Action on the Ground Project

The Effect of Landuse Classes and Soil Organic Amendments on Soil Carbon Trial Conducted Across Grazing and Cropping Industries

Project Background
The Action on the Ground Project was funded by the Australian Government Department of Agriculture, Fisheries and Forestry. Twenty seven paired demonstration sites were established across a range of grazing, horticultural and cropping industries including beef, sheep, dairy, potatoes, brassica and herbs. This was over a large geographic area extending from the Richmond to the Hastings and inland from Granite Borders to Walcha.

Objective
The aim of the project was to implement innovative practices to increase soil carbon sequestration and reduce nitrous oxide emission.

Method
Landholders were encouraged to select an organic soil amendment to suit their production type and that was available in their area. Treatments included:

- Addition of organic soil amendments such as compost, compost tea and recycled manures to replace or reduce nitrogen based fertilisers,
- adoption of biological and conservation farming practices,
- the capture and recycling of on farm by-products i.e. dairy solids for composting, dairy effluent for irrigation and wood-chipping of herb pruning.

Paired trial sites (treated area) and control sites (normal land management) were established on each of the 27 properties. Soil fertility tests were taken at 0-10 cm depths in 2012 to establish a baseline and in 2014 after product trial. Soil organic carbon (SOC) was measured using the CSIRO SCARP protocol. This involved measuring SOC concentration, and bulk density of the <2mm fraction of soil in 0-10 cm, 10-20 cm and 20-30 cm increments. A two tailed ‘t’ test was used to analyse the data. Land Use History and Northern Rivers Soil Health Card were also collected from each site.

Landuse Classes
The 27 demonstration sites were divided into the following common landuse classes:

- Cropping
- Dairy
- Grazing

Grouping the data into landuse classes allowed closer examination of the change in SOC concentrations within the different landuses categories.

Figure 1: Example of cropping, dairy and grazing Landuse classes participating in the project.
Product Rates & Sourcing

Application rates of products (see table 1) varied across grazing and cropping industries and was largely influenced by the agricultural product requirement. Product sourcing was left to the farmer’s discretion. Most sourced products locally due to the cost associated with transport and delivery.

Table 1. Product Type and Rate

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compost</td>
<td>1 – 12 tonnes/ha/year</td>
</tr>
<tr>
<td>Compost Tea</td>
<td>50 Liters/ha/year</td>
</tr>
<tr>
<td>Feedlot Manure</td>
<td>3 - 4.5t/ha/y</td>
</tr>
<tr>
<td>Chicken Litter</td>
<td>0. – 2.5 t/ha/y</td>
</tr>
<tr>
<td>Turkey</td>
<td>1.5 t/ha/y</td>
</tr>
<tr>
<td>Pig Manure</td>
<td>2 t/ha/y</td>
</tr>
<tr>
<td>Sheep Manure</td>
<td>1 – 2t/ha/y</td>
</tr>
<tr>
<td>Dairy Solids</td>
<td>0.5 - 10 t/ha/y</td>
</tr>
<tr>
<td>Liquid Dairy Effluent</td>
<td>144,000 L/y</td>
</tr>
<tr>
<td>Herb Waste</td>
<td>0.5t/ha/y</td>
</tr>
</tbody>
</table>

Results

Figure 2 shows the considerable spread of data and effect on soil organic carbon percentage (SOC%) in the top 10 cm of soil at both control sites (normal land management) and trial sites (treated) in 2014. Soil organic carbon concentration in the surface 10 cm of treated sites averaged 3.89% compared to the control sites average of 3.27%. On average all treated sites across the different landuse classes were statistically higher ($P=0.045$ or 95.5%) in SOC% in the surface 10 cm compared to control sites in 2014.

Bulk density is a measure of soil weight in a given volume and usually increases with compaction. This measure is used with the SOC% to calculate change in carbon stocks (sequestration). Figure 4 shows that on average, the bulk density was reduced in the top 10 cm across all treated landuse classes, compared to the control sites. In control sites, cropping and grazing landuses increased bulk density in the surface 10 cm, while dairy sites showed a reduction in bulk density. However the differences across all three categories were not statistically significant.

Figure 5 shows on average the mass of SOC stored in the top 10 cm layer increased under both cropping and grazing landuse treated sites. Cropping treated sites averaged an increase of 2.8 T/ha compared to the control site of 1.3 T/ha. Grazing treated sites averaged 3.7 T/ha compared to control site of 0.5 T/ha. Dairy sites showed a
The Effect of Landuse Classes and Soil Organic Amendments

reduction in SOC stored in the surface 10 cm. The differences were not statistically significant.

Figure 5: Effect of treatment on change in mass of SOC stored t/ha in the surface 10 cm across landuse classes between 2012 and 2014.

Figure 6 shows on average mass of SOC in the 0-30 cm layer of treated plots increased under grazing 13.17 T/ha compared to control sites 10.29 T/ha and fell under cropping and dairy landuses. However none of the differences were significant.

Figure 6: Effect of treatment on change in mass of SOC T/Ha at 0-30 cm across landuse classes between 2012 and 2014.

Conclusion

An examination of the three landuse classes revealed there was a statistically significant increase in SOC% in the 0-10 cm layer of treated sites across all landuse categories in 2014. This was considered a positive result by most landholders. The relative fall in bulk density on treated plots is considered an improvement in soil physical health. Grazing management as a method of increasing carbon sequestration was unexpected (figure 6). However the extent of carbon retention in pasture soils needs further investigation.

It is likely that the relatively short duration of the trials, and the often relatively low organic amendment application rates compared with the mass of SOC already present in these soils made it difficult to detect statistical significance below 10 cm depths. A further difficulty was the range in the type of treatments used. However it is noted that landholders used products that were locally available to them and were largely influenced by the agricultural production requirement.

More information

For more information on this project please contact Selina Miller on (02) 6604112 or email selina.miller@lls.nsw.gov.au

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