

What is happening below ground and what are the benefits when it works?

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Soil Health soilhealth APP

Transition Town Vincent's <u>My Healthy Soils Project</u>

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Overview

- Link between soil carbon and biodiversity
- What is needed to transform 'sand' to 'soil'?
- Community garden project in Perth soil C
- Permeable biomass barriers
 - an application for land restoration



Significance of soil biodiversity

Significance of plant diversity

Significance of **local soil type**

Significance of **land management** (= disturbance)

Significance of soil biodiversity















- nutrient transformations
- nutrient cycling
- symbiotic / non-symbiotic nitrogen fixation
- plant disease / plant disease suppression
- arbuscular mycorrhizal function
- soil structure (soil aggregation)
- water repellence / infiltration

Significance of soil biodiversity





Lack of soil carbon & biodiversity?





Lack of soil carbon & biodiversity?





After Poster by van Vliet and Gupta





Building soil carbon in sandy soil requires continuous replacement









Soil amendments

Fertilisers

Lime

Humates / biochar etc

Manures / composts

Compost teas / biological extracts

Microbial inoculants

Impacts on soil constraints

Impacts on soil biological processes





Impacts of biological amendments on soil constraints



Community garden project in Perth





Soil health and carbon storage in community gardens in the Perth metropolitan area, Australia

Haochen Zhao¹ | James O'Connor^{1,2,3} | Sarah Zou¹ | Zakaria M. Solaiman^{1,2} Bede S. Mickan^{1,2,4} | Nanthi Bolan^{1,2,3} Zone 50 UTM Northing (m) Carbon storage (kg 1-50 50 - 190 190 - 220 220 - 230 -In Garden Gno 230 - 540 Sand calcareous sand SMU3 SMU2 SMU1 384000 100008 396000 402000 Zone 50 UTM Easting (m) FIGURE 1 Soil mapping units (SMU) and community garden sample locations, Perth metropolitan area (OpenStreetMap, n.d.).

Community garden project in Perth



- Soil samples were collected from six community gardens covering three Soil Mapping Units (calcareous deep sands, coloured sand, pale sands) (bareground and adjacent raised beds)
- Soil samples in raised beds and control plots were characterised for various soil physical, chemical and biological properties.
- Soil carbon storage was calculated based on **bulk density** and total carbon content of the soil
- Raised bed soils accumulated higher levels of carbon, indicating that community gardens provide a potential source of carbon sequestration
- The improved soil health and carbon storage in community garden soil can be attributed to the regular application of compost produced within the community gardens

Haochen Zhao Honours Student, UWA Zhao et al. 2024





Building carbon in sandy garden soil requires continuous replacement



Farm demonstration to fast-track restoration of soil condition using permeable biomass barriers



Demonstration site funded by the National Landcare Program: Smart Farms - an Australian Government initiative

Intensive regenerative practices establishing permeable biomass walls and trenches





Australian Government

Department of Agriculture, Fisheries and Forestry Trees previously planted by Greening Australia as part of Australian Government 20 Million Tree programme

Howell et al. 2024

Cassie Howell, Honours Student, UWA Farm demonstration to fast-track restoration of soil condition using permeable biomass barriers



Examples of biological amendments used –

Straw Compost Biochar Worm juice Wood Vinegar



Australian Government

Department of Agriculture, Fisheries and Forestry 2019





Permeable biomass barriers





Permeable biomass barriers





Department of Agriculture, Fisheries and Forestry

Howell et al. 2024

Cassie Howell, Honours Student, UWA

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REFERENCES



Howell, CR, Jenkins SN, Abbott LK, Mickan BS (2024) Amelioration of a saline-alkaline soil using biochar and compost: impacts on plant growth, soil biological and chemical characteristics. Land Degradation & Development 35 (1), 142-155 <u>https://doi.org/10.1002/ldr.4905</u>

Zhao H, O'Connor J, Zou S, Solaiman ZM, Mickan BS, Bolan N (2024) Soil health and carbon storage in community gardens in the Perth metropolitan area, Australia. Soil Use and Management 2024;40:e13033. <u>https://doi.org/10.1111/sum.13033</u>

Abbott LK, Macdonald LM, Wong MTF, Webb MJ, Jenkins SN, Farrell M (2018) Potential roles of biological amendments for profitable grain production – A review. Agriculture, Ecosystems and Environment 256 (2018) 34–50 https://doi.org/10.1016/j.agee.2017.12.021

Macdonald L, Abbott L, Wong TF, Wong M, Webb M, Jenkins S, Farrell M (2018) "Biological amendments for the Australian grains industry: summary review and framework". <u>https://publications.csiro.au/rpr/pub?pid=csiro:EP184635</u>

Strong DT, Sale PWD and Helyar KR (1998) The influence of the soil matrix on nitrogen mineralisation and nitrification. II. The pore system as a framework for mapping the organisation of the soil matrix. *Australian Journal of Soil Research* 36: 855 – 872

Abbott LK (2024) Principles of Soil Health" Sustaining profitable agricultural production. https://www.openaccessgovernment.org/ebook/principles-of-soil-health-sustaining-profitable-agricultural-production/175939/

Abbott LK (2024) Unveiling healthy soil: Why is soil biology key to soil health? https://www.openaccessgovernment.org/ebook/unveiling-healthy-soil-why-is-soil-biology-key-to-soil-health/184158/



Australian Government





