Future Beef

Fact sheet

Soil carbon in the Maranoa Balonne

Climate Clever Beef

The Climate Clever Beef (CCB) project in northern Australia aims to investigate methods to minimise methane emissions from livestock and increase carbon sequestration in the soil while focussing on those practices that also improve the productivity and profitability of the beef business. As part of the CCB project in the Maranoa Balonne region, four beef properties undertook soil carbon assessments to gauge the impact of different land management on soil carbon levels. A fifth property has been involved in a project monitoring soil carbon over a 20 year period.

Soil carbon assessments

In 2014 soil was tested for soil organic carbon and nitrogen on four properties to assess the impacts of changing the original vegetation to cropping or pasture, or bringing cropping paddocks back to sown pasture. Overall there were not large differences in total soil organic carbon between the paired sites on each property (Table 1). Nitrogen levels were proportional to carbon levels (C: N, ~10:1). Total soil organic carbon levels in the top ten centimetres were relatively low, averaging 1.1% (range 0.64-1.6%) and in the 10-30 centimetres soil layer averaged 0.93% (range 0.51-1.33%). This compares with an average of 1.46% (0.5-6.4%) from soil tests from 2008-14 on 870 mixed farm sites in Queensland (Argent & Lawrence 2014). The results below are a snap-shot of the soil organic carbon situation at these sites. Soil carbon can vary for many reasons including soil type, therefore some caution is required in identifying the driving cause of any soil carbon differences. The paired sites in this trial were carefully matched to minimise differences due to soil type.

Table 1. Total soil organic carbon and nitrogen results on four beef properties in the Maranoa Balonne region

Site	Soil Type	Site History	Organic Carbon (%)	Nitrogen (%)
Verniew 1 Native pasture, box regrowth	Red box clay loam	▪ Cleared pre 1990, ▪ native pasture, box regrowth	0-10cm: 0.64%	0.06%
Verniew 2 Blade ploughed, sown pasture	Red box clay loam	▪ Cleared pre 1990, blade ploughed 2007 ▪ Seeded to silk sorghum & buffel	0-10cm: 1.18% 10-30cm: 0.76%	0.1%
Sydenham 1 Remnant vegetation	Coolibah flood plain grey cracking clay	▪ Historical ring barked ▪ Raked 2008 ▪ Rotational grazing	0-10cm: 0.81% 10-30cm: 0.82%	0.08%
Sydenham 2 Blade ploughed	Coolibah flood plain grey cracking clay (lighter)	▪ May have been cropped but unlikely ▪ Degraded by too many sheep in past ▪ Pasture cropping 2003-2005 ▪ Blade ploughing since 2007, 30cm depth	0-10cm: 0.66% 10-30cm: 0.51%	0.07%
Sydenham 3 Crop to pasture	Coolibah flood plain grey cracking clay	▪ Farmed pre 1994, last cropped 2003-2004 ▪ pasture cropping	0-10cm: 0.64% 10-30cm: 0.62%	0.07%

Queensland Government

Supported by funding from the Australian government

Table 1 continued: Total organic carbon and nitrogen test results on four beef properties

Site	Soil Type	Site History	Organic Carbon (%)	Nitrogen (%)
Springtime 1 Remnant	Brigalow belah, myall	▪ Never been worked or cleared ▪ Remnant (original country)	0-10cm: 1.6% 10-30cm: 1.14%	0.15%
Springtime 2 Crop to Leucaena-grass pasture	As above	▪ Cleared > 60 years ago, cropped 30 years ▪ Forage- silage, hay removal, minimal fertiliser ▪ 2008 planted leucaena, 70kg MAP, sown grass	0-10cm:1.42% 10-30cm: 1.33%	0.13%
Springtime 3 Crop to sown grass pasture	As above	▪ Cleared 60 years ago, cropped ▪ 2003 planted to bambatsi	0-10cm:1.35% 10-30cm:1.03%	0.13%
Bulala 1 Native pasture	Brigalow belah, box ridges, brown loam cracking clay	▪ Cleared 1990s ▪ Native pasture	0-10cm: 1.36% 10-30cm:1.14%	0.12%
Bulala 2 Crop (2yrs) to pasture	As above	▪ Cropped for ~2 years after being cleared ▪ Buffel pasture for 14 years	0-10cm: 1.32% 10-30cm:1.01%	0.13%

At “Verniew” a native pasture / box regrowth paddock had a soil carbon level of 0.64%. Similar soil which was blade ploughed in 2007 and sown with silk sorghum and buffel, seven years later had 1.18% soil carbon in the top 10cm of soil. If both paddocks were originally similar, it can be assumed that the higher soil carbon level may be associated with a more productive sown pasture system producing and returning more dry matter to the soil. An additional 0.54% soil carbon relates to an additional 5.4 t/ha of soil organic carbon or 9 t/ha of organic matter. This increase in organic matter would be associated with a fertiliser (not carbon) nutrient value in the order of $800-$1,100/ha. Nitrogen levels increased proportionally with the carbon levels (0.06% v 0.1%).

At “Sydenham” all three sites had relatively low soil carbon and nitrogen levels with the remnant vegetation the highest. The current owners are trying to recover the soil health of these paddocks which prior to ownership had been degraded with over-grazing by sheep.

At “Springtime” the remnant paddock has the highest soil carbon level followed by the leucaena paddock and bambatsi site. Interestingly the leucaena site has higher carbon levels at 10-30cm, presumably due to greater root growth. As a legume, leucaena would be contributing nitrogen to the system over time to promote greater sustainable productivity of the tree legume-grass system. Currently higher total nitrogen levels are not evident in the soil. Sites 2 and 3 had previously been cropped for decades and were regarded as ‘rundown’. It would have been interesting to know the soil carbon levels before being returned to pasture.

At “Bulala” both pasture sites have similar soil organic carbon and nitrogen levels.

At “Canberra” soil carbon tests were taken in the mid 1980’s as part of a national soil carbon research program. At the time of testing the property was called “Rolston”. Soil organic carbon and nitrogen levels were compared between soil with:

- remnant vegetation;
- following 20 years cropping
- following 20 years cropping and then returned to 20 years pasture.

Twenty years of cropping resulted in a large loss in soil carbon (-9.84 t C/ha in the top 10cm) compared to remnant vegetation. With return of the cropping land to grazed pasture over twenty years, the soil accumulated soil organic carbon(+1.9 t C/ha in the top 10cm, figure 5). However the soil organic carbon was still much lower than the remnant vegetation indicating potential for further soil carbon sequestration. Soil nitrogen appears to have proportionally greater recovery following return to pasture (figure 6).

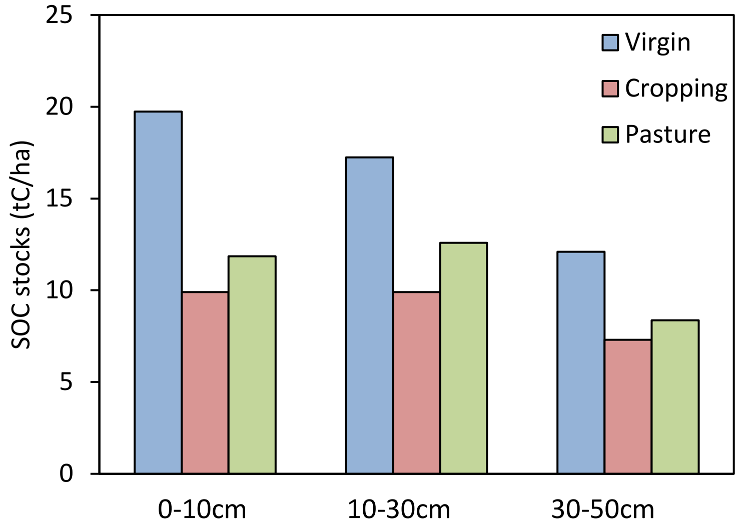

Figure 5
Soil organic carbon stocks at "Canberra".

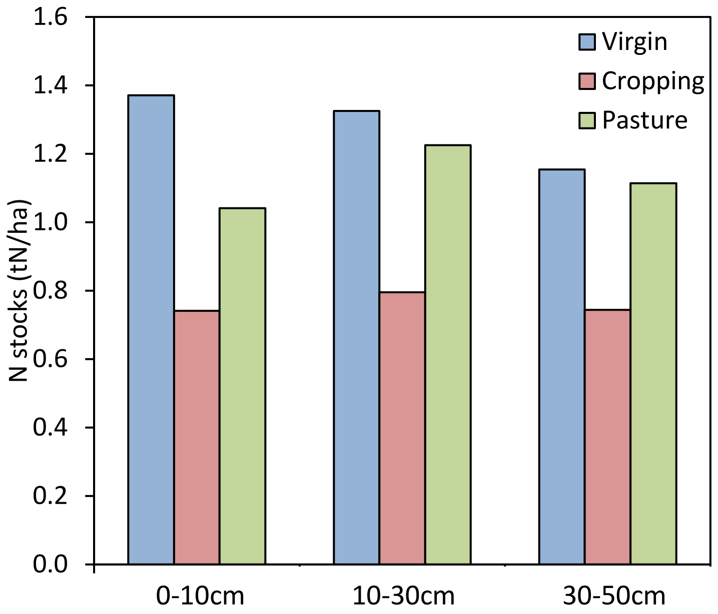

Figure 6
Soil organic nitrogen stocks at "Canberra"

Conclusion

The results show potential for producers to make slow gains in SOC and total N in the Maranoa-Balonne where cropping has been or is likely to be returned to pasture. This will be increasingly attractive where returns from cropping become more marginal due to rising input costs and difficult climatic conditions affecting yields. Apart from returning cropping land to pasture, it is unlikely that large scale opportunities exist to generate and sell carbon credits due to high project risk. However, grazing management which aims to increase soil organic carbon and total N are likely to increase pasture quality and yield, leading to improved animal performance. In turn, this leads to improved livestock emissions intensity and potentially reduced lifetime emissions from ruminants grazing these pastures. Since the driving factor for increasing soil organic carbon is total dry matter production it highlights the value of productive perennial pasture systems and the role of legumes in boosting nitrogen and productivity.

Further information - FutureBeef

Roma (07) 4622 9903, Toowoomba (07) 4688 1244
Or visit
http://futurebeef.com.au/resources/projects/climate-clever-beef/

References

1. 'Soil organic matter and carbon: Improving levels through farm management practices', Department of Agriculture and Fisheries, Queensland Government. Argent S and Lawrence D (2014, workshop notes).
2. 'Increasing soil carbon in eastern Australian farming systems: Linking management, nitrogen and productivity', Department of Primary Industries, Victoria. Robertson F.

This project was supported by funding from the Australian government.