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nitrogen - the goal posts



Nitrogen deficiency is not acceptable

not in crops



not in people





Nitrogen excess in the environment is not acceptable















Humanity depends on N fertilizers





industrial N₂ fixation



120 Mt NH₃ per year at >8 MWhr/t represents 1% of world energy consumption

this affects the **price of N**:





the price of \mathbf{N}

is the price of **energy** and **carbon**





emissions of CO₂ by landuse change



Source : Climate Change Information kit, UNEP IUC, 1997.



and for every 10 C, 1 N is "lost or liberated"

soil organic matter maintains agricultural production

ecosystem service of organic matter

compensation

provide nutrients

hold water

protect surface

store carbon

fertilize

irrigate

avoid erosion

mitigate CO₂

million km²

Total Land Area of the Earth	133
Total Area Co-opted for Human Use	45
Pasture Area	25
Biofuels Area	5 - 8
Crop Area	17



Pastures "are easy"

The high nitrogen content in food crops

- is a contaminant in the prodution of **biofuels**
- and has a high price in fertilizers

Crop lands are more difficult



What is Organic Farming?

"Organic farming is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic farming combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved."

IFOAM, 2008



It comes with issues of faith





It comes with proven advantages





ORGANIC MANURES AND ORGANIC FARMING

- Manure is organic matter used as organic fertilizer in agriculture.
- Manures contribute to the fertility of the soil by adding organic matter and nutrients, such as nitrogen that is trapped by bacteria in the soil.

source: Indian slide sharer



What are organic manures?

Farm yard manure

Crop residues Green manure

Biofertilizers Vermicompost

(from the web)



FARM YARD MANURE



- Commonly used Organic manure
 - Readily available
 - Important agricultural By-products
- Advantages
 - Ability to improve the soil, tilth & aeration.
 - Increases the water holding capacity of the soil.
 - Stimulate activity of micro-organisms that made plant food elements in the soil readily to crops

1% N in FMY 0.6% N cattle 1.2 % N chicken







the yearly balance of N in the animal-crop cycle

world cereal production:	2,530 Mt
world cereal N content:	45 Mt

world cattle production:59 Mtworld cattle manure N content:7 Mt

(manure N production 330g/day/t of beast)









some other soil and water system



organic manures:

Farm yard manure **Crop residues** Green manure

Biofertilizers Vermicompost



Crop residue quantity and N content

Agricultural	Residual		
wastage	quantity (Mt)	Ν	
Rice	110.5	0.61	
Wheat	82.6	0.48	
Sorghum	21.0	0.52	
Maize	12.5	0.52	but where
Pearl millet	15.6	0.45	does this
Barley	2.5	0.52	nitrogen
Finger Millet	5.3	1.00	come
Sugarcane	40.9	0.40	from ?
Pulses	13.7	1.60	
Total	312.6	Lal & Kimble (2	2000)



Some Protein contents (protein=6.25xN) and typical (maximum) yields:

Rice grain 8% of DM	5 t/ha (<20)
Wheat grain 15 % of DM	3 t/ha (<15)
Maize grain 10% of DM,	4 t/ha (<20)

 Soy grain 40% of DM
 2 t/ha (<4)</td>

 Lentil grain 30% of DM
 1 t/ha (<4)</td>

Forage 20% of DM (below 10%, animal requirements are not met)

Wood (forestry) 1% N of DM



solutions of "sustainable management": rotations, N fixation, minimum till, cover crops



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Biofertilizers

Bio-fertilizers refer to various inoculants or cultures containing a specific micro-organisms in concentrated form, which are derived either from nodules of plant roots or from the soil of root zone (rhizosphere). And posses unique ability to fix atmospheric N either by living symbiotically with the roots of leguminous plants or non-symbiotically (free living) or to transfer native soil nutrients such as P, Zn, Cu, Fe, S etc. from the non-usable (fixed) form to usable form through biological processes.



conserve soils maintain soil organic matter maintain soils biologically active sacrifice cropping time or space to N management

provide well-timed N provide resilient N (organic, sulfur-coated, others?)

fix N recycle N add industrial N



understand how N is embedded in biogeochemical cycles





Melillo et al. 1993, Nature 363: 234-240; Felzer et al. 2004 Tellus, 56B, 230-248

