Fertilizer Profitability across Nigeria's Diverse Agro-Ecological Zones and Farming Systems

By

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At the Nigeria Launch of Guiding Investments in Sustainable Agricultural Intensification in Africa (GISAIA), Abuja.

June 17, 2013

Introduction: Fertilizer Use Status

- Low productivity in Nigeria over years compared to leading countries like Malaysia, Thailand, Indonesia, and Brazil has been largely due to low fertilizer use (FMARD, 2011).
- Comparing Nigeria to other regions and standards:

Nigeria	= 13 kg/ha
World average	= 100 kg/ha
Asia	= 150 kg/ha
Brazil (South America)	= 165 kg/ha
FAO recommendation	= 200 kg/ha

- This shows that Nigeria is on the *Red zone* and conscious efforts are needed to be made in order to move Nigeria towards the *Green zone* and achieve Green Revolution.

Introduction contd.

- Studies have shown that fertilizer use rates are correlated with the level of yield of Maize. See FAO (2006) below:

Continent	Fertilizer (Kg/Ha)	Yield (Kg/Ha)	Yield/ fertilizer	Fertilizer use relative to Africa	Yield relative to Africa
W. Europe	276	8050	29.17	5.02	5.17
N. America	257	7908	30.77	4.67	5.08
Asia	117	3641	31.12	2.13	2.34
L. America	67	2503	37.36	1.22	1.61
Africa	55	1556	23.22	1	1

Low Use of Fertilizers

- Total potential demand for fertilizer among farmers in Nigeria is estimated at 3.5 million MT per year. However, supply of fertilizer to farmers is estimated at only a fraction of this potential (0.6 million MT in 2010, or 17% of demand), leaving a market gap of 2.9 million MT per year (PrOpCom, 2011).
- According to Morris *et al* (2007) and Kherallah te al (2002), the following factors are responsible for the low use of fertilizers in Nigeria.
  - Inaccessibility of farmers to fertilizers/unavailability of the product, especially delay in delivery of subsidized product.
  - Inadequate finance, especially lack of credit.
  - High cost of fertilizers
    - high transport cost caused by long distance travelled to purchase the product,
    - poor road network and poor and inefficient transport systems.
  - Low profitability of use of fertilizers.-
    - low producer price in the output market,
    - partial compliance with other accompanying farm operations and practices,
    - wrong method and timing of use of fertilizers (extension services).

Computing fertilizer use profitability

- Fertilizer profitability is a function of :
  - fertilizer response (that is, kilogram of additional output per kilogram of fertilizer used),
  - fertilizer prices and
  - output prices.
- In the absence of data on full production costs such as labor, seeds and transportation costs, the following measures were used in calculating fertilizer profitability:
  1. Output-Input (O/I) ratio
  2. Input-output price (P_N/P_O) ratio
  3. Value cost ratio (VCR)

Computing profitability use contd.

1. Output-Input ratio:

- A rudimentary indicator of fertilizer profitability.
- It is the technical response of fertilizer use, measured by the units of output (O) produced from one unit of nutrient (N) input (the O/N ratio).

- According to Morris *et al* (2007),
  - O-I ratio should be between 2 and 3 for wheat without subsidy.
  - Generally lower for rice (because rice is more expensive than wheat in global markets) and
  - Higher for maize and other coarse grains (because maize and coarse grains are generally cheaper).

2. Input-Output price ratio:

- The relationship between the output price and fertilizer price, expressed in units of output needed to purchase one unit of fertilizer nutrient (P_N/P_O).
- The input/output price ratio shows the number of kilograms of output a farmer needs to purchase one kilogram of fertilizer.
- The lower the ratio, the higher the profitability (Yanggen *et al*, 1998).
- The ratios of fertilizer/maize prices in Nigeria were 0.8 in 1993, compared to 5.2 in Mali and 6.1 in Ghana (Dembele & Savagodo, 1996). This implies fertilizer use was more profitable in Nigeria.

3. Value-Cost Ratio (VCR):

- The ratio of the technical response to fertilizer use and the nutrient/output price ratio, or (O/N)/ (P_N/P_O),
  - The ratio of the value of additional production attributable to fertilizer use (O/N) to the cost of using the fertilizer (P_N/P_O),
  - It takes into consideration the changes in fertilizer response as well as prices).
- The higher the ratio the more profitable is the use of fertilizer.
- According to Morris *et al* (2007) citing (CIMMYT, 1988),
- a VCR of greater than 2 is preferable in a developing economy to provide incentives for fertilizer use to overcome risks and costs of capital.
- In especially risky production environment, a minimum VCR of 3 or 4 may be needed to provide sufficient incentives for adoption of fertilizer use.
- MVCR and AVCR not computed due to data limitation but it will be included in subsequent work.
- However, these measures vary across Nigeria's agro-ecological zones.

Nigeria's Agro-Ecological Zones

- Iloeje (2001) modified the work of Oyenuga (1967) and classified Nigeria into two major agro-ecological namely:
- Forest zones further divided into:
  - Salt-water swamp
  - Fresh-water swamp
  - Tropical high forest
- Savannah zones further divided into:
  - Guinea savannah
  - Sudan savannah
  - Sahel savannah
- This classification was used for the fertilizer profitability computation in this presentation.

Description of Nigeria's Agro-Ecological Zones

Agro-Ecological Zones	Description	Crops Grown
Salt-Water Swamp	This occupies the coastal areas and consists of tidal swamps, interspersed with numerous creeks and lagoons.	Swamp rice
Fresh-Water Swamp	Low lying area which subjects it to flooding by rain water; consists of mixture of trees.	Cassava, plantain, oil palm, sugar cane, maize, swamp rice (paddy) etc.
Tropical High Forest	Presence of valuable species of vegetation	Maize, rice, cassava, rubber, oil palm, cocoa, etc.
Guinea Savannah	Broadest vegetation zone in Nigeria, divided into Northern and Southern Savannah.	Sorghum, maize, rice, yam, soybean, groundnut, cowpea, etc
Sudan Savannah	Has continuous grass vegetation and interspersed with farms and small trees.	Millet, sorghum, wheat (under irrigation), sugarcane, cowpea, groundnut
Sahel Savannah	Sparse vegetation with very short grasses.	Maize and sorghum

Table 1: Mean Output-Input (Fertilizer) Ratio (O/I) across Agro-Ecological Zones for Rice

Agro-Ecological Zone	**06/07**	**07/08**	**08/09**	**09/10**
Salt-Water Swamp	352.64 (496.69)	376.41 (532.19)	404.11 (571.02)	481.28 (679.89)
Fresh-Water Swamp	0.73 (0.12)	55.72 (78.71)	51.75 (67.68)	54.90 (71.66)
Tropical High Forest	19.11 (17.91)	10.89 (15.23)	11.53 (13.83)	11.69 (14.13)
Guinea Savannah	82.51 (83.99)	74.85 (76.69)	63.90 (49.89)	69.58 (46.95)
Sudan Savannah	65.15 (77.59)	72.58 (91.19)	59.21 (78.44)	64.17 (87.44)
Sahel Savannah	18.08 (18.08)	26.65 (33.29)	37.65 (39.50)	40.61 (43.06)
Zonal Average (O/I)	**66.50 (131.18)**	**70.55 (139.51)**	**67.56 (143.09)**	**75.66 (168.94)**

Source: Author, 2013

Note: Figures in parenthesis are standard deviation

Table 2: Mean Input-Output Price Ratio (P_N/P_O) across Agro-Ecological Zones for Rice

Agro-Ecological Zone	06/07	07/08	08/09	09/10
Salt-Water Swamp	1.89 (0.61)	2.23 (0.72)	2.44 (0.58)	2.84 (0.68)
Fresh-Water Swamp	1.96 (0.95)	2.11 (0.84)	2.43 (0.09)	2.66 (0.01)
Tropical High Forest	1.85 (0.16)	2.12 (0.12)	2.41 (0.16)	2.70 (0.28)
Guinea Savannah	1.87 (0.16)	2.24 (0.31)	2.47 (0.24)	2.79 (0.21)
Sudan Savannah	1.85 (0.15)	2.25 (0.22)	2.53 (0.20)	2.85 (0.25)
Sahel Savannah	1.84 (0.10)	2.19 (0.17)	2.52 (0.20)	2.81 (0.14)
Zonal Average (P_N/P_O)	**1.89 (0.61)**	**1.96 (0.10)**	**1.85 (0.16)**	**1.87 (0.16)**

Source: Author, 2013

Note: Figures in parenthesis are standard deviation

Table 3: Mean Value Cost Ratio (VCR) across Agro-Ecological Zones for Rice

Agro-Ecological Zone	06/07	07/08	08/09	09/10
Salt-Water Swamp	241.21 (340.25)	219.25 (310.02)	198.88 (281.10)	203.60 (287.71)
Fresh-Water Swamp	0.38 (0.77)	27.15 (38.36)	21.82 (28.66)	20.67 (26.98)
Tropical High Forest	10.66 (10.12)	4.93 (6.66)	4.61 (5.18)	4.20 (4.70)
Guinea Savannah	44.53 (43.86)	33.38 (31.90)	25.57 (19.25)	24.79 (15.87)
Sudan Savannah	36.03 (44.58)	33.03 (43.34)	24.24 (33.31)	23.65 (34.46)
Sahel Savannah	9.53 (8.95)	11.43 (13.17)	14.66 (15.07)	14.14 (14.59)
Zonal Average VCR	**39.22 (86.80)**	**34.82 (78.46)**	**29.42 (69.58)**	**29.12 (71.09)**

Source: Author, 2013

Note: Figures in parenthesis are standard deviation

Table 4: Mean Output-Input Ratio (O/I) across Agro-Ecological Zones for Maize

Agro-Ecological Zone	**06/07**	**07/08**	**08/09**	**09/10**
Salt-Water Swamp	129.36 (84.69)	77.32 (49.01)	99.42 (89.30)	124.15 (134.29)
Fresh-Water Swamp	135.71 (78.13)	106.02 (85.80)	96.25 (97.71)	114.77 (117.92)
Tropical High Forest	135.71 (97.14)	96.25 (37.34)	94.18 (55.62)	95.65 (63.74)
Guinea Savannah	145.03 (144.59)	121.43 (110.25)	102.39 (81.10)	108.00 (79.29)
Sudan Savannah	135.47 (173.30)	132.10 (175.08)	153.62 (199.80)	182.41 (244.58)
Sahel Savannah	68.93 (101.48)	51.14 (84.04)	184.10 (292.77)	68.68 (110.68)
Zonal Average (O/I)	**128.44 (124.69)**	**104.18 (107.70)**	**122.77 (148.82)**	**118.59 (137.59)**

Source: Author, 2013

Note: Figures in parenthesis are standard deviation

Table 5: Mean Input-Output Price Ratio (P_N/P_O) across Agro-Ecological Zones for Maize

Agro-Ecological Zone	06/07	07/08	08/09	09/10
Salt-Water Swamp	2.09 (0.21)	2.49 (0.31)	2.82 (0.21)	3.06 (0.30)
Fresh-Water Swamp	2.06 (0.18)	2.39 (0.24)	2.95 (0.29)	2.99 (0.25)
Tropical High Forest	2.01 (0.17)	2.46 (0.26)	2.79 (0.27)	3.05 (0.22)
Guinea Savannah	2.03 (0.91)	2.43 (0.11)	2.81 (0.25)	3.16 (0.16)
Sudan Savannah	2.08 (0.13)	2.47 (0.23)	2.77 (0.18)	3.17 (0.08)
Sahel Savannah	2.26 (0.20)	2.66 (0.30)	2.98 (0.19)	3.24 (0.19)
Zonal Average (P_N/P_O)	**2.08 (0.16)**	**2.48 (0.23)**	**2.84 (0.23)**	**3.13(0.19)**

Source: Author, 2013

Note: Figures in parenthesis are standard deviation

Table 6: Mean Value Cost Ratio (VCR) across Agro-Ecological Zones for Maize

Agro-Ecological Zone	06/07	07/08	08/09	09/10
Salt-Water Swamp	5.47 (4.48)	31.88 (21.11)	35.78 (32.51)	40.78 (43.61)
Fresh-Water Swamp	7.21 (3.84)	46.66 (38.63)	30.74 (29.69)	37.97 (36.87)
Tropical High Forest	4.88 (6.71)	39.12 (14.39)	33.60 (19.79)	31.38 (20.95)
Guinea Savannah	3.44 (3.66)	49.96 (45.49)	35.97 (26.67)	34.01 (23.52)
Sudan Savannah	4.47 (10.01)	50.69 (61.38)	56.07 (72.40)	58.00 (77.53)
Sahel Savannah	0.55 (0.90)	20.70 (33.33)	64.48 (102.29)	22.20 (36.15)
Zonal Average VCR	**4.03 (6.03)**	**42.17 (40.88)**	**43.48 (52.52)**	**38.09 (43.55)**

Source: Author, 2013

Note: Figures in parenthesis are standard deviation

Conclusion and Next Steps

- Fertilizer use rate is low in Nigeria
- Correlation between fertilizer use and maize yield is strong.
- Literature shows that low use of fertilizer is due to its low profitability.
- Preliminary analyses of the GHS data reveal that fertilizer use is profitable across majority of the agro-ecological zones.
- The inconclusiveness on this matter requires further analysis using the micro-level GHS data to:
  - estimate the MVCRs and AVCRs
  - identify if use rates are consistent with profitability findings across agro-ecological zones and farming practices, and
  - identify reasons for any inconsistencies.
  - Obtain profitability of fertilizer use under different use conditions.

Conclusion and Next Steps Contd.

- This study can be further expanded when the panel version of the GHS data becomes available in the future.
- This will enable addressing challenges associated with time invariant unobservable characteristics that are correlated with fertilizer use as well as profitability.