

There is No Such Thing as a Free Biofuel from Crop Residues

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Rationale for Biofuel: Global Issues

- 1. Global warming**
- 2. Energy demand**
- 3. Energy cost**
- 4. Dependence on foreign oil**

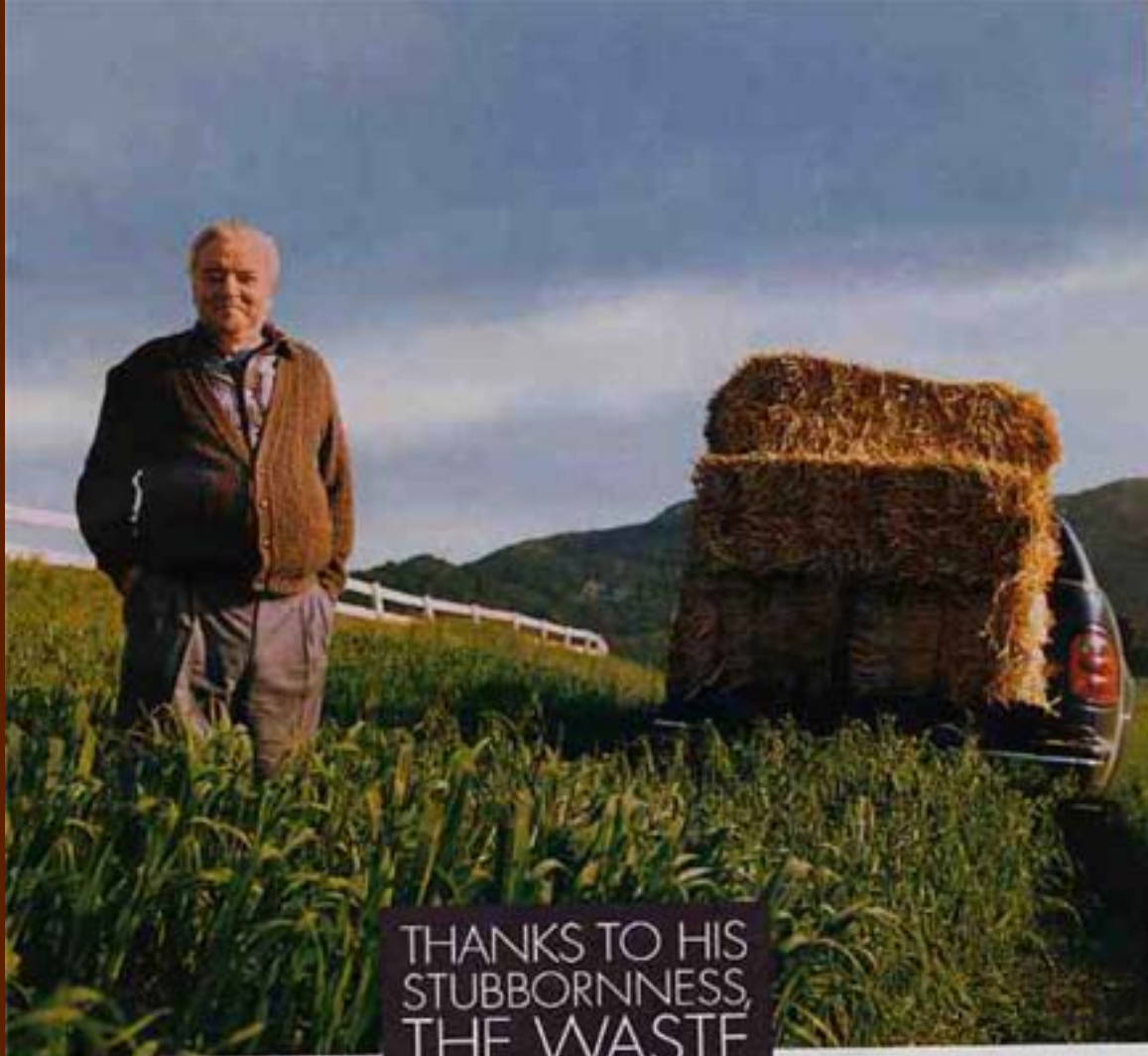
C Loss From World Soils to Atmosphere

66-90 Pg out of a Total Terrestrial Loss of
136 Pg since 1850s

Fossil Fuel and Atmospheric CO₂ Concentration

- 4 Pg of Fossil Fuel Consumption = 1ppm of CO₂ in the atmosphere
- If we set the stabilization limit to 560 ppm, then allowable fossil fuel consumption is $(560-380) \times 4 = 720$ Pg

Broecker (2007)



THANKS TO HIS
STUBBORNNESS,
THE WASTE
ON THIS TRUCK
CAN BE USED
TO FUEL IT.

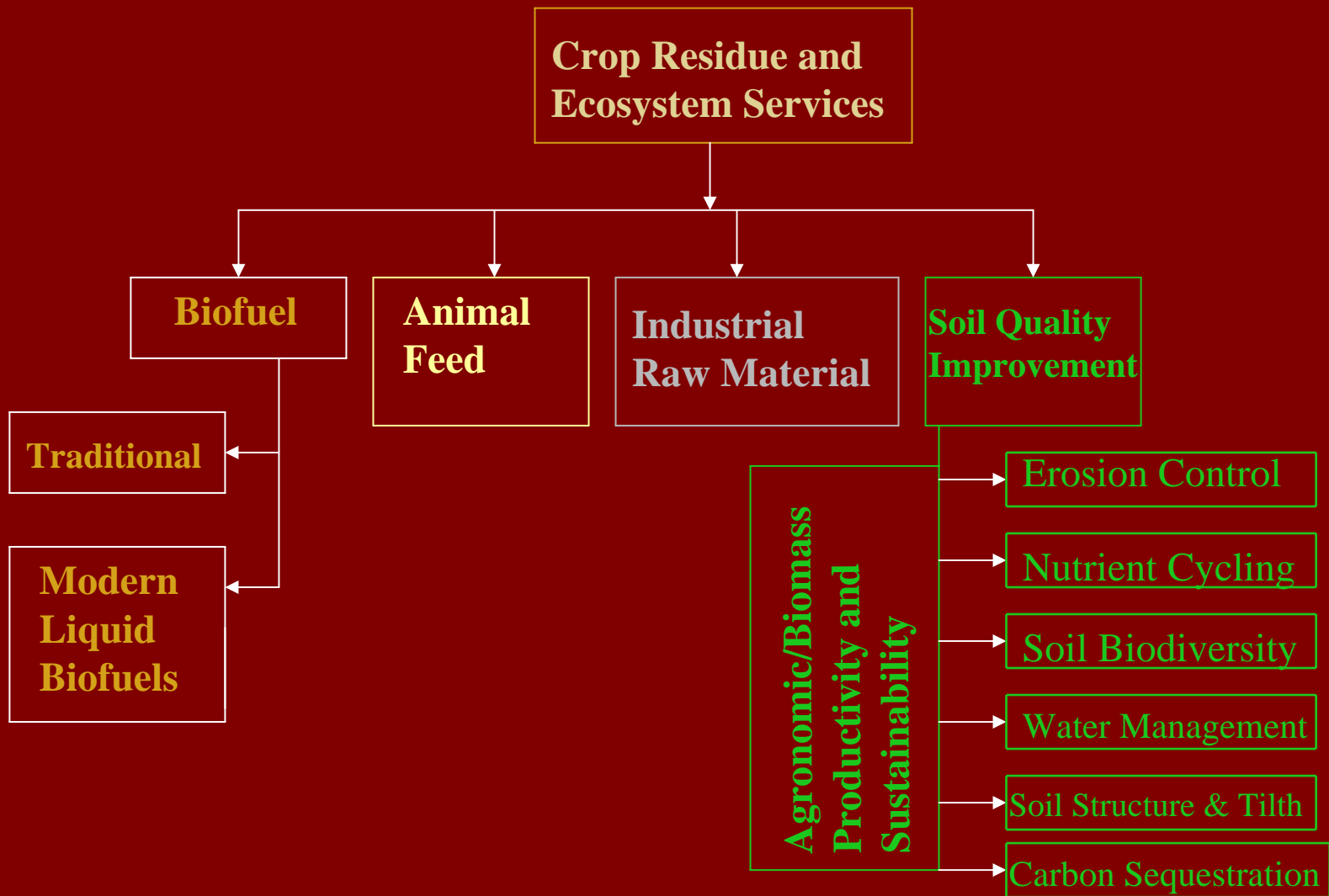
Patrick Foody Sr. is a determined man. Some 30 years ago, he had a visionary idea. He would produce ethanol, a vital ingredient in transportation fuels, from agricultural wastes like cereal straws and corn stalks.

Contemporaries doubted him. Initial attempts were costly. Still, Pat and his colleagues at Iogen Corporation pressed on. After much dogged persistence, and with help from

Shell, they found ways to make large-scale production a commercial reality. It may be a while yet before alternatives such as EcoEthanol™ can become a major source of energy. But by seeking out partners

like Pat, we're hoping to bring that day a step closer. Visit www.shell.com/biofuels for more information.





1. Crop residues have numerous competing uses, such as removal for biofuel production, animal feed, industrial raw material or returned to soil as an amendment.
2. Soil application of crop residues as amendment is necessary to enhance/maintain soil quality and sustain agronomic productivity.

Restoration of SOC Pool

- Irrespective of the climate debate, the SOC pool must be enhanced.
- Feeding a population of 6.5 billion in 2006, 7 billion in 2020, 8 billion by 2025, and 10 billion by 2050 or beyond makes it essential that soil quality is restored/enhanced.
- With 850 million people in the world food insecure, U.N. Millennium goals in jeopardy, crop residues must be used to restore soil quality.
- To provide another income stream to farmers

Nutrient contents in Crop Residue

Parameter	Kg/Mg of Dry matter		
	N	P	K
Range*	4-10	0.7-1.6	6-18
Average*	8.6	1.2	12
In 350 million Mg of Stover (10 ⁶ Mg)	3.0	0.4	1.2

(Calculated from Fixen, 2007)

Economics of Residue Removal for Biofuel



Food Insecure People

Africa = 200 million

World = 800 million

 Areas where
current population
exceeds potential
agricultural capacity



Food Gap by Region

Region	Food Gap	
	2000	2010
	- - 10^6Mg yr^{-1} - -	
Sub-Saharan Africa	10.7	17.5
Latin America	0.6	1.0
Asia	1.7	3.6
Others	<u>0.2</u>	<u>0.2</u>
Total (67 Countries)	13.2	22.3

(Shapouri, 2005)

Increase in Food Production in LDCs by Increasing SOC Pool by 1 Mg C ha⁻¹ yr⁻¹

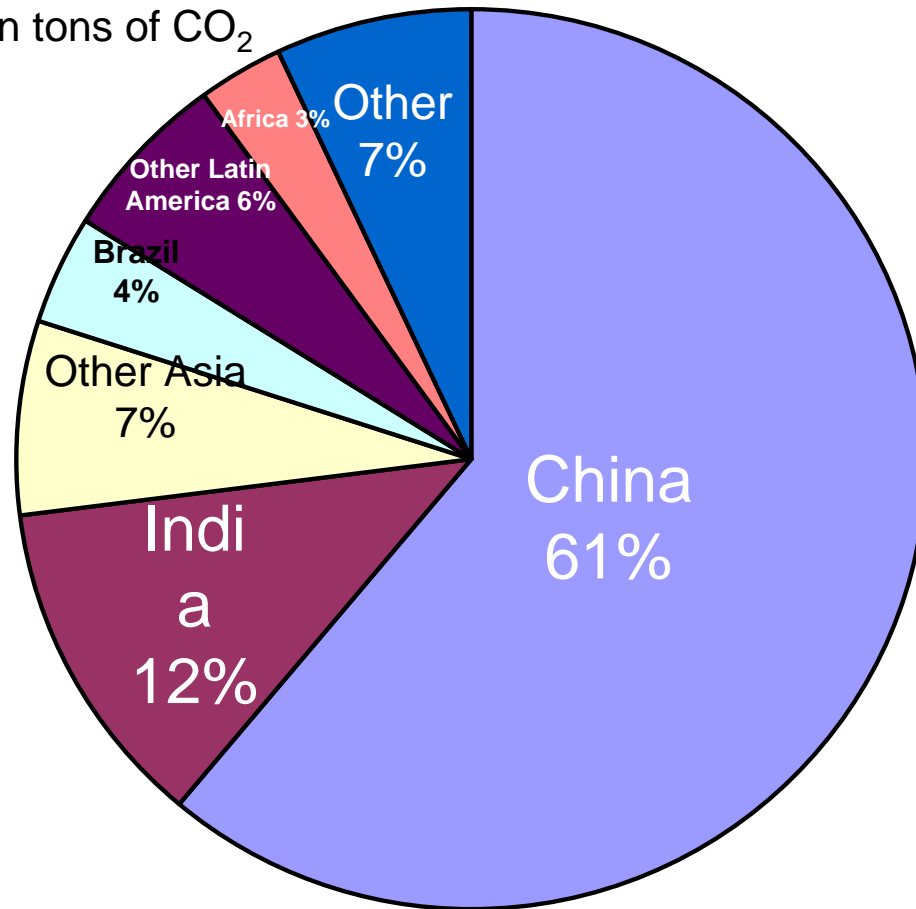
Crop	Area (Mha)	Production Increase (10 ⁶ Mg yr ⁻¹)
Cereals	430	21.8 - 36.3
Legumes	68	2.0 - 3.2
Tubers	<u>34</u>	<u>6.6 - 11.3</u>
Total	532	30.4 - 50.8

Global Carbon Trading (World Bank, 2007)

Total=450 million credits

Price=\$10.7 each

Amount=450 million tons of CO₂



U.N. Carbon Emissions Credits Sold in

2006

Need for Biofuel Plantations

- **Removal of crop residues is “robbing Peter to pay Paul”**
- **Thus, biofuel feedstock must be obtained through establishing specific plantations**

Common Species for Biofuel Plantations

Type	Name	Type	Name
<i>Warm season grasses</i>	Switch grass	<i>Broad leaf species</i>	Cup plant
	Big blue stem	<i>Short rotation woody perennials</i>	Poplar
	Indian grass		Willow
	Giant reed		Black locust
	Blue joint grass		Mesquite
	Cord grass		Birch
<i>Legumes</i>	Alfalfa		Eucalyptus
	Mucana	<i>Herbaceous spp.</i>	Miscanthus
	Kudzer		Reed canary grass
	Style		Cynara

Some Common Halophytes

Common Name	Scientific Name
Pickle weed	<i>Salicornia bigelovii</i>
Salt grass	<i>Distichlis palmeri</i>
Ny Pa forage	<i>Distichis</i> spp
Salt brushes	<i>Atriplex</i> spp.
Algae	<i>Spirulina geitleri</i>

Biomass production of 10 to 30 Mg ha⁻¹ yr⁻¹ with saline irrigation water of 10,000 to 40,000 ppm.

Switch Grass Plots in South Charleston, Ohio



Four Laws of Ecology

1. **Everything is connected to everything else.**
2. **Everything has its own way of life.**
3. **Nature knows best.**

... **Barry Commoner**
(1971)

Soil and Survival

“Upon this handful of soil our survival depends. Husband it and it will grow our food, our fuel, and our shelter and surround us with beauty. Abuse it and the soil will collapse and die, taking humanity with it”.

From Vedas

Sanskrit Scripture 1500 BC