy. Other farm management changes will also improve the chances of a major reduction in pugging damage by impacting on the whole farm system, eg improving winter grass growth to drive higher growth rates in young cattle.

Results for One Project Farm:

A number of stock policies were evaluated.

Stock Policy 1 – Current State:

Seventy five percent of the stock being dairy cows: buying empty dairy cows in the autumn, mating them in June – July, selling as incalf dairy cows calving in the autumn. The balance of the stock being a small beef herd and selling weaners plus prime cattle.

Results:

- Gross farm revenue (stock sales minus purchases) at \$610 per hectare.
- Meat production at 245 kg of liveweight per hectare.

Physically this farm has suffered pugging damage through a combination of factors, typical of much of Northland, being:

- Heavy clay soils
- Very high rainfall during the winter and spring months especially
- Moderately heavy cattle being fed slightly above maintenance
- Kikuyu dominant pastures causing two problems:
 - Making the soil wetter through the winter and early spring
 - Causing considerably slower pasture growth in July to October because of the lack of ryegrass.

Stockpol was used to analysis the result from undertaking a total stock policy change.

Stock Policy 2 – Young Cattle Only:

Stock purchased in the autumn as weaners and then a progressive selling policy of some in December and May but mostly in March. Based on no change to the pasture production and on a sell-buy margin of \$250 per head within the year, the results are:

- Gross farm revenue of \$580 per hectare
- Meat production of 410 kg live weight per hectare.

The much larger sell-buy margin in the dry dairy cow policy gives a higher financial return compared to this young cattle policy, even with the young cattle policy producing considerably more meat on a per hectare basis.

Stock Policy 3 – 10% increase in pasture growth:

If pugging damage is substantially reduced over a couple of years due to running lighter cattle, pasture growth will improve solely due to this reduction in pugging.

Based on research through New Zealand and the results of this project with the improvement in macroposity levels, a 10% improvement in pasture growth for the year would be expected.

For this Stock Policy 3, the only change is a 10% increase per month, in pasture production, compared to Stock Policy 2.

The results being:

- Gross Farm revenue of \$707 per hectare, an increase of \$97 per hectare compared to the current stock policy.
- Meat production at 504 kg of live weight per hectare.

A summary of these comparisons is shown below:

TABLE: Physical and Financial Results from Changes in Stock Policy:

	<i>Stock Policy 1 Current</i>	<i>Stock Policy 2 Young Cattle</i>	<i>Stock Policy 3 Young Cattle + 10% pasture growth</i>
Gross Revenue/ha	\$610	\$580	\$707
Meat Production Kg liveweight/ha	245	410	504

Implications for Northland:

For a typical Northland beef cattle farm of 300 hectares, if by a substantial reduction in pugging, there is a similar \$97 per hectare improvement in gross farm revenue, this would lift the overall farm gross revenue per year by \$29,100.

In practice there is very likely to be a much larger financial gain from a substantial reduction in pugging damage. This comment based on:

- The above analysis showing the \$100/ha improvement, in round figures, is based on a 10% improvement in each months pasture production, for the whole year. If we substantially reducing pugging damage the improvement in pasture production for July, August and September especially, will be much greater than 10%. Eg North Island hill pasture research has shown a 40% reduction in spring pasture growth after just one single cattle treading event.
- Medium to long term, the improvement in clover base through the reduction in pugging, will improve pasture growth via the nitrogen fixation and also improve animal growth via more feed being available and it being higher quality.
- Also medium to long term, the reduction in weed content will allow a higher production of edible pasture which will assist greater animal production.
- Also long to very long term will be the benefits that a higher earthworm population will bring to any farming system.

5.5 FUTURE ACTIONS

This group of farmers submitted an application to MAF Sustainable Farming fund for a second generation project. That is, undertaking most of this original projects monitoring to assist in improving the accuracy of the data so as to make better informed decision. Additional monitoring such as soil biological health indicators plus the adopting of new basic measures were also included. We were disappointed this application was declined.

The farmers and sponsors of this project feel strongly enough that they plan on continuing the Treading Test sampling in the spring of 2004. We also plan to re-submit an application to the MAF SFF in the next round being 2005.

The project farmers were very pleased with the excellent attendance and positive, stimulating discussion during our open field day at Geff Cooksons in June 2004. This project has played a considerable part in increasing the awareness by farmers and servicing people of pugging damage to soils and pastures in Northland.