AGRICULTURE RESEARCH GROUP ON SUSTAINABILITY

2011 Annual ARGOS Farmer Report

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December 2011

Preface

This report has been specially prepared for you. It is divided into two parts.

Part one includes

1. A summary of past report topics
2. An analysis of financial and physical productivity comparing organic and conventional dairy farms involved in the ARGOS project
3. Soil summary from the July 2011survey

Part two is an in-depth analysis of your farm business from DairyBase and benchmarks your farm against other farms in your region, your management system and all dairy farms participating in the ARGOS project.

The results/reports on streams and soil microbia will be out next year due to the complex identification and analysis required.

Every effort has been made to ensure that all the information is accurate. However, if there are any inaccuracies, please let us know as soon as possible.

Please be assured that this report and its information will remain confidential to the ARGOS team.

Please contact me if you have any questions.

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Acknowledgements

The ARGOS programme has been designed and implemented with the intention of providing quality information to both farmers and their associated industries to ensure that they are broadly sustainable, internationally competitive and profitable. To facilitate this, we greatly value the input provided by the farmers and industry partners to enable us to undertake the research and ensure that our outputs are relevant.

Thank you for your support and input.

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1 ARGOS

Introduction

The Agricultural Research Group on Sustainability (ARGOS) is an unincorporated joint venture between the AgriBusiness Group, Lincoln University, and the University of Otago. It is funded by the Foundation for Research, Science and Technology (FRST) and various industry stakeholders and commenced in October 2003. ARGOS is a longitudinal research project with the aim to model the economic, environmental, and social differences between organic and conventional systems of production as well as to investigate other issues in relation to agricultural production and its impacts. The aim is to detail the impact of these systems and develop indicators which reflect the interactions across the social, economic and environmental factors. The ARGOS study is also assessing market developments overseas and how these are likely to affect and be implemented in NZ. The costs of implementation and potential benefits of these are being assessed using the LTEM (the Lincoln Trade and Environment Model). This enables the impact of various scenarios relating to the level of production and consumption, premiums and production costs to be assessed, both NZ and other countries. The project covers different farming systems in a number of sectors including kiwifruit, sheep & beef, high country, dairy and farms owned by Ngai Tahu landowners.

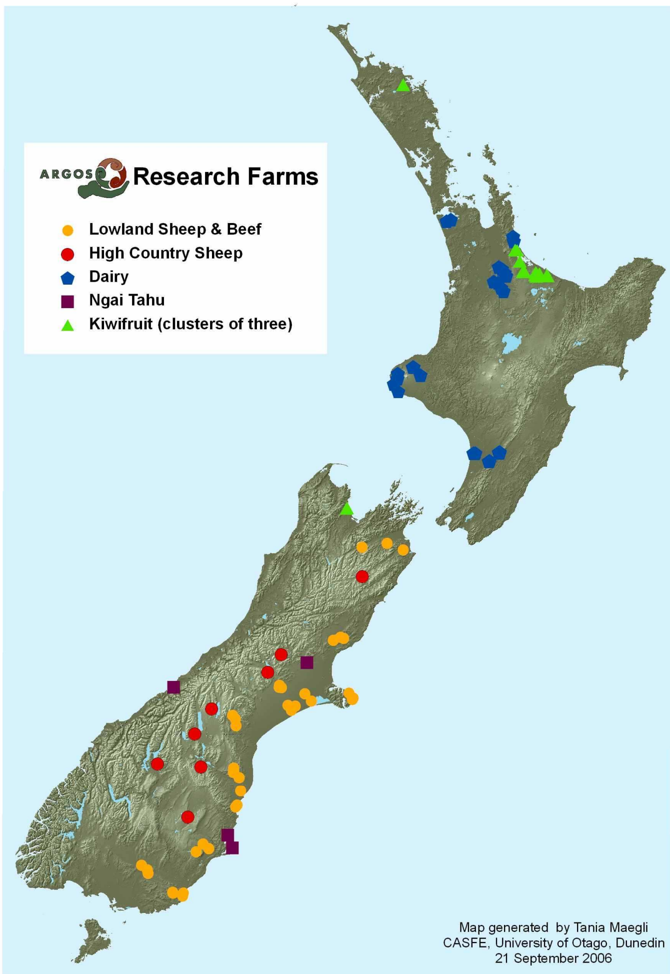

Figure 1 Location of Properties under study by ARGOS

1.1 Levels of focus in the ARGOS Project

The prime aims of this study are to undertake a comparison between agricultural sectors and between management systems within those sectors. Within the management systems, landforms, management units and soil monitoring sites are being studied. These are defined as follows:

Agricultural Sector. This includes dairy, high country and farms owned by Ngai Tahu landowners in addition to kiwifruit and sheep & beef farms.

Management System. For Dairy properties, the two management systems (Panels) are:

- Organic (initially converting to organic)
- Conventional

These 2 management systems may also be referred to as 'Panels' i.e. ARGOS is studying a panel of organic farms and a panel of conventional farms.

Cluster. ARGOS farms are arranged in clusters with each one containing two farms i.e. an organic and a conventional farm. The Dairy clusters are spread from South Auckland to the Manawatu. Within each cluster, farms are as close together as possible to minimize differences in background variables like soil type and climate.

Landform This term is used to describe the different geomorphology within a property. The principal landforms monitored here can be broadly described as river terrace (flats), hill crest (crest) and mid-slope (slope). Given the huge variation in soils and landscape across the properties being studied, we only study the two most dominant landforms within each cluster. For flat farms, only the one landform is studied.

Management Unit Management unit (MU) is a paddock. For each landform, three management units (focal paddocks) are monitored.

2 Past report summary

The ARGOS dairy reports, first compiled in 2008, have covered the environment, social and economic aspects of the dairy farm system assessing physical, financial and social performance that impacts on the way farms are managed.

The environment team assessed:

- Soils
  - Nutrient values
  - Biota (life in the soil such as earthworms, grass grub, microbial)
  - Physical attributes (porosity, bulk density, crust thickness, thatching and aggregation)
  - Pasture height and signs of clover root weevil
- Birdlife
  - Species richness, diversity
- Stream
  - physical parameters,
  - periphyton and aquatic macro-invertebrate communities,
  - nutrient levels
  - sediment levels

The social team surveyed using causal maps and retrospective surveys to gain a better understanding of the dairy farm systems. They also delved into farmers' understanding of climate change and the emissions trading system.

The economic management team reported on financial and physical productivity over up to 6 years, benchmarking farms against similar management styles, within regions (Waikato, Taranaki and the Manawatu) and comparing with all the dairy farms in ARGOS.

There was a degree of controversy round the openness of conventional systems (the ability to involve other land off farm) compared with the organic sector, which operated more of a closed system and this was addressed in the 2010 Annual Dairy Farm Report.

Energy Return On Investment (EROI) described the amount of energy in 'product' (milk, calves, cull cows) that was produced from the farm compared with the amount of energy that was used to produce those products. The EROI (2010 Annual Dairy Farm Report) report described the differences in the energy return on investment comparing sheep/beef, dairy and kiwifruit properties in ARGOS.

Energy was also used as a metric to help describe greenhouse gas emissions brought about by dairy farms. This report (2009 Annual Dairy Farm Report) compared the difference between conventional and organic farm systems and stated there was a clear correlation between decreased greenhouse gas emissions and increased productivity per cow.

A list of reports and 'ARGOnotes' can be found in the index.

3 Farm Management

3.1 Financial and physical comparisons between organic and conventional dairy farms

Introduction

Data for the 2009/2010 financial year was collated and analysed by DairyBase, a web-based package that records and reports standardised dairy farm business information - both physical and financial. Aligning with DairyBase, as the industry standard methodology, means that ARGOS data can be benchmarked across other aligned projects within New Zealand to a high degree of accuracy.

The following section of this report describes the longitudinal comparison of conventional versus organic dairy farm systems in ARGOS and then continues to benchmark your farm system with, other farms in all of ARGOS using your management style (conventional or organic), other farms in your region using your management system and all dairy farms in ARGOS.

A Standard Excel report from DairyBase, an in-depth, self-explanatory, description of your farm system can be found at the end of this report.

3.1.1 Longitudinal data

In this section comparisons between the conventional and organic farm systems for 'ALL' ARGOS is shown in relation to milksolids produced per effective hectare (Figure 2), the difference in overall farm working expenses and farm working expenses in detail.

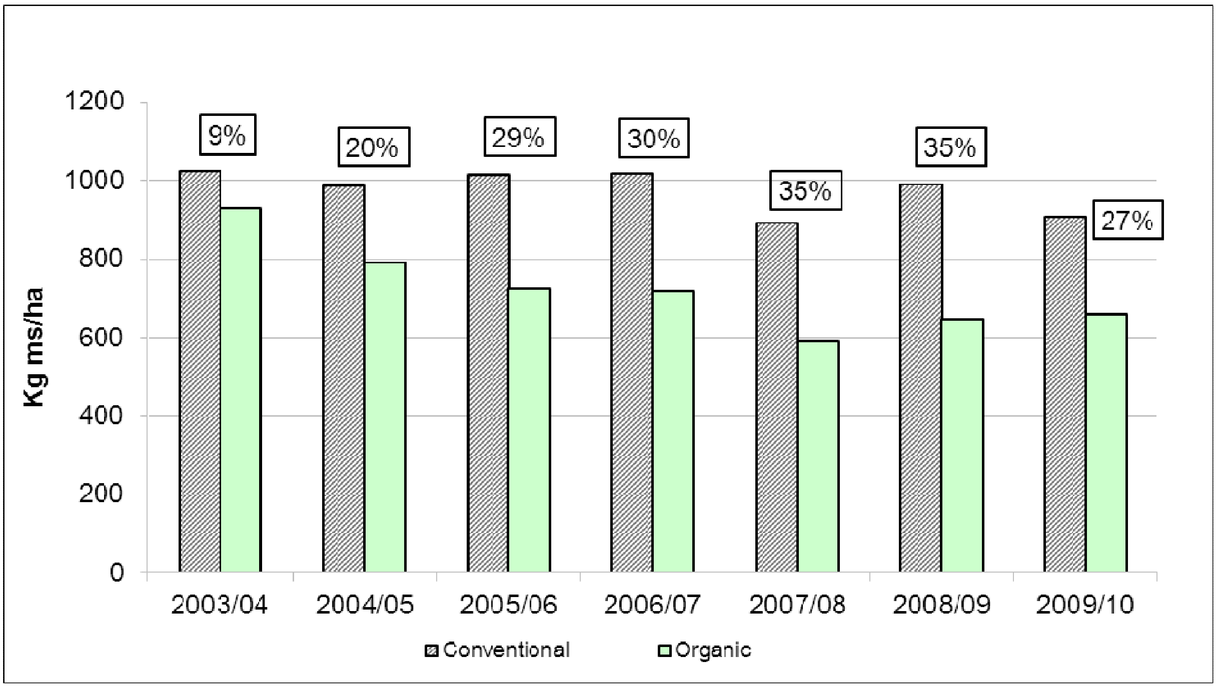

Figure 2 Milk production by the Conventional (striped) and Organic (solid) groups of farms from 2003/04 to 2009/10

Profitability metrics are described in the next section.

Figure 2 suggests that the production gap between organic and conventional has closed in the 2009/10 year, with a 27% difference compared with a 35% difference in the preceding 2 years. Using the 'net yield' methodology, as described in the 2010 Annual Dairy Farm Report could reduce this difference by approximately 5 to 8%.

3.1.2 Financial

Income

Despite all organic farmers receiving the full premium, organic farmers averaged less in net milk sales and net revenue from dairy livestock than the conventional farmers (Table 1). As discussed in the 2010 Annual Dairy Farm Report, this is considered to be a function of the lower stocking rates for the organic farmers meaning there are fewer animals to sell. Other dairy farm cash revenue was higher for organic farmers mainly due to a few organic farmers pushing the average up. This may be similar to the conventional farmers in the future.

Table 1 Income and change in livestock values comparing organic and conventional farmers participating in the ARGOS project.

	Organic	Conventional
Net Milk Sales	4200.8	4525.3
Net revenue from dairy livestock	251.8	356.0
Change in Dairy Livestock Value	3.4	-185.1
Total Other Dairy Farm cash revenue	91.2	37.2
Dairy Gross Farm Revenue	4547.3	4733.5

Expenditure

Differences in expenditure of key areas from 2005/2006 to 2007/2008 were reported in the 2010 Annual Dairy Farm Report and this has been extended to include the 2009/2010 year. Table 2 shows the greatest difference in the 2009/2010 year was in expenditure on Animal health and feed grazing compared with the other years. Additionally there was less of a difference in feed and silage costs. Does this indicate that the expansion of organic farming across dairy and sheep/beef/cropping sectors give organic dairy farmers more options in sourcing off farm feed and grazing?

Note: The difference in operating profit between Table 2 (compared with operating profit in Table 3) is because DairyBase adjusts for grazing and runoff that is unaccounted for in previous ARGOS financial data.

Table 2 Difference in expenditure comparing Organic with Conventional dairy farm management systems in the ARGOS project. Negative equates to organic spending less.

	2005/06	2006/07	2007/08	2009/10
Total labour	-10%	21%	5%	3%
Animal health	-42%	-47%	-31%	-111%
Feed hay and silage	-56%	-59%	-56%	-30%
Feed grazing	-6%	-54%	-25%	45%
Pasture renovation	-29%	-23%	5%	-24%
Total fert excluding N	-7%	-2%	20%	5%
Total N	-100%	-100%	-100%	-100%
Farm working expenses	-21%	-11%	3%	0%
Operating profit	-20%	19%	-10%	-28%

Actual average expenditure figures for 2009/2010 are described in Table 3. The least difference between organic and conventional farm systems was labour and other working expenses. The greatest difference was in total stock expenses with organic spending 34% less than conventional mainly due to animal health and breeding expenses. Organic spent 24% less than conventional all supplementary feed expenses, but more on non-milking platform grazing when runoff adjustments are taken into account. Overall expenditure for organics was 4% less than conventional

Table 3 Expenditure details for dairy farmers participating in the ARGOS project

Management	Organic	Conventional	Difference
Season	2009/10	2009/10	
Wages (incl ACC, less subsidies)	404.6	368.7	
Labour Adjustment - Non-paid	137.0	87.3	
Labour Adjustment - Management	369.5	428.5	
Total Labour Expenses	**911.1**	**884.5**	3%
Animal Health	80.5	179.7	
Breeding & Herd Testing / Herd improvement	80.3	122.4	
Farm Dairy Expenses	47.3	38.2	
Total Farm electricity	84.7	100.3	
Total Stock Expenses	**292.8**	**440.6**	-34%
Supplements purchased, Made and cropped	297.7	387.5	
Feed Inventory Adjustment	0.3	10.5	
Calf Rearing (Excluding Labour)	0.0	15.6	
Total Supplement Expenses	**297.4**	**392.6**	-24%
Net heifer/General grazing	211.5	114.2	
Net winter grazing	-13.7	-18.3	
Net cost of leased runoff land	54.0	59.0	
Owned Run-off Adjustment	202.6	59.5	
Total Grazing & Run Off Expenses	454.4	214.4	
Total Feed Expenses	**751.7**	**607.0**	24%
Fertiliser	343.9	326.2	
Nitrogen	0.0	24.9	
Total cost of Pasture Renovation	5.3	15.1	
Weed and Pest	2.2	20.0	
Total Farm Vehicle Expenses excluding fuel	176.1	135.5	
Fuel & Oil	37.1	35.3	
repairs and maintenance - land and buildings	181.7	213.3	
Repairs and maintenance	73.4	68.8	
Freight and general farm working expenses	66.4	47.6	
Total Other Working Expenses	**886.2**	**886.8**	0%
Total farm insurance	53.4	38.1	
ACC	22.0	23.5	
Rates - Land and water	85.1	63.4	
Total Depreciation	344.6	287.7	
Total Administration Expenses	129.7	122.2	
Total Overheads	**634.9**	**534.9**	19%
TOTAL OPERATING PROFIT	1142.1	1456.5	-22%

4 Environment

4.1 Soils

Introduction

Soil quality is recognised as a keystone of modern agricultural production and as such, can be highly sensitive to land management. Accordingly, monitoring soil quality is a key focus for ARGOS's environment objective. The sensitivity of the soil to land management practice is determined by the soil forming factors (climate, topography, parent materials, organisms and time) meaning soil quality is often a relative quantity that differs from region to region and is variable to management pressures.

Management practices likely to have the greatest impact on pastoral soils are those closely associated with stocking rate and soil nutrient status (different fertilisers may be used). Soil chemical analysis is important to determine if soil nutrient status is being sustained. Changes in soil nutrient status may affect pasture production or composition, and in turn, stocking rates or systems to accommodate changes in feed availability. Flow-on effects to soil biological processes and physical condition can occur from these changes. Soil micro-organisms recycle essential nutrients when they decompose dead plant and animal material. Hence an active microbial population is a key component of good soil quality. Soils were sampled in 2005, 2007 and again in 2011. A complete report on the first year of sampling is available on the ARGOS website[1].

This section of the report:

- reports timeline comparative nutrient results for Conventional and Organic dairy farms
- shows comparative soil biology results between your farm, conventional and organic farms for
    - microbial
    - earthworms
    - clover root weevil

The following definitions are provided to help you interpret our soils results:

- Soil pH.
    - o Indicates the level of acidity or alkalinity of the soil sample.
- Olsen P.
    - o A measure of the phosphorus readily available to the plant.
- Potentially mineralisable N (AMN).
    - o An indication of the nitrogen that may become available to plants through mineralisation of organic matter. An increased carbon to nitrogen ratio will decrease the availability of nitrogen to plants.
- Carbon Nitrogen ratio
    - o Measure of carbon relative to nitrogen in the soil. There is less nitrogen available for plant growth when the ratio is high

[1] http://www.argos.org.nz/pdf_files/Research_Report_07_01_Dairy_SB_Soils.pdf

4.1.1 Soil Results

Recap of 2007 survey

Soil chemical tests revealed lower P levels in Converting (to organic) and Conventional farms, although the majority of farms still exceeded recommended guidelines (Olsen-P >40 mg P/ml). Evidence of higher soil pH, soil-C and C/N ratios for Dairy Converting farms probably signifies both greater root inputs of C to SOM and less mineral-N from the withholding of N fertilisers contributing to lower rates of carbon turnover than in Conventional systems.

Explanation of soil chemical analysis including 2011

pH: There has been an increase in soil pH generally for the farms but marginally more on organic farms and particularly slope areas. Reduced Nitrogen inputs can be part of the reason although the amount of lime applied is the other of course. Values in the 6-6.5 range are desirable.

Available-P (both Olsen and resin P) was significantly less for organic than conventional (and had decreased from 2005-11) although generally, organic P values were still at acceptable levels but there was a movement of P from slope areas to crest and this was more pronounced on organic properties . This suggests that too little RPR or similar is being applied to these areas as values on some properties are heading below 20 (30 is optimum). Conventional farms show similar trends but values are higher overall. Flat landform farms are not affected.

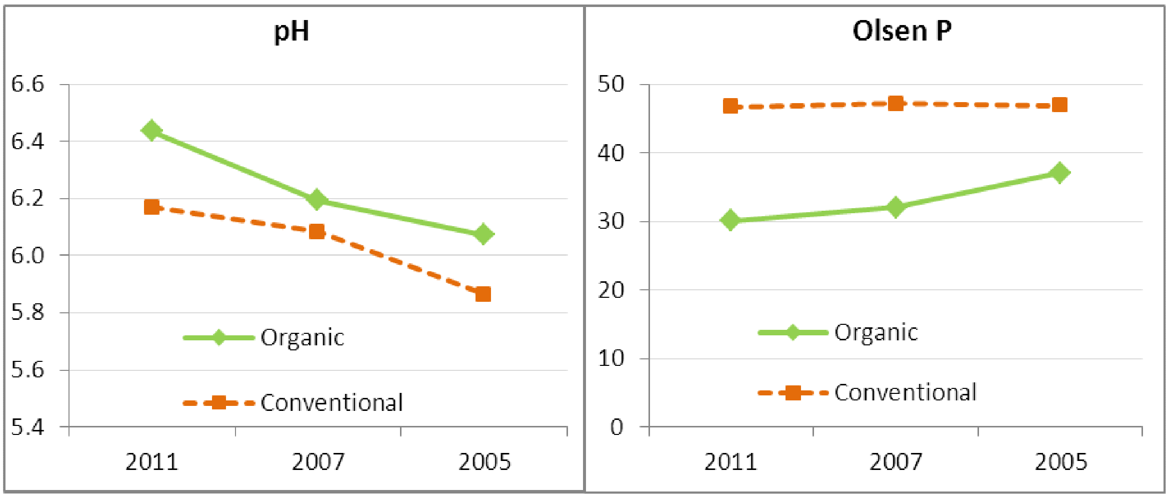

Figure 3 pH and Olsen P timeline data comparing organic and conventional dairy management systems involved in the ARGOS project

Inorganic-S (sulphate) decreased generally on farms and more so on organic farms although the values were not low overall (~12, 10-15 desirable). Watching the trends is important however; as S is a nutrient that is often limiting in hill country farms particularly and often offers better response per dollar spent than P in many instances. Organic S actually increased on farms significantly over the 6 years (~13) but more so on conventional farms and is again an issue for organic farms to watch that they continue to apply elemental-S or similar to maintain these levels (15-20).

C% and N% increased on Organic flat farms (about 10% greater) but it appears that it may be decreasing on slopes. Generally I am finding that nutrient transfer effects from slopes to other areas of the farm (like the crest areas where the cows usually camp overnight) are greater on the organic farms and is an issue that the hilly organic farms need to monitor more closely (One option may be to use different rates over the farms so more RPR, S, lime and K/Mg is applied to slope areas).

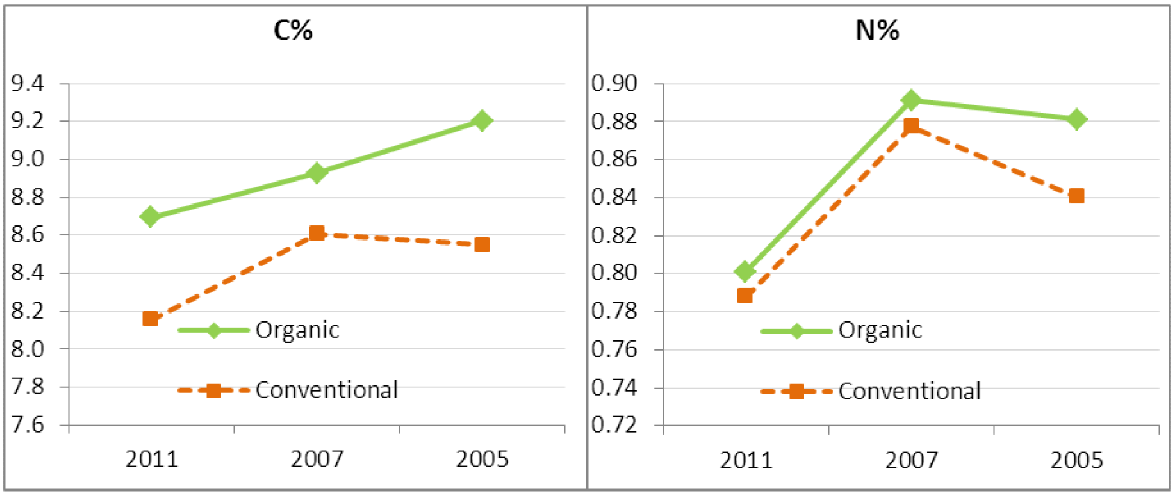

Figure 4 C% and N% timeline data comparing organic and conventional dairy management systems involved in the ARGOS project

AMN-mineralisable N was higher on Organic (5%) but this wasn't significant at the 5% level (p<0.07). Over the 2005-11 period, slope (hillside) values for both conventional and organic have decreased by about 20%.

C/N ratio- this has generally increased on Organic farms, probably in response to no added urea although some of the differences from conventional may have been affected by the missing conventional farms, especially in 2011. Conventional farm values increased as well but not to the same degree.

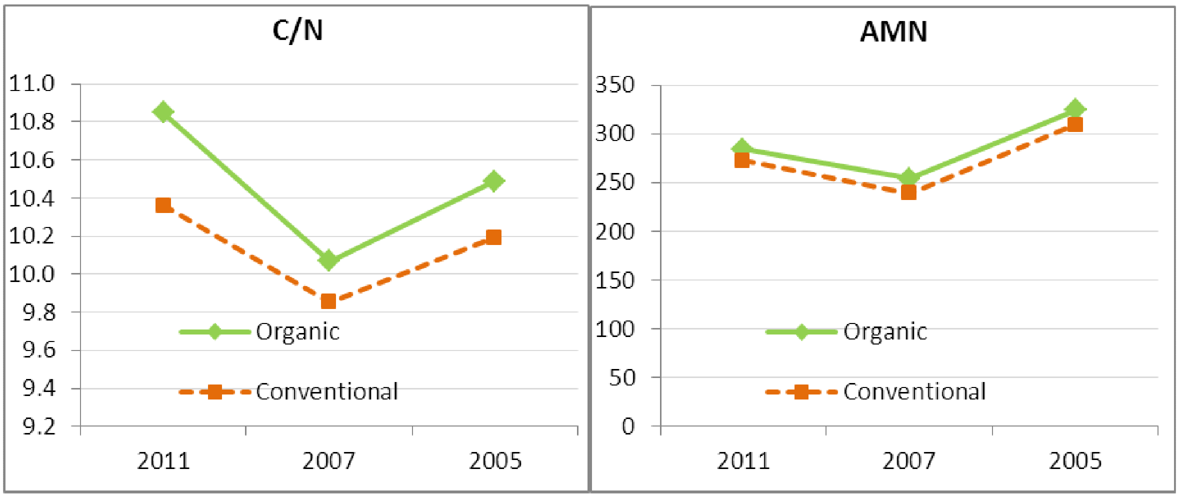

Figure 5 C/N and AMN timeline data comparing organic and conventional dairy management systems involved in the ARGOS project

Cation exchange capacity didn't change particularly between management systems from 2005 to 2011 when it was measured again although it did increase significantly overall, in keeping with the increase in soil pH also noted. There was an increase in exchangeable-Calcium (Ca) between systems, however, with greater increases for organic indicating less leaching losses of Ca overall. Exch-Ca was lower on slopes than other landforms as was exch-Mg (magnesium) and –K (potassium) but no significant differences between systems.

Total base saturation and that occupied by Ca was greater for organic than conventional.

Explanation of soil physical analysis including 2011

Soil bulk density was fractionally lower for organic but not significantly. Generally lower on crests than slopes mainly due to more organic matter deposited on crests from excreta. Conversely, soil moisture at field capacity was greater for organic but again, not significantly.

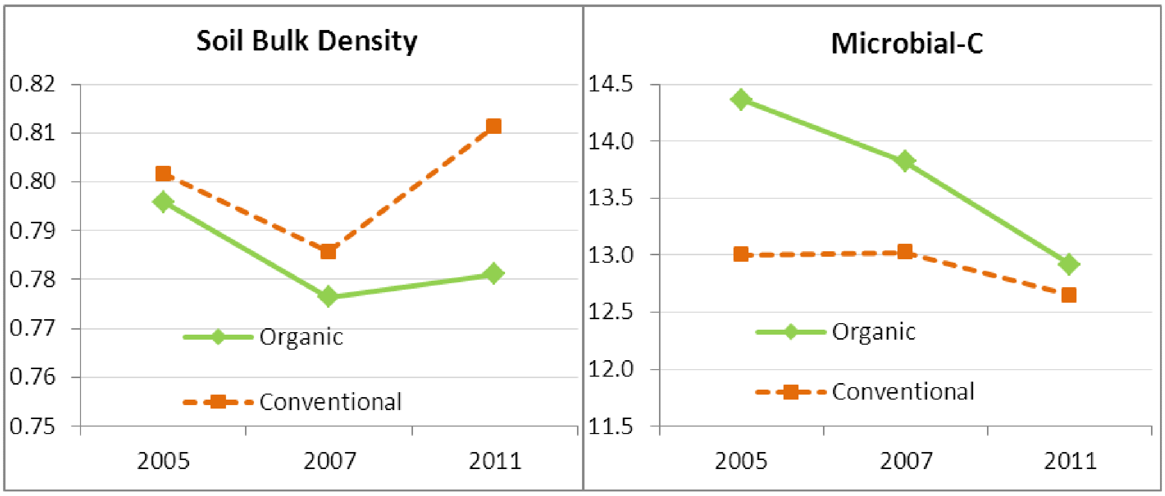

Figure 6 Soil bulk density and Microbial-C timeline data comparing organic and conventional dairy management systems involved in the ARGOS project

Explanation of microbial analysis including 2011

Microbial-C was higher overall on Organic farms (about 10%) and this may have been mainly due to C% differences as there weren't any management differences in microbial-C per unit soil-C (MC_C). Although microbial-N wasn't found to be significantly higher on organic farms, it was on a microbial-N per unit-soil N basis meaning that a bigger proportion of the soil-N was in microbial biomass for organic.

We found no differences between management systems in basal respiration or metabolic quotient so organic systems aren't stressed any more than conventional (that could occur if nutrients are limited).More detailed explanation of microbial explanations are in the appendix.

4.1.2 Your soil results

The graphs in Figure 7 describe the values found for your farm for each of the soil surveys and show the start of a trend.

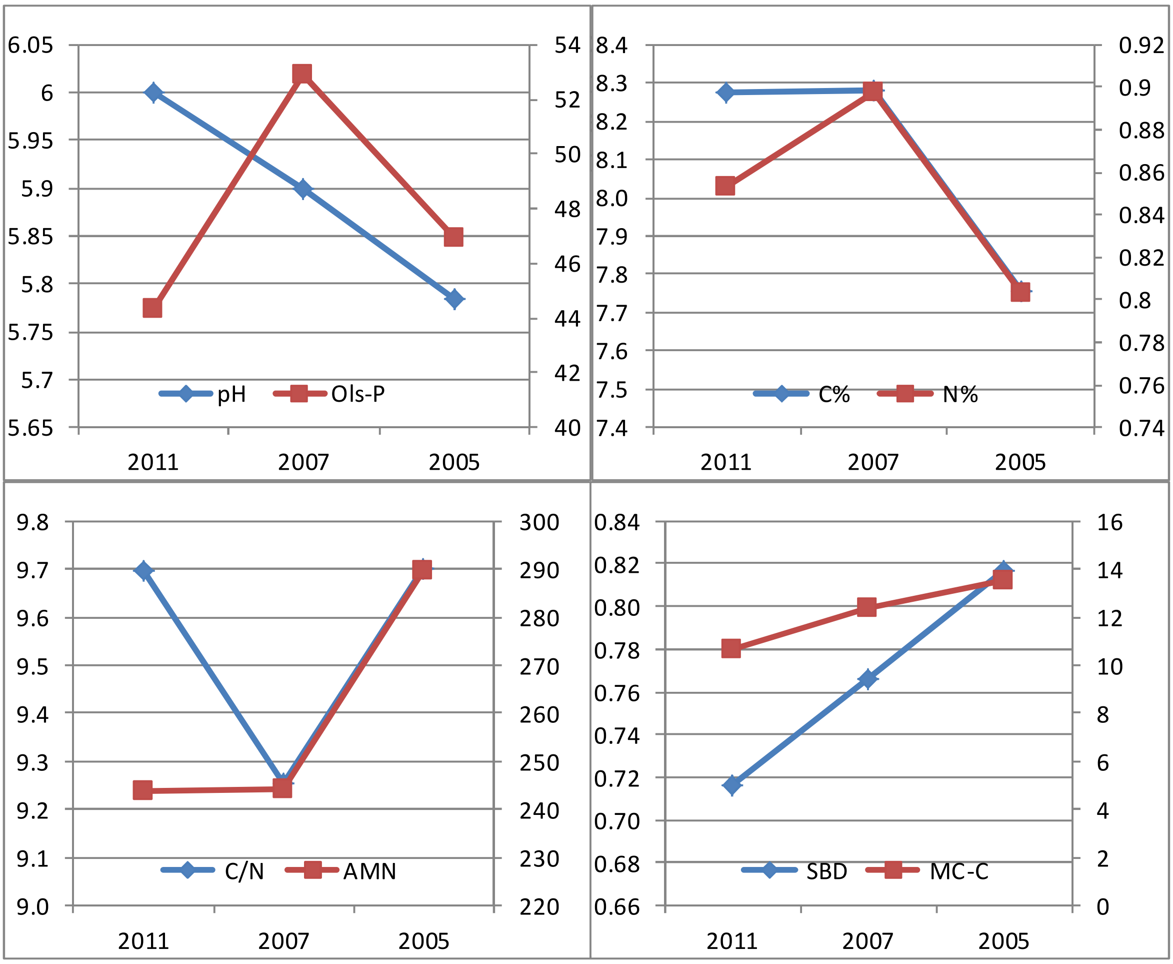

Figure 7 Chemical, physical and microbial attributes for 'your farm' that is participating in the ARGOS project

5 Appendix

5.1 Explanation of microbia measurements

Substrate for microbes (soluble C)

Sol-Cwgt = soluble C per weight of soil (mg C/kg soil)

Sol-C_C = soluble C per weight of soil-C (mg C/g soil-C)

This is a measure of substrate (food) available for microbiology in the soil. Higher soluble C can reflect higher OM turnover and may also reflect increased microbial biomass and respiration.

Microbial content (microbial C)

MCwgt = microbial C biomass per weight of soil (mg MC/kg soil)

MC_C = microbial C biomass per weight of soil-C (mg MC/g soil-C)

This is a measure of the total amount of living microbes in a soil. In temperate climates there is often a fast rate of microbial turnover that suggests that microbial biomass is a more sensitive indicator of changes in total soil organic matter than total soil carbon. Microbial biomass levels will differ between soil types and land use history.

Microbial activity (basal respiration)

CO2wgt = respiration per wgt soil (mg CO2/kg soil/min)

CO2_C = respiration per wgt soil-C (mg CO2/g soil-C/min)

Soil micro-organisms recycle essential nutrients when they decompose dead plant and animal material. Hence an active microbial population is a key component of good soil quality. Measured in the laboratory, basal microbial respiration is a process that reflects the background activity of the soil microbial population. Microbial respiration is the amount of carbon dioxide production over a fixed period.

Microbial efficiency

Met-Q = metabolic quotient; measure of microbial respiration efficiency (mg CO2/g MC/min)

The metabolic quotient is the ratio between microbial biomass carbon (the size of the soil microbial population) and basal respiration (the activity of the soil microbial population). It is a useful indicator of the metabolic efficiency of the microbial population. The lower the MetQ values, the more efficient the respiration for a given set of conditions and unit biomass

Enzyme activity

ArgN = aminase enzyme activity (converts Soil OM to mineral-N NH4; mg N/kg soil/h)

FDA = general microbial activity (units absorbance/g soil/h)

This is a measure of a key enzyme level that measures the ability of the soil to break down amino acids from organic matter to ammonium that in turn, may be converted to nitrate. Both ammonium and nitrate can be taken up by plants roots for plant nutrition.