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What are the realistic expectations for making money out of carbon credits in vineyards?

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Some background

Earning carbon (C) credits in agricultural systems first came to prominence with the Federal Government's legislation establishing the Carbon Farming Initiative (CFI) in 2011, which in 2013–14 had a mandated C price of $24.15 per tonne (t) of CO_2-equivalent (CO_2-e). However, with the change in government in 2013, the CFI was absorbed into the Emission Reduction Fund (ERF) that was established in 2015 and involved a reverse auction by those applying for C credits. Over the eight auctions that have been held up to December 2018, the average value of a C credit is just over $12 per t CO_2-e.

An article by Oli Madgett in the May (2019) issue of *Grapegrower and Winemaker* suggested that vignerons could benefit through C credits available under the ERF by increasing their soil C levels. While no one would dispute the benefits to be derived from increasing soil organic C (SOC) in terms of improved soil health and the productivity and resilience of vineyards, the chances of making a net financial gain from C credits in a vineyard are more problematic. This article briefly identifies some of the hurdles to be overcome in accumulating SOC to earn C credits, and reports some of the relevant information obtained from field experiments around the world.

Snags for vignerons in the ERF

The latest version of the Carbon Credits (Carbon Farming Initiative — Measurement of Soil Carbon Sequestration in Agricultural Systems) Methodology 2018 was 'determined' by the Department of Environment and Energy on 25 January 2018. This version incorporated elements from two previous soil C sequestration schemes, the more important of which applied to grazing systems. An outline of the mechanisms of the latest scheme is as follows:

- Landholders have a choice of which land management activities to implement to build soil C, but they must carry out one or more of the listed eligible management activities in a designated carbon estimation area (CEA). Eligible management activities must be new or materially different from the land management activity conducted during a 10-year (yr) baseline period, and must reasonably be expected to sequester C in the soil.
- The permanence obligation requires the management system be maintained for 25 or 100 yrs. If 25 yrs is selected the C credits earned are discounted by 20 percent.
- A successful project must be based on eligible land that during the baseline period was used for pasture, cropping or bare fallow. Whether viticulture is included under cropping is uncertain.
- Measurements of SOC are notoriously variable in space and time. In an attempt to ensure the scheme's integrity, an independent person must prepare or review the land management strategy, and an independent person must conduct soil sampling to at least 0.3 m depth according to a specific protocol.
- Because of the variability in SOC measurements, the criterion for accepting the significance of any increase in SOC is lowered from the usual 95 percent probability

to 60 percent. However, only 50 percent of C credits will be issued for an increase in soil C in advance of three soil sampling rounds over the initial 10–15 yrs.

- Sensibly, the scheme does not allow C materials from sources outside the CEA to be applied, except where these materials are part of a designated waste stream. Thus, manure, mulch and compost imported into the CEA is not accepted. An exemption can be made for biochar if it is made from a waste stream *and* is applied under a state or territory permit.
- The requirements for preparing a project proposal and implementing it are fiendishly complex (see https://www.legislation.gov.au/Details/F2018L00089) so that vignerons will need to employ an experienced facilitating agency to ensure they comply with the scheme's regulations.

What rates of C sequestration in vineyards can be expected?

Madgett suggested that growers could increase their soil C levels through new activities involving planting mid-row cover crops, removing constraints such as acidity, sodicity or nutrient deficiencies, or spreading mulch or compost. However, the last two are not permitted unless obtained from within the CEA or made from a designated waste stream. Madgett further suggested that a reasonable rate of SOC increase would be from 1% to 1.5% over 10 yrs.

A soil with 1%C, assuming a soil bulk density of 1.33 Mg/m^3, contains 4 x 10^4 kg C per hectare (ha) to a depth of 0.3 m. Thus, an increase of 0.5% C during 10 yrs amounts to 2 x 10^4 kg C/ha, or 20 t over 10 yrs; that is 2 t C/ha/yr. However, many literature reports have found that, apart from planting trees, the best method for increasing SOC is to convert cropping land to permanent pasture, when the increases in SOC range between 0.3 and 0.6 t C/ha/yr (Sanderman *et al*. 2010).

Achieving such increases in vineyards is unlikely because many cover crops are not based on perennial species, and if the cover crop does not extend into the vine row (because of under-vine cultivation or herbicide spraying), the proportion of each ha in which SOC can consistently accumulate is reduced to 66–75 percent. Notwithstanding these provisos, the likely increase in SOC is well short of 2 t C/ha/yr.

Madgett quoted Minasny *et al*. (2017) as support for the suggestion that an increase in SOC from 1 to 2% over 10 yrs would be 'a great result'. However, Minasny *et al*. (2017) were much more conservative in their paper, which reviewed results for SOC change under many land uses around the world. Their estimate for SOC increase for land converted to permanent pasture was ≈ 0.5 t C/ha/yr.

Thus, the most optimistic C sequestration in a vineyard might be 0.45 t C/ha/yr, corresponding to 1.65 t CO_2-e/ha. However, this figure must be reduced by the amount of any increase in greenhouse gas emissions (associated, for example, with the production of inputs such as lime, fertilizers, tractor passes and irrigation pumping). Thus, a *net* increase in C sequestration of, say, 1.5 t CO_2-e/ha would earn $18/ha at C price of $12/t CO_2-e, discounted $14.4/ha when a 25-yr permanence period is chosen.

If this net increase could be maintained for 10 yrs (i.e. a linear rate of SOC increase), the total income would be $144 per ha, which would have to be set against the cost of project establishment and the on-going costs of soil sampling, soil analysis, auditing and reporting. Moreover, although the rate of SOC increase under a new activity may well be approximately linear for the first 10 yrs or so, long-term experiments show that the rate of

increase slows over time, reaching a maximum (asymptotic value) for a given soil and environmental conditions (White and Davidson 2016a).

Conclusion

Building up soil organic matter has long been advocated for improving soil structure, promoting nutrient cycling, and stimulating an active and diverse microbiome. Achieving these improvements, which can be reflected in higher yields of better-quality grapes, should be the primary aim of managing SOC in a vineyard. Earning net income from C credits is much more problematic, given the experimental evidence for uncertain net profits accruing from C farming (White and Davidson 2016b).

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