Regenerative Organic Agriculture's Role in Reversing Climate Change

IFOAM – Organics International

The global umbrella body for the whole organic sector.

People

800 member organizations in 125 countries worldwide.

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Ecofarms
Asilomar, California, January 22, 2016
Andre Leu, President

Regenerative, Resilient, Relationship

“Regenerative organic agriculture improves the resources it uses, rather than destroying or depleting them.

It is a holistic systems approach to agriculture that encourages continual on-farm innovation for environmental, social, economic and spiritual wellbeing.” Robert Rodale

Regenerative Systems

To define this:

The paradigm shift away from a degenerative, industrial agriculture systems that are destroying our farmers and our communities income, health, biodiversity and climate

to a regenerative agriculture based on the principles of health, ecology, fairness and care that rejuvenates the soil, water and biodiversity, our health, democracy, communities, prosperity, well being and reverses the processes contributing to catastrophic climate change.

Climate Change

Just adopting renewable energy and stopping emission will not stop climate change

If a boat is sinking we have to do more than just plug the leak – we have to bail out the water.

- The world will reach 400 ppm CO_2 in 2016
- This will mean 3.5 to 5 degrees warmer
- 4 degrees is regarded as catastrophic climate change
- The target is 300 ppm to keep the world to less 1.5 degrees

Climate Change

Stopping emissions is not enough.

According to WMO Secretary-General Michel Jarraud

- "Carbon dioxide remains in the atmosphere for hundreds of years and in the ocean for even longer. Past, present and future emissions will have a cumulative impact on both global warming and ocean acidification. The laws of physics are non-negotiable,"
- **We need to draw the excess CO_2 out of the atmosphere**

- **350 ppm means 2 degrees of warming**
- Global sea levels rises that cause the atoll island countries to disappear, cause large parts of Bangladesh, coastal USA, New York, New Orleans, London and other low lying areas to go under water, causing a huge refugee crisis for millions of people
- It will mean increased frequency and severity of droughts, floods and storms causing food shortages and more humanitarian crises
- **1 in 30 years events now occur in 1 in 5 year cycles**

Climate Change

The worldwide adoption of **Regenerative Organic Agriculture can reverse climate change**

- Means that we could reduce temperatures to pre industrial levels (1750s) and avoid 2 degrees in warming.

- Need to reduce CO_2 levels by 122 ppm to reach pre industrial temps of the 1800s - From 400 ppm to 278 ppm – not just 350 ppm

Mitigation of Carbon Dioxide

Soils are the greatest carbon sink after the oceans

- ***Over 2700 Gt of carbon is stored in soils worldwide***

- ***Biomass 575 Gt most of which is wood.*** Source (Lal 2008)

- ***Atmosphere 848 Gt***
- 1 Gt (gigaton) = 1 billion metric tons
- I metric ton = 1.10231 US ton

Reducing CO_2 levels by 122 ppm = **946.72 gt of CO_2**
It would be most logical to remove the 946.72 gt of CO_2 from the atmosphere and put it as 258.64 gt of carbon into the soil – where it is needed

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- What does « 4 per 1000 » mean?

- An annual growth rate 4 parts per thousand of the soil carbon stock would make it possible to stop the present increase in atmospheric CO2.

The UNFCC recognizes this initiative by French Government as part of the Lima – Paris accord.

Many Countries, regions, FAO,IFAD, GEF, CGIAR and numerous NGOS have signed on.

Soil Carbon Sequestration

Agriculture, Ecosystems & Environment Journal study:

24 comparison trials from Mediterranean Climates in Europe, the USA and Australia. organic systems sequestered 3559.9 kg of CO2/ ha/yr. (Aguilera et al., 2013)

- **Kg/ha = lbs/acre**

The Rodale FST manured organic plots sequestered 3,596.6 kg of CO2/ha/yr.

Sekem, Egypt, has sequestered 3,303 kgs of CO_2 per hectare per year

If extrapolated globally, good organic practices can sequester around 17 Gt per year

It would take 57 years to remove the 946.72 gt of CO_2 and reverse climate change

Soil Carbon Sequestration

The Rodale Compost Utilization Trial sequestered 8,220.8 kg of CO2/ha/yr.

- (Total Agricultural Land 4,883,697,000 ha x 8,220.8 kg of CO2/ha/yr)

- If extrapolated globally would sequester 40 Gt of CO_2.

It would take 24 years to remove the 946.72 gt of CO_2 and reverse climate change

Regenerative Grazing

- ‘In a region of extensive soil degradation in the southeastern United States, we evaluated soil C accumulation for 3 years across a 7-year chronosequence of three farms converted to management-intensive grazing.

- Here we show that these farms accumulated C at 8.0 Mg ha−1 yr−1, increasing cation exchange and water holding capacity by 95% and 34%, respectively.’ (Machmuller et al. 2015)

- **If these regenerative grazing practices were implemented on the world’s grazing lands they would sequester 98.5 gt CO_2/yr.**

- (Grasslands: 3,356,940,000 ha x 29.36 = 98.5 gt CO_2/yr)

It would take 10 years to remove the 946.72 gt of CO_2 and reverse climate change

Soil Organic Matter and Nitrogen

Synthetic Nitrogen Fertilizers Deplete Carbon

Scientists from the University of Illinois analyzed the results of a 50 year agricultural trial and found that synthetic nitrogen fertilizer resulted in all the carbon residues from the crop disappearing as well as an average loss of around 10,000 kg of soil carbon per hectare.

- **Kg/ha = lbs/acre**

This is around 36,700 kg of carbon dioxide per hectare on top of the many thousands of kilograms of crop residue that is converted into CO_2 every year.

Soil Organic Matter and Nitrogen

Synthetic Nitrogen Fertilizers Deplete Carbon

The researchers found that the higher the application of synthetic nitrogen fertilizer the greater the amount of soil carbon lost as CO_2 and soil nitrogen as N_2O – two major GHG gases

This is one of the major reasons why conventional agricultural systems have a decline in soil carbon while organic systems increase soil carbon

Khan, S. A.; Mulvaney, R. L.; Ellsworth, T. R., and Boast C. W. (2007), The Myth of Nitrogen Fertilization for Soil Carbon Sequestration. Journal of Environmental Quality. 2007 Oct 24; 36(6): 1821-1832.

Mulvaney R. L., Khan S. A. and Ellsworth T. R., (2009), Synthetic Nitrogen Fertilizers Deplete Soil Nitrogen: A Global Dilemma for Sustainable Cereal Production, Journal of Environmental Quality 38:2295-2314 (2009): 10.2134/jeq2008.0527, American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America 677 S. Segoe Rd., Madison, WI 53711 USA

Soil Organic Matter and Nitrogen

Soil Organic Matter Increases Soil Nitrogen

Soil organic matter (SOM) contains nitrogen expressed in a Carbon to Nitrogen Ratio. This is usually between 11:1 to 9:1, however there can be further variations.

Accepted approximation ratio for the amount of soil organic carbon in soil organic matter. This is SOC × 1.72 = SOM.

Average ‘… a 1% increase in organic carbon in the top 20 cm [8 inches] of soil represents a 24 t/ha [24,000 kilograms] increase in soil OC…’ (Jones 2006)

Organic Matter and N

Table of the amount of organic nitrogen held in the soil

1% SOC	2,400 kg of organic N per hectare	1.72% SOM
2% SOC	4,800 kg of organic N per hectare	3.44% SOM
3% SOC	7,200 kg of organic N per hectare	5.16% SOM
4% SOC	9,600 kg of organic N per hectare	6.88% SOM
5% SOC	12,000 kg of organic N per hectare	8.50% SOM

The key to high levels of N is high levels of organic matter (kg/ha =lbs/acre)

Climate Resilience

Food Security

- World food production is already being effected by climate change
- More frequent and longer droughts
- Irregular rainfall that tends to be heavy and destructive
- Increases in climate extremes
- **1 in 30 years events now occur in 1 in 5 year cycles**

- Supplying adequate food is vital

Organic Adaptation & High Yields

Organic Higher Yields in Climate Extremes

- **Organic systems have higher yields** than conventional farming systems in weather extremes such as heavy rains and droughts. (Drinkwater, Wagoner and Sarrantonio 1998; Welsh, 1999; Lotter 2004)
- The Wisconsin Integrated Cropping Systems Trials found that organic yields were higher in drought years and the same as conventional in normal weather years. *(Posner et al. 2008)*
- The Rodale FST showed that the organic systems produced 30 per cent more corn than the conventional system in drought years. *(Pimentel D 2005, La Salle and Hepperly 2008)*

Organic 3.0 Systems

Organic Matter Increases Infiltration and Soil Stability

Organic

Conventional

Picture: FiBL DOK Trials

Soil Organic Carbon Mitigates and Adapts

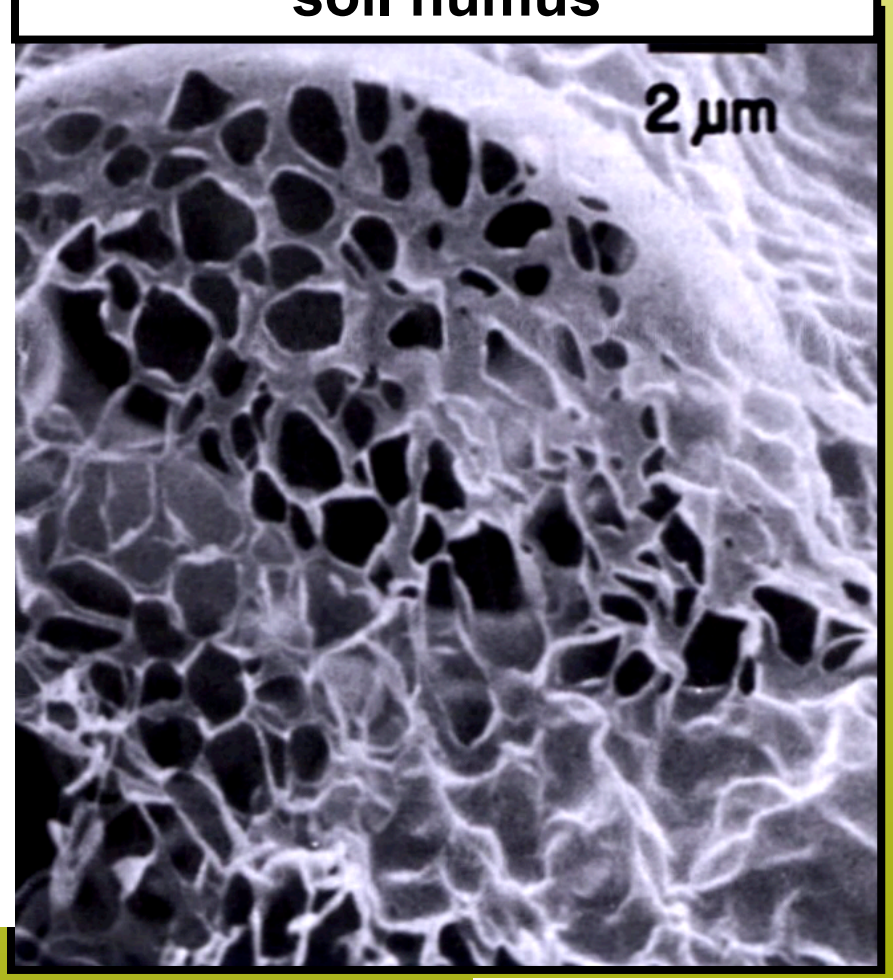
- *Higher corn and soybean yields in drought years*
- *Increased soil C and N*

- *Higher water infiltration*
- *Higher water holding cap*
- *Higher microbial activity*
- Increased stability

Soil Organic Matter
Living Carbon

- Holds up to 30X its weight in water
- Cements soil particles and reduces soil erosion
- Increases nutrient storage & availability
- Humus can last 2000 years in the soil

Electron micrograph of soil humus



Improved Efficiency of Water Use

Research Shows that Regenerative Systems use Water More Efficiently

Volume of Water Retained per Acre (to 12 inches) in relation to soil organic matter (SOM)

- **1 % SOM = 16,640 (common level Africa, Asia, Aust)**
- **2 % SOM = 33,280 Gallons**
- **3 % SOM = 49,920 Gallons**
- **4 % SOM = 66,560 Gallons (levels pre farming)**
- **5 % SOM = 83,200 Gallons (levels pre farming)**
- **6 % SOM = 99,840 Gallons (levels pre farming)**

Adapted from Morris, 2004.

Organic Corn - 1995 Drought

High Yield Regenerative Organic Agriculture

The average corn yields during the drought years were from 28% to 34% higher in the two organic systems.

The yields were 6,938 and 7,235 kg per ha in the organic animal and the organic legume systems, respectively, compared with 5,333 kg per ha in the conventional system (Pimentel et al. 2005)

Lbs per Acre = Kg per ha (close enough)

Tigray, Ethiopia

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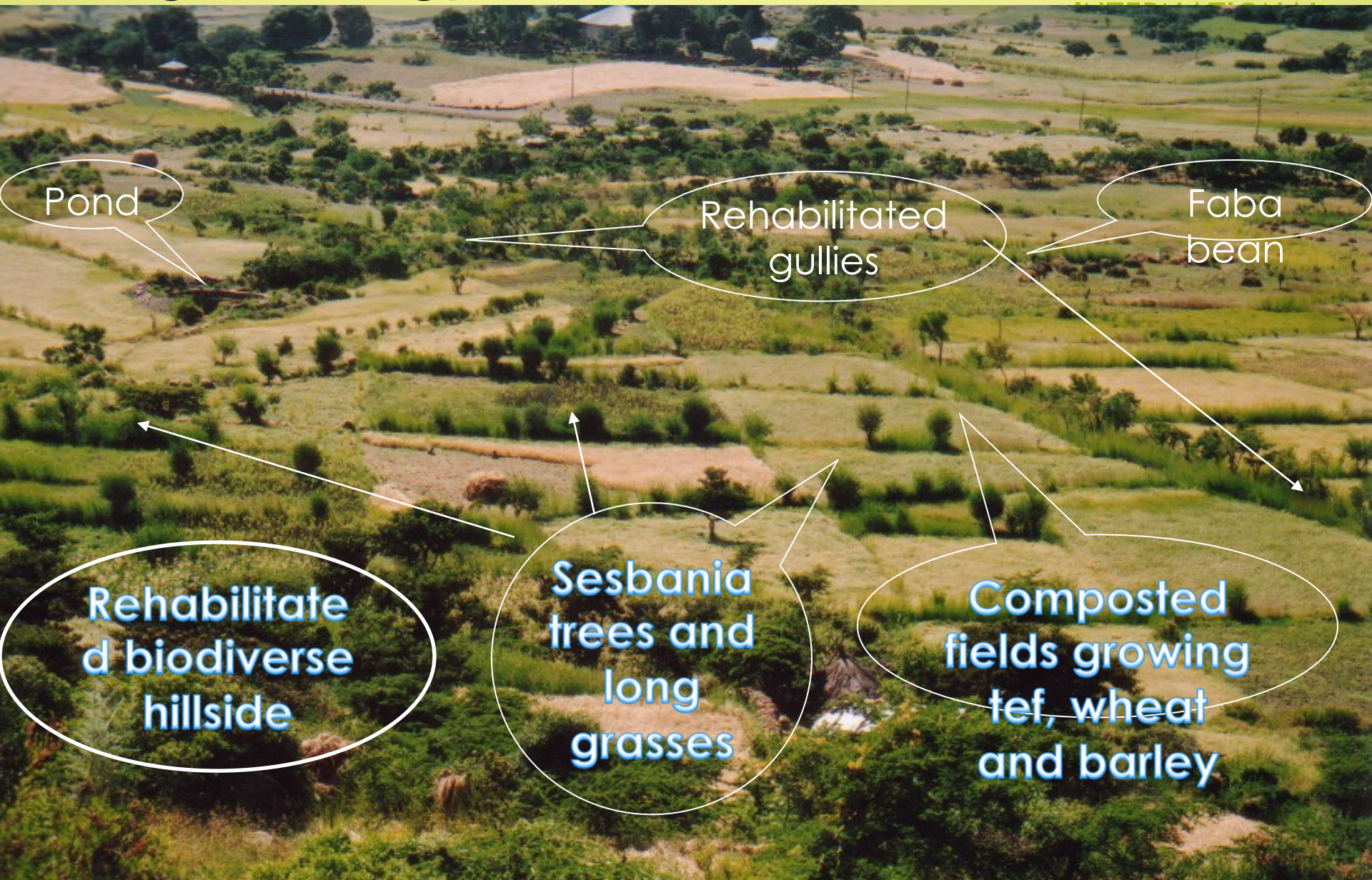
High over-grazing and burning = Deep, wide and long erosion gullies

Low soil organic matter = Low soil fertility

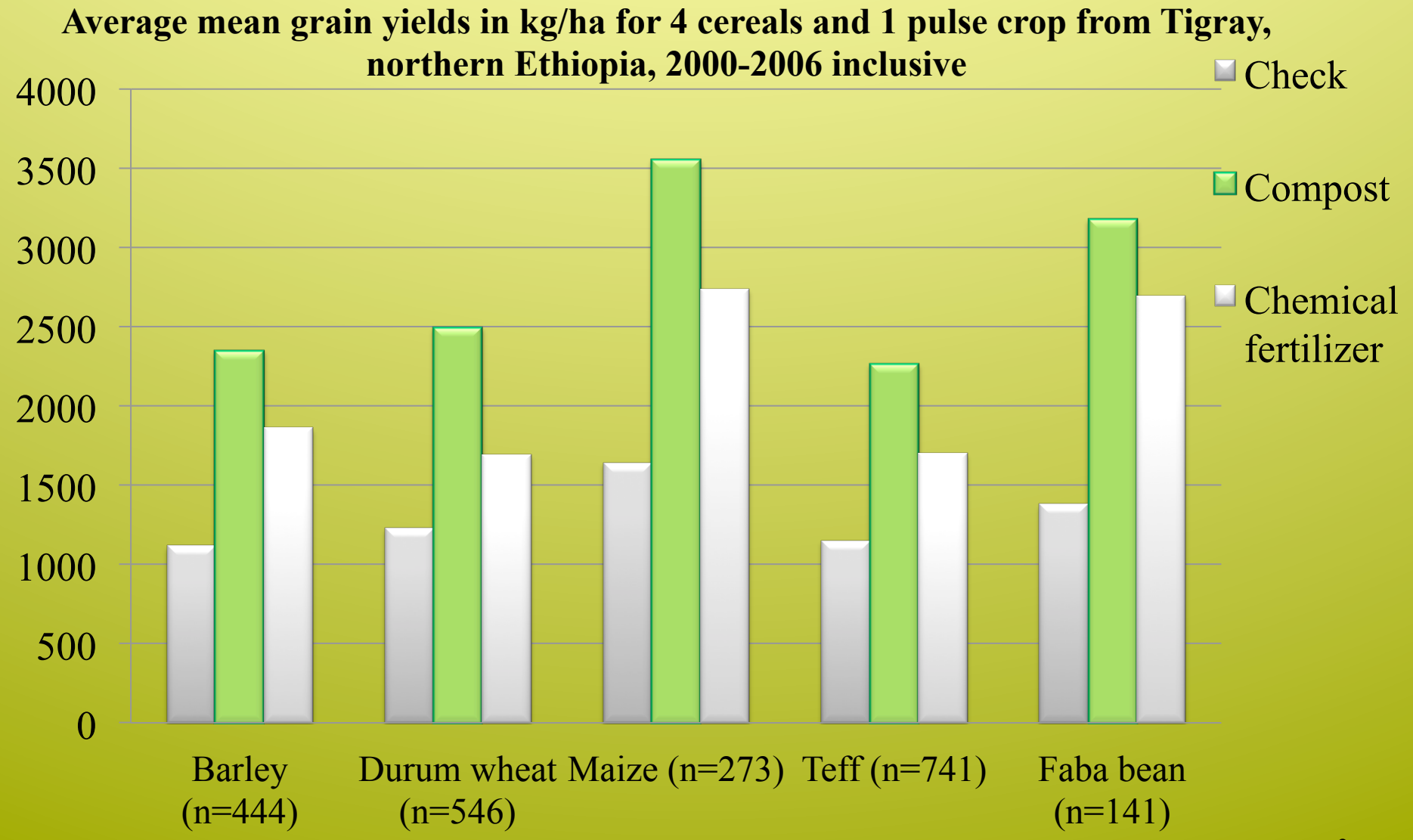
Serious food insecurity in dry years

Thousands died in famines

Adi Nefas, Tigray, Ethiopia - Agroecology



Impact of using compost - Grain yields from over 900 samples from farmers fields over 7 years



Push-Pull Adapted to New Crops

Intercropping to fix N for free

Desmodium repels pests, suppresses weeds (selective allelopathy), provides fodder

Alfalfa hosts beneficial insects

Napier grass traps pests

Push Pull and insectaries in a mango orchard gives total pest control

Chilies grown with desmodium and alfalfa

Thank You

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