Regenerative Agriculture, Zero Budget Natural Farming (ZBNF) & Organic Cotton: Do they combat climate change’?

Rajeev Baruah
81st ICAC Plenary, Mumbai India, December 2023.
THE CARBON DYNAMICS
Framers using additional regenerative practices to grow their cotton will result in practices that not only reduce carbon emissions, but also sequester carbon. Sustainable lives will strengthen the connection with local communities. This alongside the benefits from regenerative practices will create economic and positive social impacts.

Carbon is the primary component of life. It constitutes about half of organic dry biomass.

Source ICAC
Photosynthesis

Oxygen out

Light energy

Green plant cells where food is made

Glucose (sugars)

Carbon dioxide in

Water
$\text{CO}_2$ levels increased most rapidly in the past 60 years
**CO$_2$ increased 100 ppm in just 60 years:**
From 320 ppm to 420 ppm during 1960 to 2020

https://www.climate.gov/media/13611
The Atmosphere had about 600 Billion Tons of Carbon, Humans added an additional 300 Billion tons of Carbon into the atmosphere

PPM TO GIGA (Billion) TONNES
One ppm CO$_2$ = 2.125 Gt Carbon
140 ppm CO$_2$ = 297.5 Gt Carbon

Over the past 10 years we added 1.9 ppm CO$_2$ every year, which is 4.0 giga tones of Carbon every year

Source: ICAC
Greenhouse Gases & Global warming

Carbon-dioxide $\text{CO}_2$

Methane $\text{CH}_4$

Nitrous oxide $\text{N}_2\text{O}$

Fluorocarbons (PFC, HFC and SHF)

Increased $\text{CO}_2$ leads to
1. Global warming &
2. Erratic Rainfall

Source ICAC
Each GHG has its own Global Warming Potential (GWP)

AGRICULTURE CONTRIBUTES TO 18.2% OF GHG EMISSIONS

<table>
<thead>
<tr>
<th>Activity</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock and Manure (CH$_4$)</td>
<td>31.5</td>
</tr>
<tr>
<td>Agricultural soils (N$_2$O)</td>
<td>22.3</td>
</tr>
<tr>
<td>Crop burning</td>
<td>19.0</td>
</tr>
<tr>
<td>Deforestation</td>
<td>12.0</td>
</tr>
<tr>
<td>Crop land (Management)</td>
<td>7.6</td>
</tr>
<tr>
<td>Rice cultivation (Methane)</td>
<td>7.1</td>
</tr>
<tr>
<td>Grassland</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9.30</strong></td>
</tr>
</tbody>
</table>

Source ICAC
How Can we reach zero emissions?

BY CAPTURING & SEQUESTERING THE 4 GT CARBON EVERY YEAR?
Mitigation Measures

1. Enhancing carbon sequestration mechanisms, which means capturing excess CO$_2$ from the atmosphere and fixing it into the soil.

2. Curtailing the emission of GHGs into the atmosphere. Array of actions aimed at decreasing the volume of GHG’s released, spanning diverse sectors such as energy, transportation, agriculture, and industry.
Agriculture *can* combat climate change, provided we *adopt* practices with a multifaceted approach, by reducing GHG emissions and enhancing the sequestration of CO$_2$ through innovative land management practices.

**THE GLOBAL ARABLE LAND IS 1.5 BILLION HECTARES**

1.5 Billion Ha x 2.67 Tons Carbon/Ha = 4 GT
Cotton sequesters Carbon
Cotton captures 99 Million Tons (Mt) of Carbon annually

Cotton Fibres Biogenically Sequester 11.4 Mt of Carbon

About 3-4 t/ha of Carbon may be naturally captured in the fields

<table>
<thead>
<tr>
<th></th>
<th>Biomass Mt</th>
<th>Carbon content</th>
<th>Carbon mass</th>
<th>CO₂ Mt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibre</td>
<td>26</td>
<td>0.44</td>
<td>11.44</td>
<td>41.95</td>
</tr>
<tr>
<td>Seeds</td>
<td>39</td>
<td>0.5</td>
<td>19.5</td>
<td>71.5</td>
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<tr>
<td>Stalks</td>
<td>97.5</td>
<td>0.47</td>
<td>45.83</td>
<td>168.04</td>
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<tr>
<td>Roots</td>
<td>49</td>
<td>0.47</td>
<td>23.03</td>
<td>84.44</td>
</tr>
<tr>
<td>Total</td>
<td>211.5</td>
<td>0.47</td>
<td>99.8</td>
<td>365.93</td>
</tr>
</tbody>
</table>

If Biogenic sequestration is considered cotton production may well have Net-ZERO emissions

Source ICAC

Image Keshav Kranti
Key Pillars of RA, ZBNF & Organic
Six Pillars of Regenerative Agriculture

- Avoidance of Harmful Chemicals
- Zero Tillage Minimum Tillage
- Organic Mulch & Organic Manures
- Diversity of Cropping Systems
- Live Cover Crops Crop Rotation
- Integration of Animal Husbandry

Image Keshav Kranthi
Research Articles using the term RA from 1982-2019

Source P Newton, Oct 2020
Four Pillars of Zero Budget Natural Farming

- **Beejamrut**
  Seed treatment

- **Jeevamrut**
  Bio-Inoculant

- **Achadana**
  Bio-mulch

- **Whapsa**
  Soil aeration

Zero-Till, Rotation-Cover Crops, **Biopesticides**

Images ICAC
Pillars of Organic Agriculture

- Does not use chemical-synthetic pesticides and fertilizers
- Improves soil fertility
- Stable soils with less erosion
- Local recycling of nutrients
- Preventive pest and disease management
- Fair share to all market partners
- Excludes genetically modified organisms.
- Best use of both traditional and new scientific knowledge
- Stabilising agro-ecosystems
- Promotes genetic diversity and own seed production
- Make the farm more resilient and able to adapt to climate change

Source: Organic Cotton Accelerator Training Module
Principles of Regenerative Organic Cotton Agriculture

- Promotion of beneficial insects with natural hedges and flower strips
- Crop rotation
- Intercrops & cover crops
- Improved soil fertility e.g by green manure
- A healthy, living soil
- Biological pest control; supporting biodiversity
- Focus on building soil organic matter
- Minimal tilling; keeping carbon in the soil

Source: Organic Cotton Accelerator Training Module
<table>
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<th>Common Practices between RA, ZBNF and Organic</th>
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<tbody>
<tr>
<td><strong>ZBNF</strong></td>
</tr>
<tr>
<td>Avoidance of Chemicals</td>
</tr>
<tr>
<td>Zero or Minimum Tillage</td>
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<tr>
<td>Organic Mulch/ Manures</td>
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<tr>
<td>Diversity of Cropping Systems</td>
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<tr>
<td>Live Cover Crops &amp; Crop Rotation</td>
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<tr>
<td>Integration of Animal Husbandry</td>
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</table>
Influence of practices on increase in soil organic carbon

Source: E Rehberger et al

PRIMARK®
Reducing the use of synthetic fertilizer can greatly mitigate GHG emissions associated with agricultural production.

Present global demand for fertilizer is around 200 million tonnes, half of this is for nitrogen fertilizer, which results in 2300 Kilotons of N2O emissions.

Full substitution could reduce GHG emissions by 0.203 Mg CO$_2$ eq/ha, whereas partial could reduce GHG emissions by 0.0672 Mg CO$_2$ eq/ha.

Source: E Rehberger et al
The cultivation of cover crops offers a promising strategy for carbon sequestration, annual accumulation rate of 320 kgs of carbon per ha.

The 320 kgs of carbon equates to capture and fixation of 1174.4 kgs of CO$_2$ from the atmosphere per year per hectare.

Source ICAC Recorder Sept 2023
Conservation Agriculture & Carbon Sequestration

Three main principles, minimum or zero tillage, implementation of intercropping and crop rotation and maintenance of live crop throughout the year.

Quantitative estimates from a review of 20 studies in cotton production in US indicates, an average increase of 481 kg of SOC per ha per year.

Data from the studies suggested that no-tillage with a cover crop can sequester 672 kg of carbon per hectare per year.

Source ICAC Recorder Sept 2023
The Long-Term Solution: Carbon Removal Conversion of Cotton Stalks to Biochar

This can be adopted by ZBNF, Organic, RA, Sustainable Cotton and Conventional Cotton Farmers

On an average cotton farms yield 3 tons of cotton stalks. Let’s look at India with 12 million ha of cotton area, that would amount to 36 Million tons, 50% of which is carbon, that is 18 Million tons, assuming 50% efficiency in retaining carbon during production, we are still looking at 9 Million Tons of carbon which amount to 33 Million Tons of C0₂ captured in the soil and securely sequestered.
Now we have the backing of science and research, the question is how we SCALE up?
Two Critical Components

1. Measurement of soil organic. Need credible and reliable Monitoring Reporting and Verification (MRV) platforms, to enable emission trading, reporting etc.

2. Convincing farmers to adopt the practices that have been outlined, understanding the impediments to adoption and incentivising farmers for the same.
Launched nearly a decade ago in 2013, with 1251 farmers in Gujarat.

Up to July 2023, we have trained 299,388 farmers in more sustainable cotton production methods through our programme across India, Bangladesh, Pakistan and Türkiye.

In 2022, 40% of Primark's’ cotton clothing units sold contained cotton that was either organic, recycled or sourced from the above programme. The product categories include menswear, womenswear, kids wear etc.
Thanks for listening