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THE EFFECT OF AN INTEGRATED CATCHMENT
MANAGEMENT PLAN ON THE GREENHOUSE GAS BALANCE
OF THE MANGAOTAMA CATCHMENT OF THE
WHATAWHATA HILL COUNTRY RESEARCH STATION

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ABSTRACT

An integrated catchment management plan implemented in the Mangaotama catchment of the Whatawhata Research Station in 2001 demonstrated that *Pinus radiata* forestry on marginal land, along with conservation measures and intensification could produce a win-win outcome for economic output and the environment. However, greenhouse gas mitigation was never fully considered. This research investigated the effect of the plan on the land's greenhouse gas balance and carbon stocks between 2000 and 2011. Historical records, modelling with OVERSEER and CenW, literature values and field measurements were used to account for CO₂, CH₄, and N₂O from the four main land-use types: pasture, native forest, pine, and native plantings. The original land-use would have emitted a net 10.99 Gg CO_{2e} over 10yrs, whereas the new land-use sequestered a net 47.26 Gg CO_{2e} in its first 10yrs. The total carbon stocks rose by 15.9 Gg C. Forestry conversion of almost half the area explained most of this effect. Agricultural intensification increased per hectare emissions from pasture, but overall pasture emissions were lowered by over half due to the reduction in livestock numbers. The native plantings had a small impact due to the small area planted and their slower growth compared with pines. Soil carbon was lost under all land-uses, except possibly in grazed native forests, but these conclusions were hampered by a scarcity of samples. Uncertainty also surrounded the modelling of the pine forest in complex terrain, which is not yet adequately captured in CenW. A preliminary look at carbon trading suggested that it could strongly undermine the viability of the original farm system, but it could also help to fund the expensive transition to the new land-use. Overall, it was found that in addition to the benefits already shown by the integrated catchment management plan, it was also an effective way of mitigating climate change.

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ABBREVIATIONS

C	Carbon
CO ₂	Carbon Dioxide
CO _{2e}	Carbon dioxide equivalents
CH ₄	Methane
CUR	The current established land-use regime from 2006-2011
CWD	Coarse woody debris
DBH	Diameter at breast height
DEM	Digital Elevation Model
DM	Dry matter
DOC	Dissolved organic carbon
ETS	Emissions trading scheme
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
Gg	Gigagram (1000 tonnes)
GHG	Greenhouse gas
GIS	Geographic Information System
GWP	Global Warming Potential
ha	Hectare
IPCC	Intergovernmental Panel on Climate Change
LUCC	Land use capability class
LW	Live-weight (for lamb and beef carcasses)
N ₂ O	Nitrous oxide
NPP	Net primary production
NZU	New Zealand unit
OLD	The old land-use regime, pre-2001
ppb	Parts per billion
Pg	Petagram (1,000,000 gigagrams)
ppm	Parts per million
sph	Stems per hectare
SU	Stock unit
t	Tonne
TRA	The transitional period to the new land-use regime from 2001-2006

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Climate change is one of the world's foremost environmental concerns. All nations and all sectors of society will be faced with its impacts and are obligated to address it. There is great concern that the costs of change are insurmountably high, given that emissions are bound to economic growth, and that the costs of inaction could be even greater (Stern, 2007). Therefore, there is an urgent need to find ways to reconcile our economic activities with this grave environmental threat.

For New Zealand to do this, the problem is in creating viable yet 'carbon friendly' agricultural systems. The agricultural sector is New Zealand's biggest emitter of greenhouse gases, contributing 46.5% of total emissions in 2009 (Ministry for the Environment, 2011). It is also a major part of the national economy, contributing 12.2% of GDP in 2010 (Ministry of Agriculture and Forestry, 2011e). The global demand for livestock products is only expected to increase due to the growing world population and its changing consumption patterns (Thornton, 2010), driving further development in this sector.

Reforestation of marginal land, especially in hill country, is one option for mitigating emissions. An integrated catchment management plan for the Whatawhata Hill Country Research station combined reforestation and intensification, demonstrating that a win-win between growing trees and better farm profitability can be achieved (Dodd et al., 2008a). This approach could provide a workable system for hill country, likely to fit the criteria of being both productive and carbon neutral. However, its effects on greenhouse gas (GHG) mitigation have never been fully quantified. There is critical need to develop these types of farm systems, so further study is needed for the insights to be drawn out, improved and applied.

The rest of this section briefly explores the basic background of these issues, and then outlines a study to investigate the greenhouse gas balance at of the Mangaotama catchment at Whatawhata.