New Zealand Dairy Pasture Quality

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PROJECT CODE	**CC MAF POL_0708-74 (INVENT-XXC)**
PROJECT TITLE	**New Zealand Dairy Pasture Quality**
RESEARCH LEADER	**Jim Gibbs Lincoln University**
DATE	**June 30th 2008**

Business/Institution:

Lincoln University; Animal Studies

Project Goals:

1. To provide robust, mean monthly dairy pasture quality (metabolisable energy (ME) and crude protein (CP)) estimates for South Island provinces.
2. To provide a sub-sample of individually GPS co-ordinated pasture samples with accompanying estimates of ME and CP to LandCare NZ satellite sensing research team for use in the development of a novel pasture quality estimation method using satellite imagery.
3. To facilitate the development of novel pasture assessment methods via remote sensing. This was to be done by hosting the meeting of the LandCare NZ representative and the CSIRO 'Pastures from space' representative here in NZ.

Background:

The current inventory process used to estimate the methane emissions of NZ livestock relies on an estimate of pasture quality at specific times to estimate dry matter intake. The research used as benchmarks for these pasture quality estimates are of low relevance to contemporary South Island dairy pastures (eg. Litherland *et al* 2002). The on-going South Island Dairy Lameness project (2006-2008) has collected monthly samples of pre-grazed dairy pastures from a large number of farms across every region of the South Island since 2006, and the resulting database of pasture quality is highly relevant to contemporary dairy production systems in NZ. This data is to be made available to the NZ inventory process by extending it and formatting it into relevant regional means (ME and CP) for each month.

In addition, this project contributed to the NZ inventory process by facilitating the preliminary groundwork for the development of a robust remote sensing method for pasture quality assessment using NIRS. The development of a satellite based tool for pasture quality assessment is highly desirable, but to date the methods used in NZ are insufficiently accurate to deliver any estimates suitable for dry matter intake predictions. International work has progressed the development of satellite based

methods much further to date, and there is strong interest in significant collaboration from the Australian CSIRO 'Pastures from space' project leadership. This project facilitated the meeting (May 08) of the current NZ research team in satellite sensing (LandCare NZ) and the CSIRO "Pastures from space' leadership, here in NZ, for preliminary discussions on a significant collaboration that will take the work forward.

Materials and Methods:

1. **Developing regional pasture quality monthly means**

Mean monthly pasture quality (ME and CP) values were produced for each province in the South Island except Marlborough. These were developed from the three year data collection (2006-08) in the South Island Dairy Lameness Project from dairy farms in each region, and also from targeted pasture sampling from March – June 2008. The mean, maximum and minimum ME and CP values for each month sampled and all regions, for the years 2006-2008, were produced from this data. To increase the specificity of the information provided, the two large dairy provinces – Canterbury and Otago – were further divided into north and south sub-provinces.

2. **Supplying GPS co-ordinated pasture samples to LandCare NZ**

A subsample of 120 of the pasture samples described in 1) above, distributed across the regions, seasons and years, was selected. The location of each of these samples was then recorded using a hand held GPS unit, to give paddock specific GPS co-ordinates. The database produced by this method was delivered to Dr John Dymond, LandCare NZ, for use in subsequent development of NZ satellite sensing methodologies.

3. **Facilitating collaboration between LandCare NZ and CSIRO Australia in research in remote sensing of pasture quality**

A meeting between Dr Dave Henry – leader of the CSIRO 'Pastures from Space' project – and Dr John Dymond – leader of the LandCare NZ satellite sensing project – was hosted at Lincoln University on 6/5/08 for preliminary discussions on collaboration on the development of a NIRS method of pasture quality estimation via remote sensing. The meeting was then followed up by telephone discussions and a charter document to summarise the meeting and the intended path forward in the collaboration.

Results:

1. Tables 1 a)-f) (attached) present the monthly mean, maximum and minimum values of CP and ME for the months sampled in the 2006-2008 period, in each province of the South Island that was sampled, and in Table 2 for the South Island as a whole.

Table 1a) For the West Coast region, the monthly mean crude protein values (grams/ kilogram dry matter) (CP), minimum crude protein (CP Min) and maximum crude protein (CP Max) values; the mean metabolisable energy values (megajoules/ kilogram dry matter) (ME), minimum metabolisable energy (ME Min) and maximum metabolisable energy (ME Max) values.

Month	CP	CP Min	CP Max	ME	ME Min	ME Max
January	19.6	15.3	24.1	11.0	10.4	11.9
February	21.5	17.1	26.0	11.3	10.7	11.9
March	22.4	18.2	29.2	11.4	10.6	12.0
April	24.3	19.3	30.1	11.7	10.6	12.1
May	22.7	15.8	27.6	12.2	11.5	12.9
June	23.5	20.7	26.9	12.0	11.7	12.4
September	24.9	21.9	27.5	12.3	11.7	12.8
August	25.7	19.0	33.1	12.0	11.5	12.4
October	22.9	16.6	29.7	12.1	11.7	12.6
December	20.0	14.4	27.1	11.0	9.7	12.3

Table 1b) For the Southland region, the monthly mean crude protein values (grams/ kilogram dry matter) (CP), minimum crude protein (CP Min) and maximum crude protein (CP Max) values; the mean metabolisable energy values (megajoules/ kilogram dry matter) (ME), minimum metabolisable energy (ME Min) and maximum metabolisable energy (ME Max) values.

Month	CP	CP Min	CP Max	ME	ME Min	ME Max
January	22.7	17.0	28.5	11.2	10.3	11.9
February	22.3	16.4	27.3	11.7	11.2	12.4
March	24.9	11.4	30.0	11.4	10.5	11.8
April	26.5	19.9	31.3	11.6	11.2	11.9
May	27.8	25.5	29.7	11.6	11.0	12.1
June	28.5	26.6	30.8	11.4	10.9	11.9
August	24.1	20.9	27.6	12.3	11.7	13.3
September	24.4	18.9	29.2	12.0	11.4	12.4
October	22.2	15.7	27.3	12.2	10.6	12.7
November	24.2	17.8	29.2	11.7	11.4	12.1
December	23.0	16.5	29.7	11.0	10.3	11.5

Table 1c) For the South Otago region, the monthly mean crude protein values (grams/ kilogram dry matter) (CP), minimum crude protein (CP Min) and maximum crude protein (CP Max) values; the mean metabolisable energy values (megajoules/ kilogram dry matter) (ME), minimum metabolisable energy (ME Min) and maximum metabolisable energy (ME Max) values.

Month	CP	CP Min	CP Max	ME	ME Min	ME Max
January	19.6	14.1	24.7	11.3	10.3	11.8
February	20.7	14.8	26.6	11.3	10.4	11.9
March	26.8	18.9	31.3	11.4	10.8	12.0
April	26.5	20.0	31.8	11.6	10.9	12.0
May	27.6	24.8	32.0	11.8	10.6	12.2
June	28.3	25.1	31.1	11.9	11.3	12.4
August	24.3	20.0	28.0	11.9	11.4	12.9
September	22.6	15.1	27.5	12.3	11.4	14.1
October	24.6	18.5	32.7	11.9	11.1	12.7
November	24.7	16.0	31.2	11.4	10.9	12.0
December	23.4	14.9	30.9	10.8	10.1	11.7

Table 1d) For the North Otago region, the monthly mean crude protein values (grams/ kilogram dry matter) (CP), minimum crude protein (CP Min) and maximum crude protein (CP Max) values; the mean metabolisable energy values (megajoules/ kilogram dry matter) (ME), minimum metabolisable energy (ME Min) and maximum metabolisable energy (ME Max) values.

Month	CP	CP Min	CP Max	ME	ME Min	ME Max
January	21.2	18.9	26.0	11.8	10.9	12.6
February	23.3	18.0	31.9	11.9	10.8	12.8
March	25.5	21.9	29.7	12.3	11.6	13.1
April	28.0	23.7	30.9	12.4	11.9	12.8
June	24.6	23.3	26.1	12.4	12.2	12.7
May	26.3	20.5	32.4	12.4	11.9	13.0
September	25.5	18.8	31.9	12.2	11.5	13.1
October	23.2	14.8	29.8	12.3	11.1	13.0
November	25.0	18.2	29.9	12.0	10.9	12.9
December	21.6	17.5	25.4	12.1	11.2	12.7

Table 1e) For the South Canterbury region, the monthly mean crude protein values (grams/ kilogram dry matter) (CP), minimum crude protein (CP Min) and maximum crude protein (CP Max) values; the mean metabolisable energy values (megajoules/ kilogram dry matter) (ME), minimum metabolisable energy (ME Min) and maximum metabolisable energy (ME Max) values.

Month	CP	CP Min	CP Max	ME	ME Min	ME Max
January	21.7	12.8	26.6	11.7	10.8	12.7
February	24.0	18.3	29.8	12.0	11.2	13.1
March	25.8	18.8	33.7	12.1	10.9	13.2
April	26.1	21.5	31.5	11.6	11.1	12.2
May	27.4	20.2	32.7	12.0	11.0	13.1
June	27.2	23.5	30.5	12.0	11.3	12.3
August	22.2	18.4	29.6	12.5	12.2	12.9
September	25.2	17.7	30.7	12.2	11.2	12.6
October	24.5	16.3	32.1	12.1	11.3	12.9
November	24.1	17.2	30.5	12.0	10.1	13.5
December	23.2	13.2	30.7	11.7	10.5	12.9

Table 1f) For the North Canterbury region, the monthly mean crude protein values (grams/ kilogram dry matter) (CP), minimum crude protein (CP Min) and maximum crude protein (CP Max) values; the mean metabolisable energy values (megajoules/ kilogram dry matter) (ME), minimum metabolisable energy (ME Min) and maximum metabolisable energy (ME Max) values.

Month	CP	CP Min	CP Max	ME	ME Min	ME Max
January	21.2	18.9	26.0	11.8	10.9	12.6
February	22.2	21.1	23.4	11.7	11.6	11.9
March	25.5	21.9	29.7	12.3	11.6	13.1
April	28.0	23.7	30.9	12.4	11.9	12.8
June	24.6	23.3	26.1	12.4	12.2	12.7
August	22.8	19.5	26.9	12.3	11.9	12.6
September	23.6	20.3	26.9	12.5	12.1	12.8
October	26.6	23.7	29.1	12.6	12.4	12.7
November	25.0	18.2	29.9	12.0	10.9	12.9
December	21.6	17.5	25.4	12.1	11.2	12.7

Table 2 For the entire South Island, the monthly mean crude protein values (grams/ kilogram dry matter) (CP), minimum crude protein (CP Min) and maximum crude protein (CP Max) values; the mean metabolisable energy values (megajoules/ kilogram dry matter) (ME), minimum metabolisable energy (ME Min) and maximum metabolisable energy (ME Max) values.

Month	CP	CP Min	CP Max	ME	ME Min	ME Max
January	21.4	12.3	30.3	11.6	10.3	13.0
February	22.8	14.8	31.9	11.8	10.4	13.1
March	25.1	11.4	33.7	11.9	10.5	13.2
April	26.2	11.6	32.1	11.9	10.6	13.1
May	26.7	15.8	32.7	12.0	10.6	13.1
June	27.0	20.7	31.1	12.1	10.9	13.3
August	23.5	18.4	32.1	12.2	11.4	13.3
September	24.7	15.1	31.9	12.2	11.2	13.1
October	24.0	14.8	33.1	12.2	10.6	13.0
November	23.8	15.4	31.2	11.9	10.1	13.5
December	22.4	13.0	30.9	11.6	9.7	13.5

2. LandCare NZ has been delivered a tabular list of 120 pasture quality assessments (ME and CP) from individual samples drawn from the database used to produce Table 1 above. For each individual sample in that list, a paddock specific GPS co-ordinate is also provided.

3. The meeting between LandCare NZ (Dr John Dymond) and CSIRO Australia 'Pastures from Space' (Dr Dave Henry) was held on 6/5/08. The meeting was productive, and was the first such meeting between NZ and Australian researchers in the field. It was concluded that there are significant existing strengths in the research capacities of both organisations that could be combined in the first genuine attempt in either country to produce a method of pasture quality analysis robust enough to give both specific (paddock) and broad (regional) values on a temporal basis. The method would use cutting edge NIRS satellite assessments in combination with the existing chlorophyll (biomass) assessments, and would involve targeted field sampling across the seasons in a similar manner to that done in the South Island Dairy Lameness Project. There was strong optimism that such a method could provide pasture data suitable for use in estimating intake of ruminants to an accuracy acceptable to the international research community, which is not the case with the current method in use.

The process and division of research inputs between LandCare NZ and CSIRO to achieve this - using NZ pasture field sampling in the first instance – was established in this meeting.

Discussion and Conclusions:

1. This project has provided the first robust pasture quality assessments available to date of dairy pastures in the South Island for use in the NZ GHG Inventory process. The seasonal changes in the pasture ME and CP values are much reduced relative to traditional rain fed dairy, beef and sheep pastures (Litherland *et al* 2002), due to a consistently higher quality pasture across the year in all South Island regions (Table 1a)-f)). This is consistent with the goals and advice of the South Island dairy industry extension content to farmers to maximise cow intake (production). This has obvious relevance to the NZ GHG Inventory given both the current size of the South Island dairy herd (at 1.2 million cows, approximately one quarter of the national herd, and one third of the milk solids produced) and the projected continuing increase in these (50% of national production in the next decade).

2. The provision of a representative sample of South Island pasture assessments coupled with GPS co-ordinates provides a starting point for future national research programmes seeking to deliver a method of remote pasture quality estimation accurate enough to base intake estimates on. At present in NZ this is not the case, and for the NZ Inventory process to credibly use remote sensing of pasture quality in estimating intake, new methods are required.

   The method by which this database was designed and produced also provides a blueprint for obtaining the field samples that are critical in developing remote sensing methods for pasture quality estimation.

3. The CSIRO 'Pastures from Space' project remains one of the most advanced research efforts in the field of remote sensing of pastures, and the meeting with LandCare NZ demonstrated that there is much that the current NZ research team, field methodology and funding opportunities can offer in productive collaboration. This collaboration would benefit both countries, and may offer the first genuine opportunity to develop a method of pasture assessment that meets the two requirements of the NZ Inventory for such a method - assessment on a regional scale and accuracy at the site specific level.

Project Outcomes and Deliverables (Re: Project Goals)

1. This project has provided robust, mean monthly dairy pasture quality (metabolisable energy (ME) and crude protein (CP)) estimates for the South Island.

2. This project has provided a sub-sample of individually GPS co-ordinated pasture samples with accompanying estimates of ME and CP to LandCare NZ satellite sensing research team for use in the development of a novel pasture quality estimation method using satellite imagery.

3. This project has facilitated the development of novel pasture assessment methods via remote sensing by hosting the meeting of the LandCare NZ representative and the CSIRO 'Pastures from space' representative here in NZ (May 08).

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