SOIL HEALTH IN TROPICAL AFRICA: AN ESSENTIAL ELEMENT OF IMPROVED AGRICULTURAL PRODUCTIVITY

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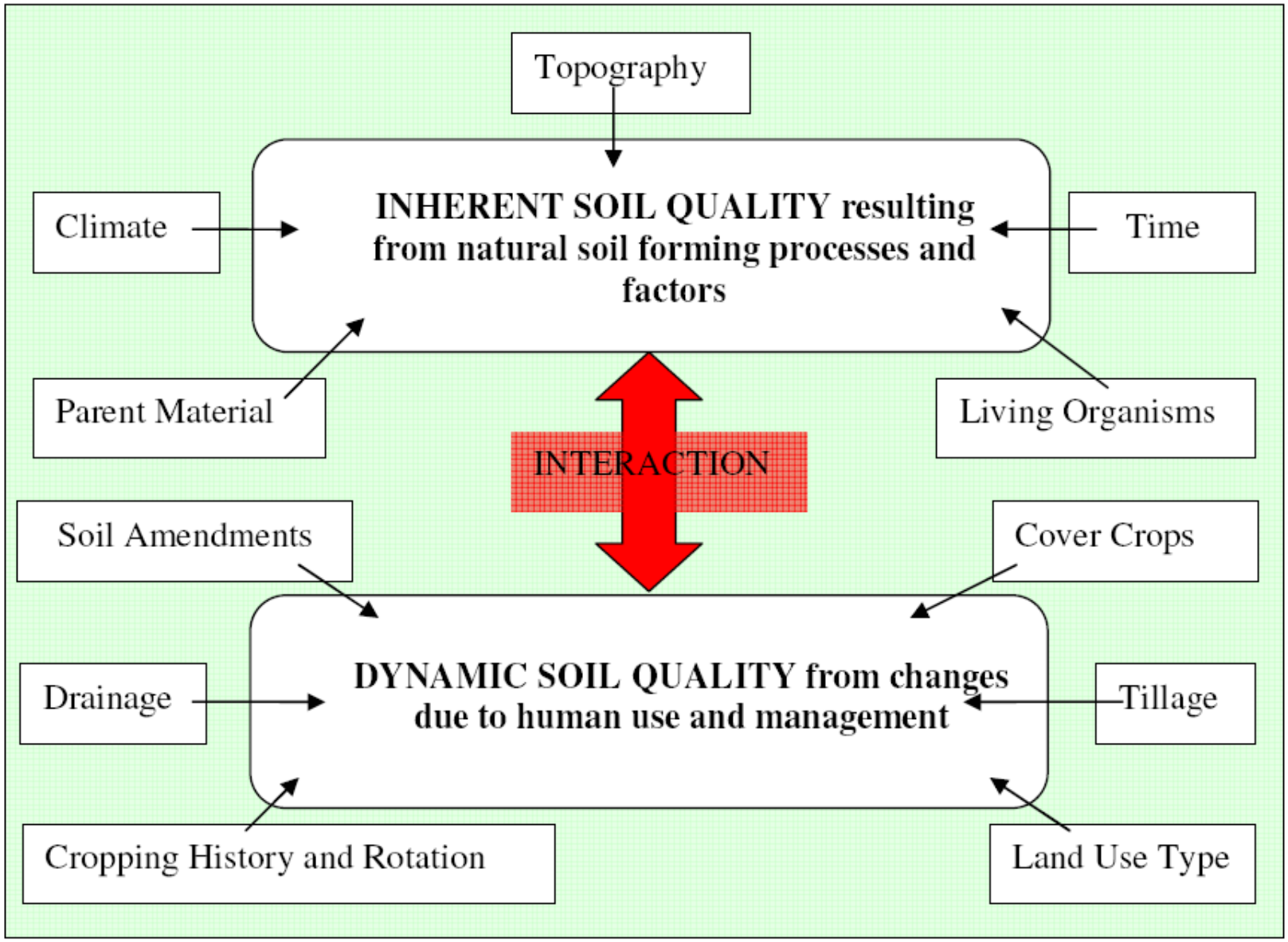
OUTLINE

- FACTORS THAT DEFINE AND IMPACT SOIL QUALITY
- TROPICAL AFRICAN FARMERS' REACTION
- WHY PROGRESS HAS BEEN SLOW
- SUGGESTIONS ON HOW TO IMPROVE THE SOIL HEALTH OF TROPICAL AFRICA ON A SUSTAINABLE BASIS


Topography
Climate
INHERENT SOIL QUALITY resulting from natural soil forming processes and factors
Time
Parent Material
Living Organisms
INTERACTION
Soil Amendments
Cover Crops
Drainage
DYNAMIC SOIL QUALITY from changes due to human use and management
Tillage
Cropping History and Rotation
Land Use Type

TROPICAL AFRICA: INFLUENCE OF TIME AND PARENT MATERIALS

- ROCKS OF PRE-CAMBRIAN ORIGIN
- GRANITE, QUARTZ AND QUARTZITE-LIKE MATERIALS.

THESE PARENT MATERIALS HAVE GIVEN RISE TO:

- SOILS THAT ARE *SANDY*
- SOILS DOMINATED BY *1:1 LATTICE CLAYS*
- SOILS WITH *LOW CAPACITY TO HOLD ON TO EXCAHNGEABLE BASES*
- SOILS WITH *INHERENT LOW FERTILITY*

TROPICAL AFRICA: INFLUENCE OF CLIMATE

- HIGH TEMPERATURES AND RAINFALL PROMOTE INTENSE WEATHERING AND LEACHING
- HIGH TEMPERATURES AND RAINFALL INFLUENCE CLIMAX VEGETATION
- HIGH TEMPERATURES ALSO PROMOTE THE DECOMPOSITION OF ORGANIC MATERIALS

TROPICAL AFRICA: INFLUENCE OF CLIMATE (CONT.)

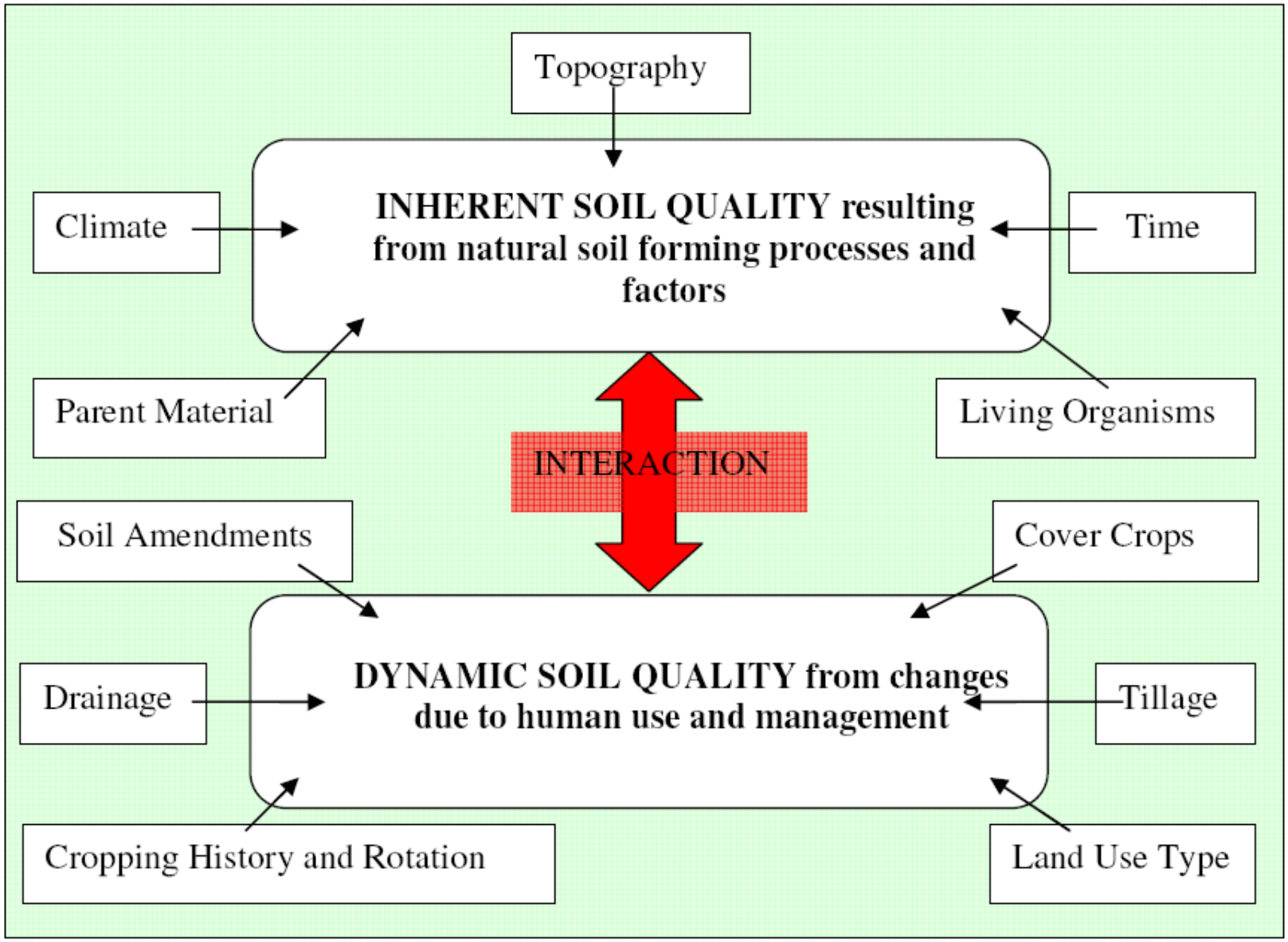
- VERY LOW ORGANIC MATTER IN THE SOILS (<0.1% TO 10%)

TROPICAL AFRICA:

BASED ON NATURAL ENDOWMENTS:

- THE SOIL HEALTH IS POOR

- ONLY 14% IS FREE OF MOISTURE STRESS
- EASILY DEGRADABLE AND CHEMICALLY FRAGILE (55%)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HOW DID THE AFRICAN FARMERS MANAGE THE NATURAL “ASSETS”?

- SHIFTING CULTIVATION

HOW DID THE AFRICAN FARMERS MANAGE THE NATURAL “ASSETS”?

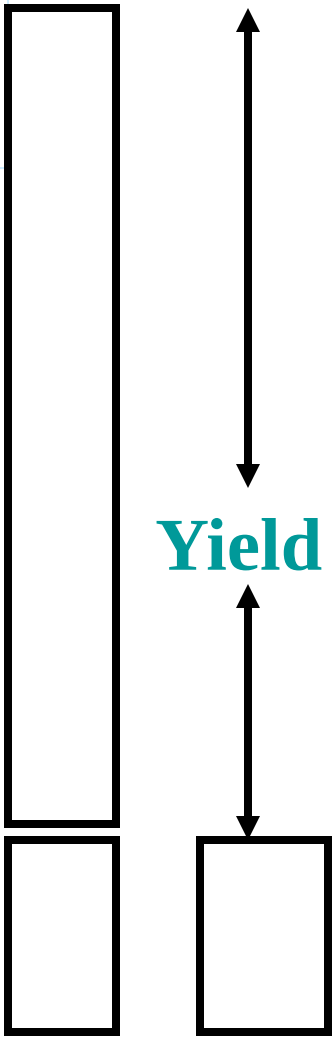
INCREASING POPULATION LED TO:

- ABANDONMENT OF SHIFTING CULTIVATION
- INCREASED DEFORESTATION
- MOVE TO MARGINAL LANDS
- INTENSIVE CULTIVATION

Soil Fertility Depletion

132 million tons of N
15 million tons of P
90 million tons of K (worth $11 billion/year)
lost from cultivated land in 37 African countries during the last 30 years
Smaling, 1993
Sanchez, 2002

Potential yield
(Experimentation)



Yield gap

Actual yield

Biophysical limitations
- Soil fertility
- Water
- Improved Variety, etc

Which inputs are lacking?

Socio economic and policy limitations
- Knowledge
- Credit
- Availability

Why inputs are not used?

The yield gap and the limitations that cause it

WHICH INPUTS ARE LACKING?

- BECAUSE OF LOW ORGANIC MATTER, MOST SOILS LACK NITROGEN.
- 80% OF SOILS HAVE INADEQUATE SUPPLIES OF PHOSPHORUS

The Marching Orders from the Africa Fertilizer Summit

FERTILIZER AS STRATEGIC COMMODITY WITHOUT BORDERS

INCREASE USE FROM 8 TO 50kg/ha

Table 3. Ammonia production and natural gas consumption and reserves.

Ammonia production, million metric tons N			Natural gas, cubic meters (January 1, 2008)			
				Consumption	Reserves[2]	
Country	2007	2008[1]	Country	Billion	Trillion	Total, %
China	42.48	44.60	Russia	610	47.57	27.2
India	11.00	11.00	Iran	112	26.84	15.3
Russia	10.50	11.00	Qatar	21	25.63	14.6
United States	8.84	8.24	Saudi Arabia	76	7.16	4.1
Trinidad and Tobago	5.10	5.10	United Arab Emirates	43	6.06	3.5
Indonesia	4.40	4.40	United States	653	5.97	3.4
Ukraine	4.20	4.20	Nigeria	13	5.21	3.0
Canada	4.10	4.10	Venezuela	27	4.70	2.7
Germany	2.75	2.80	Algeria	26	4.50	2.6
Saudi Arabia	2.60	2.60	Iraq	2	3.17	1.8
Pakistan	2.25	2.25	Turkmenistan	19	2.83	1.6
Iran	2.00	2.00	Kazakhstan	31	2.83	1.6
Egypt	1.75	1.90	Indonesia	23	2.66	1.5
Poland	1.90	1.90	Malaysia	33	2.35	1.3
Netherlands	1.80	1.80	China	71	2.27	1.3
Qatar	1.80	1.80	Norway	7	2.24	1.3
Japan	1.09	1.36	Uzbekistan	51	1.84	1.1
Bangladesh	1.30	1.30	Egypt	32	1.67	0.9
Romania	1.30	1.30	Canada	93	1.64	0.9
			Kuwait	13	1.59	0.9
			Libya	6	1.40	0.8
			Netherlands	46	1.40	0.8
			Ukraine	85	1.10	0.6
			India	42	1.10	0.6
			Azerbaijan	10	0.85	0.5
			Australia	29	0.85	0.5
			Oman	11	0.85	0.5
			Pakistan	31	0.79	0.5
			Bolivia	3	0.75	0.4
			Trinidad & Tobago	21	0.53	0.3
			Yemen	0	0.48	0.3
			Argentina	44	0.45	0.3
			United Kingdom	91	0.41	0.2
			Mexico	68	0.39	0.2
			Brunei	4	0.39	0.2
			Brazil	20	0.35	0.2
			Peru	2	0.34	0.2
Other countries	20.30	22.00	Other countries	727	3.83	2.2
World total	131.5	135.7	World total	3,196	175	100

[1]Estimated. [2]Reserves can be recovered under present technology and prices.
Sources: Ammonia – U.S. Geological Survey, 2009b; Gas – *Oil and Gas Journal*, 2007; NationMaster.com.
Note: Production of a ton of ammonia N requires 1,230 cubic meters of natural gas.

AFRICA'S SHARE OF THE PRODUCTION OF N FERTILIZERS

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	%
NH3	3408	3139	3328	3487	3494	3302	3318	3342	4200	4155	4756	3.8
AMN	1008	872	890	799	947	1011	981	900	904	866	870	6.2
AMS	48	55	70	58	56	46	31	23	31	19	50	0.3
CAN	111	48	29	117	111	100	103	94	107	87	78	2.1
UR	1297	1294	1456	1468	1557	1462	1474	1652	2236	2354	2571	3.8

Source: IFA (www.fertilizer.org)

Table 1. Phosphate mine production, reserves, and reserve base.

	Mine production[1] 2007	Mine production[1] 2008[2]	Reserves[3]	Reserve base[4]	Reserve life[5]	Reserve base life[5]
Country	Million metric tons				Years	
Morocco & W. Sahara	27.00	28.00	5,700	21,000	207	764
China	45.40	50.00	4,100	10,000	86	210
United States	29.70	30.90	1,200	3,400	40	112
S. Africa	2.56	2.40	1,500	2,500	605	1,008
Jordan	5.54	5.50	900	1,700	163	308
Australia	2.20	2.30	82	1,200	36	533
Russia	11.00	11.00	200	1,000	18	91
Israel	3.10	3.10	180	800	58	258
Syria	3.70	3.70	100	800	27	216
Egypt	2.20	3.00	100	760	38	292
Tunisia	7.80	7.80	100	600	13	77
Brazil	6.00	6.00	260	370	43	62
Canada	0.70	0.80	25	200	33	267
Senegal	0.60	0.60	50	160	83	267
Togo	0.80	0.80	30	60	38	75
Others	8.11	10.80	890	2,200	94	233
World total	156	167	15,000	47,000	93	291

[1] P_2O_5 content varies from 23 to 39% P_2O_5 with an average in 2007 of 32%. U.S. rock averages 29%. [2] Estimated. [3] Reserves can be economically mined at the time of determination. [4] Reserve base includes economic, marginally economic, and some currently subeconomic resources. [5] Life based on 2007-2008 production. Source: U.S. Geological Survey, 2009c.

P PRODUCTS FROM AFRICAN COUNTRIES
('000 NUTRIENT TONNES)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	%
DAP	1182	1122	1281	1243	1158	1009	992	1039	1010	914	1273	8.9
MAP	204	268	259	413	465	487	386	397	408	396	378	4.7
PA	5452	5274	5622	5947	5967	6302	6233	5924	6105	5926	5566	17
PR	38697	37887	37139	38759	40562	43566	44618	43087	44055	40657	34167	21
TSP	633	685	657	603	679	713	701	689	757	813	561	27

Source: IFA: www.fertilizers.org

Significant Phosphate Deposits of Africa

Algeria
- Djebel Onk
- Djebel Kouif

Angola
- Cabinda
- Longonjo
- Lucunga

Benin
- Mekrou
- Pobe

Burkina Faso
- Arly
- Diapega-Kodjari

Burundi
- Matongo

Cameroon
- Douala
- Yaoundé

Central African Republic
- Bakouma

Congo
- Comba
- Holle
- Offshore

Egypt
- Abu Tartur
- Hamrawein
- Safaga
- Sebaiya
- Quseir

Ethiopia
- Gorrahei

Gabon
- Iguela

Guinea Bissau
- Farim-Saliquinhe

Kenya
- Longolonga
- Mrima Hill
- Rangwa

Ghana
- Sekondi

Liberia
- Bambuta-Bomi Hill

Madagascar
- Barren Islands

Malawi
- Chilwa Island
- Tundulu

Mali
- Assakerei
- Tilemsi

Mauritania
- Bofal-Loubboira

Morocco
- Oulad Adboun
- Ganntour
- Bou Craa

Mozambique
- Maputo
- Muambe

Niger
- Aschia Tinamou
- Tahoua
- Tapoa

Nigeria
- Abeokuta

Senegal
- Gambia-Namel
- Matam
- Taiba-Thies
- Ziguinchor (Casamance)

Somalia
- El Bur

South Africa
- Glenover
- Langebaan
- Phalaborwa

South-West Africa (Namibia)
- Epembe
- Kalkfeld
- Offshore

Sudan
- Halaib
- Shereik

Tanzania
- Minjingu
- Morogoro
- Panda Hill (Mbeya)

Togo
- Akoumape-Hahotoe

Tunisia
- Gafsa
- Kalaâ Khasba
- Sra Ouertane

Uganda
- Sukulu

Zaire
- Bingo
- Lueshe

Zambia
- Kaluwe-Chasweta
- Nkombwa

Zimbabwe
- Dorowa
- Shawa

Fertilizer prices

	Metric ton Urea(FOB) US$
Europe	90
Mombasa or Beira	400
Western Kenya	500
Malawi	770

Transport Costs

Africa's road density: < India's in 1960

Move 1 ton fertilizer 1000 kms:

- USA: $15
- India: $30
- SS Africa: $100
- *Double if truck returns empty*

•*Vijay Modi, Columbia University*

Move 1 ton maize:

- Iowa to Mombasa (13,600 km): $50
- Mombasa to Kampala (900 km): $100

World Bank

Africa Must Cut Down High Fertilizer Prices:

Value-to-cost ratio for fertilizers declined rapidly as fertilizer prices increased dramatically

	1980's	early 2000's	% Decline:
Ghana	6.8	2.2	209
Malawi	7.4	1.3	469
Nigeria	7.5	3.1	141
Zambia	5.2	1.1	372
Tanzania	6.5	1.1	490

FIVE PRACTICAL WAYS TO IMPROVE TROPICAL AFRICA'S SOIL HEALTH

- "RECAPITALIZE" SOIL FERTILITY
- MANAGE MORE BY DISTURBING SOIL LESS
- USE CROP ROTATION
- DIVERSIFY YOUR CROPS
- KEEP THE SOIL COVERED AS MUCH AS POSSIBLE

African Governments Must be helped to faithfully Implement the

THE COMPREHENSIVE AFRICA AGRICULTURAL DEVELOPMENT PROGRAMME

CAADP


ThankYou