

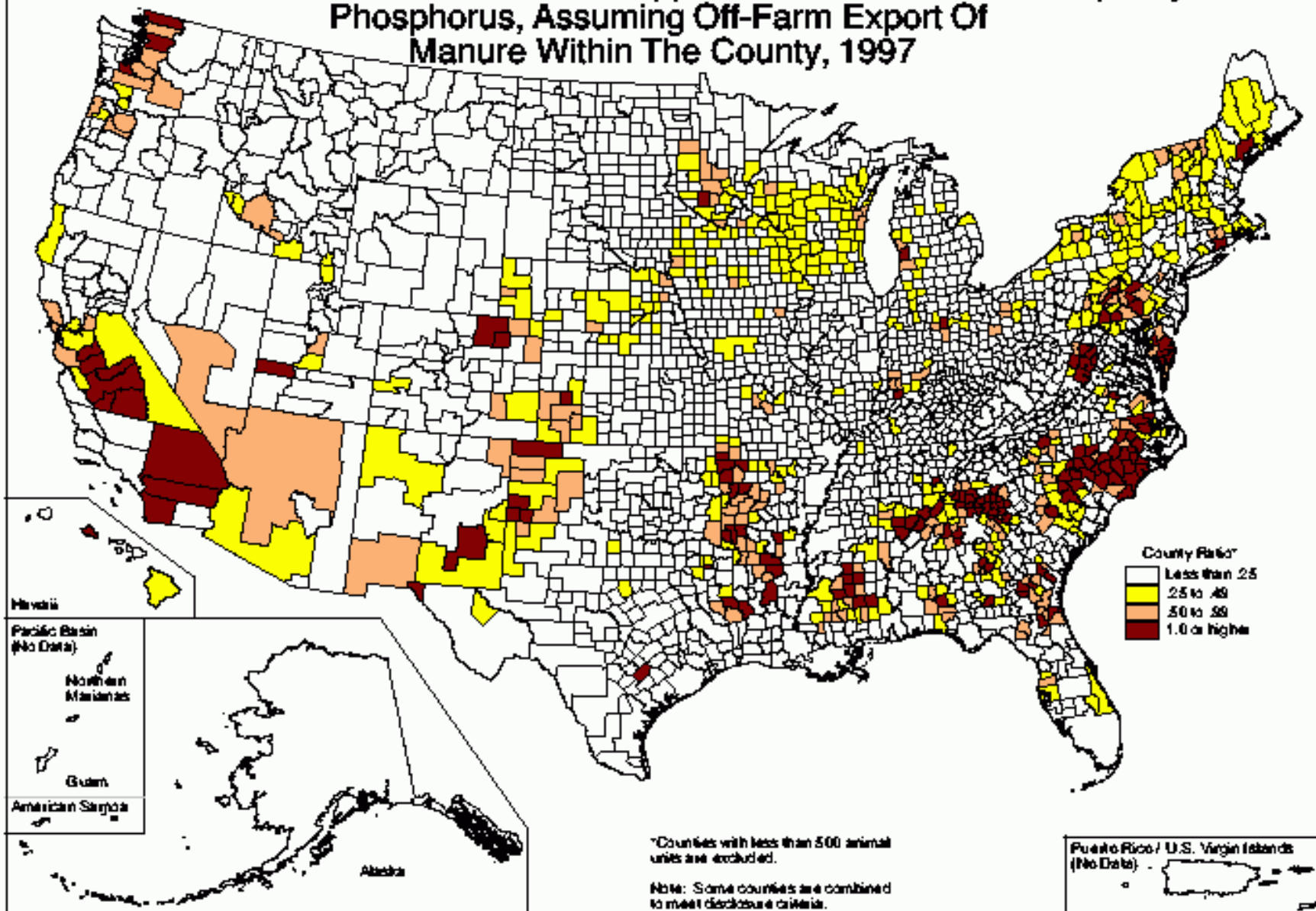
Potential for Ash Value to Make or Break a Poultry Litter Energy Project

Bert Bock

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Ratio of Manure Available For Land Application To Assimilative Capacity For Phosphorus, Assuming Off-Farm Export Of Manure Within The County, 1997



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 Natural Resources Conservation Service
 Resource Assessment Division
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Map ID: m5445

Data Source: Calculations based on 1997 Census of Agriculture, NASS, using procedures presented elsewhere in this report.



Granulated Ash



Poultry Litter Ash from Combustion



Granulated Ash



**Poultry Litter Ash
from Gasification**

Equivalent Values

Ash	Poultry Litter
\$/ton	
50	7.50
100	15.00

PL Ash and Steam Revenues

PL Ash	PL Ash: Steam equivalent	Steam	PL Ash
\$/ton	\$/1000 lb	\$/1000 lb	% of steam
50	1.30	4.50	29
100	2.60	4.50	58

PL Ash and Electricity Revenues

PL Ash	PL Ash: Electricity equivalent	Electricity	PL Ash
\$/ton	¢/kWh	¢/kWh	% of elect.
50	1.0	7.0	14
100	2.0	7.0	28

Nutrients of Primary Value

Nutrient	PL Ash	DCP
Fertilizers		
Total P ₂ O ₅ , %	24.4	
Total K ₂ O, %	16.3	
Mineral Feed Supplements		
Total P, %	10.7	18.5
Total Ca, %	12.4	24.1

Ash Value and Cost Factors

Value Factors	Fertilizers	P Feed Supp.
% of P credited		
w/o further processing	50-70	100
w/ further processing	90-100	N/A
% of K credited	95-100	0
Value add for low F	no	yes
Cost Factors		
Granulation required	yes	no
Transportation	Med to High	Low





Granule Inputs and Properties

- $\sim\frac{1}{2}$ PL ash, $\frac{1}{2}$ phosphoric acid + ammonia
- Final product analysis $\sim 5 \text{ N} - 40 \text{ P}_2\text{O}_5 - 5 \text{ K}_2\text{O}$
 - $\sim\frac{3}{4}$ of P_2O_5 water-soluble
 - $\sim\frac{1}{4}$ of P_2O_5 citrate-soluble
- Granule hardness \geq current commercial fertilizers
- Bulk density \geq current commercial fertilizers

Fertilizer Ash Value: FOB Energy Plant

		Wholesale price	
		%	
P ₂ O ₅	24	4.00	96.00
K ₂ O	16	2.00	32.00
Total			128.00
30% discount			38.40
Ash trans.			12.00
Net			77.60

Fertilizer Ash Value: FOB Energy Plant

		Wholesale price		
		%		\$/20 lb nutrient
P ₂ O ₅	12		4.00	48.00
K ₂ O	13		2.00	26.00
Total				74.00
30% discount				22.20
Ash trans.				12.00
Net				39.80

Poultry Litter Ash in Fertilizers: Environmental Considerations

- Trace metals: As, Cd, Co, Hg, Mo, Ni, Pb, Se, Zn
Cu, Cr
- Trace metals comply with following standards:
 - American Association of Plant Food Control Officials
 - CFR 503 for sewage sludge
 - Canadian Food Inspection Agency
- Dioxins/Furans
 - Very low, mostly below detection limits
 - No national standards

Ash P Supplement Trial—41 days

Starter	Grower	Finisher	Body wt.	Feed Eff.
% P replacement: ash for DCP			lb	
0	0	0	5.64	2.21
25	25	25	5.66	2.25
50	50	50	5.74	2.15
75	75	75	5.65	2.22
100	100	100	5.55	2.17
25	100	100	5.59	2.14
50	100	100	5.63	2.21
75	100	100	5.72	2.13

Ash Value as Mineral P Feed Supplement

	%P₂O₅	%P	\$/ton
DCP	42.4	18.5	250
PL Ash	24.4	10.7	145
Ash trans.			5
Net			140

Ash Value as Mineral P Feed Supplement

	%P₂O₅	%P	\$/ton
DCP	42.4	18.5	200
PL Ash	24.4	10.7	116
Ash trans.			5
Net			111

Poultry Litter Ash in Feeds: Environmental Considerations

- Dioxins/Furans
 - Very low, mostly below detection limits
 - < WHO standard (1.0 pg TEQ/g mineral supplement)
- No standards for trace metals; trace metals in the ash are of feed origin

Factors Affecting Realization of Potential Revenue from PL Ash

- Fertilizer vs. mineral feed supplement end use
- Poultry litter management factors
- Phytase enzyme amendment of poultry feed
- Energy conversion factors

Poultry Litter Management Factors

- Soil contamination during clean out, rototilling poultry litter
 - Dilutes nutrients
 - Silica gel formation: reduced P solubility
- Bedding material: wood vs. rice hulls
 - Rice hulls much higher in silica; affects similar to soil
- Frequency of whole-house cleanout
- Alum (aluminum sulfate) amendment of PL
 - Dilutes nutrients in ash
 - Reduces P solubility in PL; likely more important in fertilizers than feed supplements

SiO₂ in Ash, %

	Number of houses sampled	Mean	Range
Delmarva broiler litter	24	8.1	3.7 to 21.3
NC turkey litter	12	26.5	9.3 to 43.8
NC turkey litter	10	23.9	9.5 to 35.4

Phytase Enzyme Addition to Poultry Feed

- Enhances availability of P in corn and soybeans to poultry
- Enables reduction of mineral P supplement
- Reduces excretion of manure P=>less P in PL ash

Energy Conversion Factors

- Unburned carbon: dilutes nutrients
 - Combustion vs. gasification
 - Operating conditions
- Fluidized bed sand contamination: inert, dilutes nutrients (normally minimal dilution)
- High temperatures: silica gel or glass formation
- Dioxin levels in ash, especially fly ash
- Lime (CaCO_3) addition with poultry litter
 - Dilutes P and K; increases Ca concentration
 - Replaces some of lime normally added to feeds
 - May enhance P and K segregation
 - More of P in bottom ash; more of K in fly ash

Summary

- PL ash is nutrient-rich (~40 units of $P_2O_5 + K_2O$)
- Good potential for energy plants to net:
 - \$40 to 80/ton of PL ash used in fertilizers
 - \$80 to 110/ton of PL ash used in mineral feed supplements
- Need to optimize PL management and energy conversion factors to realize these potentials
- With poor management of PL and energy conversion factors, PL ash will have minimal or perhaps even negative net value at energy plants

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