CARBON FARMING

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Adaptive Management to build soil carbon

29th NSW Coastal Conference .31st May-2nd June

Mantra on Salt Beach Kingscliff,

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Overview

- The practices we have changed to meet the challenges of climate change and build soil carbon.
- The risks of denying/doing nothing.
- The changed practices developed in Australia and how we are moving these around the local/global sugar cane industries .

NOW: How We Manage Risk From Climate Variability On The Farm

- **Longer Dry Periods:**

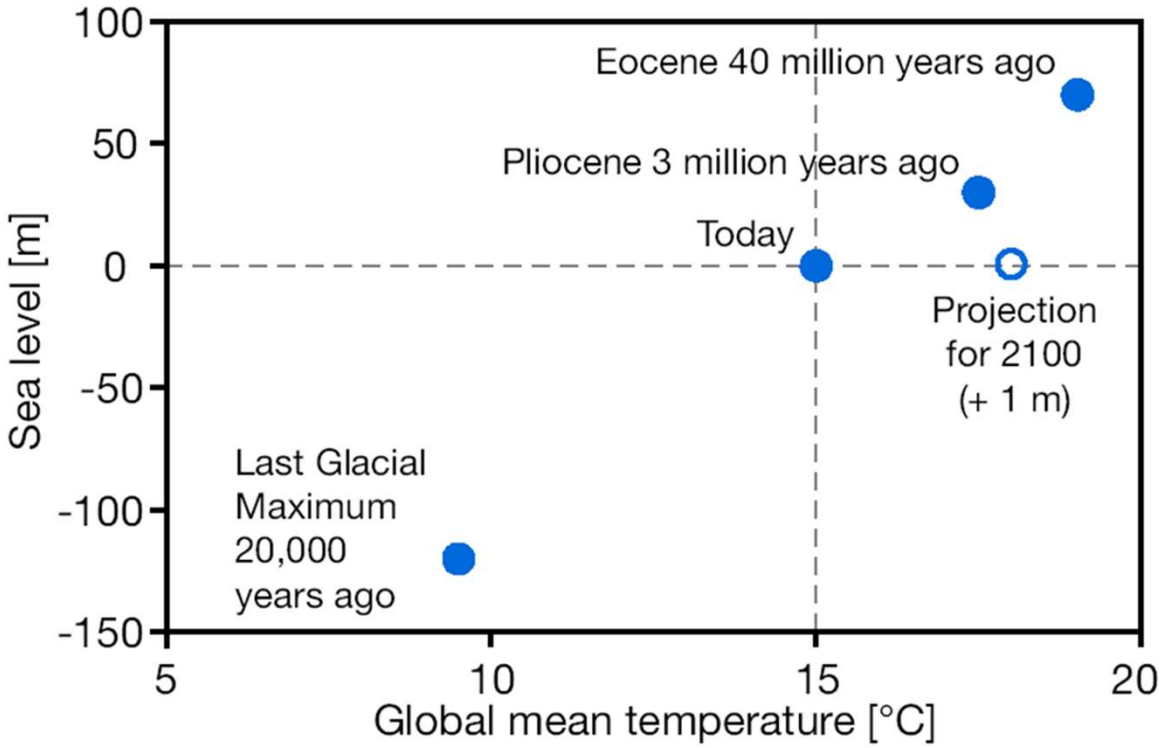
  -Conserving soil moisture;

  - Improving soil health;

  - Ingenuity in adapting harvesting and mechanisation equipment;

  Hotter Days when permanent wilting will occur.

- **More Intense Rainfall:** Improving drainage; planning spraying and harvesting using forecasts .
- **Sea Level Rise:** monitoring water table; pumping an increasing volume of water.


100
50
0
-50
-100
-150
Sea level [m]
5
10
15
20
Global mean temperature [°C]
Eocene 40 million years ago
Pliocene 3 million years ago
Today
Projection
for 2100
(+ 1 m)
Last Glacial
Maximum
20,000
years ago

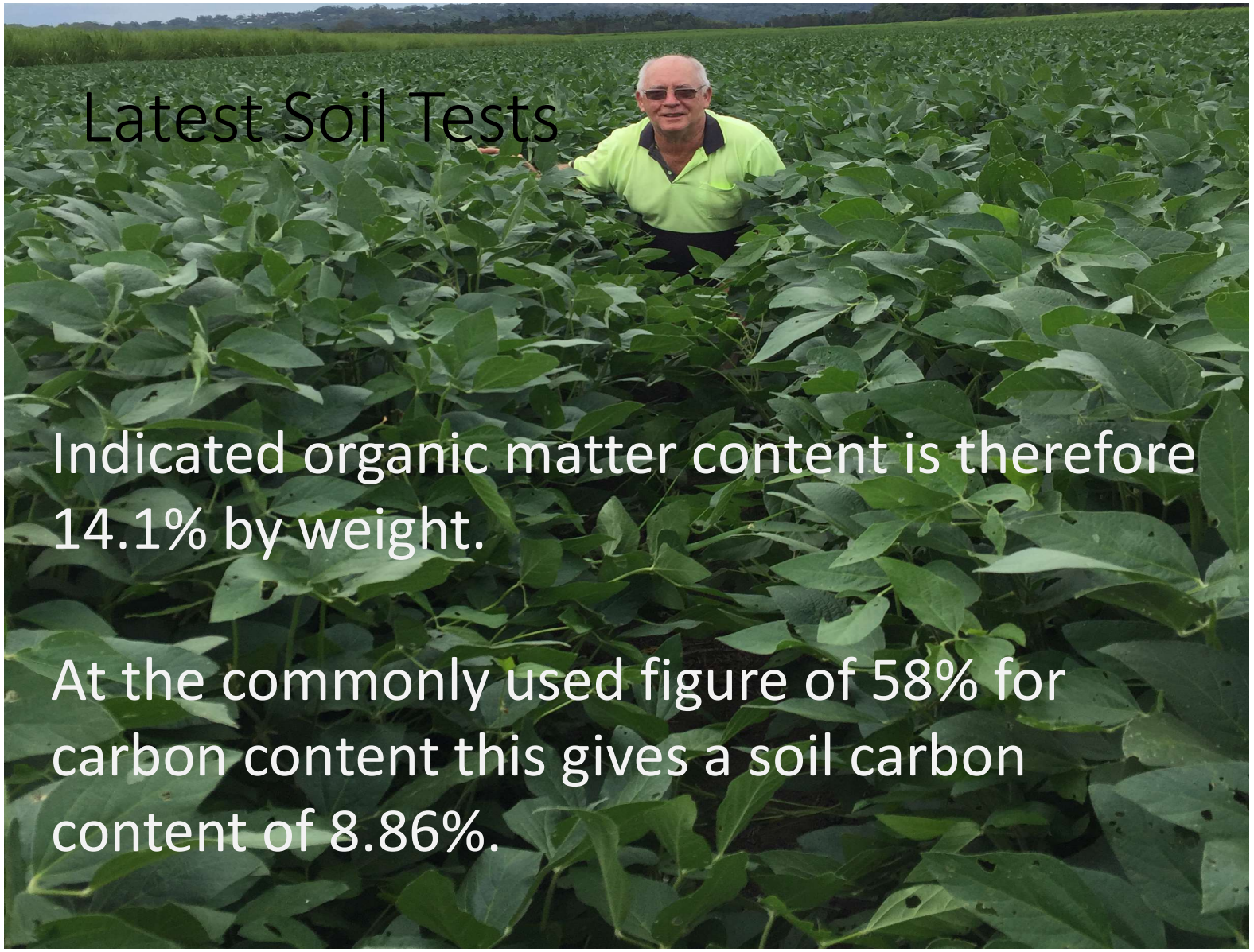
What we have changed

Changing farming business decisions: farm less

Burning off organic carbon

Building Carbon Content

- Minimum Input Oats
- OM Incorporation
- Urea Application


Latest Soil Tests
Indicated organic matter content is therefore 14.1% by weight.
At the commonly used figure of 58% for carbon content this gives a soil carbon content of 8.86%.

Results of Changing My Farming System

- Trash Flotation Almost Eliminated
- Fertiliser Application Reduced by 40%
- Herbicide Application Reduced by about the same
- Fuel Usage Cut by 50%+
- Tractor Hours Reduced by 40%
- Labour Component Cut by 66%
- Eliminated the Use of Phosphorous Fertilisers for 10 yrs
- OM Reduces the Discharge of Heavy Metals
- Macro-Fauna Introduced and Sustained
- Soil Biota Population has Positively Evolved and Increased
- Productivity Increased 5,000 to 9,000 ton per year
- Unit Cost Decreased by 50%

The importance of Building soil carbon

- For every 1% soil carbon increases the soil can absorb an extra 120,000lt per hectare per rain event
- The drainage is also improved
- Nutrient and irrigation inputs are reduced, while achieving the same production
- Sugar cane takes up around 40% of its N from the break down of organic matter. If there is no or little organic matter this has to be chemically applied

Wet and Dry: Intense rainfall and longer dry periods

Difference in Drainage

Flooding

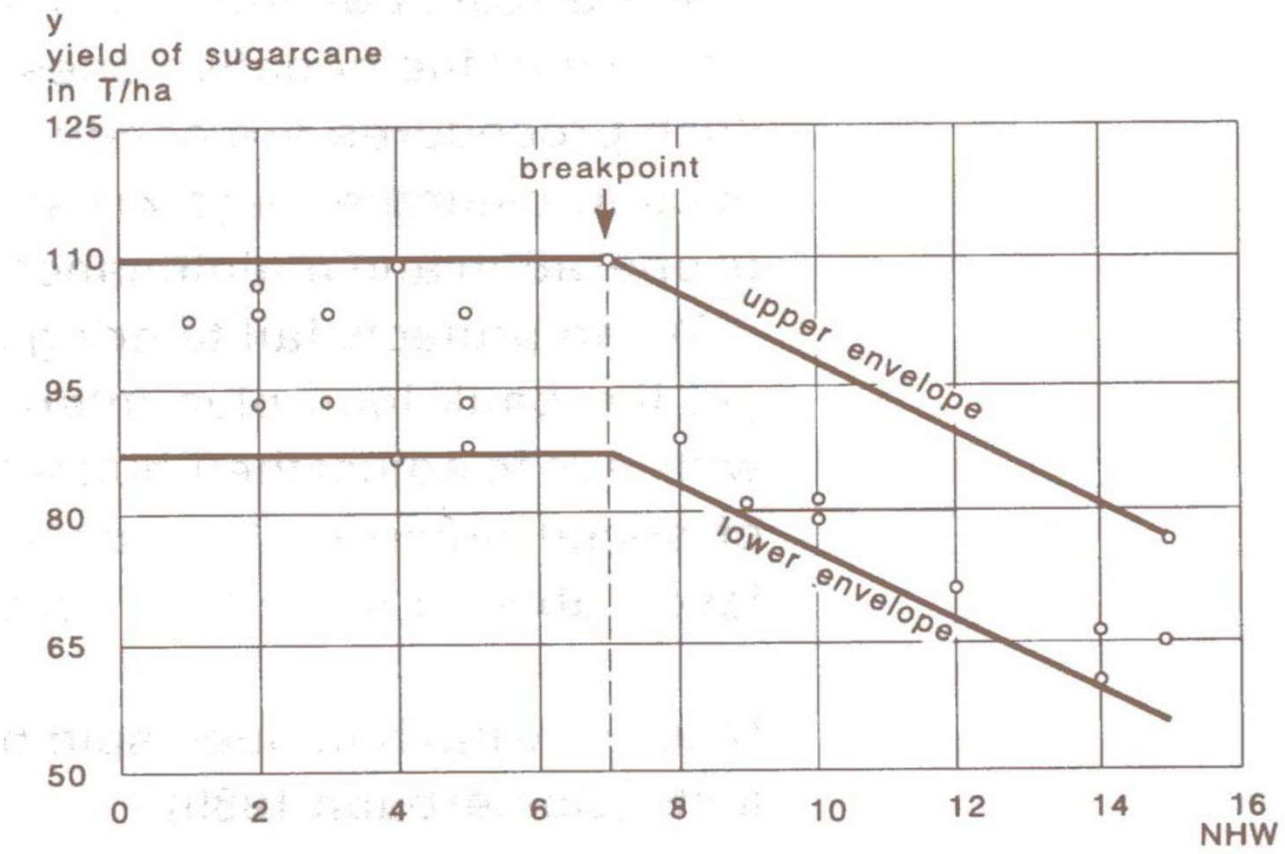
Waterlogging

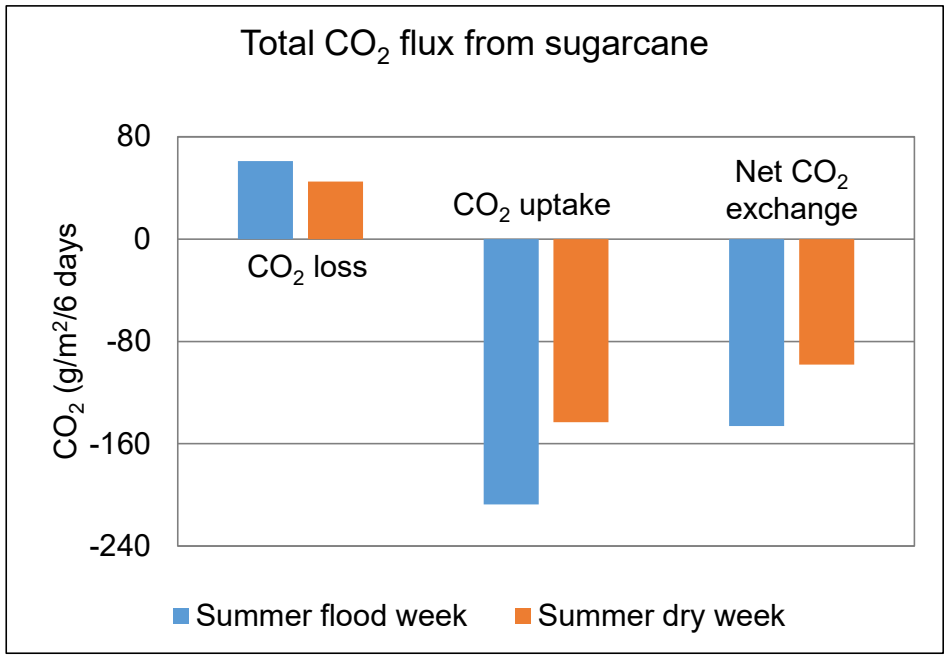
Waterlogging

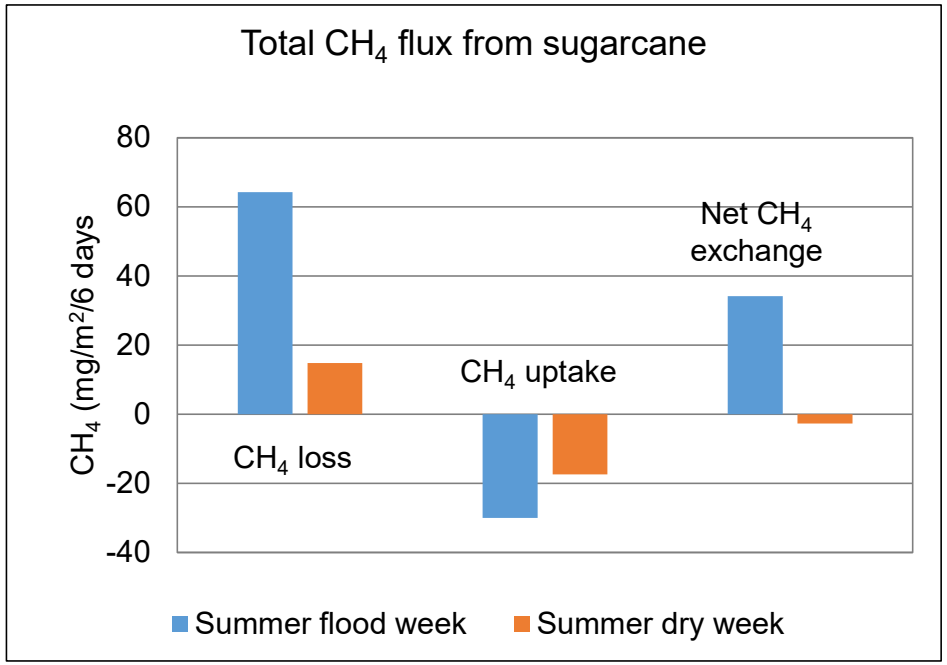
- *Water logging is the major obstacle for sustainable agriculture. Plants subjected to water logging suffer from substantial yield losses. Under natural environmental conditions, plants often get exposed to transient or permanent water logging. Flooding induces a number of alterations in important soil physiochemical properties like soil pH, redox potential and oxygen level. Thus, the plants growing on the waterlogged soil face the stressful environment in terms of hypoxia (deficiency of O2) or anoxia (absence of O2). These oxygen deficient conditions substantially hamper plant growth, development and survival. Plants under O2-restrictive environment exhibit metabolic switch from aerobic respiration to anaerobic fermentation.*

- Waterlogging stress in plants: A review
- Muhammad Arslan Ashraf
- Department of Botany, University of Agriculture, Faisalabad.

Yield Response to Waterlogging







CO_2 uptake relative to total CO_2 flux

- Summer flood week = **77%**
- Summer non-flood week = **76%**

CH_4 uptake relative to total CH_4 flux

- Summer flood week = **32%**
- Summer non-flood week = **54%**

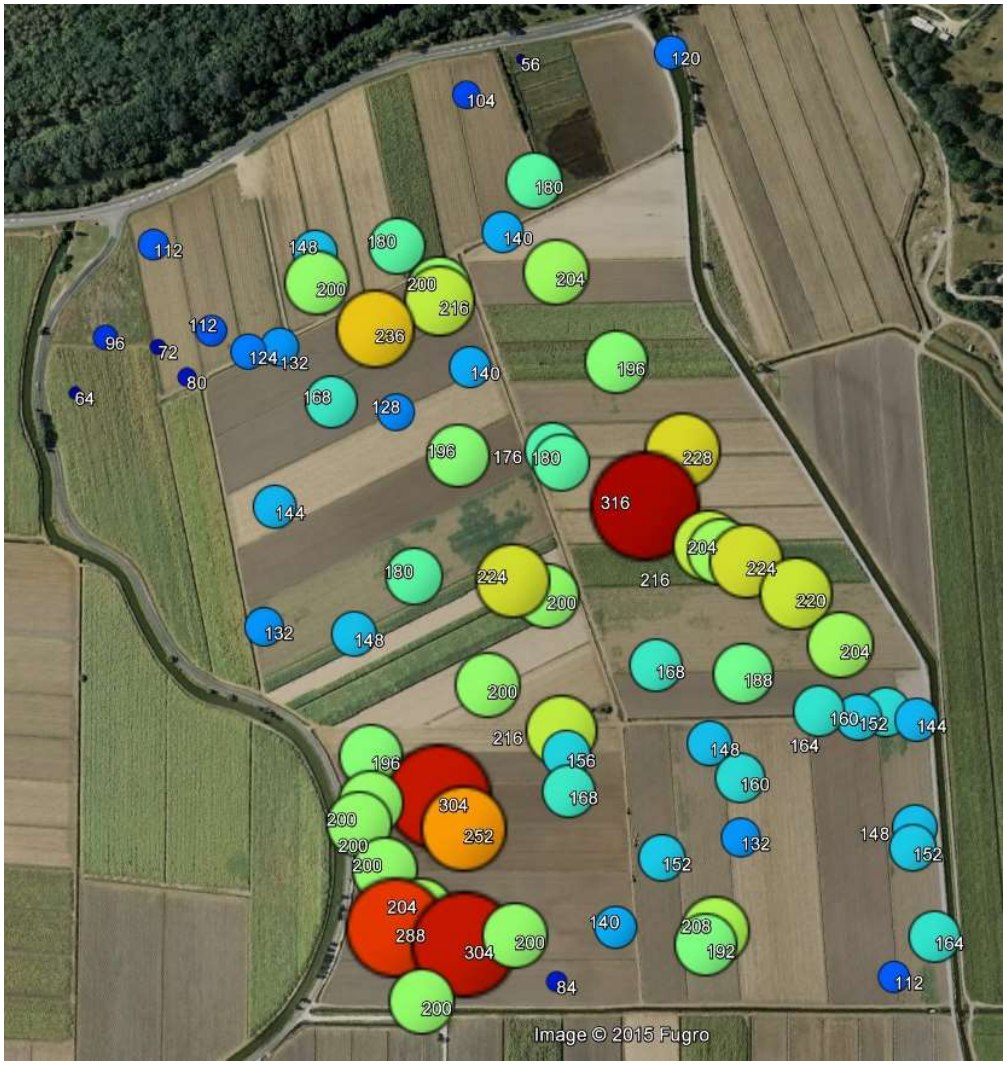
Melanised Fungi

Building Macro Fauna (earthworms)

RESULTS

Measured OC stock Mg/ha

(0-30cm)



cCalculation of baseline

whole farm measure of C stocks

with error marginsalculation of baseline

SOC stocks (± standard error)

Whole farm measure of C stocks

17,478 tonnes ± 132.2 (0—30cm)

0-100cm 20,000 tonnes around 77,000 tonnes in co2 equivalents

Emissions

						Total			
	Total	Area	Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3	Total
Diesel	18600	108	0.003			55.8	0	0	55.80
									0.00
Nitrogen	90	108	3.9		6.2	60.264	0	37.908	98.17
		108							0.00
Phosphorus	23	108	0.714					1.773576	1.77
		108							0.00
Pottassium	43	108	1.61					7.47684	7.48
		108							0.00
Electricity	3920		0.89		0.13		3.4888	0.5096	4.00

Total									167.22

Sequestration

Nitrogen Avoidance 59kg/ha over avearge

Nitrogen	59	108	3.9		6.2	37.908	0	60.264	98.17

Plant Stones	400kg/C/year
Plant stones CO2	688
Plant stones co2 over property	74.304

GHG Emissions

Accumulation OC

Total Emissions	167.220816				
Avoidance of N/year	98.172				
Plant stones	74.304				
	2	3	4	5	
Co2 sequested	14266.37	21399 .55	28532.74	35665.92	
years of offseting your activities N/avoidance	153.54	230.31	307.08	383.85	
Excluded plant stones included					
years of offseting activities plant and n excluded	85.31	127.97	170.63	213.29	

Role of Phytolith in Sugarcane

- Indian estimates indicate that there is an accumulation of approximately 87 million tonnes per annum of carbon from crops.
- Research done in Australia showed sugarcane accumulated, depending on cultivar, between 160 and 600 kilograms per hectare per year.

FUTURE: What Can We do to help Australian Cane Farmers build carbon.

- Help growers to understand the risks of doing nothing about Climate Change. Show them how/ what they can do to build soil carbon.
- We all need to increase food production for an increasing global population .
- By increasing productivity, and reducing the cost of production, the Australian sugar cane industry will be much more resilient and will be able to continue to deliver its eco system services .
- Should the Global community pay farmers to store carbon ?.Yes and there is an appetite for this .
- Is additionality the right formula for paying for carbon capture and storage?
- Practice change in the developed countries , can and will help them.
- Together we can store carbon in our soils, increase our sustainability , and have a future for generations to come.

Some take home messages

Sugar cane can capture and accumulate OC at 9tph per year.

A wetland does 1.5t per hectare per year .

Do not drain the wetlands to plant sugar cane but don't plough out sugar cane to develop wetlands .

The acid sulphate soil oxidation zone is well below the bottom of any of the drains. The drains did not cause the oxidation but they are the conduit for the acid to reach the river.

There is around 50t of oxidized sulphur acid per ha on the Tweed flood plain , the 1987 fish kill was the result of a discharge of half a ton per hectare the removal of sugar cane from the Tweed flood plain would mean fish kills for the next 100 year.

Sugar cane on the Tweed flood plain is delivering eco system services these include greatly reducing acid discharges and capturing carbon.

Any Questions

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- Thank you