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Soil Wealth
NURTURING CROPS

Integrated Crop Protection
PROTECTING CROPS

THE CARBON SERIES

Part 3: Carbon emissions in vegetable production

This four-part Carbon Series from the Soil Wealth ICP project breaks down the practicalities of carbon farming for vegetable growers and soil carbon management.

KEY MESSAGES

- ✔ **Carbon emissions on vegetable farms can occur from a range of activities including fuel and electricity use to power machinery and equipment, applying nitrogenous fertilisers and manures, and crop residues and organic waste.**
- ✔ **The main greenhouse gas emissions from agriculture and vegetable production include carbon dioxide, nitrous oxide and methane (from livestock).**
- ✔ **It is important for vegetable production businesses to understand where their emissions come from and how they can be reduced to maximise potential opportunities to increase efficiencies and lower input costs.**

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This project has been funded by Hort Innovation using the vegetable, fresh potato and potato processing research and development levies and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

ABOUT THE CARBON SERIES

This four-part Carbon Series from the Soil Wealth ICP project breaks down the practicalities of carbon farming for vegetable growers and looks more closely at soil carbon management. It provides links to further information and project resources on the following topics:

- **Part 1: Carbon farming and its relevance to Australian vegetable growers**
- **Part 2: Soil carbon and carbon sequestration**
- **Part 3: Carbon emissions in vegetable production**
- **Part 4: Carbon accounting and the Emissions Reduction Fund.**

Additional resources were produced including a podcast on certified carbon neutral sweet corn developed by Mulgowie Farming Company in Queensland and a webinar recording of Carbon management on vegetable farms – emissions, sequestration and beyond.

The Carbon Series has been produced to help Australian vegetable growers to:

- Make decisions to manage soil carbon for increased productivity
- Calculate current emissions and assess the potential for emission reductions within their business
- Assess the viability of participating in an official carbon credit scheme
- Consider carbon neutrality as a path to differentiate products and their business on the market.

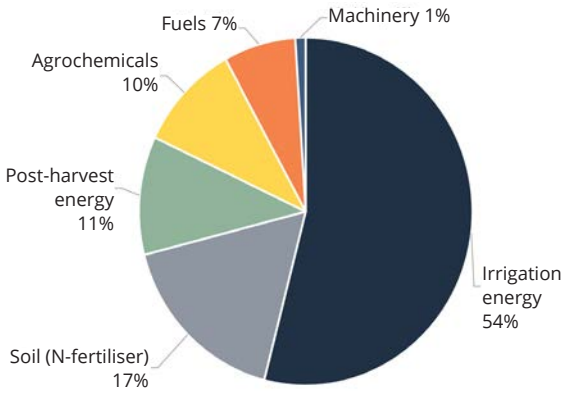
Part 3 of The Carbon Series discusses carbon emissions relevant to vegetable producers.

EMISSIONS IN VEGETABLE PRODUCTION

As outlined in Figure 1, vegetable production can produce greenhouse gases from:

- Using fuel and electricity to power machinery and equipment
- Applying nitrogenous fertilisers (especially without nitrification inhibitors, urease inhibitors or as nitrate to wet or temporarily waterlogged soils, or large volumes of nitrogen-rich organic amendments) and animal manures such as chicken manure
- Decaying or burning biomass and organic waste
- Nitrogen leaching and run-off from fertilisers and soil amendments
- Returning crop residues to the soil through intensive tillage and soil disturbance
- Anaerobic rotting of organic matter during flood irrigation
- Refrigerant loss to the atmosphere.

Figure 1: Greenhouse gas emissions from farm inputs/ activities in the Australian vegetable industry.
(Source: An assessment of greenhouse gas emissions from the Australian vegetables industry)



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DID YOU KNOW?

- **About 20% of total greenhouse gas emissions from irrigated production are associated with nitrogen fertiliser due to emissions during manufacturing and use on-farm.**
- **About 70% of total greenhouse gas emissions from irrigated cropping are due to energy consumption, especially pumping irrigation water.**
- **The annual carbon dioxide release from deforestation is about 25% of that from fossil fuel burning, due to the loss of carbon from vegetation and soil.**
- **In agriculture overall, about 70% of emissions are due to methane from livestock. Increasing soil carbon by 1% to 1 cm depth would require 1.2 tonnes of carbon or about 2.4 tonnes of organic matter.**

Farming by its very nature produces a range of greenhouse gas emissions. The main emissions from agricultural production include:

- **Carbon dioxide (CO_2)** – mainly released through plant decay and insect/microbial activity in soils, as well as burning of fossil fuels for energy.
- **Nitrous oxide (N_2O)** – mainly released through soil disturbance such as tillage and cropping practices involving fallow periods, as well as application of nitrogen fertilisers. In many cases these emissions can be higher than expected. See Nitrous oxide emissions from vegetable soils: What's all the fuss about? – fact sheet.
- **Methane (CH_4)** – mainly released from ruminants (cows and sheep) following digestion of plant matter. It is therefore more applicable to mixed farming enterprises with livestock and intensive grazing systems.

MEASURING EMISSIONS

Carbon dioxide equivalent (CO_2-eq) is the standard measurement which accounts for global warming potentials (GWP) of the various greenhouse gases.

CO_2-eq is commonly expressed as million metric tonnes of a gas, abbreviated as MMTCDE.

As methane and nitrous oxide emissions are more potent (have a greater warming potential) than carbon dioxide emissions, the carbon dioxide equivalent allows all emissions to be measured by one consistent unit.

The carbon dioxide equivalent for a gas is derived by multiplying the tonnes of the gas by the associated GWP. For example, **the GWP for carbon dioxide is 1, methane is 25 and nitrous oxide 298**. This means that emissions of 1 million metric tonnes of methane and nitrous oxide respectively is equivalent to emissions of 25 and 298 million metric tonnes of carbon dioxide respectively.

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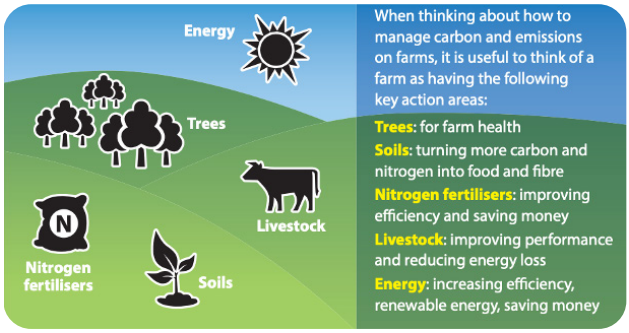
REDUCING EMISSIONS ON-FARM

There is a close link between resource use efficiency, productivity and emissions. Generally, lower emissions in an agricultural business result in higher productivity.

It is important for vegetable production businesses to estimate where their emissions come from and how they can be reduced to maximise potential opportunities to increase efficiencies and lower input costs. Practices can include:

- **Minimising tillage operations and better managing nitrogen fertiliser applications**, which will reduce fertiliser costs and nitrous oxide emissions as well as potential nitrate runoff into waterways.
- **Using fuel and electricity more efficiently, or finding alternative energy sources** such as solar and wind power, which will reduce both energy costs and carbon dioxide emissions. It is also important to check irrigation pump use efficiencies and make sure pumps are well matched to the entire system.
- **Emissions from electricity production will vary across Australia** due to the location and type of energy source (e.g. coal fired power stations versus renewables). Finding ways to use lower emission energy sources is a potential avenue to reduce emissions.

Figure 2: An approach to carbon farming. (Source: Tas Farming Futures)



Each of these emission sources can be addressed by how growers manage their production. Figure 2 outlines key areas of a farm that can be targeted to manage carbon and emissions.

A 2010 research report into 23 vegetable crops' emissions profile considered emission from post-harvest on-farm activities; the use of fossil fuels; and the use of machinery and accessories. It showed that per hectare:

- Higher emitting vegetables (10-15 tCO_2^e /ha) included: asparagus, broccoli, capsicum, green peas (shelled), watermelon, mushroom, pumpkin, sweet corn and zucchini
- Lower emitting vegetables (7-1 tCO_2^e /ha) included: beans, beetroot, carrot, cabbage, cauliflower, celery, chilli, cucumber, green peas (fresh pod), lettuce, rockmelon/cantaloupe, onion, potatoes and tomato.

NEXT IN THE CARBON SERIES

- **Part 4: Carbon accounting and the Emissions Reduction Fund**

You can also catch up on:

- **Part 1: Carbon farming and its relevance to Australian vegetable growers**
- **Part 2: Soil carbon and carbon sequestration**