From The Soil Up

Working Miracles With Nature

Proud supporter of Lomandra – Land for Life

Carolyn Ditchfield

- BAgSc – University of Queensland specialising in entomology
- 2 years breeding and marketing biological control agents
- 7 years developing the industrial hemp industry in Australia
- 3 years as head agronomist for Nutri-Tech Solutions

From The Soil Up

- Biological consulting from Inverell for 8 years
- Synthesise information from a wide-range of sources and people
- Created a website to share this information with the world and to support the biological industry
- Forever questioning conventional wisdom and seeking anomalies

WARNING!!

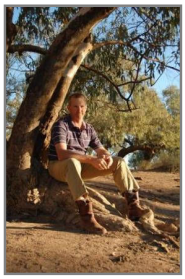
- The intention of this talk is to present ideas that have been pulling together over many years
- The ideas are not necessarily scientific fact or existing theory, but rather ideas that have emerged from on-the-ground discoveries and observations
- You are welcomed to take any of these concepts that resonate with you on board and explore them further – there is so much more to know and learn!

LINKING THE PIECES

- Something is wrong with our landscape
- Everything is drying out and running down

- Despite all the inputs in the world, without water there can be no life or carbon
- What is happening?

THE ROLE OF CARBON

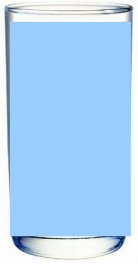


- Glenn Morris wanted to know the humus : water ratio
- Discovered very little research has been done since the 1950s
- The answer…

1 HUMUS : 4 WATER

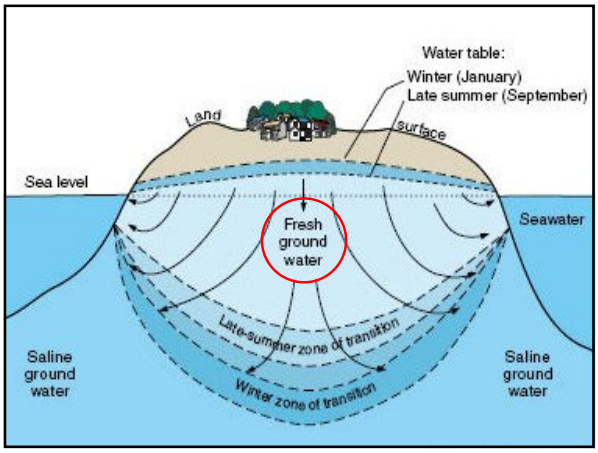
CARBON AND WATER

- So what does this mean… every additional 1% of total soil humus over one hectare, at a given depth of 30cm would be capable of storing an additional 160,000 litres of water!
- Consider… a 100mm (4") rainfall event over one hectare can deliver 1,000,000 litres of water



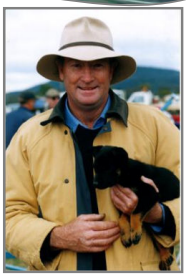
FRESH WATER/SALT WATER

- Peter Andrews is also fascinated with our landscape's hydrology
- But starting with the hard science first…. he notes that fresh water always sits on top of salt water



HISTORICAL GRASSLANDS

- Colin Seis and Darryl Cluff became intrigued with the argument that removing trees causes dryland salinity
- After reading the diaries of Colin's forefathers, then researching further at the Mitchell library, they discovered that Australian floodplains were originally covered in grasses – not trees!

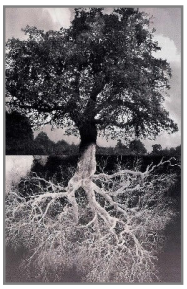


Dryland Salinity Theory

- When trees and deep rooted plants are removed, water is not transpired from the soil
- Water tables rise bringing salt up with them
- The solution is to lower the watertable via drainage and deep-rooted plants

Tree Roots/Grass Roots

- Dryland salinity is a growing problem, but was not a problem in the past
- Australian native perennial grasses have relatively shallow dense root systems, which is supposedly at the heart of the problem…
- Something is wrong with the theory



Capturing Water

- The first paradox here is the continuing call for draining our landscape in the name of salinity prevention
- Surely we want on to hold ANY water falling on our land????
- We are a nation of extremes – flooding rains and extended droughts

If you were God…

- How would you design a landscape to collect all the rain you could to last through to future droughts without flooding the soil profile in the short term?

A Sponge Landscape

- This is the answer that struck Christine Jones one night
- In the past our floodplains were in fact vast carpets of sponge
- This is what has been destroyed, and often replaced with either bare ground or exotic rootsystems not suited to our landscape

EXOTIC ROOT SYSTEMS

- Other countries have regular small doses of rain all year round, so capturing water in preparation for droughts is not critical
- Their plants tend to have long deep roots, which can act as water pumps to balance the water in, to water out rapidly
- These landscapes are rarely afflicted with flooding excesses

HISTORICAL LANDSCAPE

- Native grasses, with a diverse mix of perennials, annuals, C3s and C4s were extremely productive, but they were set stocked and declined rapidly
- Improved grasses and crops were introduced which gave a tremendous boost, but their persistence remains poor, and their costs high

PRODUCTIVE NATIVES

- Natives pastures are just as productive, often more productive, than most exotics, but they do need to be managed for diversity and health
- Alan Savory's holistic management approach is one grazing management method being used very successfully

THE PARADOX

At the moment …

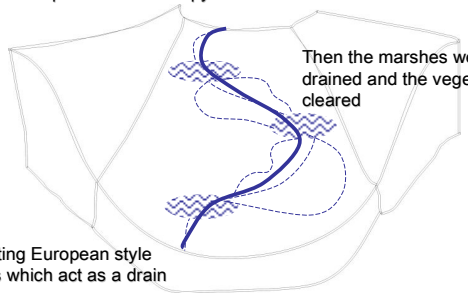
Australian farmers are hell bent on getting rid of their perennials, and even worst, introducing exotic plants totally unsuited to our environment

In addition…

Our government agencies are hell bent on removing water off our landscapes as quickly as possible via drainage works and deep rooted plants

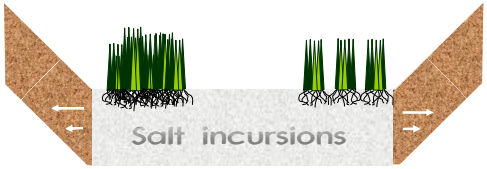
CHAIN-OF-PONDS

The landscape was made up of intermittent streams and permanent swampy marshes



FRESH WATER LENS

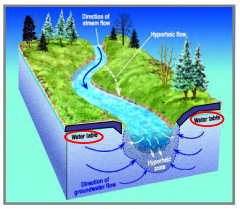
- Slow flowing rivers and marshes feed water into the landscape
- Plants, especially perennial grasses, hold water in their rootzone
- Fresh water pushes salt downwards and sidewards
- The whole river valley hydrates



HYPORHEIC ZONE

- Is the subsurface flow of water between the watertable and surface water flow
- Note that it is not the watertable itself

HYPORHEIC ZONE



- I would argue that hyporheic zones extend out across and under grasslands as a 'carbon' sponge
- Fresh water flows across landscapes via gravity

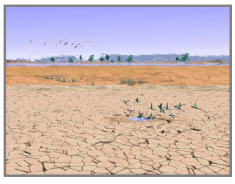
GULLIES

- Gullies and incised river banks expose hydrated soil profiles
- Over time this 'soil water' evaporates away, slowly dehydrating the landscape
- In addition, any surface water is shed straight off farm immediately

GULLIES

- Bare soils also contribute to the ongoing dehydration
- And many contour banks are designed to shed water quickly which continues to accelerate the dehydration of the landscape

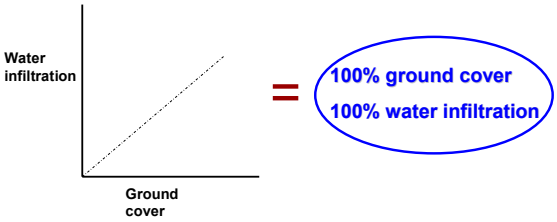
PARADOXES



- We live an a country where any water is extremely precious
- Yet all our land management practices either dehydrate it passively
- Or more alarmingly, is actually designed to shed water off farm asap

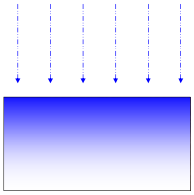
GROUND COVER CONFUSION

- The experts have found that ground cover is a solution to salinity – but obviously don't understand why…



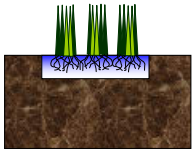
INFILTRATION

- But conventional wisdom claims that water infiltration is THE problem????
- Then talk about salt water wicking…



SALT WATER WICKING

- This assumes that the top soil is dry
- But if plants are growing, are they really dry around their roots?



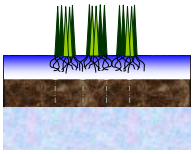
MASSIVE DRAINS

- Conventional intervention for dryland salinity continues to revolve around the idea of minimising soil water recharge – using drains, contour banks and deep rooted plants – despite the evidence that 100% water recharging vegetation is working…

FRESH WATER LENS

So why is vegetation working?

- They hold fresh water in a lens of carbon above the salt!
- Take the thick rooted vegetation away and salt will rise and water will leach out of the landscape and refill with saline water table water



FILLING DAMS

- One of the first alarming things noticed by sustainable farmers is the retention of rain in the landscape – without filling their dams!
- But once the landscape is rehydrated dams do retain water, even during droughts

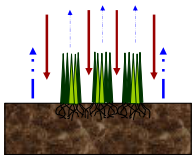
FILLING RIVERS

A Continuous Tap

- The same happens with rivers, where water in the landscape continually drains into these water features – filtered and clean

WATER CONSERVATION

- Soil water only moves one way on bare earth – UP!
- With vegetation, water moves both up AND down
- Biology actively pulls in water and holds it in their bodies

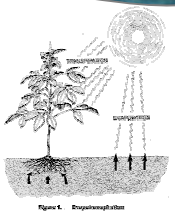


BARE EARTH

In a Drought

- Imagine a bare fallow paddock with some native grasses on the boundaries
- Where are you likely find moisture – in the bare fallow soil or around the roots of a perennial grass tussock?

BARE FALLOW



Crops

- Bare fallow is an Australian innovation
- It is supposedly a water conservation tool used by most arid farmers today
- It was adopted under the presumption that:
  1) Bare soils capture all rainfall; and
  2) Plants lose this water through transpiration

SOIL SEALING

- But degraded soils often result in soil sealing
- A lot of rainfall simply runs off bare fallow paddocks (often taking soil and carbon with it)
- Bare soils do not support soil life because soil life requires active soil carbon and moderate temperatures
- Evaporation is the enemy!

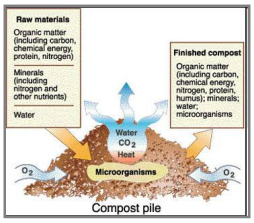
WATER EFFICIENT PLANTS

- Plants, especially native plants, have strategies to hold onto water
- Along with their associated biology they draw in water, as well as transpire water
- Even weeds would be better for water conservation than bare fallow!

CARBON CAPTURE

- Bare soil has no means of sequestering carbon
- Plants sequester carbon through biomass decomposition as well as the liquid carbon highway
- Biomass decomposition is not very efficient

COMPOSTING

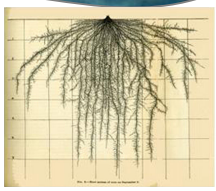


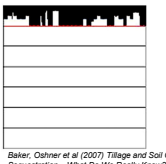
- Composting is perhaps the most efficient way humans capture carbon from plants
- Yet up to 60% of the carbon 'blows off' into the atmosphere
- The Carbon Myth Busters are correct – this is not a soil carbon winner

CHEMICAL NO-TILL

- Chemical no-till is not a solution either
- A majority of any remaining carbon in stubble 'blows off' to the atmosphere, especially if standing
- And the chemicals limit biological activity

NO-TILL VS TILL

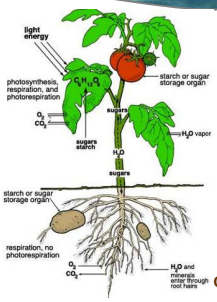




Baker, Oshner et al (2007) Tillage and Soil Carbon Sequestration – What Do We Really Know? Agriculture, Ecosystems and Environment 118:1-5.

- Interestingly, there appears to be no difference between no-till and till farming for carbon sequestration
- The difference only lies in the depth to which carbon is sequestered (and chemical additions)!

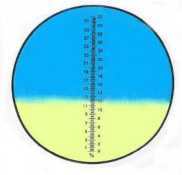
LIQUID CARBON HIGHWAY



So what works?

- Living green plants actively pumping carbon via photosynthesis from the atmosphere to the soil
- The green solar panels work all day, and carbon is dumped into the soil at night

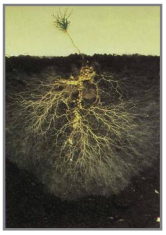
BRIX TEST



How do we know?

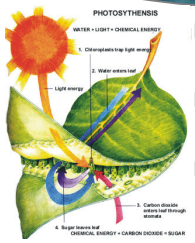
- Brix meters measure sap sugars/carbon
- Brix levels rise during the day
- Brix levels are lower in the morning

MYCORRHIZAE



- Mycorrhizae are symbiotic plant fungi that produce glomalin
- Glomalin is a very concentrated form of carbon
- Higher CO2 levels stimulate more glomalin production!
- Mycorrhizae only work on living plant roots and cannot tolerate chemicals (even fertilisers)

CARBON BUILDING



- While a living plant is growing, it is photosynthesising
- While it is photosynthesising, it is building soil carbon
- More soil carbon holds more water in the landscape

- If a plant is seasonal, like an annual crop, any carbon sequestration is negated by subsequent seasons of bare fallow

SUMMARY

- Cycles of bare fallow, stubble and chemicals do not build good soil carbon, and hence are not good at conserving soil water
- Pastures, especially perennial pastures, do build soil carbon
- But crops are profitable and provide the bulk of human and animal food stocks today

CROPPING DILEMMA

So what is a cropper to do?

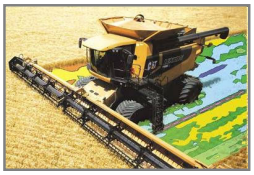
- All conventional cropping practices seem to work against the health of the soil and the hydrology of the landscape
- All research suggests that you either crop or graze – not both

PASTURE CROPPING

- Growing crops into established pasture
- Often winter cereals into native pastures
- No soil preparation

- Easy to be chemical free
- Little down time
- Minimal profit risk

PARADIGM SHIFT

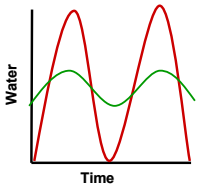


Yield vs Profit

- This is the hardest belief to shift
- Yield is the dominating principle behind most farming decisions today

- Yet surely profit is the desirable outcome???

SOIL WATER CYCLES



Takes out the peaks

- CSIRO have discovered that under pasture cropping soil water peaks and troughs flattened out

- There are trials also indicating that perennial grasses are more water efficient than annuals during dry times

BIOCHAR

What about biochar?

- Biochar can physically put carbon (and water) back into the soil
- It could also stimulate plants to grow more carbon

- But it is a centralised proposition that requires massive logistics and will cost farmers
- Plants do it all for free when given the chance

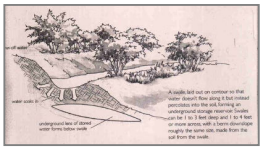
HUMATES

- Humates can do a similar job
- It is mined, but not as logistically demanding as biochar

- Perhaps putting coal into soils is a better short-term option than supposed clean coal technologies!

KEYLINE/PERMACULTURE

- Bill Mollison passed the permaculture banner to Geoff Lawton
- Using keyline principles, swales and vegetation are used to hold water in the landscape



- Geoff has greened deserts this way…

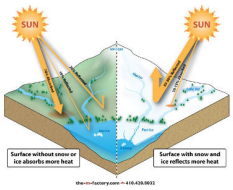
TREES IN THE LANDSCAPE

What is the role of trees?

- Naturally they did not dominate flood plains
- They draw up water from deep down, beyond the hyporheic zone
- They transpire water to the atmosphere

- Anecdotal evidence suggests they also influence rainfall…

TREES AND COOLING

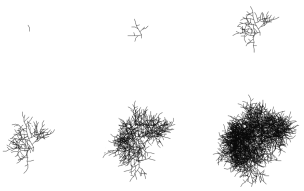


- Trees are very effective at both absorbing heat and cooling air
- This also plays a role in keeping pools of water healthy

- This effect might partly also explain why storms lose their intensity over forests

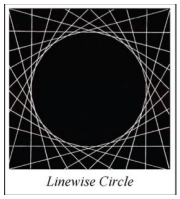
CLOUDS

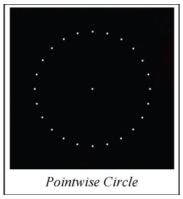
- There is much to learn about clouds
- Even the seeding of clouds has an air of mystery
- Ever noticed how cloud formation resembles the growth of microbes across a petri dish over time?



BOUNDARIES

- Boundaries define context – internal vs external
- Organisation arises at boundaries
- Life arises from organisation





MICROBES AND CLOUDS

- Microbes naturally seed clouds
- Rain dancing is another natural way to seed clouds
- Artificial ways include silver iodide and frozen CO2
- Dust and pollution are the least effective

TREES AND MICROBES

- Trees aerosol cloud-seeding microbes into the atmosphere!
- Could this be one of the roles of trees in the landscape?
- Notice how clouds seem to form above forests
- Does elevation aid in the dispersal of the aerosols?

WATER VAPOUR

- You can only form clouds if water vapour is present in the atmosphere
- Interestingly, water vapour levels are increasing in our atmosphere
- Perhaps our reduction in trees is related to our reduction in rainfall?

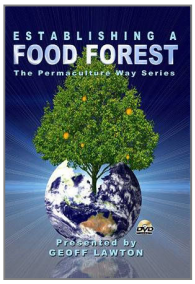
TREES VS PRODUCTION

Bluegum runoff after 95ml

- Trees dehydrate our landscape
- They become carbon neutral over time
- They don't produce the bulk of our animal and human foods

HOW DO WE BALANCE TREES AND PASTURES?

PRODUCTIVE TREES



- Certainly an attractive option is to start using productive food trees more
- Though changing the diet habits of society is a mammoth ask on the scale required

PRODUCTIVE PASTURES

- Productive pastures are an obvious choice
- Crops can even be grown in pastures
- Well managed pastures can increase the carbon and water level of soil

WELL MANAGED PASTURE

What is well managed pasture?

- Anything that keeps pumping carbon into the soil and holds fresh water in the hyporheic zone
- Green living solar panels working 24/7 365

PASTURE DIVERSITY

- Different plants produce different sugars at different depths
- C3 vs C4
- Perennial vs annual
- Crop vs weed

WEEDS

- Anything that grows to the exclusion of anything else
- Indicators of a soil imbalance – biological or mineral

- But many are bandaids
- Or ideal medicinals

ACTIVE GROWTH

- Carbon is only being fixed when photosynthesis is occurring
- Need to maximise green solar panel surfaces at all times
- Rank grasses do not fix carbon

GRAZING GRASSES

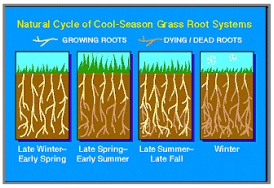
- Grasses are designed for grazing
- Grazing removes old blades and stimulates the production of fresh green new blades
- The plant draws much of its stored energy from its roots

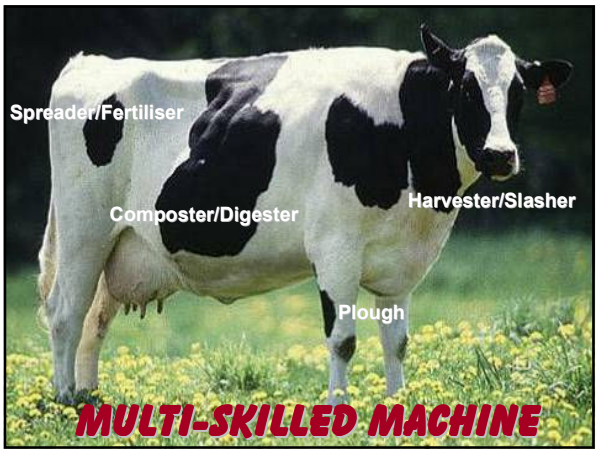
OVERGRAZING

- Overgrazing reduces the surface area of photosynthesis
- Which reduces root development
- Poorly developed roots are not quick to respond to improved conditions

IDEAL GRAZING

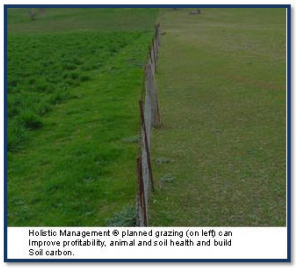
- Ideally, pasture is grazed for maximum photosynthesis
- The volume of rank grass is limited
- Root volume is sufficient for quick regrowth
- Livestock are ideal tools to use to do all of this





NATURAL HERDS

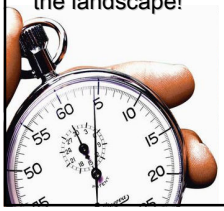
- Alan Savory noted that wild herbivores tend to herd as a response to predation
- They move through quickly giving pastures long rests
- Animal impact stirs up soil activity

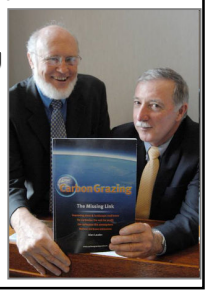


TIMING

ITS TIMING, NOT TIME THAT DETERMINES PASTURE RESPONSE

- Most growth, and hence carbon sequestration occurs straight after rainfall
- What a combination for rehydrating the landscape!

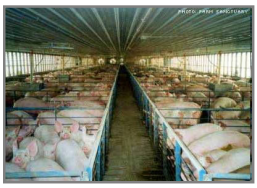




METHANE

- As an aside – the methane debate is misleading
- While it is a more potent greenhouse gas, it is also more unstable
- Need to take into account the whole carbon cycle
- Besides, healthy rumens produce less methane

NO LIVESTOCK



- Imagine no managed/herded livestock in the landscape
- Grasses would turn rank or be overgrazed and limit carbon sequestration
- Food would come from technologically managed paddocks – all fossil fuel dependent
- The end result is no carbon reduction and less water in the landscape

GRASS FED VS GRAIN FED

- Grain fed cattle succumb to many problems, many of which can be attributed to acidosis
- Unhealthy rumen 'blow off' more methane
- But poorly managed pastures can be just as bad for both methane production and environmental destruction

ONLY MANAGED PASTURES

- Only well managed pastures can neutralise methane production
- Their plants pull in more carbon and they require less fossil fuel assistance

UNFORTUNATELY THIS DIFFERENTIATION IN NOT NOTED IN MAINSTREAM DISCUSSIONS

SUMMARY

- Rehydration of the landscape requires trees, pastures and crops – but all in balance
- The primary driver for rehydration is the use of any method that provides green living solar panels 24/7 365
- Also remember, observations are 'real', its only the theories that may be in doubt!